Waikato Regional Council Technical Report 2018/08

Waikato and Waipā River restoration strategy

Volume 2: Appendices

www.waikatoregion.govt.nz
ISSN 2230-4355 (Print)
ISSN 2230-4363 (Online)

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June 2018

Document #: 12770427

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Approved for release by: Tracey May	Date	July 2018

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The report and references are published in Waikato Regional Council Technical Report 2018/08-Volume 1

APPENDIX 1 – Objectives of the Vision & Strategy

In order to realise the vision, the following objectives will be pursued:

1. The restoration and protection of the health and wellbeing of the Waikato River.
2. The restoration and protection of the relationships of Waikato-Tainui with the Waikato River, including their economic, social, cultural and spiritual relationships.
3. The restoration and protection of the relationships of Waikato River iwi according to their tikanga and kawa with the Waikato River, including their economic, social, cultural and spiritual relationships.
4. The restoration and protection of the relationships of the Waikato region's communities, with the Waikato River, including their economic, social, cultural and spiritual relationships.
5. The integrated, holistic and coordinated approach to management of the natural, physical, cultural and historic resources of the Waikato River.
6. The adoption of a precautionary approach towards decisions that may result in significant adverse effects on the Waikato River and, in particular, those effects that threaten serious or irreversible damage to the Waikato River.
7. The recognition and avoidance of adverse cumulative effects, and potential cumulative effects, of activities undertaken both on the Waikato River and within the catchment on the health and wellbeing of the Waikato River.
8. The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities.
9. The protection and enhancement of significant sites, fisheries, flora and fauna.
10. The recognition that the strategic importance of the Waikato River to New Zealand's social, cultural, environmental and economic wellbeing requires the restoration and protection of the health and wellbeing of the Waikato River.
11. The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length.
12. The promotion of improved access to the Waikato River to better enable sporting, recreational, and cultural opportunities.
13. The application to the above of both maatauranga Maaori and the latest available scientific methods.

APPENDIX 2 – Standard costs and assumptions

Works	Cost estimate (excl. gst)	Additional details/assumptions
Fencing		
5 wire (with 2 electric)	$8 per metre	
7 or 8 wire post and batten on LUC 8 land	$25 per metre	
7 or 8 wire post and batten on all other LUC land	$20 per metre everywhere except the central/lower Waikato catchment where it is up to $25 per metre	
Planting		
Native trees		**Note: For most projects infill planting has not been specifically provided for in the costings unless indicated in the PAF. However, estimates of planting areas are generous and it is expected that costings should allow for some infill planting.**
Native planting – standard site (e.g. grassy riparian margin)	$37,552 per ha	Assumes planting at 1.5m spacing (4444 stems per hectare) and includes $2000 per hectare for site preparation, $3.50 for plant purchase (including transport), $1.50 planting labour, $3 for five releasing events.
Native planting – weedy site (e.g. gully wetland with a range of weeds present)	$39,552 per ha	Assumes planting at 1.5m spacing (4444 stems per hectare) and includes $4000 per hectare for site preparation, $3.50 for plant purchase (including transport), $1.50 planting labour, $3 for five releasing events.
Native planting – wetland site (e.g. for whitebait habitat) where native plantings are predominantly monocots and a broadleaf specific herbicide can be used for releasing without killing plantings.	$117,550 per ha	Assumes planting at 0.75m spacing (17,777 stems per hectare) and includes $2000 per hectare for site preparation, $3.50 for plant purchase (including transport), $1.50 planting labour and $1.50 for five releasing events predominantly using a broadleaf specific herbicide.
Willows and poplars		**Those undertaking planting of willow and poplar poles should use varieties bred for erosion control purposes and note the restrictions on planting pest willow species (e.g. grey and crack).**
Willow/poplar poles – 3m tall (including planting labour and transport to site).	$12 per pole	Assumes a low grade pole for planting in areas that are retired from stock and where possums aren't considered a threat to plantings.
Willow/poplar poles for river margin planting – 3m tall (including planting labour and transport to site an easily accessible site).	$14 per pole	Assumes a high grade pole with a dynex sleeve.
Willow/poplar poles for hill country planting – 3m tall (including planting labour and transport to a remote site).	$16 per pole	Assumes a high grade pole with a dynex sleeve.
Plantation species		

Reforestation with *Pinus radiata* or *Leptospermum scoparium* (mānuka) in the Waipā and central/lower Waikato catchment.	$3000 per hectare	This is based on planting 2.5-3m spacings. It does not include pruning and maintenance costs but does include site preparation.
Reforestation with *Pinus radiata* or *Leptospermum scoparium* (mānuka) in the upper Waikato catchment.	$2500 per hectare including fencing	
Animal Pest Control		
Possum control using bait stations and brodifacoum bait.	$200 per hectare per year (over 3 years). Note: this cost is generous and would accommodate purchasing additional bait stations if more were required e.g. for a narrow riparian area.	This cost allows for placing approximately one bait station per hectare at a cost of $16 for each bait station (if purchased at wholesale rates). Start-up requires three 500g bait station fills over several months (totalling 1.5kg bait per station). Night shooting may also be required during start-up. Maintenance requires four 500g fills per year for each bait station. Labour to service bait stations is approximately 0.5 hours per fill at $50 per hour. One 10kg bag of bait costs $50. This will be sufficient to cover start up and maintenance for three years. Costs have been averaged over three years as possum control within the *Restoration Strategy* is primarily for native plant establishment over three years.
Possum control using A12 good nature traps. (This method of possum control has been recommended in urban areas instead of bait stations).	$175 per hectare in the first year and $90 per hectare thereafter	The estimated cost is based on installing one trap per hectare. It includes purchase of A12 good nature traps @ $150 each and 0.5 hours to install each trap. Traps require checking 4 x per year. Costs allow an average of 0.5 hours to check each trap each time (at $50 per hour) and include purchase of a replenishment pack at $40 per year.
Goat control	$51 per hour per hunter $408 per 100ha per year	This cost assumes one hunter for 8 hours per 100ha of control area. Estimates include expected ammunition costs.
Earthworks		
12 tonne excavator	$140 per hour $270 for transport to site	A 12 tonne excavator will move approximately 150m^3-200m^3 of soil per hour (assuming it is semi dry), slower for wet soil.
Long reach excavator	$180 per hour $400 for transport to site	A long reach excavator would take approximately 4 days (9 hours per day) to dig a 2m x 50m x 50m pond and spread the soil out behind – approximately 150m^3 per hour.
Project Management Costs		
Project management of very large projects e.g. more than three different types of work (such as riparian management, fish barrier remediation and	30% of overall works cost	This includes all aspects of project management and general staffing including landowner/iwi/stakeholder consultation, procurement and contract management, vehicle use, koha for hui, office overheads, health and safety planning and incidentals

erosion control) and 20+ landowners and stakeholders.		such as equipment for a community planting day, printing and stationery.
Project management of large projects e.g. multiple works actions (such as riparian management, fish barrier remediation and erosion control) and more than 10 landowners and stakeholders but likely less than 20.	25% of overall works cost	
Project management of small and medium sized projects e.g. one or two different types of work (e.g. fencing, fish passage remediation) and consultation with up to 10 landowners and stakeholders.	20% of overall works cost	
Project management of a small projects e.g. one type of work (e.g. riparian management) and consultation with up to 10 landowners and stakeholders.	15% of overall works cost	
Fish passage rehabilitation		
A range of options are available including fish ramps, baffles and mussel rope.	$5000	Most options will be cheaper than the cost estimate provided but this cost covers all options.
Culverts		
Installation of 6m long 450mm culvert with 150mm of metal underneath (1 truckload)	$900 per 6m length of culvert	Includes $550 for culvert purchase and $350 for installation.
Timber Weir		
6m wide timber weir	$7000 installed	
In-stream woody debris structures		
Total estimate for installing woody debris or rock for fish habitat at a site (comprising of up to three structures over a 1km length).	$11,403	Includes site visit with experts, design and installation. Cost estimate excludes resource consent fees.
Total estimate for installing woody debris or rock for fish habitat at a site (comprising 4- 6 structures over a 2km length).	$20,826	Includes site visit with experts, design and installation. Cost estimate excludes resource consent fees.
Total estimate for installing woody debris or rock for fish habitat at a site (comprising 7-9 structures over a 2km length).	$29,589	Includes site visit with experts, design and installation. Cost estimate excludes resource consent fees.
Weed and Willow Control		

1ha of weed spraying (where weeds cover 10% to 20% of the site) using a ute or quad bike.	$1400 per hectare per year	Cost includes chemical (typically glyphosate, grazon or tordon, pulse penetrant and marker dye) and labour.
As above but using a knapsack.	$2800 per hectare per year	
1ha of weed spraying (where weeds cover more than 20% of the site) using a ute or quad bike.	$2800 per hectare per year	
As above (weedy site) and using a knapsack.	$5000 per hectare per year	
Ground based willow control using x-tree basal.	$4000 per ha per year	Cost includes chemical and labour.
Mechanical willow removal along a waterway where willow is up to 30cm in diameter and low to medium density.	$20 per metre (including both sides). Burning of debris piles is an additional 20% of cost of removal.	Cost includes chemical and labour.
Mechanical willow removal along a waterway where willow is larger than 30cm in diameter and/or areas where willow vegetation is high density	$40 per metre (including both sides). Burning of debris piles is an additional 20% of cost of removal.	Cost includes chemical and labour.
Labour costs		
Technical specialist	$100-$200 per hour	Examples of technical specialists include ecologists, scientists, cultural specialist, engineers and environmental planners.
Field labourer	$40-$80 per hour	Examples of field workers include those undertaking water sampling, fish monitoring, weed control, checking animal traps and overseeing a native planting team.
Walkway Development		
A flat 1.5m wide gravel track with no boardwalk sections or bridges and easy access.	$100 per metre	
A 1.5m-2m wide gravel track with little or no sections of boardwalk and/or some access challenges.	$150 per metre	
A 1.5m-2m wide gravel track with several small sections of boardwalk, waterways crossings and/or some access challenges.	$200 per metre	
Where large sections of boardwalk or crossings are required this has been costed specific to the project.		

Appendix 3 – Mitigations and assumptions applied to erosion and sedimentation projects

The following assumptions were used to estimate the quantities of work required in relation to reducing erosion and sedimentation.

Waipā unit

Stream fencing mitigations

<u>Data used</u>

- REC2 GIS data was used to estimate stream bank length
- All calculations are for bank length not stream length
- LCDB4 GIS data for stream banks through pasture
- Waikato Regional Council 2007 riparian survey data was used to estimate unfenced areas
- NZLRI GIS data was used to identify LUC 6e, 7 and 8 land
- NZLRI erosion and NZEEM GIS data were used to identify erosion outside LUC 6e, 7 and 8

<u>Assumptions</u>

Riparian protection

Riparian surveys indicate that 55.4 per cent of the waterway bank length in the Waipā catchment is fenced. To determine the remaining fencing requirements we have assumed the following:

- All unfenced waterways are grass vegetation (not woody vegetation)
- Of the unfenced waterways:
    - 50 per cent of bank length will require fencing for soil conservation purposes; 44.6 per cent is unfenced and therefore 50 per cent = 22.3 per cent of total bank length
    - and 50 per cent of newly fenced bank will also require planting with native species (not willows or other river management vegetation)
- Riparian planting is based on buffer of 5m per side, and therefore 2km of one side = 1ha planting
- Cost of planting native (including site prep, plants, labour and 5 x release) = $37,552 per hectare

Soil conservation mitigations (LUC 6e, 7 and 8)

<u>Data used</u>

- NZLRI LUC (GIS layer) – the dominant LUC class was used for each area
- LCDB4 (GIS layer) for pasture

<u>Assumptions</u>

LUC 6e treatment

- 75 per cent of the total area of LUC class 6e land will not require any treatment
- 25 per cent of 6e land in pasture will require some sort of erosion protection work
    - 12.5 per cent of the 6e land in pasture can be treated with pole planting ($3000/ha)
    - 12.5 per cent of the 6e land in pasture is likely to be suited for plantation forestry or mānuka; both costed at $3000/ha.
    - Fencing plantation and mānuka combined is calculated at 12.5 per cent of total 6e perimeter at $20/m

LUC 7 treatment

- 100 per cent of this area is likely to be suited for plantation forestry or mānuka ($3000/ha)
- Fencing costs for this land have been calculated separately at 50 per cent of perimeter fence required at $20/m

LUC 8 treatment

- 100 per cent of this area would be recommended for retirement and reversion
- Assume no native planting required, just fence and leave
- Retirement requires fencing
- 75 per cent of perimeter of LUC 8 in pasture fencing required $25/m

Additional erosion areas outside LUC 6e, 7 and 8

- Assumes treatment of specific erosion areas such as landslips, earthflows etc. This active slip area is estimated at 5 per cent of erosion prone land identified (hectares). Combined pole planting, stabilisation and dewatering will cost $8000/ha

Protecting indigenous vegetation bordering pasture

Data used

- NZLRI LUC – the dominant LUC class was used for each area
- LCDB4 for pasture

Assumptions

- 25 per cent of LUC 6e in pasture bordering indigenous vegetation requires fencing. LUC 7 and 8 bordering indigenous won't require cost inclusion; it will already be covered by the other LUC 7 and 8 mitigations.
- Fencing costs for this land have been calculated separately at $25/m

Upper Waikato unit

Stream bank mitigations

Data used

- REC2 GIS data was used to estimate stream bank length
- All calculations are for bank length not stream length
- LCDB4 GIS data for stream banks through pasture
- Waikato Regional Council 2007 riparian survey data was used to estimate unfenced areas
- NZLRI GIS data was used to identify LUC 6e, 7 and 8 land
- NZLRI erosion and NZEEM GIS data were used to identify erosion outside LUC 6e, 7 and 8

Assumptions

Riparian protection

Field assessments indicate that 66.6 per cent of the waterway bank length in the upper Waikato catchment is fenced. To determine the remaining fencing requirements we have assumed the following:

- All unfenced waterways are grass vegetation (not woody vegetation)
- Of the unfenced waterways:
    - 75 per cent of bank length will require fencing for soil conservation purposes; 33.4 per cent is unfenced and therefore 75 per cent of this = 25.1 per cent of

total bank length
    - and 50 per cent of newly fenced bank will also require planting with native species (not willows or other river management vegetation); 25 per cent of the newly fenced area will also require pole planting at spacing of 1 per 10m of bank. (25 per cent x 25.1 per cent= 6.3 per cent of total bank length).
- Riparian planting is based on buffer of 5m per side, and therefore 2km of one side = 1ha planting
- Cost of planting native (including site prep, plants, labour and 5 x release) = $37,552.00 per hectare

Soil conservation mitigations (LUC 6e, 7 and 8)

Data used
- NZLRI LUC – the dominant LUC class was used for each area
- LCDB4 for pasture

Assumptions

LUC 6e treatment
- For all 6e land in pasture it is estimated that this will require on average one erosion control structure per 250ha of land and at an average cost of $15,000 per structure
- 10 per cent of 6e land in pasture will require additional treatment and is likely to be suitable for pine or mānuka at an average cost of $2500 per ha (including fencing)

LUC 7 treatment
- 30 per cent of this area is likely to be suited for plantation forestry or mānuka (average of $2500/ha including fencing)
- The remainder of this land could be suitable for retirement and reversion.

LUC 8 treatment
- 100 per cent of this area is likely to be suitable for retirement and reversion
- Assume no native planting required, just fence and leave
- Retirement requires fencing
- 75 per cent of perimeter of LUC 8 in pasture requires fencing at $25/m

Additional erosion areas outside LUC 6e, 7 and 8
- Treat 5 per cent of area with poles/structures/dewatering etc at $5000/ha
- Assumes treatment of specific erosion areas such as landslips, earthflows etc.

Additional treatment for specific catchments
- Whirinaki catchment: 25 sediment traps constructed within the upper catchment at an average of $20,000 per trap including fencing.

Protecting indigenous vegetation bordering pasture

Data used
- NZLRI LUC – the dominant LUC class was used for each area
- LCDB4 for pasture

Assumptions
- 25 per cent of LUC 6e in pasture bordering indigenous vegetation requires fencing. LUC 7 and 8 bordering indigenous won't require cost inclusion it will already be covered by

the other LUC 7 and 8 mitigations.

- Fencing costs for this land have been calculated separately at $25/m

Central/lower Waikato unit

Stream bank mitigations

Data used

- REC2 GIS data was used to estimate stream bank length
- All calculations are for bank length not stream length
- LCDB4 GIS data for stream banks through pasture
- Waikato Regional Council 2007 riparian survey data was used to estimate unfenced areas
- NZLRI GIS data was used to identify LUC 6e, 7 and 8 land
- NZLRI erosion and NZEEM GIS data were used to identify erosion outside LUC 6e, 7 and 8

Assumptions

Riparian protection

Field assessments indicate that 44 per cent of the waterway bank length in the lower Waikato catchment and 54.2 per cent in the central Waikato catchment is fenced. To determine the remaining fencing requirements we have assumed the following:

- All unfenced waterways are grass vegetation (not woody vegetation)
- Of the unfenced waterways:
    - 50 per cent of bank length will require fencing for soil conservation purposes; (lower Waikato 56 per cent is unfenced and therefore 50 per cent = 28 per cent of the total bank length; central Waikato 45.8 per cent is unfenced and therefore 50 per cent = 22.9 per cent of the total bank length)
    - and 50 per cent of newly fenced banks will also require planting with native species (not willows or other river management vegetation)
- 25 per cent of the stream network is estimated to require pole planting at one per 10m
- Riparian planting is based on buffer of 5m per side, and therefore 2km of one side = 1ha planting
- Cost of planting native (including site prep, plants, labour and 5 x release) = $37,552 per hectare

Soil conservation mitigations (LUC 6e, 7 and 8)

Data used

- NZLRI LUC – the dominant LUC class was used for each area
- LCDB4 for pasture

Assumptions

LUC 6e treatment

- 75 per cent of the total area of LUC class 6e land will not require any treatment
- 25 per cent of 6e land in pasture will require some sort of erosion protection work
    - 12.5 per cent of the 6e land in pasture can be treated with pole planting ($3000/ha)
    - 12.5 per cent of the 6e land in pasture is likely to be suited for plantation forestry or mānuka; both costed at ($3000/ha)

    - Fencing plantation and mānuka combined calculated at 12.5 per cent of total 6e perimeter at $25/m

LUC 7 treatment

- 100 per cent of this area is likely to be suited for plantation forestry or mānuka ($3000/ha)
- Fencing costs for this land have been calculated separately at 50 per cent of perimeter fence required at $25/m

LUC 8 treatment

- 100 per cent of this area would be recommended for retirement and reversion
- Assume no native planting required, just fence and leave
- Retirement requires fencing
- 75 per cent of perimeter of LUC 8 in pasture requires fencing at $25/m

Additional erosion areas outside LUC 6e, 7 and 8

- Assumes treatment of specific erosion areas such as landslips, earthflows etc. This active slip area is estimated at 5 per cent of erosion prone land identified (ha). Combined pole planting, stabilisation and dewatering will cost $8000/ha

Protecting indigenous vegetation bordering pasture

<u>Data used</u>

- NZLRI LUC – the dominant LUC class was used for each area
- LCDB4 for pasture

<u>Assumptions</u>

- 25 per cent of LUC 6e in pasture bordering indigenous vegetation requires fencing. LUC 7 and 8 bordering indigenous won’t require cost inclusion; it will already be covered by the other LUC 7 and 8 mitigations.
- Fencing costs for this land have been calculated separately at $25/m

Appendix 4 – Funders and contributors

Funding organisations that regularly fund the kinds of projects identified in the *Restoration Strategy* are detailed below, along with information about their funding criteria and/or the types of projects they fund.

Waikato River Clean-up Trust

The Waikato River Clean-up Trust (WRCuT) provides funding for projects that improve the health and wellbeing of the Waikato River and Waipā River and those that work towards the restoration and protection of the health and wellbeing of the rivers for present and future generations. The funding available is up to $7 million per year.

Each year the trust releases an annual funding strategy that outlines funding priorities for that year. Examples of projects that have been funded in the past include (but are not limited to) riparian fencing and planting, puna restoration, lake and wetland restoration, protection and restoration of forest remnants, retirement and planting of erosion prone areas, restoration of cultural sites of significance, iPou, whitebait spawning restoration, enhancing river and lake access, and Iwi capacity building.

Some of the key funding criteria are:

- WRCuT must not fund a project or part of a project that another agency would fund or be likely to fund if the trust did not exist
- There will be contestability in the allocation of funding
- There will be a preference for funding practical projects rather than research. In allocating funding, adequate regard must be given to the *Vision & Strategy,* the scoping study, other relevant research, and furthering iwi environmental plans
- Projects that have matched or supplementary funding will be given a priority (50 per cent co-funding is desirable).

For further information and to view a copy of the funding strategy on the Waikato River Authority website, go to www.waikatoriver.org.nz.

Waikato Catchment Ecological Enhancement Trust (WCEET)

The Waikato Catchment Ecological Enhancement Trust was established to foster and enhance the sustainable management of ecological resources in the Lake Taupō and Waikato River catchments. Funding awarded varies each year but is generally around half a million dollars.

Examples of projects that have been funded in the past include weed removal, wetland and lake restoration, predator control, wetland creation, planting and restoration.

For more information about the key funding criteria visit the trust's website at www.wceet.org.nz

Afforestation Grants Scheme (AGS)

This funding programme is run by the Ministry for the Environment and designed to help establish 15,000ha of new forest in New Zealand between 2015 and 2020. Up to $19.5 million is available until 2020 and grants of $1300 per hectare are available for growers to plant new small to medium-sized forests (5ha-300ha).

Some of the funding criteria are:

- Eligible land must be new forest planting. It must not:
    a. be classed as 'forest land' under the Climate Change Response Act 2002 when you apply
    b. have been 'forest land' on 31 December 1989
    c. have been 'forest land' at any time in the five years before you apply.

- Planting must be with a forest species as defined in the Climate Change Response Act 2002. That is a species that is:
    a. capable of reaching at least 5m in height at maturity in the place where it is located
    b. not grown or managed primarily for the production of fruit or nut crops.

A number of pine and mānuka plantings in the Waikato catchment have received funding through AGS. Download the document titled *A Guide to the Afforestation Grants Scheme* from the website for more information – www.mpi.govt.nz/funding-and-programmes/forestry/afforestation-grant-scheme.

Trust Waikato

Trust Waikato provides donations to not-for-profit community groups and projects that improve the wellbeing of Waikato communities. The types of groups and projects supported is broad from social services, education, sport, recreation, youth, art, culture, history and the environment. Trust Waikato is particularly interested in projects that target communities with the highest need. The trust awards around $10 million per annum.

Examples of projects funded in the past include community facilities, walkways, Hamilton Gardens development and educational projects.

Visit the website for detailed information on funding criteria – www.trustwaikato.co.nz.

Nga Whenua Rahui

This national fund supports the protection of indigenous ecosystems on Māori-owned land while honouring the rights guaranteed to landowners under Te Tiriti o Waitangi. It provides protection for Māori landowners through the use of 25-year renewable kawenata (covenants). It also provides significant support for the landowners, including pest control programmes, monitoring, and consequent operational support.

Māori land authorities such as trusts and incorporations, organisations representative of whānau, hapū or iwi, and Māori owners of general land can apply.

Full Ngā Whenua Rāhui Fund criteria is outlined in the application pack, which can be found on the website – http://www.doc.govt.nz/ngawhenuarahui.

Ministry for the Environment – Freshwater Improvement Fund

This national fund is for projects which improve the management of New Zealand's lakes, rivers, streams, groundwater and wetlands. The aim is to fund projects that will make the biggest difference with the available funding. The fund is therefore focusing on waterbodies in vulnerable catchments that are showing signs of stress but have not yet reached a 'tipping point'. There is $100 million is available over 10 years through a contestable funding round. The frequency of funding rounds is yet to be determined. However $44 million was allocated in year 1 (2017).

Some of the funding criteria are:

- The project must contribute to improving the management of New Zealand's freshwater bodies.
- The project must meet one or more of the following:
    a. achieve demonstrable co-benefits such as:
        - improved fresh, estuarine or marine water quality or quantity
        - increased biodiversity
        - habitat protection
        - soil conservation
        - improved community outcomes such as to recreational opportunity or mahinga kai

    - reduction to current or future impacts of climate change
    - reduced pressure on urban or rural infrastructure
  b. increase iwi/hapū, community, local government, or industry capability and capacity in relation to freshwater management
  c. establish or enhance collaborative management of fresh water
  d. increase the application of mātauranga Māori in freshwater management
  e. include an applied research component that contributes to improved understanding of the impacts of freshwater interventions and their outcomes.
- The minimum request for funding is $200,000 (excluding GST).
- The fund will cover a maximum of 50 per cent of the total project cost.
- The project will be funded for a maximum period of up to five years after which the project objectives will have been achieved or the project will be self-funding.
- The project must achieve benefits that would not otherwise be realised without the fund or are not more appropriately funded through other sources.
- The effectiveness of the project and its outcomes will be monitored, evaluated and reported.
- An appropriate governance structure in place (or one will be established as part of the project).
- The applicant must be a legal entity.

For further information visit the fund website - www.mfe.govt.nz/more/funding/freshwater-improvement-fund.

Ministry for the Environment – Community Environment Fund

The Community Environment Fund (CEF) empowers New Zealanders to take environmental action by funding projects that:

- strengthen environmental partnerships
- raise environmental awareness
- encourage participation in environmental initiatives in the community.

Some of the projects funded to date have involved pest proof fence construction, protection of rare and endangered freshwater and coastal ecosystems, ecosystem monitoring, weed control, riparian planting and animal pest control.

Funding criteria include:

- The project will contribute to one or more of the following:
  a. strengthening partnerships
  b. raising environmental awareness
  c. encouraging participation in environmental initiatives in the community
- The project is for a discrete time frame of up to three years. After this time, the project objectives will have been achieved and, where appropriate, the initiative will have become self-funding.
- The applicant is a legal entity.
- The application is seeking between $10,000 and $300,000 (excluding GST) from the Community Environment Fund.

For further information visit the fund website – www.mfe.govt.nz/more/funding/community-environment-fund.

Waikato Regional Council – Integrated Catchment Management Directorate

The Integrated Catchment Management (ICM) directorate undertakes catchment management, which includes land management, biosecurity and biodiversity projects.

Funding is often available for various aspects associated with catchment management including fencing, planting and pest control. They are able to fund up to 35 per cent of the project costs for work in priority catchments.

Contact a Waikato Regional Council catchment management officer for further information on 0800 800 401 or visit www.waikatoregion.govt.nz/services/regional-services/river-and-catchment-management.

Waikato Regional Council – Natural Heritage Fund

This regional fund contributes to ecosystem restoration projects that aim to achieve "landscape scale" outcomes. The fund aims to protect and manage, in perpetuity, special places of ecological significance. The amount of funding available annually is expected to be in the range of $40,000 to $300,000.

Key priorities include the preservation of access to waterways and the coast, as well as protection of biodiversity, heritage sites and landscapes of significance to the community. To date, the Natural Heritage Fund has been used for a wide range of projects including Maungatautari Ecological Island Trust, Waipā peat lakes reserves and the purchase of the Ed Hillary Hope Reserve.

More information can be found on the website – www.waikatoregion.govt.nz/community/whats-happening/funding-and-scholarships/natural-heritage-fund.

Queen Elizabeth II National Trust

Queen Elizabeth II National Trust (QEII Trust) was set up in 1977 to "encourage and promote, the provision, protection, preservation and enhancement of open space".

QEII Trust helps private landowners in New Zealand permanently protect special natural and cultural features on their land with open space covenants. The trust can contribute to fencing costs and covers the cost associated with covenanting a site (e.g. surveying and legal fees).

To obtain QEII support you must be wanting to secure long-term protection of natural and cultural features on private land with a covenant. For more information visit the website – www.openspace.org.nz.

Iwi authorities – Te Arawa River Iwi Trust, Raukawa Charitable Trust, Maniapoto Māori Trust Board, Tūwharetoa Māori Trust Board and Waikato Raupatu River Trust.

Sometimes iwi authorities will have funding available to support environmental initiatives in their rohe. Iwi groups looking to undertake work should contact their iwi authority to see if funding and/or support is available.

Appendix 5 - Central/Lower Waikato Project Assessments

Contents

CLW 1 Priority: high	Water quality improvement in the Aka Aka catchment	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of freshwater is protected and restored for aquatic species.	
Name of feature	Waterways and wetlands within the Aka Aka sub-catchment	
Brief description of feature	One of the most north-western catchments in the Waikato River catchment, the Aka Aka catchment covers 6915ha north of the river near Port Waikato. The catchment is predominately pastoral (85%) but retains approximately 8% indigenous vegetation cover. The main waterway in the catchment is the Aka Aka Stream. This enters the Waikato River east of Otaua. Catchment waterways are highly modified and channelised and are managed as part of the Aka Aka/Otaua drainage scheme. Catchment land use is predominantly dairy farming. In recent years wetland protection and enhancement works have been undertaken in this catchment by local iwi and landowners. The key aim of this has been to improve whitebait spawning habitat. The Aka Aka and lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River, Aka Aka and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. There are many existing and historic pā sites within the area. Modelling undertaken in 2016 indicates that the Aka Aka catchment is a high priority for actions that assist in nitrogen and *E.coli* reduction.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter. - Forest remnants and wetlands are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present including non-climbing native fish. - The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the catchment streams and are active in their use, protection and restoration.	

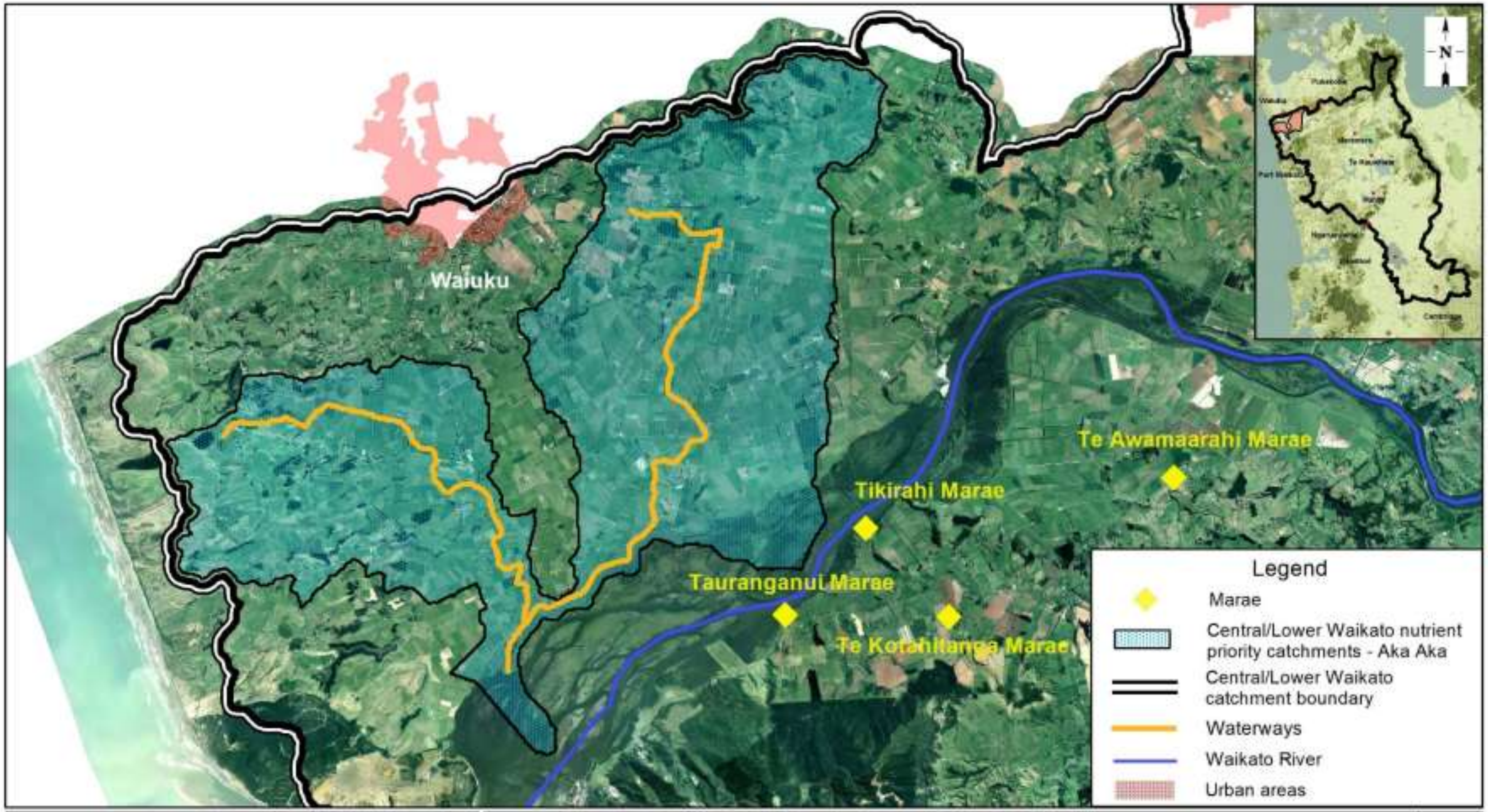
<table>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, waterways and wetlands in the Aka Aka sub-catchment would have a high impact on giving effect to the Vision & Strategy at a Central and Lower Waikato catchment level.</td><td>VS = 50</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands.</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100% of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components.

Wetland and ephemeral stream protection
55km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8/m. Fence should be 5 wire – 2 electric ($440,000). The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.</td><td>L = 8</td></tr>
<tr><td>Effectiveness of works</td><td>The waterways and wetlands within the Aka Aka sub-catchment are currently in a poor condition when compared to desired state with few of the Vision and Strategy aspects being met. It is anticipated that there could be some improvement in condition over the next 20 years even in the absence of this project, with some works in the catchment already underway. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to contribute to further improvement in waterway condition. However it is acknowledged that achieving desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term.</td><td>W = 0.025</td></tr>
</table>

<table>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.</td><td>A = 0.5</td></tr>
<tr><td>Information quality</td><td>Poor – based on modelled information and limited local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desk top exercise. Farm scale information will need to be gathered as part of this project. It is uncertain how many wetlands and seeps retain natural hydrology. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing wetlands and ephemeral streams (55km)</td><td>440,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>110,000</td></tr>
<tr><td>Total</td><td>550,000</td></tr>
</table></td><td>C = 0.55</td></tr>
</table>



Water quality improvement in the Aka Aka catchment

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0 1 2 3 4 5
Kilometers

Scale 1:100,000@A4 Landscape

A4

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An example of a small wetland area that would be suitable for fencing and protecting

CLW 2 Priority: high	Īnanga spawning habitat rehabilitation – Hills Drain	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a “bottleneck” for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a “sink” population as reduced larval production reduces the Waikato’s contribution to the next generation of whitebait. A 2ha section of streambank adjacent to Hills Drain at the end of Fisherman Road has been identified as a priority for īnanga spawning habitat rehabilitation. In 2013 and 2014, four īnanga spawning sites were identified along the stopbank. These are the first documented īnanga spawning sites associated with the flood protection works on the true right side of the lower Waikato River and therefore this habitat should be protected and enhanced. Grazing and	

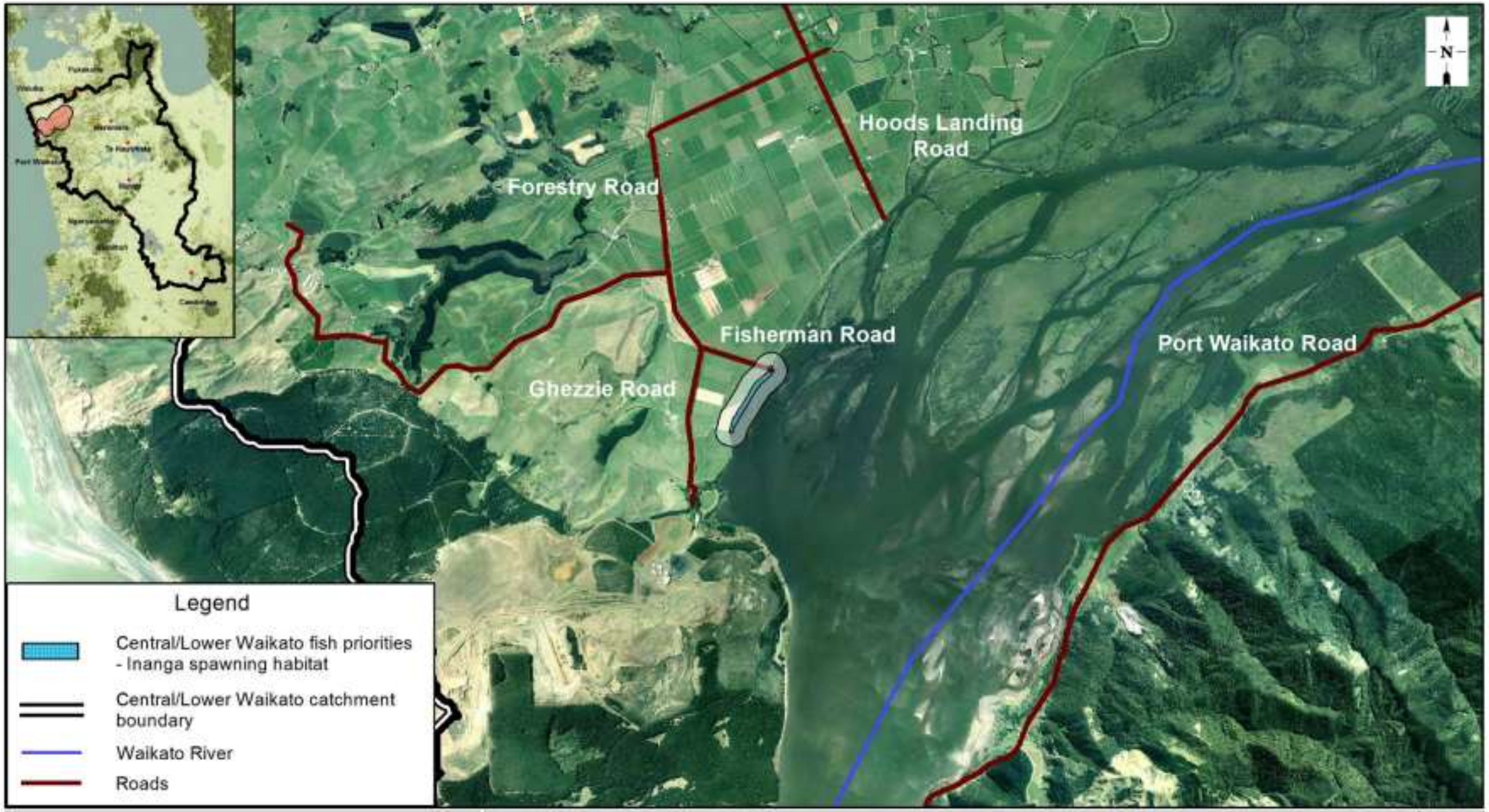
<table>
<tr><td></td><td>weed infestation are the main threats to the suitability of the vegetation for īnanga spawning.

The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors).</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.
- Iwi and communities have a strong connection to the īnanga habitat areas and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of spawning vegetation</td></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The intertidal vegetation adjacent to the Waikato River is fenced to exclude stock with a minimum 5 wire (2 electric) fence.
- Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species.
- Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth that provides suitable spawning habitats for adult īnanga.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components. To protect the existing īnanga spawning areas within the site, works should be implemented by an organisation/group with knowledge of īnanga spawning. **Restoration plan** A restoration plan will be developed that details: - the exotic plant species to be removed and retained - the native planting layout - measures that will be undertaken to ensure the existing īnanga spawning sites are not compromised during the enhancement works - methods recommended for weed control - accurate costings. To ensure the success of enhancement and expansion of spawning habitats at this site, planting and weed control needs to be overseen by a suitably experienced fish ecologist. The estimated cost of a restoration plan for this site is $8000. **Fencing** The spawning area should be fenced to exclude stock. Fencing should be at least 5m from the waterway and be a minimum standard of 5 wire (2 electric). Ideally this would be followed immediately by weed control and native planting. The estimated length of fencing required is 640m ($5120). **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima*, is detrimental to spawning habitat) so a comprehensive weed control plan will be essential to ensure success of the project. Estimated costs for weed control are based on carrying out weed control over the 2ha site for a period of 4 years, using a knapsack, at a cost of $2800 per hectare ($22,440 for four years). **Planting** Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge, swamp millet), high density planting is advised with	

	spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates assume native planting over 50% of the site at an average spacing of 0.75m ($120,490). This cost estimate assumes planting to cost $117,550 per hectare (at 0.75m spacing) and includes site preparation, plant purchase, planting labour and five releasing events. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen by the time the project is completed.	L = 4.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain conditions suitable for spawning. This project makes up only a very small percentage of this area and therefore the overall condition of the feature is still expected to decline even if this project is completed. It will, however, make an important contribution to the retention of this important habitat.	W = 0.003
Risk of technical failure	There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels.	F = 0.4
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however,	A = 0.8

<table>
<tr><td></td><td>generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td></td></tr>
<tr><td>Information quality</td><td>Good – judgement of expert, based on detailed knowledge of the species and of the Lower Waikato whitebait spawning habitat. Work requirements estimated mostly through examination of aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (640 m)</td><td>5120</td></tr>
<tr><td>Weed control for 4 years</td><td>22,440</td></tr>
<tr><td>Native planting (50% of site at 0.75m spacing)</td><td>120,490</td></tr>
<tr><td>Restoration plan</td><td>8000</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>23,407</td></tr>
<tr><td>Total</td><td>179,458</td></tr>
</table>
</td><td>C = 0.18</td></tr>
</table>



Inanga spawning habitat rehabilitation – Hills Drain

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:40,000@A4 Landscape

A4

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Area where fencing is required to exclude stock from īnanga spawning area. (Source: NIWA)

An area where glyceria control and planting is required. (Source: NIWA)

CLW 3 Priority: high	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 3	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a “bottleneck” for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a “sink” population as reduced larval production reduces the Waikato’s contribution to the next generation of whitebait. Two unnamed tributary streams feeding into the true left of the lower Waikato River were documented as īnanga spawning sites in the 1980s. Grazing and weed infestation has reduced the suitability of these sites for īnanga spawning and eggs are no longer deposited along the streambanks. Therefore, both streams have been	

<table>
<tr><td></td><td>identified as a priority for īnanga spawning habitat rehabilitation.

The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors). Discussions will be required with marae.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.
- Iwi and communities have a strong connection to the īnanga habitat areas and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of spawning vegetation</td></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The intertidal regions of the island provide suitable spawning habitats for adult īnanga.

- Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species.</td><td></td></tr>
</table>

	- Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth suitable for īnanga spawning.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components. To protect the existing īnanga spawning areas within the site, works should be implemented by an organisation/group with knowledge of īnanga spawning. **Restoration plan** A restoration plan should be developed that details: - the exotic plant species to be removed and retained - the native planting layout - methods recommended for weed control - accurate costings. To ensure the resulting vegetation is suitable for adult īnanga spawning, advice on weed control and planting needs to be sought from a suitably experienced fish ecologist. The estimated cost of a restoration plan for this project is $5000 for each site ($10,000). **Fencing** The restoration sites should be fenced adjacent to the tributary streams to exclude stock and horses. Fences should be at least 5m back from waterways. Ideally fencing would be followed immediately by weed control and native planting. Fencing costs are estimated as follows: - Stream A, 620m of fencing required (a minimum of 5 wire with two of those being electric) – $4960 - Stream B, 520m of fencing required (a minimum of 5 wire with two of those being electric) – $4160 **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima,* is detrimental to spawning habitat) so a comprehensive weed control plan will be essential to ensure success of the project. Estimated costs for weed control are based on carrying out weed control over a period of 4 years, using a knapsack, at $2800 per hectare per year. - Stream A (2.2ha) is $24,640	

	- Stream B (0.55ha) is $6160 **Planting** Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge, swamp millet), high density planting is advised with spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates are $117,550 per hectare for planting at 0.75m spacing and $39,552 per hectare for planting at 1.5m spacing) and include site preparation, plant purchase, planting labour and five releasing events, and are based on the following estimates: - Stream A – planting 25% (0.6ha) of the site with grasses/rushes/sedges at 0.75m spacing and 50% (1.1ha) of the site with shrubs at 1.5m spacing ($114,037). - Stream B – planting 20% (0.11ha) of the site with grasses/rushes/sedges at 0.75m spacing (12,691). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen by the time the project is completed.	L = 4.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain	W = 0.004

	conditions suitable for spawning. This project makes up only a very small percentage of this area and therefore the overall condition of the feature is still expected to decline even if this project is completed. It will, however, make an important contribution to the retention of this important habitat.	
Risk of technical failure	There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels.	F = 0.4
Adoptability	It is estimated that 80% of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.8
Information quality	Very good – judgement of expert, based on detailed knowledge of the species and of the Lower Waikato whitebait spawning habitat.	
Knowledge gaps	Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required. There are also knowledge gaps around the attractiveness of such projects to landowners.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task – Stream A site</th><th>Cost ($)</th></tr>
<tr><td>Fencing (620 m)</td><td>4960</td></tr>
<tr><td>Weed control for 4 years</td><td>24,640</td></tr>
<tr><td>Native planting (25% of site at 0.75m spacing, 50% at 1.5m spacing)</td><td>114,037</td></tr>
<tr><td>Restoration plan</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>29,727</td></tr>
<tr><td>Total</td><td>178,364</td></tr>
</table>
<table>
<tr><th>Task – Stream B site</th><th>Cost ($)</th></tr>
<tr><td>Fencing (520 m)</td><td>4160</td></tr>
<tr><td>Weed control for 4 years</td><td>6,160</td></tr>
<tr><td>Native planting (20% of site at 0.75m spacing)</td><td>12,691</td></tr>
<tr><td>Restoration plan</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>5602</td></tr>
<tr><td>Total</td><td>33,613</td></tr>
<tr><td>Grand total</td><td>211,977</td></tr>
</table>
</td>
<td>C = 0.21</td>
</tr>
</table>

Inanga spawning habitat rehabilitation - Tuakau Bridge-Port Waikato Road: Site 3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale 1:20,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Example of glyceria growing along stream margins (Note: glyceria is unsuitable īnanga spawning habitat). Source: NIWA

CLW 4 Priority: high	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 2	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a "bottleneck" for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a "sink" population as reduced larval production reduces the Waikato's contribution to the next generation of whitebait. A 750m long section of an unnamed tributary stream and associated wetland along the true left margin of the lower Waikato River has been identified as a priority for īnanga spawning habitat rehabilitation (8.4ha in total). In the 1980s, this location was known to contain a major īnanga spawning site. Weed infestation has reduced the suitability of this location for īnanga spawning and no	

<table>
<tr><td></td><td>spawning has been observed within this site in recent years.

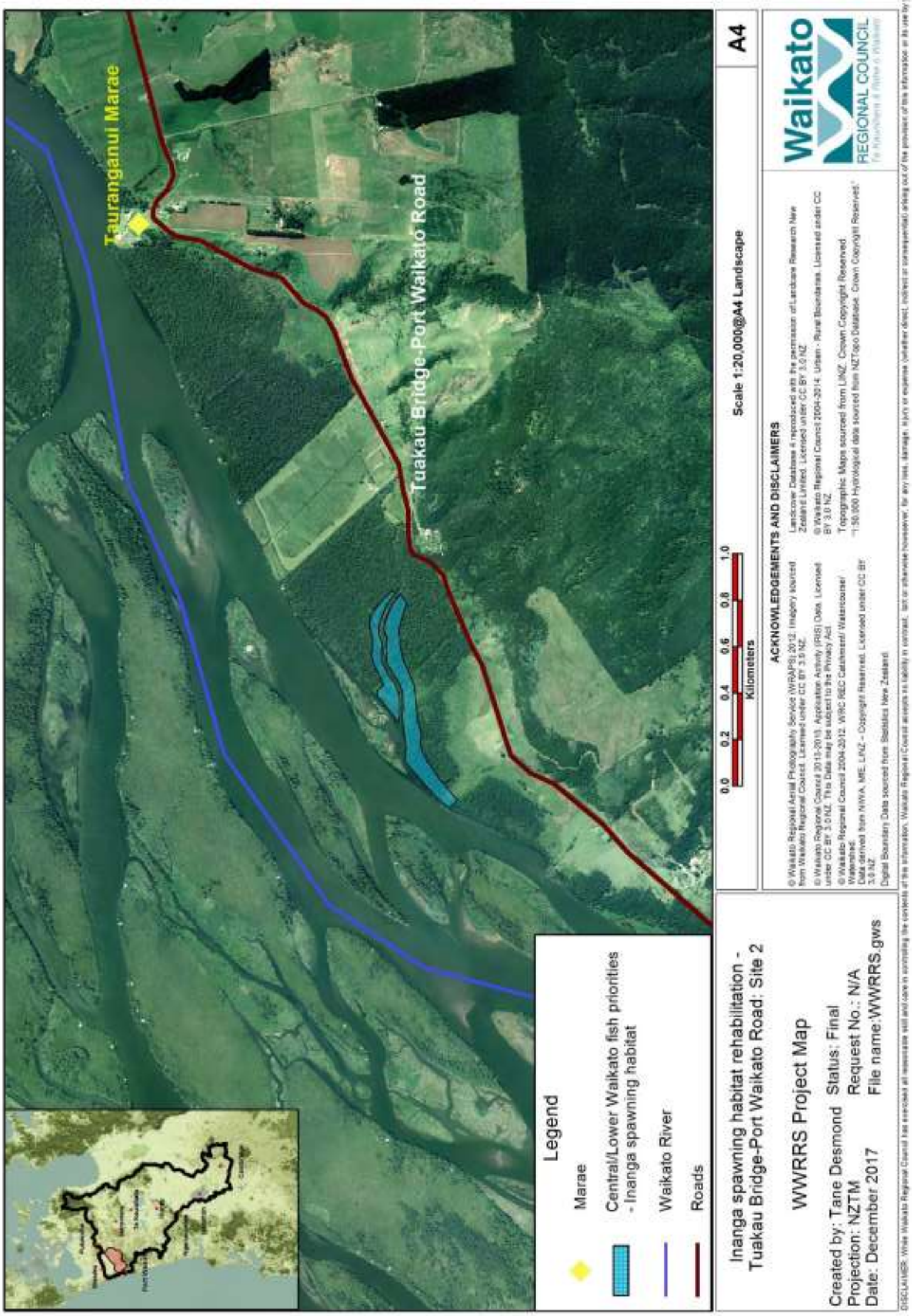
The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors).</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.

Iwi and communities have a strong connection to the īnanga habitat areas and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of spawning vegetation</td></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The intertidal regions of the island provide suitable spawning habitats for adult īnanga.
- Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species.</td><td></td></tr>
</table>

	- Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth that provides suitable spawning habitats for adult īnanga.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components. To protect the existing īnanga spawning areas within the site, works should be implemented by an organisation/group with knowledge of īnanga spawning. **Restoration plan** A restoration plan will be developed that details: - the exotic plant species to be removed and retained - the native planting layout - method recommended for weed control - accurate costings. To ensure the resulting vegetation is suitable for adult īnanga spawning, advice on weed control and planting needs to be sought from a suitably experienced fish ecologist. The estimate cost for a restoration plan is $10,000. **Fencing** The restoration site should be fenced adjacent to the tributary stream and wetland to exclude stock. Fences should be at least 5m back from waterways and be a minimum of 5 wire (2 electric). Ideally, fencing would be followed immediately by weed control and native planting. The estimated length of fencing required is 670m ($5360). **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima,* is detrimental to spawning habitat) so a comprehensive weed control plan over the 8.4ha site will be essential to ensure success of the project. Estimated costs for weed control are based on carrying out weed control over a period of 4 years, using a knapsack, at $2800 per ($94,080). **Planting** Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge,	

	swamp millet), high density planting is advised with spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates are $117,550 per hectare and include site preparation, plant purchase, planting labour and five releasing events. Planting cost estimates assume native planting 60% of the site at an average spacing of 0.75m ($592,452). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen by the time the project is completed.	L = 4.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain conditions suitable for spawning. This project makes up only a small percentage of this area and therefore the overall condition of the feature is still expected to decline even if this project is completed. It will, however, make an important contribution to the retention of this important habitat.	W = 0.013
Risk of technical failure	There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels.	F = 0.4
Adoptability	It is estimated that about 80% of landowners would adopt the works if they were fully incentivised. Some	A = 0.8

<table>
<tr><td></td><td>may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td></td></tr>
<tr><td>Information quality</td><td>Very good – judgement of expert, based on detailed knowledge of the species and of the Lower Waikato whitebait spawning habitat.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required. There are also knowledge gaps around the attractiveness of such projects to landowners.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (670 m)</td><td>5360</td></tr>
<tr><td>Weed control for 4 years</td><td>94,080</td></tr>
<tr><td>Native planting (60% of site at 0.75m spacing)</td><td>592,452</td></tr>
<tr><td>Restoration Plan</td><td>10,000</td></tr>
<tr><td>Project Management/staffing/incidentals (20%)</td><td>140,378</td></tr>
<tr><td>Total</td><td>842,270</td></tr>
</table>
</td><td>C = 0.84</td></tr>
</table>



Tauranganui Marae
Tuakau Bridge-Port Waikato Road
Legend
Marae
Central/Lower Waikato fish priorities - Inanga spawning habitat
Waikato River
Roads
Inanga spawning habitat rehabilitation - Tuakau Bridge-Port Waikato Road: Site 2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0.0 0.2 0.4 0.6 0.8 1.0
Kilometers
ACKNOWLEDGEMENTS AND DISCLAIMERS
Scale 1:20,000@A4 Landscape
A4
Waikato
REGIONAL COUNCIL

CLW 5 Priority: medium	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 1	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a “bottleneck” for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a “sink” population as reduced larval production reduces the Waikato’s contribution to the next generation of whitebait. A 2.1ha section of streambank consisting of one unnamed tributary stream along the true left margin of the Waikato River near Port Waikato has been identified as a priority for īnanga spawning habitat rehabilitation. The tributary stream has a tide gate in the lower reaches and the site contains stopbanks limiting tidal penetration. The unregulated 2.1ha area of land adjacent to the river	

<table>
<tr><td></td><td>margin is not fenced and lacks continuous suitable spawning vegetation. Weed infestation has reduced the suitability of this site for īnanga spawning since the 1980s.

The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors).</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.
- Iwi and communities have a strong connection to the īnanga habitat areas and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a Central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of spawning vegetation</td></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The intertidal regions of the island provide suitable spawning habitats for adult īnanga.</td><td></td></tr>
</table>

	- Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species. - Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth that provides suitable spawning habitats for adult īnanga.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components. To protect the existing īnanga spawning areas within the site, works should be implemented by an organisation/group with knowledge of īnanga spawning. **Restoration plan** A restoration plan will be developed that details: - the exotic plant species to be removed and retained - the native planting layout - methods recommended for weed control - accurate costings. To ensure the resulting vegetation is suitable for adult īnanga spawning, advice on weed control and planting needs to be sought from a suitably experienced fish ecologist. **Fencing** The spawning area should be fenced adjacent to the stopbanks to exclude stock. Fences should be at least 5m back from waterways and fences should be a minimum 5 wire (2 electric) or a lesser standard if the area is flood prone (2 wire electric). Ideally this would be followed immediately by weed control and native planting. The estimated length of fencing required is 350m ($2800). **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima,* is detrimental to spawning habitat) so a comprehensive weed control plan will be essential to ensure success of the project. Estimated costs for weed control are based on carrying out weed control over the 2.1ha site for a period of 4 years, using a knapsack sprayer, at $2800 per hectare ($23,520 for 4 years). **Planting**	

	Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge, swamp millet), high density planting is advised with spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates assume native planting over 50% (1.05ha) of the site at an average spacing of 0.75m ($123,427). This cost estimate assumes planting to cost $117,550 per hectare (at 0.75m spacing) and includes site preparation, plant purchase, planting labour and five releasing events. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen by the time the project is completed.	L = 4.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain conditions suitable for spawning. This project makes up only a very small percentage of this area and therefore the overall condition of the feature is still expected to decline even if this project is completed. It will, however, make an important contribution to the retention of this habitat.	W = 0.003
Risk of technical failure	There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There	F = 0.4

<table>
<tr><td></td><td>is a particularly high risk of project failure due to technical feasibility if weed control isn’t well planned and a focus given to key high priority weeds that can be managed to very low levels.</td><td></td></tr>
<tr><td>Adoptability</td><td>It is estimated that about half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td>A = 0.5</td></tr>
<tr><td>Information quality</td><td>Very good – judgement of expert, based on detailed knowledge of the species and of the lower Waikato whitebait spawning habitat.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required. There are also knowledge gaps around the attractiveness of such projects to landowners.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (350 m)</td><td>2800</td></tr>
<tr><td>Weed control for 4 years</td><td>23,520</td></tr>
<tr><td>Native planting (50% of site at 0.75m spacing)</td><td>123,427</td></tr>
<tr><td>Restoration plan</td><td>7000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>31,349</td></tr>
<tr><td>Total</td><td>188,096</td></tr>
</table></td><td>C = 0.19</td></tr>
</table>


Tauranganui Marae
Tuakau Bridge-Port Waikato Road
N
Legend
Marae
Central/Lower Waikato fish priorities - Inanga spawning habitat
Waikato River
Roads
Inanga spawning habitat rehabilitation - Tuakau Bridge-Port Waikato Road: Site 1
WWRRS Project Map
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0.0 0.1 0.2 0.3 0.4 0.5
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Scale 1:10,000@A4 Landscape
A4
ACKNOWLEDGEMENTS AND DISCLAIMERS
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Photos showing an area where fencing is required to exclude stock. (Source: NIWA)


Example showing an area where control of glyceria and planting is required. (Source: NIWA)

CLW 6 Priority: high	Īnanga spawning habitat rehabilitation – island adjacent to Mawhitiwhiti Road	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a “bottleneck” for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a “sink” population as reduced larval production reduces the Waikato’s contribution to the next generation of whitebait. A 188ha island adjacent to Mawhitiwhiti Road along the true right margin of the Waikato River near Aka Aka has been identified as a priority for īnanga spawning habitat rehabilitation. The island contains a mixture of native and exotic vegetation with īnanga known to historically use	

<table>
<tr><td></td><td>pockets of intertidal vegetation as spawning habitat. Weed infestation has reduced the suitability of much of this island for īnanga spawning.

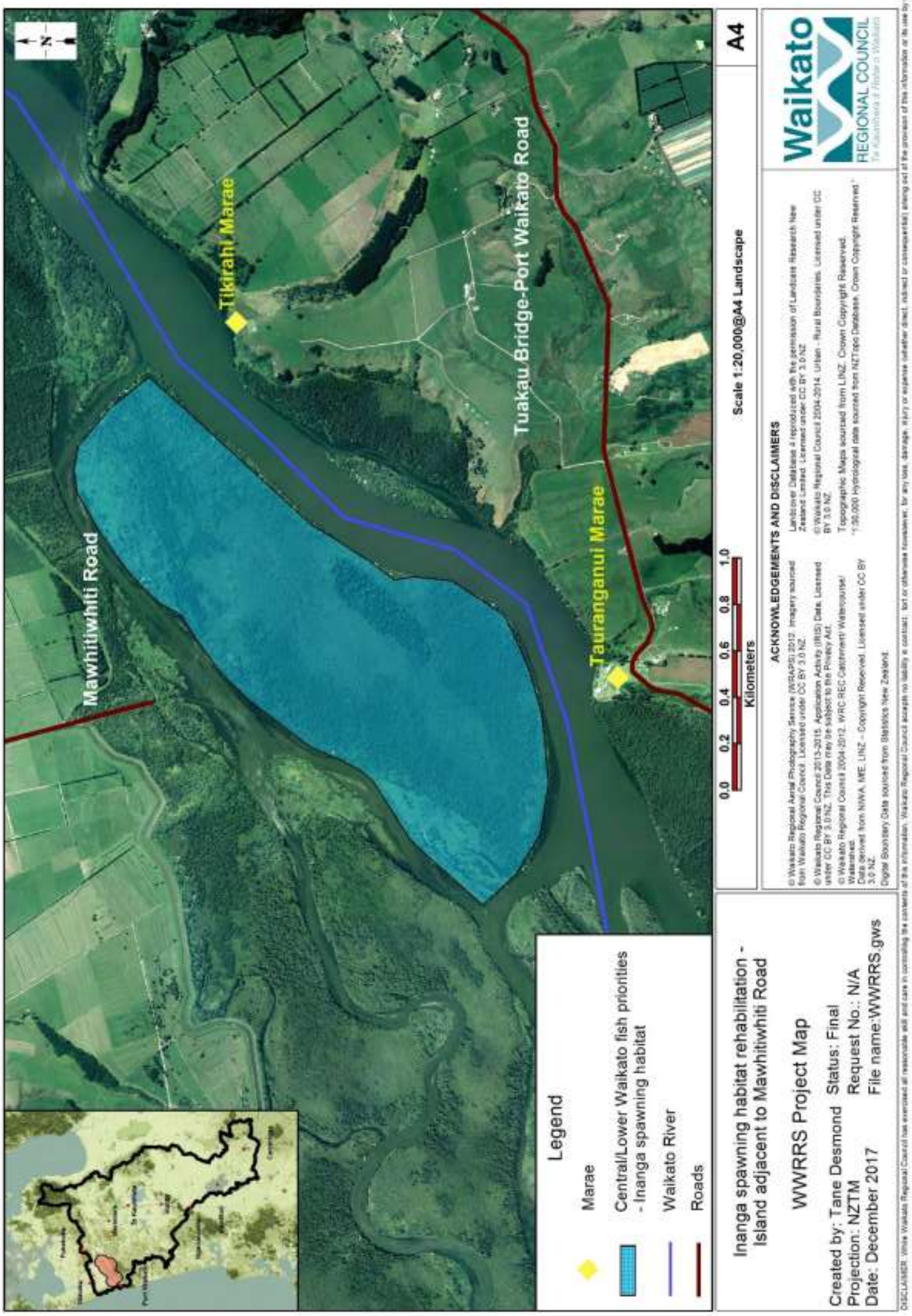
The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors).</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature not meeting V&S aspirations</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other areas</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5-10 years, the intertidal regions across at least half (94ha) of the island provides suitable spawning habitats for adult īnanga. Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species. Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth suitable for īnanga spawning.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components.

Restoration plan</td><td></td></tr>
</table>

	A restoration plan will be developed that details: - the exotic species to be removed and retained across the 94ha area - the native planting layout. To ensure the resulting vegetation is suitable for adult īnanga spawning, advice on weed control and planting needs to be sought from a suitably experienced fish ecologist. The estimated cost of a restoration plan for this site is $25,100. **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima,* is detrimental to spawning habitat) so a comprehensive weed control plan will be essential to ensure success of the project. Estimated costs are based on carrying out weed control over a period of 4 years ($1,052,800). This assumes a cost of $2800 per hectare per year, using a knapsack sprayer and appropriate herbicide. **Planting** Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge, swamp millet), high density planting is advised with spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates assume native planting over 60% of the 94ha area at an average spacing of 0.75m ($6,629,820). The cost estimate includes site preparation, plant purchase, transport to site, planting labour and five releasing events. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office	

	overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen in the year before project completion.	L = 9.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain conditions suitable for spawning. Mawhitiwhiti Island makes up about half of this area. Therefore if this project is successfully completed, then it is expected that whitebait habitat in the lower river will move significantly closer to the desired state to meet the Vision & Strategy.	W = 0.3
Risk of technical failure	There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels.	F = 0.4
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.5
Information quality	Very good – judgement of expert, based on detailed knowledge of the species and of the Lower Waikato whitebait spawning habitat.	
Knowledge gaps	Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required. There are also knowledge gaps around the attractiveness of such projects to landowners.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	10 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Weed control for 4 years</td><td>1,052,800</td></tr>
<tr><td>Native planting (60% of site at 0.75m spacing)</td><td>6,629,820</td></tr>
<tr><td>Restoration plan</td><td>25,100</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>1,156,158</td></tr>
<tr><td>Total</td><td>8,863,878</td></tr>
</table>
</td>
<td>C = 8.8</td>
</tr>
</table>


Tikirahi Marae
Tuakau Bridge-Port Waikato Road
Mawhitiwhiti Road
Tauranganui Marae
N
Legend
Marae
Central/Lower Waikato fish priorities - Inanga spawning habitat
Waikato River
Roads
Inanga spawning habitat rehabilitation - Island adjacent to Mawhitiwhiti Road
WWRRS Project Map
Created by: Tane Desmond
Status: Final
Projection: NZTM
Request No.: N/A
Date: December 2017
File name:WWRRS.gws
0.0 0.2 0.4 0.6 0.8 1.0
Kilometers
Scale 1:20,000@A4 Landscape
A4
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An example of vegetation present at the site (note the dense area of glyceria).

CLW 7	Fish habitat rehabilitation in Whauwhautahi Stream, Port Waikato	BCR value
Priority: very high		
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whauwhautahi Stream	
Brief description of feature	A short stream (approximately 5km long) flowing from hill country near Te Kohanga under Tūākau Bridge, Port Waikato Road, and into the Waikato River near Motutieke Island. The lower 500m of the stream has a stopbank on the western side preventing flood waters from inundating farmland in behind. This stream has been identified as important for īnanga (both for spawning and adult life stages), banded kōkopu, shortfin eel and longfin eel and as a waterway that would benefit from further habitat rehabilitation. Previous native planting work has been undertaken by Genesis Energy on the east side of the stream along a 300m stretch before it enters Waikato River. The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors).	
Desired state to achieve Vision & Strategy	- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present including non-climbing native fish. - The stream is fenced to exclude stock from its entire length. It has a riparian margin (at least 5m wide) that is vegetated with native plants to provide stream shading and cover for fish. - The stream is swimmable, fishable and safe for collecting kai.	

<table>
<tr><td></td><td>- Iwi and communities have a strong connection to the streams and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Whauwhautahi Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 10</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencing:
- The full length of waterways identified are fenced to exclude stock. They have a riparian margin that is at least 5m wide which is vegetated with native plant species to provide stream shade and enhance habitat for adult native fish.
- There are no manmade barriers to native migratory fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple components.

Riparian management
Undertake native riparian planting along the waterway and carry out associated weed control and maintenance for native plant establishment.

Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence – 2 electric wires). Include adjoining wetland areas within the riparian fencing.

- Fencing costs assumes 100% (10km) requires fencing or fence upgrade ($80,000).
- Planting of a 10km length of streambank with a 5m wide margin of plants is 5ha ($197,760). This cost estimate includes site preparation, plant purchase, planting labour and five releasing events.

Weed control
This part of the catchment is known to have a range of weed</td><td></td></tr>
</table>

	issues so additional weed control will be important for the success of this project. Weed control, using a knapsack, will be required within riparian areas (10ha) following native plant establishment, at an estimated cost of $2800 per hectare per year ($84,000). **Remediation of fish barriers** Determine the location and type of barriers to fish passage. It is estimated that there is one barrier/partial barrier to fish passage on this watercourse. Undertake works to remedy fish barriers if required ($5000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over an 8-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 8
Effectiveness of works	When compared to desired state, this stream is currently in poor condition with few of the Vision & Strategy desired state aspects being met. Condition is not expected to either decline or improve significantly over the next 20 years in the absence of this project, given existing measures that are in place such as the Dairy Water Accord. However, if this project is successfully completed then the Mangauika Stream is expected to move closer to desired state with aspects related to fish habitat and passage and stock exclusion all being addressed. This project will not fully address the ongoing threats to water quality at this site and it is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term.	W = 0.15
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to plant establishment and weed control.	F = 0.87
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake.	A = 0.8

<table>
<tr><td>Information quality</td><td>Average – management requirements estimated using aerial photography and judgement of a fish expert with local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>8 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (10km)</td><td>80,000</td></tr>
<tr><td>Planting (10ha)</td><td>197,768</td></tr>
<tr><td>Weed control</td><td>84,000</td></tr>
<tr><td>Investigation and remediation of fish barriers</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (20% of project cost)</td><td>73,354</td></tr>
<tr><td>Total</td><td>440,122</td></tr>
</table>
</td><td>C = 0.44</td></tr>
</table>

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale 1:16,500@A4 Landscape

A4

Fish habitat rehabilitation in Whauwhautahi Stream, Port Waikato

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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Whauwhautahi Stream (and upper catchment in background) where riparian planting is recommended.


Whauwhautahi Stream where riparian planting and fence relocation is recommended. Planting may need to be low growing species such as *Carex* to allow for stopbank and stream maintenance work.

CLW 8 Priority: high	Īnanga spawning habitat rehabilitation – wetland opposite Elbow Hill	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Whitebait spawning habitat in the lower river	
Brief description of feature	In the Waikato region, īnanga is the main whitebait species, comprising >90% of whitebait recruiting into the river. Īnanga are the only whitebait species to utilise tidal waters in the estuary to spawn. As īnanga spawn on high spring tides, only habitat that is inundated between mean high water spring tide (MHWS) and highest astronomical tide (HAT) is likely to be utilised for spawning. Since flood protection works have been implemented in the lower Waikato River, only 7.5% of the estuary, delta and floodplain that is inundated between MHWS and HAT remains accessible to īnanga. Of the remaining intertidal habitat available to īnanga, ongoing weed infestation, grazing, pest fish proliferation and streambank erosion is reducing the suitability of many sites for spawning. In the late 1980s, 11 spawning sites were located downstream of the Elbow in the lower Waikato River. Presently, spawning only occurs at three of these sites. In addition, the loss of indigenous vegetation and expansion of exotic plant species throughout much of the lower river has resulted in all known īnanga spawning sites to now be located within exotic pasture grasses or perennial plants. The loss of intertidal floodplains and vegetation changes over the past half century is thought to be limiting īnanga spawning habitat and creating a “bottleneck” for īnanga production from the catchment. This is because if spawning habitat is limited, Waikato īnanga become a “sink” population as reduced larval production reduces the Waikato’s contribution to the next generation of whitebait. A 140ha wetland opposite Elbow Hill along the true left margin of the lower Waikato River has been identified as a priority for īnanga spawning habitat rehabilitation. Several farm drains and an unnamed tributary flowing through Te Kohanga feed into the Waikato River through the wetland. Īnanga spawning occurred in the lower reaches of the unnamed tributary in the 1980s but	

<table>
<tr><td></td><td>weed infestation has reduced the suitability of the stream and much of the wetland for īnanga spawning. Waikato-Tainui have also identified the unnamed tributary as an important site for tuna and whitebait rearing habitat restoration.

The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and the river islands sustained the tangata whenua for centuries with īnanga (whitebait), tuna (eel), pātiki (flounder), kāeo and many more mahinga kai species. It was also an important area for trade and travel. Flour and flax mills were established and run by tangata whenua along this stretch. There are many existing and historic pā sites within the area. There are papakāinga, historic settlements and wāhi tapu within this project area. Īnanga and other taonga fisheries are a staple food for marae. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors). Discussions will be required with marae, in particular Te Awamārahi and Tikirahi marae.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The remaining intertidal habitat available to īnanga in the lower Waikato River has suitable vegetation to support spawning, is free from grazing stock and is utilised by īnanga for spawning.
- Iwi and communities have a strong connection to the īnanga habitat areas and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, whitebait spawning habitat in the lower river would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of spawning vegetation</td></tr>
<tr><td>Lack of intertidal spawning vegetation and associated fish habitat</td><td>Reduced habitat for adult fish and reduced reproduction success</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to spawning habitats</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The intertidal regions of the wetland provide suitable spawning habitats for adult īnanga.</td><td></td></tr>
</table>

	- The wetland and its associated tributary streams and farm drains are fenced to exclude stock with a minimum 5 wire (2 electric) fence. - Weed control is carried out prior to and after native planting to maintain the habitat free of undesirable exotic plant species. - Native planting is undertaken amongst the desirable exotic vegetation to create a dense plant growth that provides suitable spawning habitats for adult īnanga.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. To protect the existing īnanga spawning areas within the site, works should be implemented by an organisation/group with knowledge of īnanga spawning. **Restoration plan** A restoration plan will be developed that details: - the exotic plant species to be removed and retained - the native planting layout - methods recommended for weed control - accurate costings. To ensure the resulting vegetation is suitable for adult īnanga spawning, advice on weed control and planting needs to be sought from a suitably experienced fish ecologist. The estimated cost of a restoration plan for this site is $25,000. **Fencing** The site should be fenced along the stopbanks that form the perimeter of the wetland to exclude stock. Ideally, this would be followed immediately by weed control and native planting. The estimated length of fencing required is 4000m ($32,000). **Weed control** The lower Waikato River has a range of weed species present with varying impacts on īnanga spawning habitats (e.g. sweet reed grass, *Glyceria maxima,* is detrimental to spawning habitat) so a comprehensive weed control plan will be essential to ensure success of the project. Estimated costs for weed control are based on carrying out weed control over the 140ha site for a period of four years,	

	using a knapsack, at $2800 per hectare ($1,568,000 over four years). **Planting** Native planting should be carried out within open areas to create a native and exotic plant dominated ecosystem over the long term. Using suitable intertidal spawning vegetation (e.g. *Carex* sp., *Juncus* sp., umbrella sedge, swamp millet), high density planting is advised with spacing determined by species. For example, *Carex* sp. should be spaced at 0.75m and *Juncus* sp. and swamp millet spaced at 0.45m. Exotic vegetation utilised by īnanga for spawning should be retained at the site (e.g. wandering willie, Yorkshire fog, Mercer grass, creeping bent and kikuyu). Planting cost estimates assume native planting over 60% (84ha) of the site at an average spacing of 0.75m ($9,874,200). This cost estimate assumes planting to cost $117,550 per hectare (at 0.75m spacing) and includes site preparation, plant purchase, planting labour and five releasing events. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 9-10 years after project commencement.	L = 9.5
Effectiveness of works	When compared with desired state, whitebait spawning habitat in the lower river is currently in poor condition. It is expected that it will deteriorate further over the next 20 years if this project is not undertaken, particularly due to spread of exotic plants that are not suitable for spawning. The whitebait spawning projects identified in the Restoration Strategy represent about 70% (350ha) of all remaining locations in the lower river that retain conditions suitable for spawning. This wetland makes up more than a third of this area. Therefore, if this project is successfully completed, it is expected that	W = 0.22

<table>
<tr><td></td><td>whitebait habitat in the lower river will move significantly closer to the desired state to meet the Vision & Strategy.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>There is a very high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn’t well planned and a focus given to key high priority weeds that can be managed to very low levels.</td><td>F = 0.4</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about 80% of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td>A = 0.8</td></tr>
<tr><td>Information quality</td><td>Good – judgement of expert, based on detailed knowledge of the species and of the Lower Waikato whitebait spawning habitat.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Costings for this site is largely based off aerial photography with some local knowledge. Further work is required to determine the specific amounts of planting and weed control required. There are also knowledge gaps around the attractiveness of such projects to landowners.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (4000 m)</td><td>32,000</td></tr>
<tr><td>Weed control for 4 years</td><td>1,568,000</td></tr>
<tr><td>Native planting (60% of site at 0.75m spacing)</td><td>9,874,200</td></tr>
<tr><td>Restoration plan</td><td>25,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>2,299,840</td></tr>
<tr><td>Total</td><td>13,799,040</td></tr>
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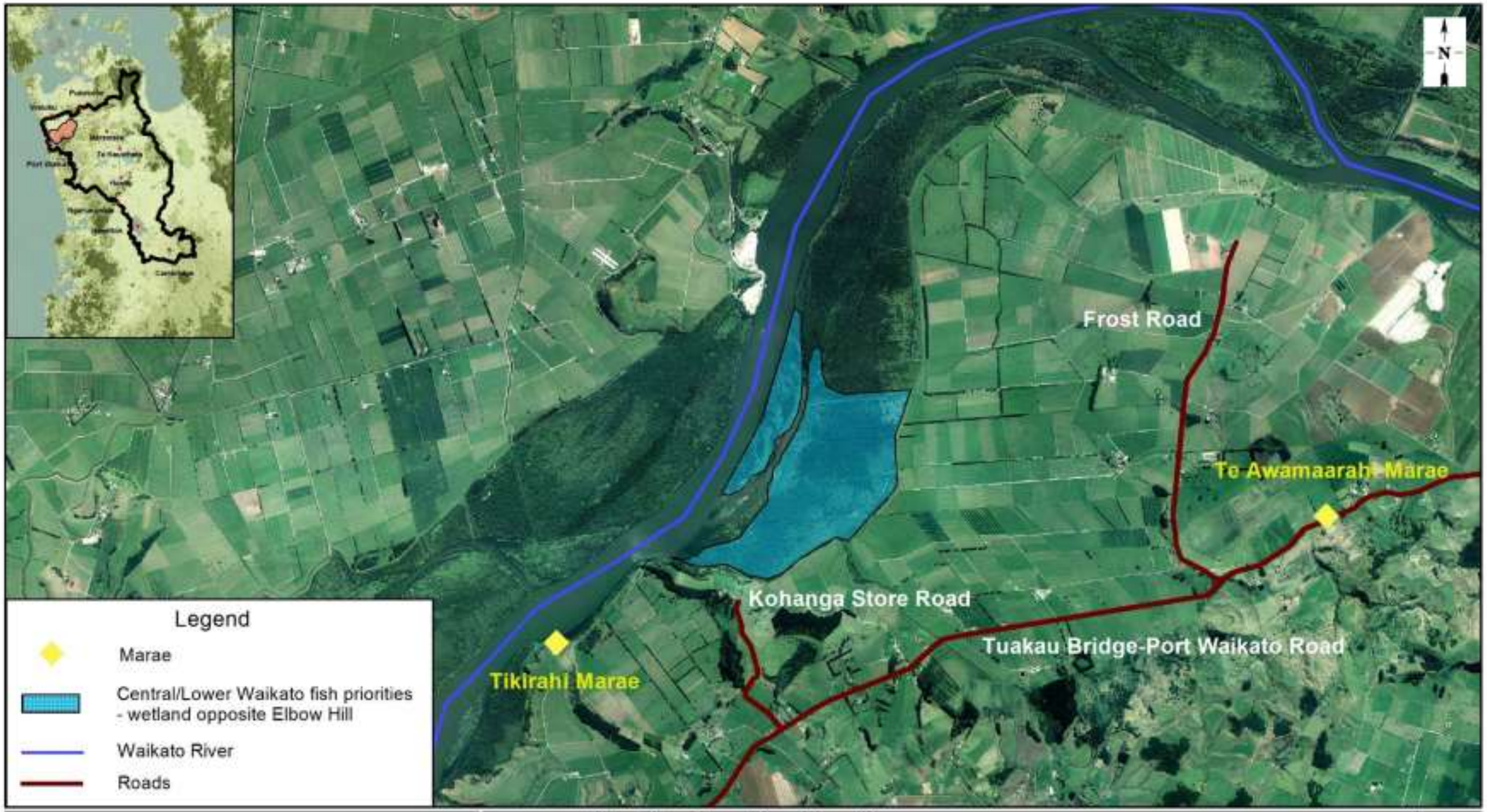
</td><td>C = 13.8</td></tr>
</table>



Inanga spawning habitat rehabilitation – Wetland opposite Elbow Hill

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:30,000@A4 Landscape

A4

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Island wetland identified for enhancement of spawning habitat. (Source: NIWA)

CLW 9 Priority: very high	Increased control of yellow flag iris and alligator weed within the Lower Waikato River catchment	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced and where feasible expanded and re-established. Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.	
Name of feature	Waikato River between Rangiriri and Port Waikato	
Brief description of feature	The Waikato River between Rangiriri and Port Waikato extends over 67km as it passes through large areas of mineralised swamp and takes in the outflows of many shallow lakes. It flows through a diverse delta habitat to the sea at Port Waikato. From Rangiriri to Port Waikato the river is generally broad and meandering, with elongated low-lying islands in its lower reaches. The Waikato River provides rich habitat for a range of fish and bird species, including rare and threatened species such as banded rail, spotless crake and Australasian bittern; and fish species such as longfin eel, shortfin eel, four whitebait species, grey mullet and common smelt. The river delta contains a number of islands, some of which are vegetated with native kahikatea and tōtara. There are large wetland communities that support a variety of plant and animal species which are uncommon or rare elsewhere in New Zealand. A serious threat to biodiversity in this section of the river (as well as the north Waikato lakes, Whangamarino Wetland and upstream to Ngāruawāhia) are the plant pest species yellow flag iris and alligator weed. Both are aggressive aquatic plants and can take over low lying flood plains, lake margins, and wetland areas, leading to the loss of wetland habitat and a decline in the diversity and abundance of indigenous plants and fauna (Reeves 2012). Once established, yellow flag develops a thick rhizome mat that can suppress germination of other plant seedlings and also elevate local topography by trapping sediment and creating a drier habitat. This can allow it to spread into previously unsuitable habitat and also enable other species to invade, altering successional trajectories (Thomas 1980). Alligator weed occupies similar habitat to yellow flag iris and the species have been found together along the banks of the	

	Waikato River. The wide range of habitats occupied and severity of impacts make alligator weed one of, if not the greatest, weed threat to the Waikato (Champion 2016). The Waikato Regional Council Biosecurity group currently undertakes some control of alligator weed and yellow flag iris where it occurs along the banks of the Waikato River and its tributaries. Most of the effort is concentrated between Ngāruawāhia and Rangiriri for the yellow flag control, due to the limited resources available and the upstream areas of infestation needing to be controlled first to prevent seeds floating downstream. At the current rate of 14km every 3 years, it would take 12 years before the council is in a position to undertake control at Port Waikato (60km downstream of Rangiriri). During this time, habitat will be lost for native fish species, including tuna and white bait, and also birds, invertebrate species and native flora. The lower Waikato River area is very significant to Waikato-Tainui and the river marae. The lower Waikato River and its tributaries sustained tangata whenua for centuries with īnanga (whitebait), tuna (eel), kāeo, birds and many more taonga species. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors). Waikato was known for its richness in resources. It was also an important area for trade and travel along its entire length. Flour and flax mills were established and run by tangata whenua. There are many existing and historic pā sites within the area. Papakāinga, historic settlements and wāhi tapu are strategically located within this project area.	
Desired state to achieve Vision & Strategy	- Native fish are healthy, abundant and the full range of species expected to be found in the waterway can be found there. - The Waikato River is fenced to exclude stock along 100% of its margin, and the margin is at least 10 metres wide and vegetated with native species. - Forest remnants and wetlands adjacent to the river are densely vegetated with native plant species, connected to riparian corridors and protected from grazing stock. - Native plant regeneration occurs naturally within the native bush and wetland areas and these areas are protected from further invasion by new and existing weed species. - The river is swimmable, fishable and has access for recreation and collection of kai.	

<table>
<tr><td></td><td>- Iwi and communities have a strong connection to the waterways and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Waikato River between Rangiriri and Port Waikato would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 375</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.
Displace native plant communities and spawning habitat for native fish species.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 6 years of project commencement, infestations of yellow flag iris and alligator weed within the lower Waikato River catchment are significantly reduced to a point where Waikato Regional Council’s control programme is able to eradicate any remaining and/or new infestations.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Works could be implemented either by an organisation or private citizens (using contractors or their own labour) but it is envisaged that a project manager would be required to co-ordinate with the Waikato Regional Council, provide information and manage aspects of the project.

Herbicide control
Yellow flag iris is easily controlled by using the herbicide metsulfuron-methyl. However, the seed bank that is left after initial control can be substantial, requiring follow up spraying for up to 5 years.

To reduce the alligator weed infestations in the Lower Waikato, each site requires herbicide control at least 3 times per season. Alligator weed will grow underwater so at some sites the opportunity to spray is reduced due to water levels. Perseverance is therefore required.

The following resources are required (additional to Waikato Regional Council’s programme):<table><tr><th>Work required</th><th>Cost per year for years 1,2,3</th><th>Cost per year for years 4,5,6</th></tr><tr><td>Land based control of yellow flag and alligator weed around Lake Whangape.
- Years 1,2,3 – two contractors for 10 days per year ($1000 per day)</td><td>$10,000</td><td>$5000</td></tr></table></td><td></td></tr>
</table>

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>- Years 4,5,6 – two contractors for 5 days per year</td><td></td><td></td></tr>
<tr><td>Extend yellow flag iris control area to include Rangiriri to Port Waikato (60km)
- Years 1,2,3 – two contractors for 96 days per year
- Years 4,5,6 – two contractors for 48 days per year</td><td>$96,000</td><td>$48,000</td></tr>
<tr><td>Opuatia Wetland – extend current WRC control area to cover an additional 65ha areas
- Years 1,2,3 – two contractors for 40 days per year
- Years 4,5,6 – two contractors for 20 days per year</td><td>$40,000</td><td>$20,000</td></tr>
<tr><td>Land based control of alligator weed on the lower Waikato River
- Years 1,2,3 – two contractors for 10 days per year
- Years 4,5,6 – two contractors for 5 days per year</td><td>$10,000</td><td>$5000</td></tr>
</table>

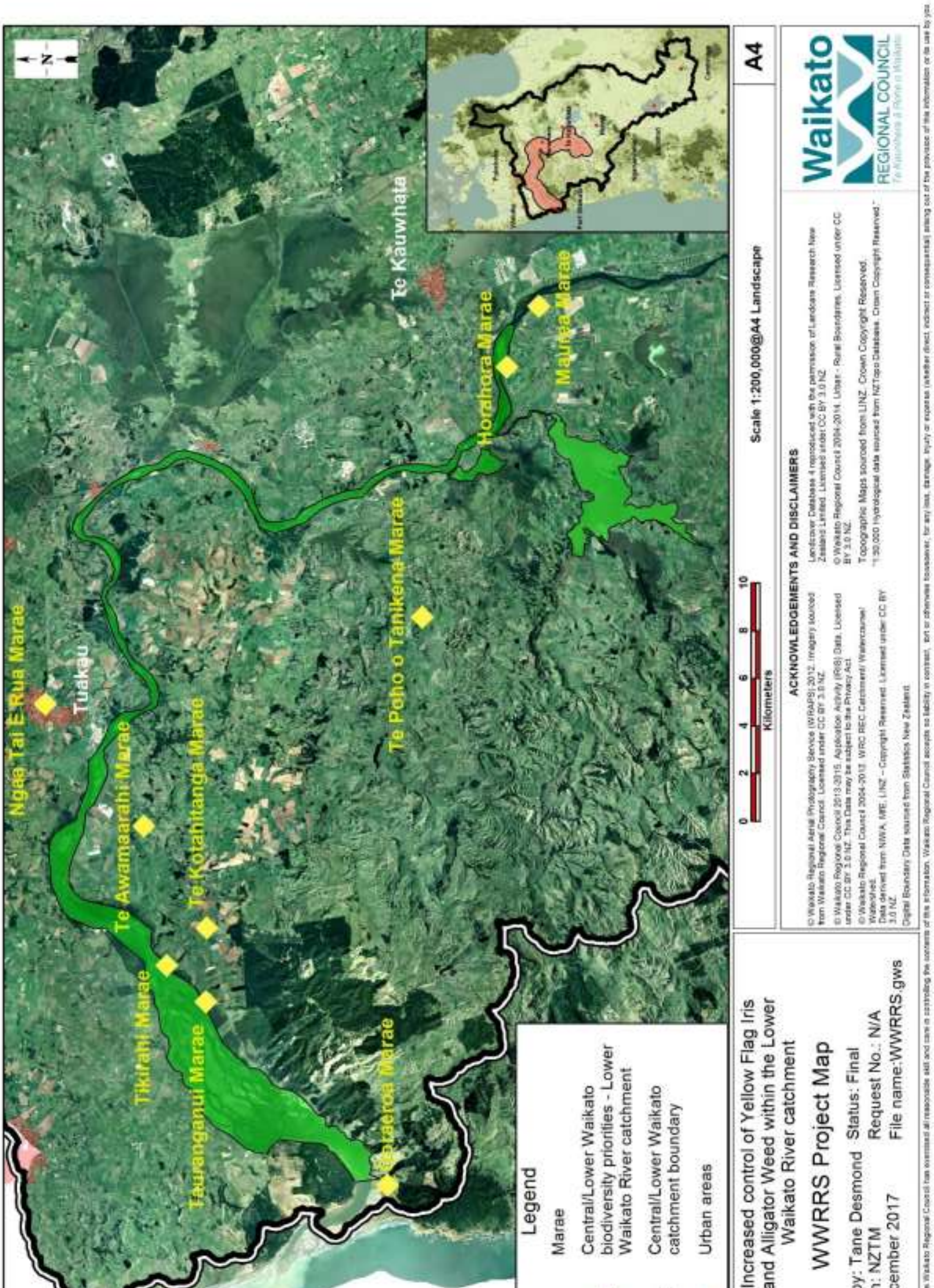
Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 20% of the direct project costs.
</td>
<td></td>
</tr>
<tr>
<td>Time lag for benefits to be realised</td>
<td>If works were implemented at an even pace over a 6-year period, it is estimated that the majority of the project benefits would be seen approximately 4 years after project commencement.</td>
<td>L = 4</td>
</tr>
<tr>
<td>Effectiveness of works</td>
<td>The Waikato River between Rangiriri and Port Waikato is currently in poor condition with few of the Vision & Strategy desired state aspects being met. The river has unsatisfactory levels of E. coli and is not safe for swimming in places, the riparian condition is generally poor and stock have access to the river at a number of locations. The river still has very important values, however, and is used by iwi and the community for recreation and the collection of kai. It retains very significant cultural values.

Some deterioration in overall condition is expected over the next 20 years in the absence of this project, with impacts of the upper catchment likely to lead to further decline in water</td>
<td>W = 0.05</td>
</tr>
</table>

	quality and habitat for fish. Invasive weeds are also expected to cause a decline in ecological values and continue to be an impediment to restoration efforts. This expected decline would be offset by the outcomes of this project which will improve the ecological values of the river and provide an important contribution to assisting other projects that are threatened by the presence of alligator weed and yellow flag iris. It is acknowledged that achieving the Vision & Strategy desired state along this stretch of river will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. Whilst this project will not directly improve water quality in the river it will have secondary impacts on other projects focusing on water quality, fish habitat, biodiversity, recreation and cultural values.	
Risk of technical failure	There is a high risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure control of these pest plants is effective.	F = 0.82
Adoptability	It is estimated that this work would be fully adopted. The Waikato Regional Council already has a small control programme in place and has expressed interest in upscaling this programme if funding was available. There is strong community support for the programme to be upscaled as it has benefits to the agricultural industry as well as agencies and groups undertaking environmental projects along the lower Waikato River and connected lakes and wetlands.	A = 1
Information quality	Very good – based on information from Waikato Regional Council staff who are very familiar with the area and the work requirements.	
Knowledge gaps	Costs are estimates based on current work programmes, however, actual costs may vary as work is undertaken and sites reassessed.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	6 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Herbicide control – Year 1</td><td>156,000</td></tr>
<tr><td>Herbicide control – Year 2</td><td>156,000</td></tr>
<tr><td>Herbicide control – Year 3</td><td>156,000</td></tr>
<tr><td>Herbicide control – Year 4</td><td>78,000</td></tr>
<tr><td>Herbicide control – Year 5</td><td>78,000</td></tr>
<tr><td>Herbicide control – Year 6</td><td>78,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>140,000</td></tr>
<tr><td>Total</td><td>842,400</td></tr>
</table>
</td>
<td>C = 0.84</td>
</tr>
</table>


Ngaa Tai E Rua Marae
Tuakau
Te Awamaarahi Marae
Te Kotahitanga Marae
Tikirahi Marae
Tauranganui Marae
Te Poho o Tanikena Marae
Horahora Marae
Maurea Marae
Te Kauwhata
Legend
Marae
Central/Lower Waikato biodiversity priorities - Lower Waikato River catchment
Central/Lower Waikato catchment boundary
Urban areas
Increased control of Yellow Flag Iris and Alligator Weed within the Lower Waikato River catchment
WWRRS Project Map
Created by: Tane Desmond Status: Final
Projection: NZTM Request No.: N/A
Date: December 2017 File name:WWRRS.gws
0 2 4 6 8 10
Kilometers
Scale 1:200,000@A4 Landscape
A4
ACKNOWLEDGEMENTS AND DISCLAIMERS
Waikato
REGIONAL COUNCIL

Yellow flag iris in Kimihia Wetland, Huntly.

Alligator weed in Tumate Mahuta Lagoon, Huntly.

Yellow flag iris dominates Maurea Islands.

CLW 10 Priority: medium	Upper and middle Opuatia catchment hill country erosion protection and remediation	BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species	
Name of feature	Opuatia sub-catchment including the wetland	
Brief description of feature	The upper and middle Opuatia catchments consist of 18,251ha of steep to rolling land, and drain from the northwest into the Opuatia wetland. 80% of this area is in pasture and nearly 10,400ha of this is Land Use Capability (LUC) class 6e or 7. The predominant land use in the catchment is dry stock farming. The target part of the catchment extends from Port Waikato Hills (Klondyke Road) southeast to where SH22 crosses the Opuatia Stream. Below this, the Opuatia Stream eventually drains through the Opuatia Wetland and into the Waikato River at Churchill Road. The Opuatia Wetland is a nationally significant wetland that covers approximately 950ha of low lying land at the bottom of the Opuatia catchment. The wetland is largely privately owned and contains several wetland types including fen, fen-young bog and swamp. The Opuatia area was regularly visited and traversed by Waikato River marae to gather foods, as the seasons dictated. There are many marae and historic papakāinga within the project area. There are some historic soil conservation works that have been carried out in the upper and middle catchment but these are now aged and likely due for replacement. There have been some more recent works undertaken through the use of pole planting, including through private landowner initiative, but there is scope for significant additional soil conservation works. Modelling undertaken in 2016 indicates that the upper and middle Opuatia are a high priority for management of hill country erosion.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide).	

<table>
<tr><td></td><td>- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing.
- Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The catchment streams are swimmable, fishable and have access for recreation.
- Iwi and community have a strong connection to the catchment and stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Opuatia would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams, Opuatia Wetland and the lower Waikato River.</td></tr><tr><td>Stock access to wetlands</td><td>Reduced water quality and destruction of the wetland ecosystem.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 20 years of project commencement:
- LUC class 7 soils are managed within their capabilities and are retired from heavy stock grazing.
- There is a 40% reduction in suspended sediment in the Opuatia Stream.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 1259ha LUC 6e land managed with open space pole planting at $3000 per hectare

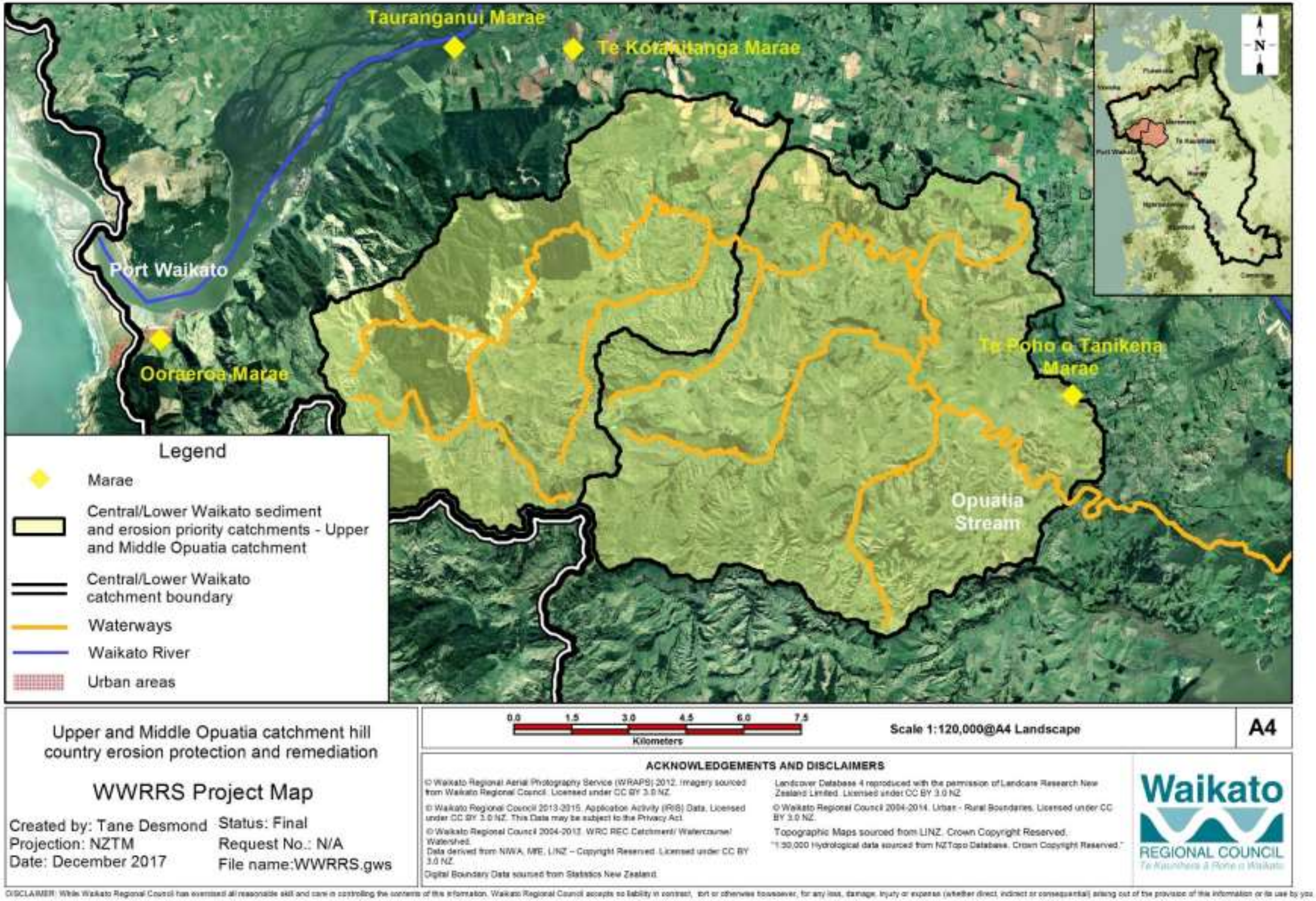
- 1259ha LUC 6e land managed with plantation species (pine or manuka) at $3000 per hectare

- 225km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten)

- 319ha LUC 7 land managed with plantation species (pine or mānuka) at $3000 per hectare</td><td></td></tr>
</table>

	- 36km of fencing the managed LUC 7 land at $25 per metre (8-wire and batten) - 8ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $8000ha (e.g. dewatering, retiring seepages, etc) - 54km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) - 104 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 10,400ha area. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 15 years after project commencement.	L = 15
Effectiveness of works	The Opuatia sub-catchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed the sub-catchment will be significantly closer to the Vision & Strategy desired state in 20 years' time, particularly when it comes to land use matching capability and waterways being swimmable. The project does not directly address E. coli, fish habitat and biodiversity, however, the proposed fencing and planting works provide secondary benefits which would be expected to reduce E.coli to waterways, improve habitat and enhance local biodiversity.	W = 0.3

<table>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about one third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.3</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e and 7 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>1259ha LUC 6e managed with pole planting</td><td>3,777,000</td></tr>
<tr><td>1259ha LUC 6e managed with pole planting</td><td>3,777,000</td></tr>
<tr><td>Fencing managed LUC 6e land (225km)</td><td>5,625,000</td></tr>
<tr><td>319ha LUC 7 managed with plantation species</td><td>957,000</td></tr>
<tr><td>Fencing managed LUC 7 land (36km)</td><td>900,000</td></tr>
<tr><td>Reducing sediment outside LUC 6e, 7 and 8 (8ha)</td><td>64,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (54km)</td><td>1,350,000</td></tr>
<tr><td>Goat control on treated 6e and 7</td><td>127,185</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>4,973,155</td></tr>
<tr><td>Total</td><td>21,550,340</td></tr>
</table>
</td><td>C = 21.6</td></tr>
</table>



Tauranganui Marae
Te Kotahitanga Marae
Port Waikato
Ooraeroa Marae
Te Poho o Tanikena Marae
Opuatia Stream
Legend
Marae
Central/Lower Waikato sediment and erosion priority catchments - Upper and Middle Opuatia catchment
Central/Lower Waikato catchment boundary
Waterways
Waikato River
Urban areas
Upper and Middle Opuatia catchment hill country erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0.0 1.5 3.0 4.5 6.0 7.5
Kilometers
Scale 1:120,000@A4 Landscape
A4
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Hill country is prone to erosion in the upper Opuatia catchment.

Examples of poplar and willow pole planting to prevent erosion in the Middle Opuatia.

CLW 11 Priority: high	Naike catchment hill country erosion protection and remediation	BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed, including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species	
Name of feature	Naike catchment	
Brief description of feature	This is a relatively large catchment of 10,608 ha. It extends from the west at the catchment divide and in the north at Matakitaki Road and travels east down to where the Maire Stream crosses under SH22 and becomes the Awaroa Stream. Approximately 87% of the catchment is in pasture and 6230ha is estimated to be LUC 6e or 7 in pasture. The predominant land use is dry stock farming. This area was travelled and established by Waikato-Tainui as its sits between the lakes, the sea and the Waikato River. Old papakāinga and midden sites reflect the areas and paths that were populated. The seasonal weather determined where hunting and gathering would occur within this area. The main waterways in the catchment are the Maire, Naike and Taringapeka streams, all of which are tributaries to the Awaroa Stream and eventually drain into the Awaroa Wetland adjacent to Lake Whangape. There are a number of fenced and covenanted bush blocks in the steeper parts of the catchment, along with areas of riparian protection and enhancement. There are also areas of regenerating native bush, however, there remains significant scope for soil conservation works in the catchment. Modelling undertaken in 2016 indicates that the Naike catchment is a high priority for hill country erosion management.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide). - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.	

	- The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Naike sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.	VS = 200
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams, Lake Whangape and the lower Waikato River.</td></tr></table>	
Project goal/s	Within 20 years of project commencement: - LUC class 7 soils are managed within their capabilities and are retired from heavy stock grazing. - There is a 40% reduction in suspended sediment in the Maire and Naike streams.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 730ha LUC 6e land managed with open space pole planting at $3000 per hectare - 730ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare - 133km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten) - 392ha LUC 7 land managed with plantation species (pine or mānuka) at $3000 per hectare - 47km of fencing the managed LUC 7 land at $25 per metre (8-wire and batten) - 3ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $8000 per ha (e.g. dewatering, retiring seepages, etc) - 38km fencing existing indigenous forest cover at $25 per m (8-wire and batten)	

	- 62 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 6200ha area. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 15 years after project commencement.	L = 15
Effectiveness of works	The Naike sub-catchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed the sub-catchment will be significantly closer to the Vision & Strategy desired state in 20 years' time, particularly when it comes to land use matching capability and waterways being swimmable. The project does not directly address E. coli, fish habitat and biodiversity, however, the proposed fencing and planting works provide secondary benefits which would be expected to reduce E.coli to waterways, improve habitat and enhance local biodiversity.	W = 0.3
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.87
Adoptability	It is estimated that about one third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to	A = 0.3

<table>
<tr><td></td><td>date. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e and 7 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>730ha LUC 6e managed with pole planting</td><td>2,190,000</td></tr>
<tr><td>730ha LUC 6e managed with plantation species</td><td>2,190,000</td></tr>
<tr><td>Fencing managed LUC 6e land (133km)</td><td>3,325,000</td></tr>
<tr><td>392ha LUC 7 managed with plantation species</td><td>1,176,000</td></tr>
<tr><td>Fencing managed LUC 7 land (47km)</td><td>1,175,000</td></tr>
<tr><td>Reducing erosion outside LUC 6e, 7 and 8 (3ha)</td><td>24,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (38km)</td><td>950,000</td></tr>
<tr><td>Goat control on treated 6e and 7</td><td>75,888</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>3,331,766</td></tr>
<tr><td>Total</td><td>14,437,654</td></tr>
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</td><td>C = 14.4</td></tr>
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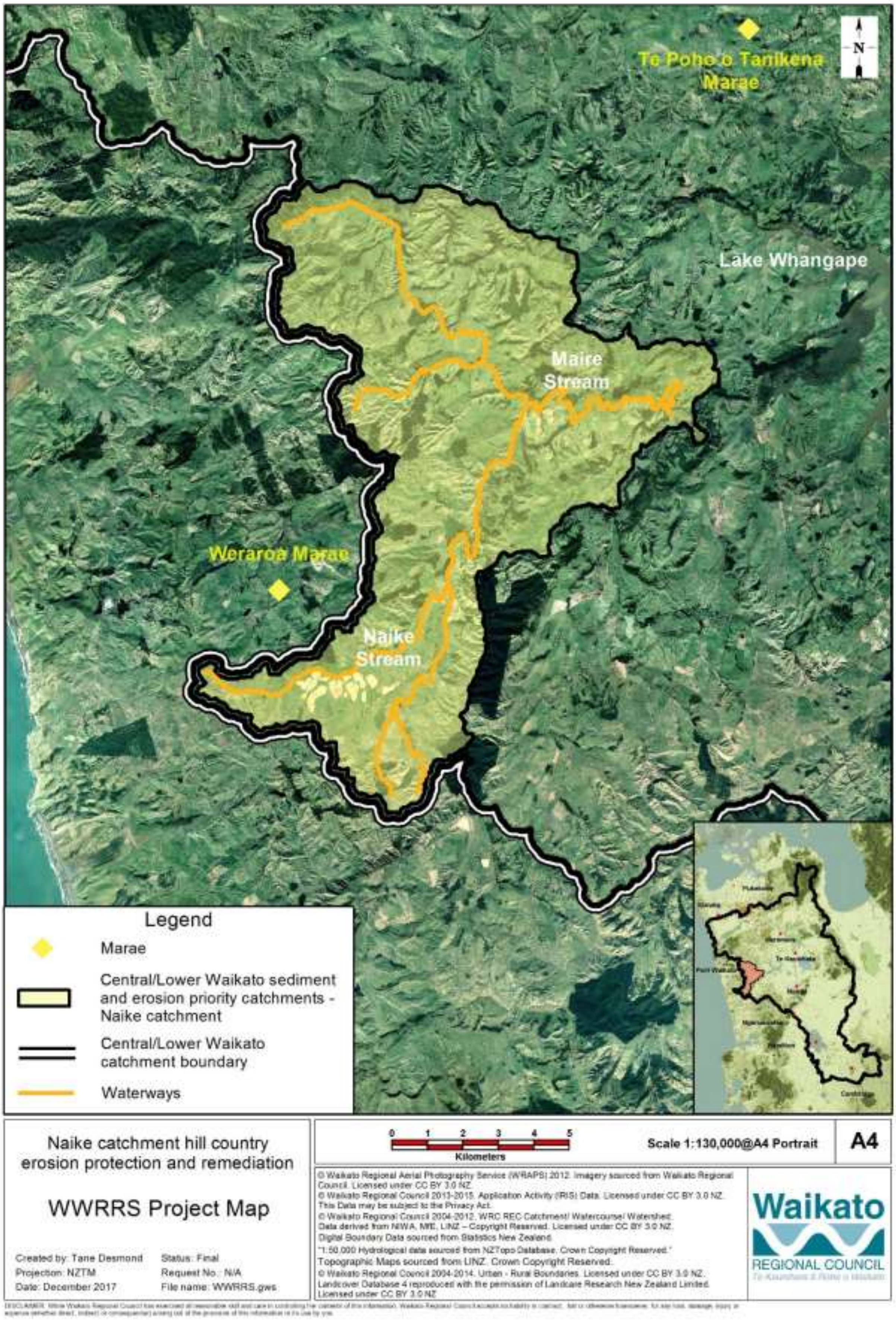
Te Poho o Tanikena Marae
N
Lake Whangape
Maire Stream
Weraroa Marae
Naike Stream
Legend
Marae
Central/Lower Waikato sediment and erosion priority catchments - Naike catchment
Central/Lower Waikato catchment boundary
Waterways
Naike catchment hill country erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale 1:130,000@A4 Portrait
A4
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Waikato REGIONAL COUNCIL

Active erosion and potential erosion in the Naike catchment hill country.

Active erosion and potential erosion in the Naike catchment hill country.

Example of a hill country wetland that could be retired for erosion and sedimentation prevention and protection.

CLW 12 Priority: very high	Middle Mangatawhiri Stream erosion protection and remediation	BCR value
Relevant unit goal(s)	Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of freshwater is protected and restored for aquatic species.	
Name of feature	Mangatawhiri Stream	
Brief description of feature	This 4305ha section of the Mangatawhiri catchment extends from DOC reserve boundary southwest and down to where the stream becomes stopbanked. The upper catchment (not included in this project) includes the Mangatawhiri Dam and is predominantly in indigenous vegetation. The middle Mangatawhiri catchment itself also retains some indigenous vegetation with only 60% of the catchment in pasture. Approximately 47km of stream network lies within this pastoral area and is considered high priority for prevention and remediation of bank erosion. The lower extent of the middle Mangatawhiri is where the stream crosses under Lyons Road. Below this the stream is bordered by stopbanks on both sides until it reaches a Fish & Game wetland and enters the Waikato River north of Mercer. The catchment land use includes dairy farms and lifestyle blocks. The Dilworth Rural Campus also sits within the catchment which provides outdoor education activities and could present an opportunity for a catchment partnerships. Some riparian planting has been undertaken upstream of the campus. The Mangatawhiri is regarded as the aukati (boundary) with which the British troops crossed and triggered the Waikato invasion. Papakāinga, marae and historic sites populate the area. This area provided food resources for the tangata whenua and is very significant to iwi and marae.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to	

<table>
<tr><td></td><td>riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangatawhiri Stream would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 40</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Mangatawhiri Stream and lower Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The main channel and tributaries of the middle Mangatawhiri Stream are stable and fenced to exclude stock with a minimum 3-wire electric fence.
- Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management of rivers/streams in pasture for soil conservation purposes
Costs for fencing are based on a 5-wire (2 electric) fence, however, in these flood prone streams a 3-wire electric fence would also be acceptable.

Carry out riparian fencing with a minimum 5m setback from the top of the streambank (preferably 5-wire with 2 electric wires at $8 per metre) along an estimated 27km of streambank (13.5km of stream length). Include adjoining wetland areas within the riparian fencing ($216,000). Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 10ha of planting and associated weed control and maintenance</td><td></td></tr>
</table>

	($373,520). 2369 poplar poles are estimated to be required for stream erosion control ($33,163). The main reach of the middle Mangatawhiri is 9km long and it is estimated that erosion control structures would be required at a frequency of 1 per km ($2500 per km for a total cost of $22,500). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 1-2 years after project completion.	L = 6.5
Effectiveness of works	The Mangatawhiri Stream is in a moderate condition when compared with the Vision & Strategy desired state. The stream is not safe for swimming due to high levels of E. coli, and has poor clarity by the time it reaches Lyons Road. In the absence of this project, significant changes to stream condition are not expected in the next 20 years. The work addresses mainly sedimentation from streambank erosion but this would also reduce the amount of E.coli and nutrients entering the waterways to further improve fisheries and catchment biodiversity. The project doesn’t address catchment processes that are driving erosion and it is acknowledged that achieving the Vision & Strategy desired state here will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, this work is expected to move the catchment streams closer towards this state if fully completed.	W = 0.125
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 5m, and by planting sterile willow poles to stabilise banks while native plantings establish.	F = 0.82
Adoptability	It is estimated that approximately three-quarters of the landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide	A = 0.75

<table>
<tr><td></td><td>some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information, Lower Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of stream fencing requirements come from a desktop exercise and local knowledge. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost</th></tr>
<tr><td>Riparian fencing (27km)</td><td>216,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (2369 poles)</td><td>33,163</td></tr>
<tr><td>Native riparian planting (10ha)</td><td>375,520</td></tr>
<tr><td>Erosion control structures</td><td>22,500</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>129,436</td></tr>
<tr><td>Total</td><td>776,619</td></tr>
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</td><td>C = 0.78</td></tr>
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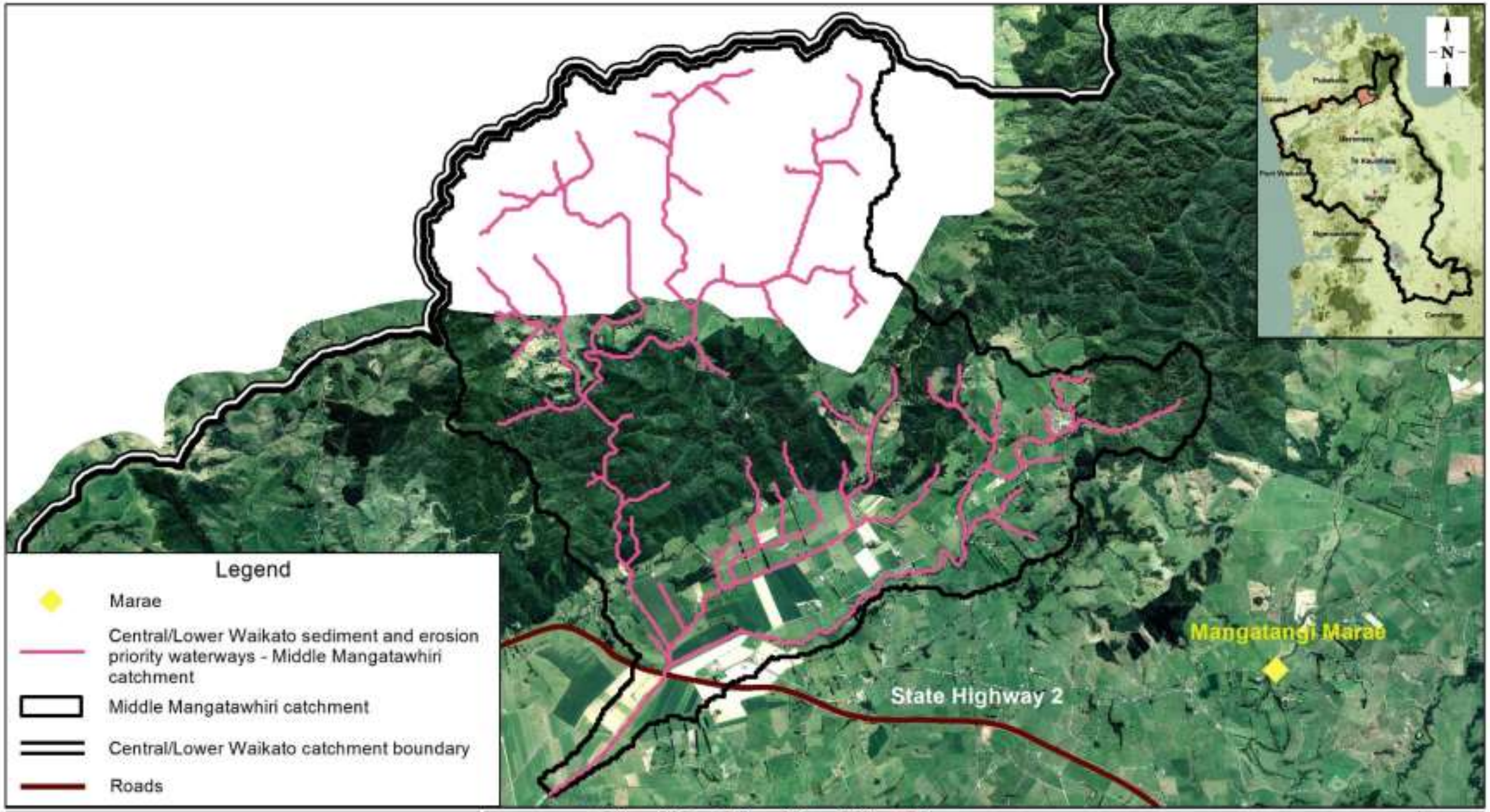

Middle Mangatawhiri Stream erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:65,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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Erosion and unfenced banks along the Mangatawhiri Stream.

Example of fencing and planting on the Mangatawhiri Stream

CLW 13 Priority: very high	Northern Mangatangi Stream erosion protection and remediation	BCR value
Relevant unit goal(s)	Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Mangatangi Stream	
Brief description of feature	The 5200ha northern Mangatangi catchment extends southwest from the DOC reserve on the southern side of the Hunua Ranges at Workman Road to the Maramarua River at SH2. The Maramarua joins the Whangamarino River at Island Block Road. Almost 30% of the catchment retains indigenous vegetation. There is an approximately 90km stream network in this catchment, with 67km estimated to run through pastoral land. Land use in the catchment is a mix of dairy and dry stock. The Maramarua and Whangamarino are very significant to Waikato-Tainui and the marae. The wetland and tributaries sustained tangata whenua for centuries with īnanga (whitebait), tuna (eel), kāeo, birds and many more taonga species. Its abundance is regarded as a reflection of the mana of the iwi and marae, and their ability to sustain whānau (family) and manuwhiri (guests or visitors). There are many existing and historic pā sites within the area. Papakāinga, historic settlements and wāhi tapu are strategically located within this project area. Previous attempts to fence and plant the Mangatangi have been hampered by severe weather events and loss of works. Some in-channel willow management and bank stabilisation plantings have been undertaken over the past 10 years with some success. The stream is very incised and in order for works to be successful, fencing and planting will need to be carried out in conjunction with riverbank stabilisation work. Modelling has identified the catchment as a high priority for prevention and management of streambank erosion.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.	

<table>
<tr><td></td><td>- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangatangi Stream would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 50</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Mangatangi Stream and lower Waikato River.</td></tr>
<tr><td>Stock access to the streams</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement:
- The main channel and tributaries of the northern Mangatangi Stream are stable and fenced to exclude stock with a minimum 3-wire electric fence.
- Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management of rivers/streams in pasture for soil conservation purposes
Costs for fencing are based on a 5-wire (2 electric) fence, however, in these flood prone streams a 3-wire electric fence would also be acceptable.

Carry out riparian fencing/fence upgrade with a minimum 5m setback from the top of the streambank (preferably 5 wire with 2 electric wires at $8 per metre) along an estimated 37km of streambank (18.5km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 14ha of</td><td></td></tr>
</table>

	planting and associated weed control and maintenance. 3325 poplar poles are estimated to be required for stream erosion control. The main reach of the Mangatangi is 20km long and it is estimated that erosion control structures would be required at a frequency of 1 per km ($2500 per km). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 9 years after project commencement.	L = 9
Effectiveness of works	The Mangatangi Stream is in a moderate condition when compared with the Vision & Strategy desired state. The stream is not safe for swimming due to high levels of E. coli, and has poor clarity by the time it reaches Maramarua. In the absence of this project, significant changes to stream condition are not expected in the next 20 years. Works included address mainly sedimentation from streambank erosion but would also reduce the amount of E.coli and nutrients entering the waterways, further improving fisheries and catchment biodiversity. The project doesn’t address catchment processes that are driving erosion and it is acknowledged that achieving the Vision & Strategy desired state here will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, this work is expected to move the catchment streams measurably closer towards this state if fully completed.	W = 0.125
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 5m, and by planting sterile willow poles to stabilise banks while native plantings establish.	F = 0.82
Adoptability	It is estimated that approximately half of the landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake,	A = 0.5

<table>
<tr><td></td><td>and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information, Lower Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of stream fencing requirements come from a desktop exercise and local knowledge. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.75</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (37km)</td><td>296,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (3325 poles)</td><td>46,548</td></tr>
<tr><td>Native riparian planting (14ha)</td><td>525,728</td></tr>
<tr><td>Erosion control structures</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>183,655</td></tr>
<tr><td>Total</td><td>1,101,931</td></tr>
</table></td><td>C = 1.10</td></tr>
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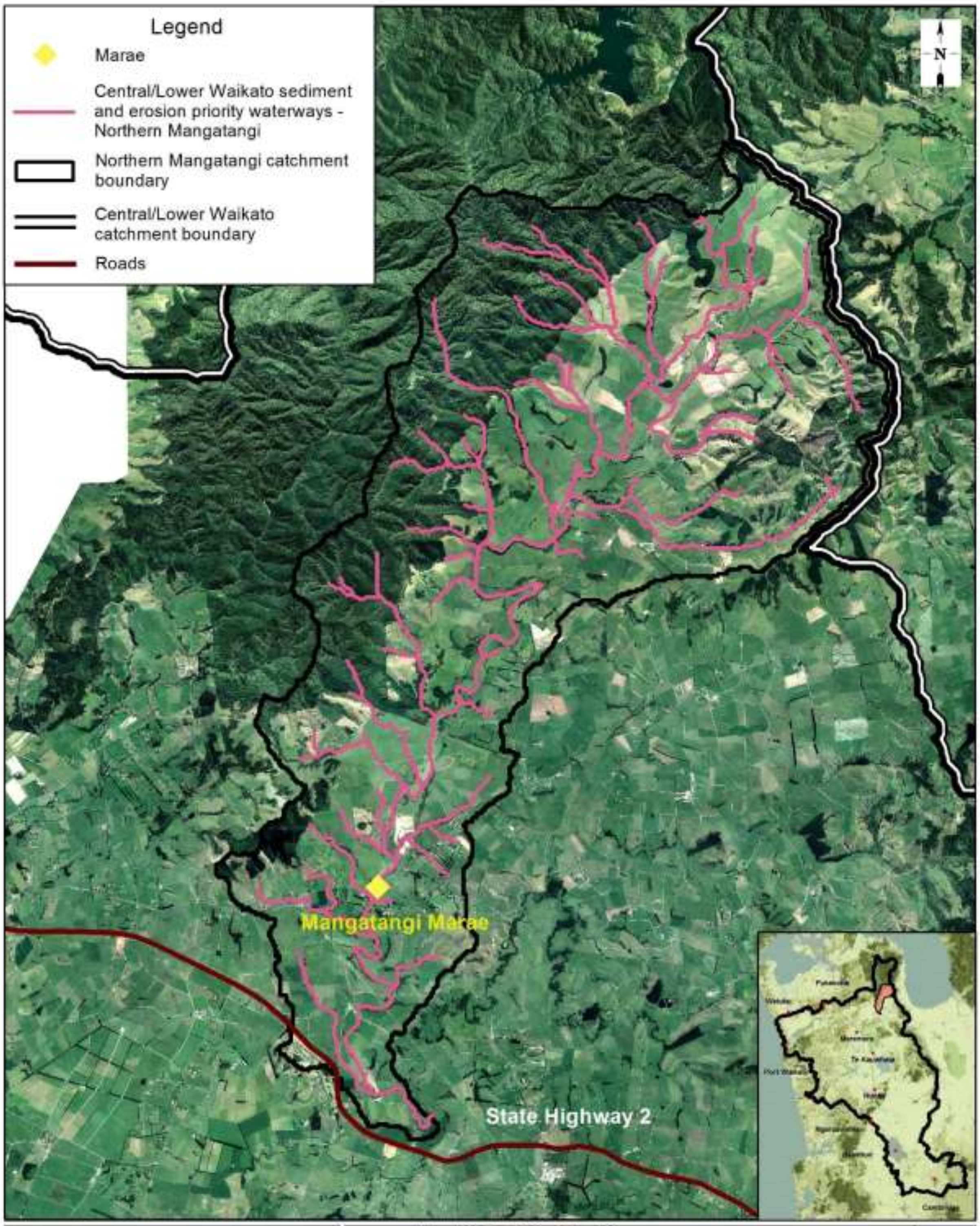


0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:70,000@A4 Portrait

A4

Northern Mangatangi Stream erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

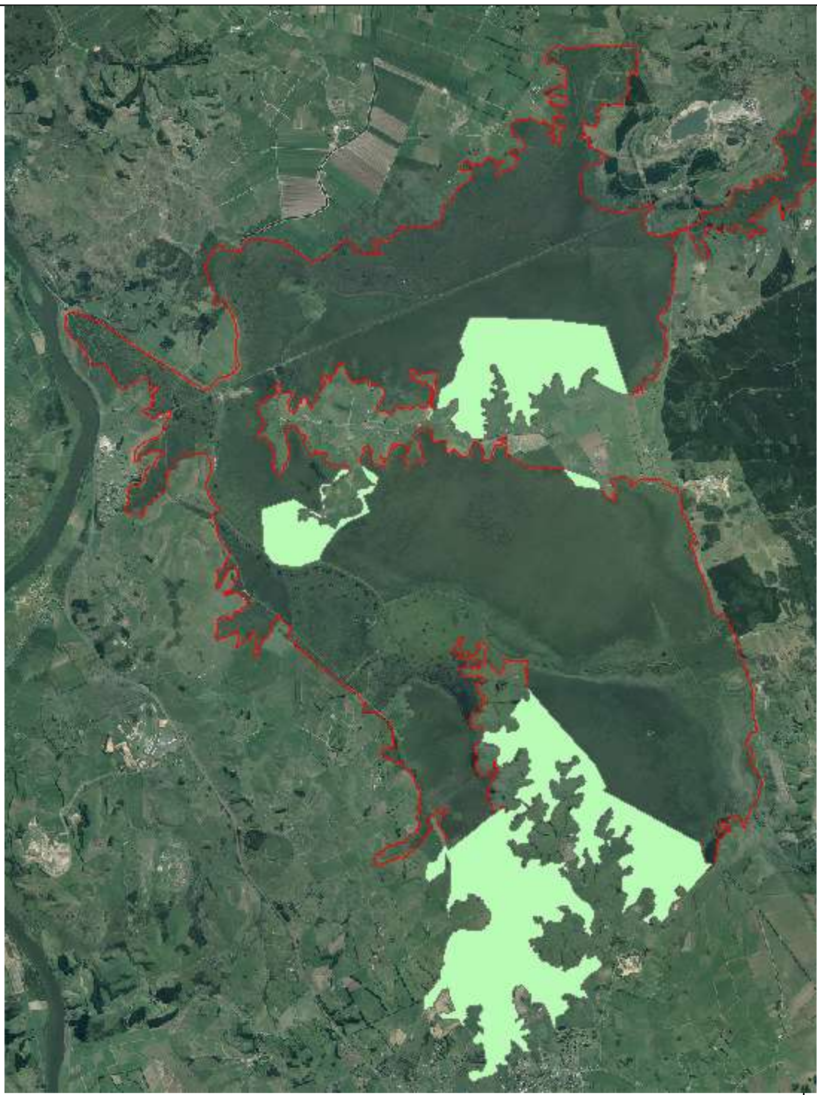
Status: Final
Request No.: N/A
File name: WWRRS.gws


An example of a retired margin along the Mangatangi Stream.

CLW 14 Priority: high	Biodiversity enhancement of Whangamarino Wetland	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced and, where feasible, expanded and re-established. Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.	
Name of feature	Whangamarino Wetland	
Brief description of feature	The Whangamarino Wetland is 7290 hectares in size and located between Meremere and Te Kauwhata. It is the largest bog and swamp complex in the North Island and is of international significance under the Ramsar Convention. Most of the wetland is owned and managed by the Department of Conservation and the second largest landowner is Fish & Game New Zealand who manage wetland habitat for gamebird hunting. The wetland is also an integral part of the Lower Waikato Flood Control Scheme managed by Waikato Regional Council. The Whangamarino contains a rich and representative variety of wetland ecosystems, including peat bog, swamp, open water, mesotrophic lags and river systems. It contains a number of uncommon or extremely rare plants, including watermilfoil *Myriophyllum robustum*, clubmoss *Lycopodium serpentinum* and the critically endangered swamp helmet orchid (*Anzybas carseii*), not found nowhere else in the world. These diverse ecosystems provide habitat to a wide range of native wetland birds including the Australasian bittern/matuku (*Botaurus poiciloptilus*), spotless crake/pūweto (*Porzana tabuensis plumbea*), marsh crake/koitareke (*Porzana pusilla*), North Island fernbird/mātātā (*Bowdleria punctata vealeae*), and New Zealand dabchick/weweia (*Poliocephalus rufopectus*). Occasionally, the Whangamarino is visited by other unusual birds such as royal spoonbill/kōtuku-ngutupapa (*Platalea regia*) and Japanese snipe (*Gallinago hardwickii*). The wetland is also home to a range of native freshwater fish including longfin and shortfin eel, galaxid species and the black mudfish (nationally endangered). The Whangamarino is culturally and historically significant to Waikato-Tainui. There are many historic pā surrounding the	

<table>
<tr><td></td><td>wetland including Te Teoteo, reflective of the pakanga (battles) that occurred as part of the Waikato invasion. The wetland provided habitat for many of the resources that iwi accessed for kai, clothing and medicines.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The wetland is fully fenced and stock are excluded.
- The wetland is densely vegetated with native plant species, and native plant regeneration occurs naturally.
- There is minimal threat from invasive weed species to native plants and animal species.
- A sub-catchment where land use matches capability.
- Wetland margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Native fish are abundant and the full range of species expected to be found in the waterway can be found there e.g. kōkopu, tuna, black mudfish.
- Water quality within the wetland is fishable and safe for collection of kai.
- Iwi and communities have a strong connection to the wetland and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Whangamarino Wetland would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 375</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the wetland</td><td>Reduced water quality, destruction of wetland vegetation, compaction of peat.</td></tr>
<tr><td>Weed species</td><td>Compete with and modify native plant communities and spread to other areas.</td></tr>
<tr><td>Land drainage</td><td>Lowers water levels in the bog causing peat oxidation and changes to vegetation.</td></tr>
<tr><td>Environmental impacts from upper catchment</td><td>The condition of the wetland and the ecosystem types present in it are impacted by nutrient and sediment runoff from upstream catchment land use.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native species.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 5 years of project commencement, the DOC reserve boundary is 100% fenced and stock are excluded from the wetland.</td><td></td></tr>
</table>

	- Within 5 years of carrying out fencing, previously grazed pasture areas are regenerating with native vegetation or planted with native plants.	
Priority works for funding	The project seeks to influence DOC to restrict grazing on DOC land and fence the reserve boundaries to exclude stock. Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) and need to be carried out in collaboration with DOC and Fish & Game. This project could be undertaken as a whole, or in multiple smaller components. **Fencing** Carry out fencing of unfenced areas of public conservation land to exclude stock from the Whangamarino Wetland. The areas of focus are shown in green on the map below. These are areas of wetland that are unfenced and that stock are able to access. Approximately 35km of fencing is required to prevent stock accessing the wetland. Fencing should be 7-wire post and batten ($595,000).	



Map of Whangamarino Wetland (red boundary) showing public conservation land where there is no fencing present to exclude stock (green shaded areas).

Native planting
Newly fenced areas where cattle grazing previously occurred may regenerate into native wetland vegetation naturally. However, it is estimated that 50% of these areas will require native planting (25ha).

Native planting should be undertaken using a mix of species that would grow naturally in the wetland ecosystem. The estimate cost for 25ha of native planting in a previously grazed area is $938,800.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include

	transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within one year of project completion.	L = 5.5
Effectiveness of works	The Whangamarino wetland is currently in a moderate condition when compared to Vision & Strategy desired state. It remains very significant and highly valued by iwi and the community, but is under considerable threat as a result of stock access, catchment land use, pest plants and animals, and modified hydrology. Because of these threats and in absence of this project, it is expected that the wetland will decline in condition over the next 20 years. If this project is successfully completed, then it will locally address and offset some of these threats, however the wetland will still be expected to decline. It is acknowledged that achieving the Vision & Strategy desired state will take a fuller ranger of initiatives and a longer period of time than the 20 year horizon used for the purposes of the Restoration Strategy. However, this project will complement other actions undertaken to protect and restore the wetland.	W = 0.015
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings but these are generally minimal in wetland areas.	F = 0.92
Adoptability	It is estimated that about two-thirds of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.65
Information quality	Very good – detailed knowledge from Department of Conservation staff who manage the wetland.	
Knowledge gaps	Specific details on area and numbers of plantings would need to be developed once stock are removed from the wetland and fences are erected.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P= 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (35km)</td><td>595,000</td></tr>
<tr><td>Native planting (25ha)</td><td>938,800</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>306,760</td></tr>
<tr><td>TOTAL</td><td>1,840,560</td></tr>
</table>
</td>
<td>C = 1.84</td>
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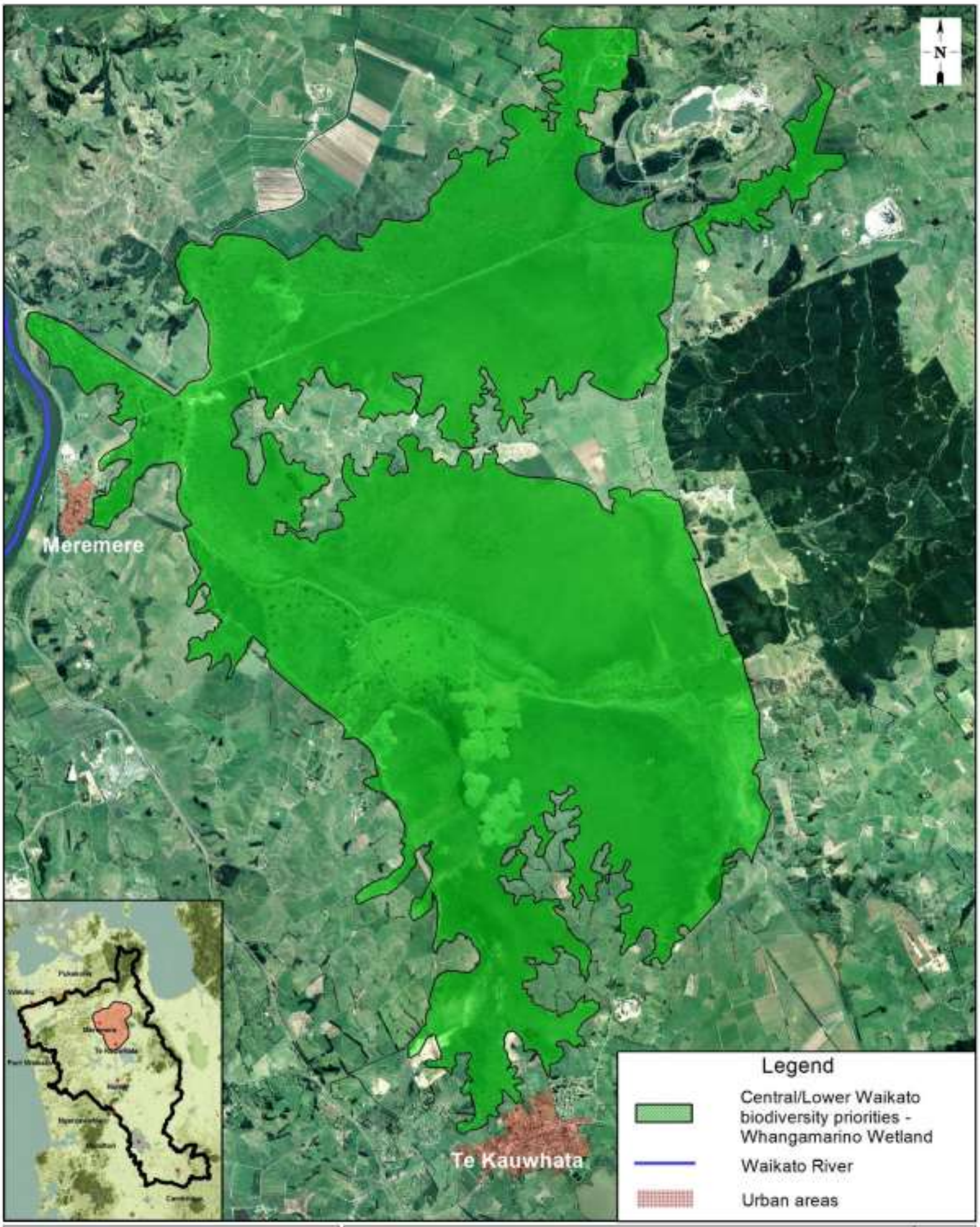
</table>



Biodiversity enhancement of Whangamarino Wetland

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:75,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Whangamarino Wetland

CLW 15 Priority: high	Biodiversity enhancement of selected lowland forest fragments with strong connections to waterways	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced and, where feasible, expanded and re-established. Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.	
Name of feature	Lower Waikato lowland forest remnants	
Brief description of feature	This project involves three lowland forest remnants (or clusters of kahikatea within a few hundred metres of each other) located in the lower Waikato River catchment. The remnants are dominated by kahikatea trees. A total of 67ha of forest remnants have been identified. Fragments range in size from 0.5ha to 36ha as follows: - A cluster of kahikatea remnants near Meremere located in close proximity to each other (45ha in total) - Two nearby kahikatea remnants at Naike (16ha) - Kahikatea remnants at the end of Jefferis Road, Waerenga (6ha). All of these sites have components that are within the top 30% of sites for biodiversity protection within the Waikato catchment because of their terrestrial biodiversity values and representativeness of this ecosystem type. Biodiversity values are under threat from a range of factors, but particularly invasion from weeds. Most of the sites identified are lowland kahikatea forest remnants. This forest type used to cover 42,800ha of the Lower Waikato catchment. Only 1.3% of the former extent remains. Kahikatea was a valuable resource to tangata whenua. Te koroī berry was eadible and also consumed by birds. The bark was burnt to create dyes and apply to bruises.	
Desired state to achieve Vision & Strategy	- The identified forest remnants are densely vegetated with native plant species, connected to riparian corridors where possible and protected from livestock grazing. - Native plant regeneration occurs naturally within the native bush remnants.	
Impact on Vision & Strategy	In a restored condition, the Lower Waikato lowland forest remnants would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 7

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat and underlying cause</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Livestock access to native forest fragments</td><td>Livestock prevent native regeneration, trample roots and open up areas to plant pests.</td></tr>
<tr><td>Weeds</td><td>Compete with native vegetation.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 10 years of this project commencing:
- The identified forest remnants and associated waterways are 100% fenced to exclude livestock with a minimum 5 wire (2 electric) fence, and connected to other forest remnants and riparian areas where possible.
- Riparian margins are at least 5m wide and native planting (and associated weed control) is carried out within the riparian margin and open areas at 1.5m spacing.
- Weed species present are dramatically reduced and native re-generation occurs naturally in extensive areas across all bush remnants.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the exact amount of fencing and planting and weed control required. However, based on aerial photographs and local knowledge, the following estimates and assumptions have been made:

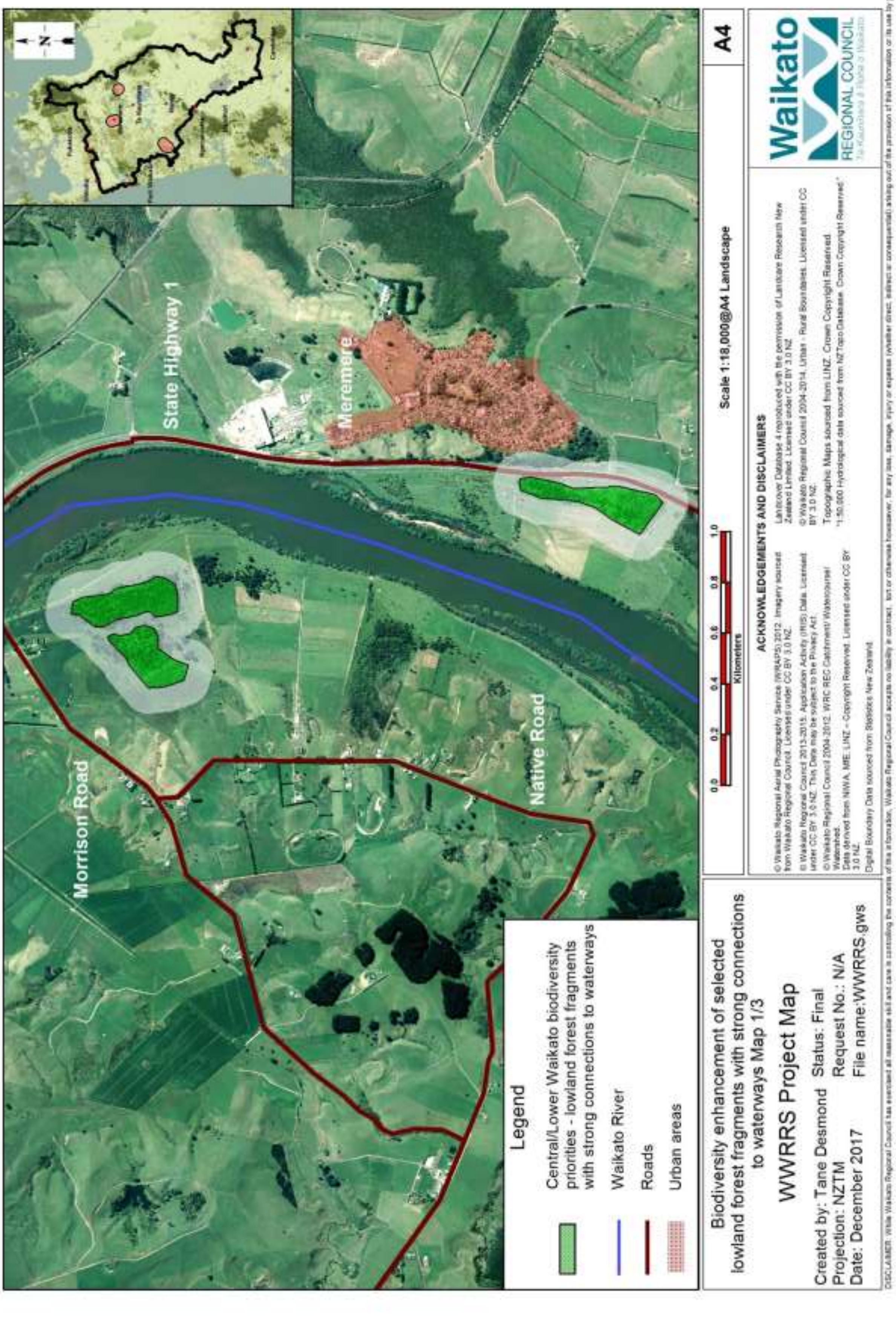
Fencing
Fencing would be required to exclude livestock from forest remnants and associated waterways. Fences should be a minimum of 5m back from waterways and a minimum of 5-wire (2 electric) for cattle and 7-wire post and batten for sheep.
<u>Kahikatea remnants near Meremere</u> – 8km of fencing (7 wire post and batten), $136,000.

<u>Kahikatea remnants at Naike</u> – 3km fencing (a minimum of 5 wire with 2 electric wires), $24,000.</td>
<td></td>
</tr>
</table>

	Kahikatea remnants at the end of Jefferis Road, Waerenga – 2.5km fencing (a minimum of 5 wire with 2 electric wires), $20,000. **Native planting** Native planting may be required to infill open areas within and around native bush remnants. Native planting should be undertaken with 1.5m spacing between plants. Plant species selected for planting should be hardy colonising species that would have naturally existed within the location. The following native planting requirements have been estimated. Cost estimates include site preparation, plant purchase, planting labour and five releasing events: Kahikatea remnants near Meremere – 2ha of native planting within open areas at a cost of $39,552 per hectare ($79,104). Kahikatea remnants at Naike – 1.5ha of native planting within open areas at a cost of $39,552 per hectare ($59,328). Kahikatea remnants at the end of Jefferis Road, Waerenga – 0.5ha of native planting within open areas at a cost of $39,552 per hectare ($19,776). **Weed control** Weed control is required to promote regeneration of native species and enhance biodiversity. The following weed control estimates have been made (note: these are in addition to native plant releasing which is provided in the native planting costs). Kahikatea remnants near Meremere – weed control will be required over a 4ha area for 3 years. It is assumed that the most appropriate method of weed control will be undertaken using a knapsack sprayer at a cost of $2800 per hectare for a 2ha portion of the site and more intensive control required over a further 2ha area at an estimated cost of $4000 per hectare ($40,800). Kahikatea remnants at Naike – ground control of pest willow trees using x-trail basal and general control of other weed species required over a 1ha area for 3 years at $4000 per hectare ($12,000).	

	Kahikatea remnants at the end of Jefferis Road – weed control required over a 0.5ha area for 3 years at $1400 per hectare per year ($2100). **Animal pest control** Possum control is recommended during the establishment of native plantings. Lowland kahikatea remnants at Naike and Meremere are both within the northwest Waikato possum control scheme area so no further possum control is currently required. Possum control is recommended in the Waerenga site. Kahikatea remnants at the end of Jefferis Road, Waerenga – possum control (using bait stations) for native plant establishment over a 6ha area ($3600 over 3 years). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	These fragments are currently in a moderate condition when compared to Vision & Strategy desired state. They also remain at risk of further fragmentation, loss of important hydrological conditions to sustain them, and further invasion by plant pests. As a result of these threats it is expected that the fragments will deteriorate slowly over the next 20 years if this project is not undertaken. If this project is successfully completed, then it is expected that these forest fragments will be in an improved condition in 20 years' time due to increased regeneration of native species and reduction in weeds. However, this project does not address the concerns around retention of wetland hydrology at these sites.	W = 0.125
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to weed control – to minimise this, work should be carried out by experienced practitioners to ensure it is effective.	F = 0.82

<table>
<tr><td>Adoptability</td><td>It is estimated that about two-thirds of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the values of these remnants are well accepted.</td><td>A = 0.65</td></tr>
<tr><td>Information quality</td><td>Poor information – quantity of work required and costings for sites are based off aerial photography and minimal local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Further work is required to determine specific amounts of fencing, planting and weed control required. This should be carried out during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing</td><td></td></tr>
<tr><td>- Meremere (8km)</td><td>136,000</td></tr>
<tr><td>- Naike (3km)</td><td>24,000</td></tr>
<tr><td>- Waerenga (2.5km)</td><td>20,000</td></tr>
<tr><td>Native planting</td><td></td></tr>
<tr><td>- Meremere (2ha)</td><td>79,104</td></tr>
<tr><td>- Naike (1.5ha)</td><td>59,328</td></tr>
<tr><td>- Waerenga (0.5ha)</td><td>19,776</td></tr>
<tr><td>Weed control</td><td></td></tr>
<tr><td>- Meremere</td><td>40,800</td></tr>
<tr><td>- Naike</td><td>12,000</td></tr>
<tr><td>- Waerenga</td><td>2100</td></tr>
<tr><td>Animal Pest Control</td><td></td></tr>
<tr><td>- Waerenga</td><td>3600</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>79,341</td></tr>
<tr><td>Total</td><td>476,050</td></tr>
</table>
</td><td>C = 0.48</td></tr>
</table>



Morrison Road
Native Road
State Highway 1
Meremere
Legend
Central/Lower Waikato biodiversity priorities - lowland forest fragments with strong connections to waterways
Waikato River
Roads
Urban areas
Biodiversity enhancement of selected lowland forest fragments with strong connections to waterways Map 1/3
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0.0 0.2 0.4 0.6 0.8 1.0
Kilometers
Scale 1:18,000@A4 Landscape
ACKNOWLEDGEMENTS AND DISCLAIMERS
A4
Waikato
REGIONAL COUNCIL

Biodiversity enhancement of selected lowland forest fragments with strong connections to waterways Map 2/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:37,000@A4 Landscape

A4

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Waikato REGIONAL COUNCIL

Biodiversity enhancement of selected lowland forest fragments with strong connections to waterways Map 3/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.06 0.12 0.18 0.24 0.30
Kilometers

Scale 1:5,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

CLW 16 Priority: high	Waerenga catchment hill country and streambank erosion protection and remediation	BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Waerenga catchment	
Brief description of feature	The Waerenga catchment comprises 13,627ha of steep to rolling land. 75% of this is estimated to be in pasture, however, there are also reasonably large areas of forestry (18%) and indigenous vegetation (7%). The 4321ha upper catchment has been identified as a priority for hill country erosion protection and remediation. An estimated 2300ha of this area is Land Use Capability (LUC) class 6e in pasture. The middle 9306ha catchment is a high priority for protection and remediation of streambank erosion, with an estimated 110km stream network lying within pastoral areas. Land use is a mix of dry stock and dairy with dairy predominant in the middle to lower reaches. The catchment originates in the northern Hapuakohe Range and the main waterway is the Waerenga Stream which extends northwest down the catchment and joins the Whangamarino River at Jefferis Road. The Taniwha Stream lies on the western boundary of the catchment and is a tributary to the Waerenga. Landowners have previously undertaken a range of riparian protection works in the catchment, however, scope remains for further river and hill country protection work. The middle to lower parts of the Waerenga Stream are susceptible to flooding during large rain events. The Waerenga area provides valuable resources to marae, in particular Waikare, Taniwha and Okaeria marae. The streams and puna (springs) provided drinking and cleaning water for tangata whenua. Fisheries and pā tuna (eel weirs) were plentiful here and a symbol of mana (authority).	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.	

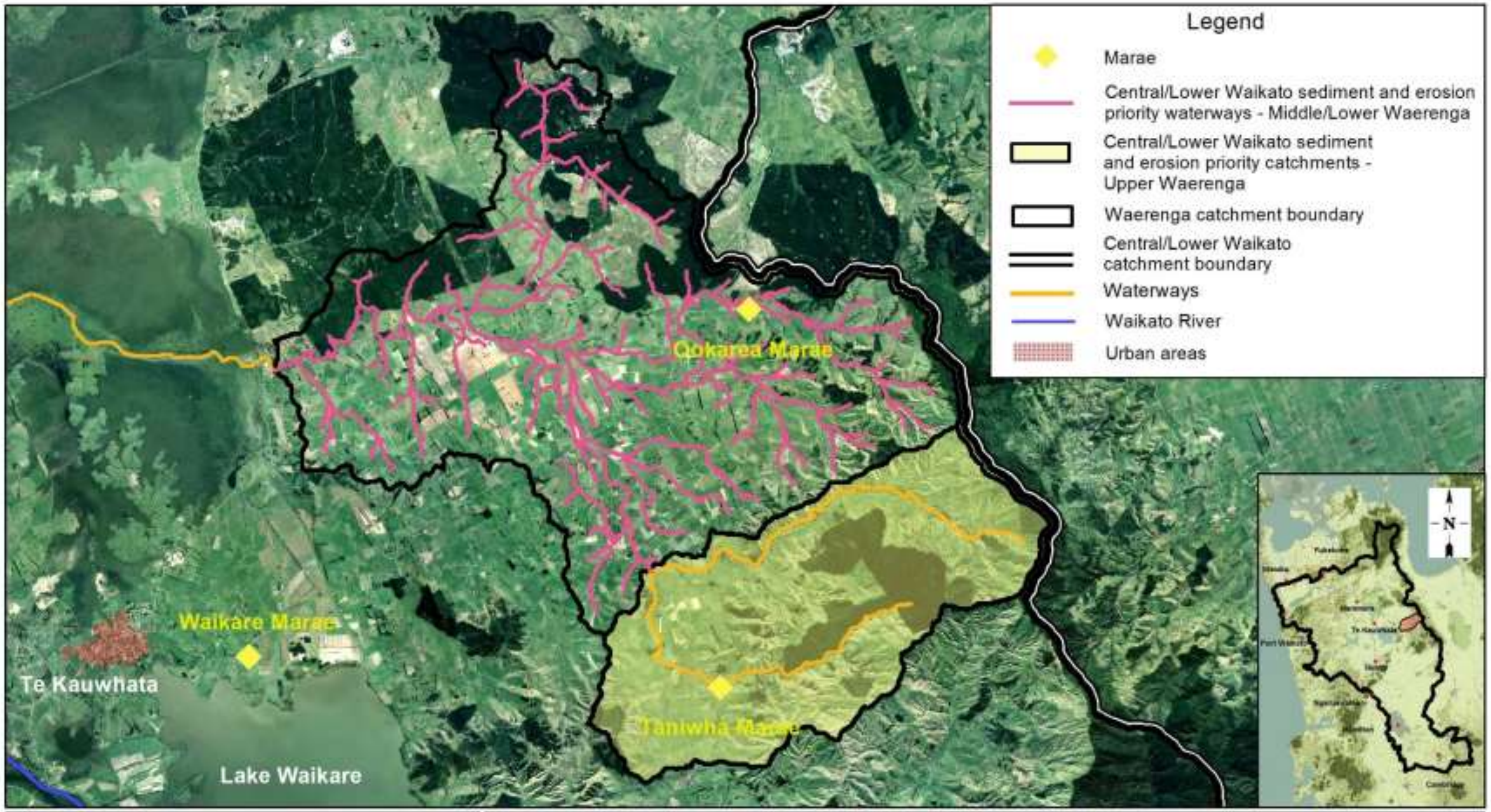
<table>
<tr><td></td><td>- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Waerenga sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams, the Whangamarino Wetland and the lower Waikato River.</td></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the catchment streams, the Whangamarino Wetland and the lower Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years of project commencement:
- The main channel and tributaries of identified waterways are stable and fenced to exclude stock with a minimum 3-wire electric fence.
- Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.
- There is a 30% reduction in suspended sediment in the Waerenga Stream.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 287ha LUC 6e land managed with open space pole planting at $3000 per hectare</td><td></td></tr>
</table>

	- 287ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare - 50km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten) - 13km fencing existing indigenous forest cover at $25 per metre (8-wire and batten). **Riparian management of rivers/streams in pasture for soil conservation purposes** *Costs for fencing are based on a 5-wire (2 electric) fence, however, in these flood prone streams a 3-wire electric fence would also be acceptable.* Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 101km of streambank (50.5km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 38ha of planting and associated weed control and maintenance. 7466 willow poles are estimated to be required for river and stream erosion control. The main channel of the Waerenga Stream through this reach is 20km long (40km of streambank). It is estimated that 4km of streambank will require vegetation or rock structures at a cost of $20,000 per km ($80,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	The Waerenga sub-catchment retains some very important values, however, the overall condition of the sub-catchment is significantly below desired state for meeting the Vision &	W = 0.25

	Strategy. Over the next 20 years it is expected that some aspects may deteriorate in the absence of this project. Works included here address several key threats and it is anticipated that if the project is fully completed, the catchment will move substantially closer to the Vision & Strategy desired state in areas such as land use meeting capability and streambank stability. The project has secondary benefits in protecting and improving water quality by reducing E. coli to waterways, and in enhancing catchment biodiversity. It is acknowledged that achieving the Vision & Strategy desired state in the Waerenga will take a fuller range of initiatives over the longer term, and will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to the sub-catchment.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the stream fencing setbacks being at least 5m, and by planting sterile willow poles to stabilise banks while native plantings establish. Erosion prevention and protection works should be planned by people with appropriate technical expertise and local knowledge.	F = 0.82
Adoptability	It is estimated that about a third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e land may be low and we are not aware of significant similar works being undertaken in this catchment to date. There are large sections of streams that are erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. Fencing setbacks of at least 5m from the top of banks should help to minimise this, however, this loss of grazing land may also be a challenge with uptake. It would be beneficial to establish sites that demonstrate the benefits of stable, vegetated stream margins. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.35
Information quality	Average – estimates are based on modelled information, Lower Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchment.	
Knowledge gaps	Estimates of LUC class 6e and stream lengths come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	

<table>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.75</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>287ha LUC 6e managed with pole planting</td><td>861,000</td></tr>
<tr><td>287ha LUC 6e managed with plantation species</td><td>861,000</td></tr>
<tr><td>Fencing managed LUC 6e land (50km)</td><td>1,250,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (13km)</td><td>325,000</td></tr>
<tr><td>Riparian fencing (101km)</td><td>808,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (7466 poles)</td><td>125,917</td></tr>
<tr><td>Native riparian planting (38ha)</td><td>1,426,976</td></tr>
<tr><td>Erosion control structures</td><td>80,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>1,721,368</td></tr>
<tr><td>Total</td><td>7,459,261</td></tr>
</table></td><td>C = 7.5</td></tr>
</table>



0.0 1.5 3.0 4.5 6.0 7.5
Kilometers

Scale 1:120,000@A4 Landscape

A4

Waerenga catchment hill country and stream bank erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato


An example of unfenced margin of the Waerenga Stream.

CLW 17 Priority: high	Matahuru catchment hill country and streambank erosion protection and remediation	BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species. Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality and so that lakes are safe for swimming and gathering of taonga species.	
Name of feature	Matahuru sub-catchment and selected tributaries to Lake Waikare	
Brief description of feature	This collection of sub-catchments lie to the southeast of Lake Waikare and collectively contain 9971 ha. 87% of this is pasture, 9% indigenous vegetation and 5% forestry. 4892ha (50%) of the catchment is LUC class 6e or 7 in pasture. Some 160km of streams extend through these catchments, with the 50km stream network in the middle Matahuru being particularly susceptible to erosion risk. The two main streams within this area are the Mangapiko and Matahuru streams, with the former a tributary of the latter joining at Mangapiko Valley Road. Onekura Stream and several unnamed waterways also flow directly into Lake Waikare. Upper catchment streams have a stony bottom whereas the streams lower in the catchment tend to be silty bottomed. Streams in the Matahuru catchment are deeply incised with highly erodible banks and are prone to flash flooding. This needs to be taken into account when fencing setbacks and standards are determined. Land use in the upper catchment is predominantly dry stock, however, there are some dairy farms in the lower end of these catchments. Some bush remnants in the upper catchment have been fenced and some landowners have undertaken riparian fencing. The Matahuru rohe (area) feeds Lake Waikare and is home to taniwha, taonga species for gathering and historic pā sites. The catchment and lake, although degraded, is still of high significance to the local marae, in particular Matahuru, Taniwha,	

<table>
<tr><td></td><td>Waitii and Hoe-o-tainui. There are many historic routes along the Hapuakohe Range.

Modelling undertaken in 2016 has identified these catchments as a high priority for management of hill country and streambank erosion. Water quality monitoring by Waikato Regional Council indicates that the Matahuru Stream at Waiterimu Road is not suitable for swimming due to high levels of E. coli.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Matahuru catchment and selected tributaries to Lake Waikare would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 300</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams, Lake Waikare and the lower Waikato River. This reduces water and habitat quality.</td></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the catchment streams, Lake Waikare and the lower Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 20 years of project commencement:
- 100% of LUC class 8 soils are retired from grazing.</td><td></td></tr>
</table>

	- LUC class 7 soils are managed within their capabilities and are retired from heavy stock grazing. - The main channel and tributaries of identified waterways are stable and fenced to exclude stock with a minimum 3-wire electric fence. - Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion. - There is a 40% reduction in suspended sediment in the Matahuru Stream.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** *These apply to the Mangapiko, upper Matahuru and Waikare east catchments:* - 452ha LUC 6e land managed with open space pole planting at \$3000 per hectare - 452ha LUC 6e land managed with plantation species (pine or mānuka) at \$3000 per hectare - 76km of fencing the managed LUC 6e land at \$25 per metre (8-wire and batten) - 655ha LUC 7 land managed with plantation species (pine or mānuka) at \$3000 per hectare - 51km of fencing the managed LUC 7 land at \$25 per metre (8-wire and batten) - 12ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at \$8000 per hectare (e.g. dewatering, retiring seepages, etc) - 18km fencing existing indigenous forest cover at \$25 per metre (8-wire and batten). **Riparian management of rivers/streams in pasture for soil conservation purposes** *These apply to the Mangapiko, upper Matahuru and middle Matahuru catchments. For these catchments, fencing estimates were double those used for the rest of the Lower Waikato. This was based on the advice of local land management staff familiar with the catchment and who estimated that less than 25% of the target waterways were currently fenced. Costs for fencing are*	

	based on a 5-wire (2 electric) fence, however, in these flood prone streams a 3-wire electric fence would also be acceptable. Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 120km of streambank (60km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 44ha of planting and associated weed control and maintenance. 12,436 willow poles are estimated to be required for river and stream erosion control. 25% of newly fenced streambanks are estimated to require a combination of hard and soft erosion structures. This equates to 30km of streambank with an estimated cost of $20,000 per km. (Note: Waikato Regional Council holds a current resource consent for such works and should therefore be consulted on river management proposals.) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 15 years after project commencement.	L = 15
Effectiveness of works	The Matahuru sub-catchment and tributaries to Lake Waikare retain some very important values, however the overall condition of the sub-catchment is significantly below desired state for meeting the Vision & Strategy. Over the next 20 years it is expected that some aspects may deteriorate in the catchment in the absence of this project. Works included here address several key threats and it is anticipated that if the project is fully completed, the catchment will move substantially closer to the Vision & Strategy desired state in areas such as land use meeting capability and streambank stability. The project has secondary benefits in protecting and improving water quality by reducing E. coli to waterways, and enhancing catchment biodiversity. It is acknowledged that achieving the Vision & Strategy desired state in these locations will take a fuller range of initiatives over the	W = 0.3

	longer term and will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to the Matahuru sub-catchment.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the stream fencing setbacks being at least 5m, and by planting sterile willow poles to stabilise banks while native plantings establish. Erosion prevention and protection works should be planned by people with appropriate technical expertise and local knowledge.	F = 0.82
Adoptability	It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. There are large sections of streams that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. Fencing setbacks of at least 5m from the top of banks should help to minimise this, however, this loss of grazing land may also be a challenge with uptake. It would be beneficial to establish sites that demonstrate the benefits of stable, vegetated stream margins. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.25
Information quality	Average – estimates are based on modelled information, Lower Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchments.	
Knowledge gaps	Estimates of LUC classes 6e and 7 and 8 and stream lengths come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.	P = 0.75
Project duration (years)	20 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>452ha LUC 6e managed with pole planting</td><td>1,356,000</td></tr>
<tr><td>452ha LUC 6e managed with plantation species</td><td>1,356,000</td></tr>
<tr><td>Fencing managed LUC 6e land (76km)</td><td>1,900,000</td></tr>
<tr><td>655ha LUC 7 managed with plantation species</td><td>1,965,000</td></tr>
<tr><td>Fencing managed LUC 7 land (51km)</td><td>1,275,000</td></tr>
<tr><td>Erosion control outside LUC 6e, 7 and 8 (12ha)</td><td>96,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (18km)</td><td>450,000</td></tr>
<tr><td>Riparian fencing (120km)</td><td>960,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (12,436 poles)</td><td>174,104</td></tr>
<tr><td>Native riparian planting (44ha)</td><td>1,652,288</td></tr>
<tr><td>Erosion control structures</td><td>600,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>3,535,317</td></tr>
<tr><td>Total</td><td>15,319,709</td></tr>
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</td>
<td>C = 15.32</td>
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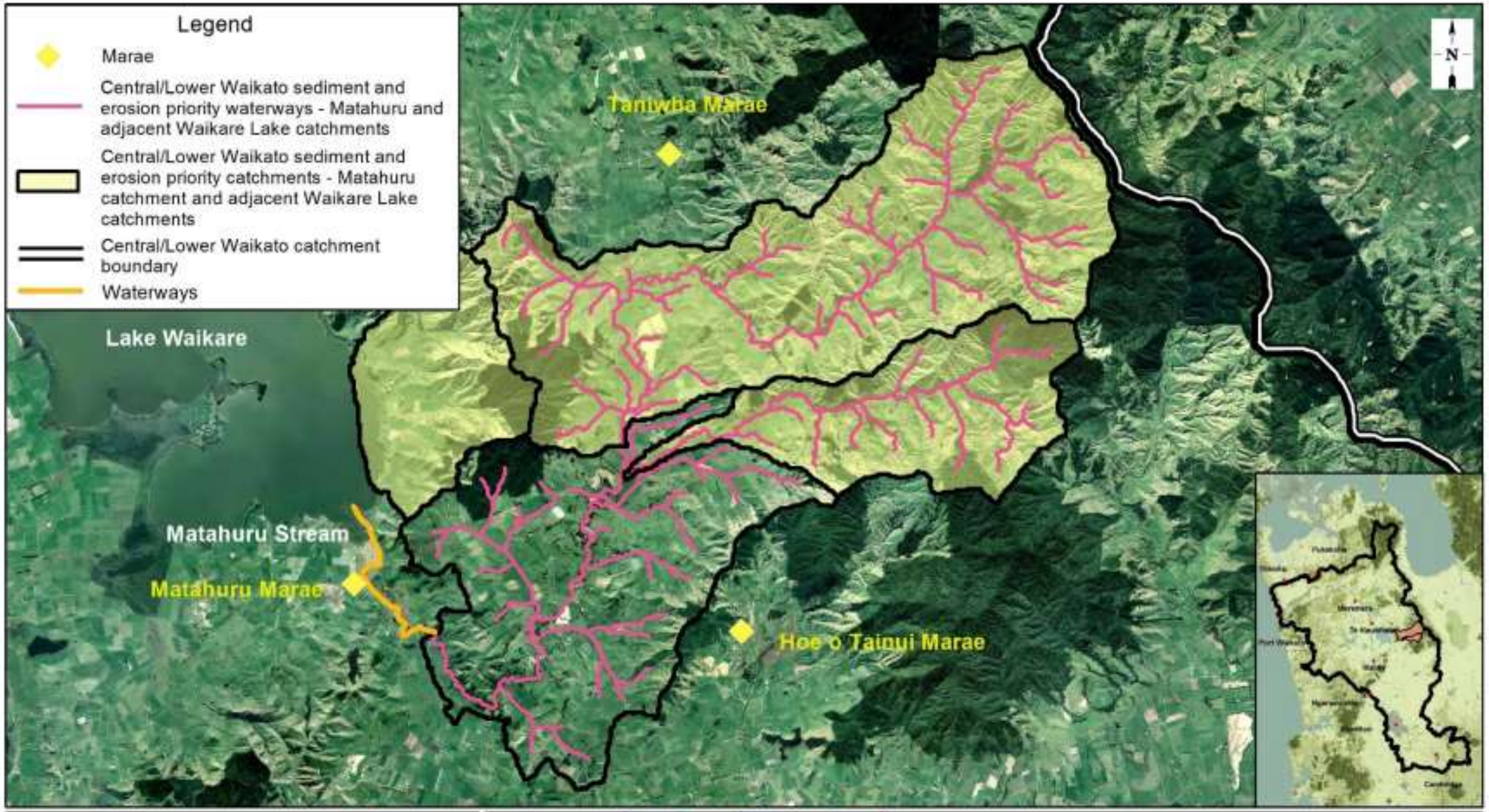

0 1 2 3 4 5
Kilometers

Scale 1:100,000@A4 Landscape

A4

Matahuru catchment hill country and stream bank erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

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Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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Hill country in the upper Matahuru catchment.

Hill country in the Mangapiko Stream catchment (a tributary of the Matahuru Stream).

A slip in the Matahuru catchment has been planting with poles in an attempt to stabilise.

The Matahuru Stream where it enters Lake Waikare.

Erosion on the Matahuru Stream.

An unfenced and eroding section of the Matahuru Stream.


Active erosion on hill country adjacent to Lake Waikare.

CLW 18 Priority: high	Rehabilitation of banded kōkopu habitat on selected inflows to Lake Puketirini and Lake Waahi	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Selected inflows to Lake Puketirini and Lake Waahi	
Brief description of feature	Waterways identified for this project include: - Awaroa Stream from Waikokowai Road (near Rotowaro Coal Mine) to Lake Waahi: this section of stream is approximately 4.5km long and flows through flat intensively farmed pasture land. - Waitawhara Stream: flowing from rugged hill country southwest of Lake Waahi (approximately 50% pasture and 50% native bush), it then flows alongside Rotowaro Road to join Awaroa Stream near Rotowaro Coal Mine. - Mangakōtukutuku Stream flowing downstream from Hakarimata Range for approximately 2km to where it enters the Rotowaro Mine site. The stream flows through a mixture of farmland, exotic forest and regenerating native forest. - A 4.5km length of unnamed tributaries to Lake Puketirini immediately west of Hillside Heights Road and flowing under Rotowaro Road to Lake Puketirini. Riparian vegetation consists mainly of pasture grasses. These waterways were identified as priorities as they are known to have populations of banded and giant kōkopu and these are expected to respond well to habitat rehabilitation. The total length of waterways identified is 23km. Puketirini and Lake Waahi are a valuable for source of mahinga kai for many marae within the Rahui Pokeka (Huntly) area.	
Desired state to meet Vision & Strategy	- Waterways are fenced to exclude stock from their entire length. - Waterways have riparian margins that are vegetated with native plants to provide stream shading and cover for fish. - Native fish are abundant, particularly banded kōkopu and giant kōkopu. - There are no manmade barriers to native migratory fish.	

<table>
<tr><td></td><td>- The streams are swimmable, fishable and have access for recreation.
- Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition these streams would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 40</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 7 years of project commencing:
- 100% of the waterways are fenced to exclude stock.
- On both sides of the stream there is a vegetated riparian margin (at least 5m wide) that provides stream shade and enhances habitat for adult native fish.
- There are no manmade barriers to native migratory fish. Barriers to pest fish are left in place.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence – 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 50% (this equates to 23km in total, including both sides) requires fencing or fence upgrade/moving back ($184,000).

Undertake native riparian planting within the fenced area and associated weed control and maintenance for native plant establishment.</td><td></td></tr>
</table>

	- Assume 50% (6ha) requires planting ($237,312) - Additional weed control, using a knapsack, within fenced areas (23km long riparian area or 11.5ha) to assist in establishing plantings and promoting native regeneration. The estimated cost of this is $2800 per hectare per year ($96,600 over 3 years). **Remediation of fish barriers** Reduce the length of the culvert that flows under Rotowaro Road. Estimated cost $5000. Note: the weir located at the bottom of the catchment is in the process of being reinstated by NIWA to exclude pest fish from this catchment. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 7-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 7.5
Effectiveness of works	The selected inflows to Lake Puketirini and Lake Waahi are currently in reasonable condition with some of the Vision & Strategy desired state aspects already being met, including being fishable. The Lake Waahi tributaries are considered to be in better condition than those of Puketirini. Overall, some improvement may be expected over the next 20 years even in the absence of this project. This is because catchment mining is expected to cease over this time. Works included here are expected to substantially increase the quality of fish habitat. Although it won’t address catchment land use, the wide riparian setbacks should contribute to protecting and restoring water quality through shading, stock exclusion and reduction of nutrients and pathogens entering the streams. It is anticipated that if the project is fully completed, in 20 years’ time the streams will be in good condition and closer to the Vision & Strategy state being achieved.	W = 0.075
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.	F = 0.87

<table>
<tr><td>Adoptability</td><td>It is estimated that approximately three-quarters of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake.</td><td>A = 0.75</td></tr>
<tr><td>Information quality</td><td>Good information – advice of local expert/s with a history of association to selected sites. Costings for most sites are largely based off aerial photography and local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>7 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (23km)</td><td>184,000</td></tr>
<tr><td>Planting (6ha)</td><td>237,312</td></tr>
<tr><td>Additional weed control within riparian area to promote native regeneration</td><td>96,600</td></tr>
<tr><td>Remediation of fish barriers</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (25% of project cost)</td><td>130,728</td></tr>
<tr><td>Total</td><td>653,640</td></tr>
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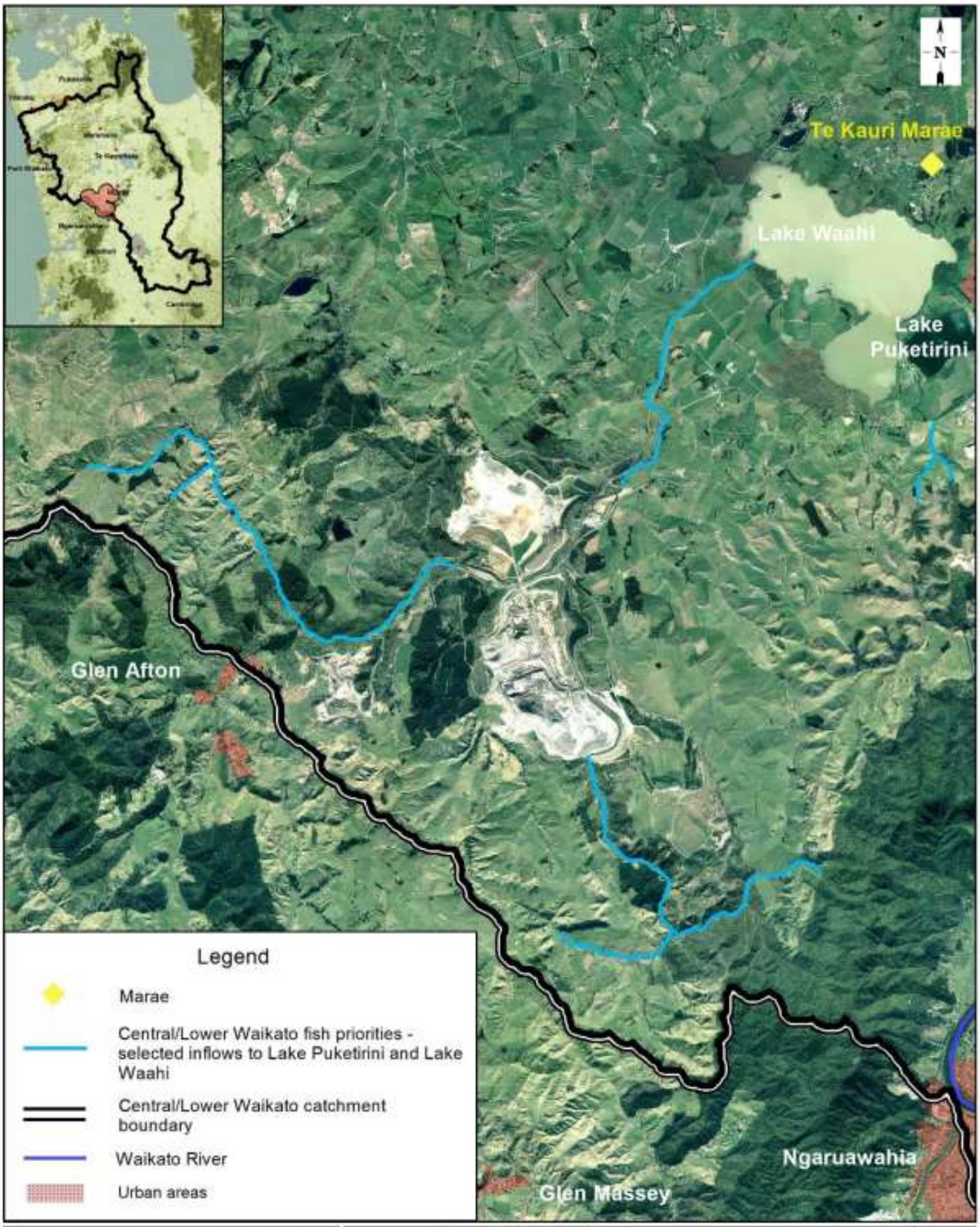
</table>



Rehabilitation of banded kōkopu habitat in selected inflows to Lake Puketirini and Lake Waahi

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:70,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL


Awaroa Stream showing unfenced riparian margin.

CLW 19 Priority: high	Upper Awaroa (Waahi) catchment hill country erosion protection and remediation	BCR value
Relevant Unit Goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Awaroa sub-catchment in the headwaters above Lake Waahi	
Brief description of feature	This is a relatively small catchment of 3536ha. It extends from the west at the catchment divide and goes northeast down to the confluence with the Te Wha Stream. From here it travels through the lower Awaroa and into Lake Waahi. Approximately 52% of the catchment is in pasture and 1227ha is estimated to be Land Use Capability (LUC) 6e in pasture. The predominant land use on this land is dry stock farming. Approximately 25% of the catchment is in either indigenous vegetation or plantation forestry. The main waterways in the catchment are the Mangakōtukutuku, the Awaroa and the Waitawhara streams. The catchment contains a series of current and rehabilitated open cast mines that lie west of Rotowaro. These include the township mine, Awaroa mine and Waipuna mine. The area was known for the gathering of bird life, fisheries and other taonga species for iwi and marae. The Hakarimata Range was regularly crossed by Māori to access the lakes and resources in the Awaroa catchment. There is little information on current soil conservation and riparian protection works in the catchment, however, there are only a small number of works that have been undertaken in partnership with Waikato Regional Council. There remains significant scope for soil conservation works here. Modelling undertaken in 2016 indicates that the upper Awaroa (Waahi) catchment is a high priority for hill country erosion management.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide). - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the native bush remnants.	

	- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present. - The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, Awaroa sub-catchment in the headwaters above Lake Waahi would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.	VS = 50
Key threats to the feature that this project addresses	**Key threat** / **Impact on feature** Hill country erosion: Contributes significant sediment to the catchment streams, Lake Waahi and the lower Waikato River.	
Project goal/s	There is a 30% reduction in suspended sediment in the upper Awaroa streams within 15 years of project commencement.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 153ha LUC 6e land managed with open space pole planting at $3000 per hectare - 153ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare - 29km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten) - 7ha reducing sediment to waterways outside Class 6e, 7 and 8 land at $8000 per hectare (e.g. dewatering, retiring seepages, etc) - 6km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) - 12 hunter days per year for 3 years of goat control while plantings on 6e land establish. Control carried out over a 1200ha area. **Project management/staffing/incidentals**	

	Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	The Awaroa sub-catchment is in moderate condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take a fuller range of initiatives and longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Awaroa, however, in addition to addressing land use matching capability, the proposed fencing and planting works would provide secondary benefits of reducing E. coli to waterways and improving fish habitat and biodiversity.	W = 0.2
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F =0.87
Adoptability	It is estimated that approximately one third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken recently in this catchment. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.3
Information quality	Average – estimates are based on modelled information and input from catchment officers who are familiar with the sub-catchment.	
Knowledge gaps	Estimates of LUC class 6e come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85

<table>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
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<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>153ha LUC 6e managed with pole planting</td><td>459,000</td></tr>
<tr><td>153ha LUC 6e managed with plantation species</td><td>459,000</td></tr>
<tr><td>Fencing managed LUC 6e land (29km)</td><td>725,000</td></tr>
<tr><td>Erosion control outside LUC 6e, 7 and 8 (7ha)</td><td>56,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (6km)</td><td>150,000</td></tr>
<tr><td>Goat control on treated 6e and 7</td><td>14,688</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>465,922</td></tr>
<tr><td>Total</td><td>2,329,610</td></tr>
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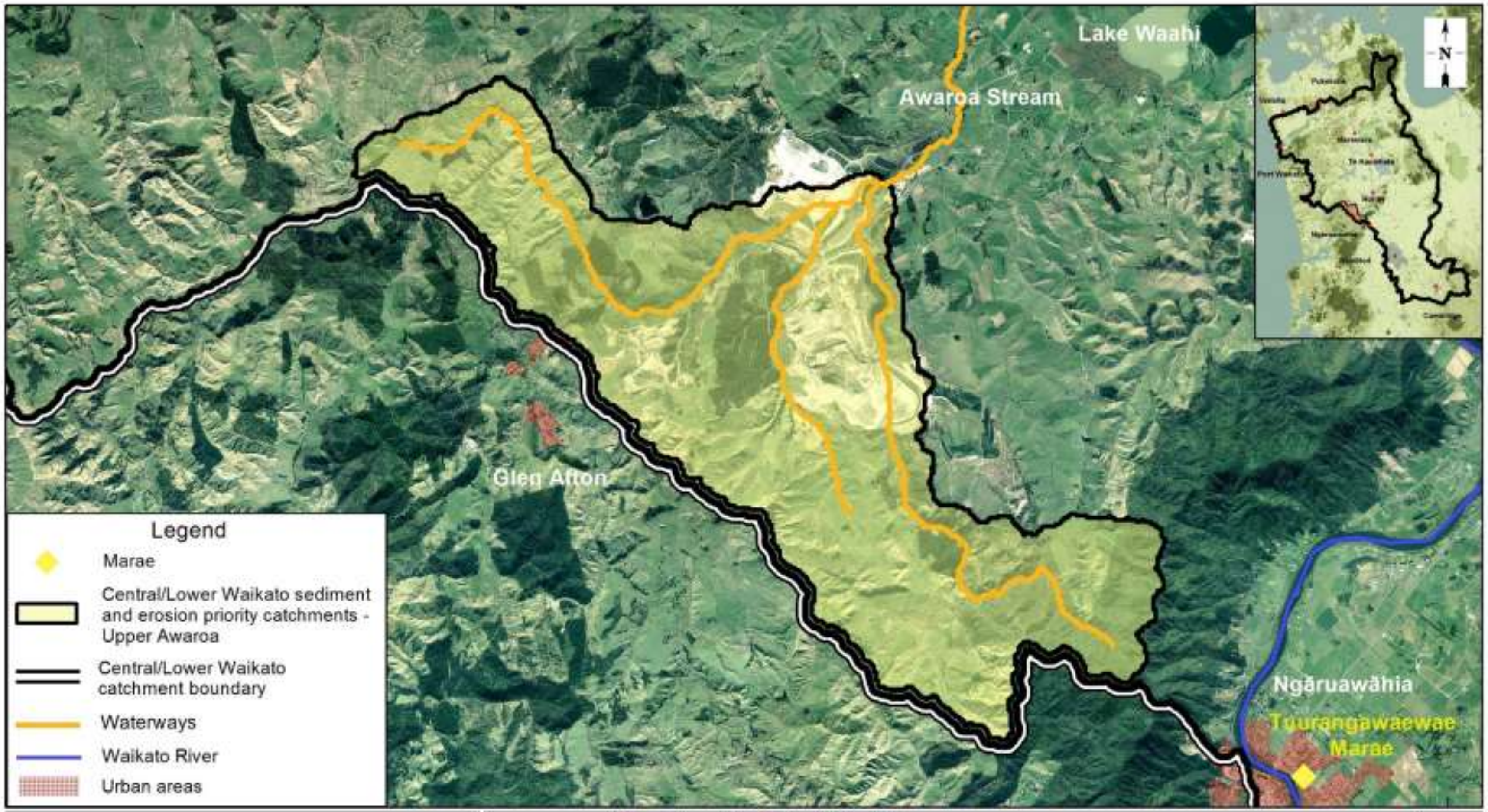

Upper Awaroa (Waahi) catchment hill country erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:75,000@A4 Landscape

A4

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Te Kaunihera ā Rohe o Waikato

Hill country erosion following a large rain event.

A soil slip following a heavy rain event.

CLW 20 Priority: very high	Rehabilitate fish habitat in streams flowing from Hakarimata Range to the Waikato River	BCR value
Relevant Unit Goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including Taonga species, in the catchment is restored and protected.	
Name of feature	Streams flowing from Hakarimata Range to Waikato River	
Brief description of feature	These are a selection of mostly short streams flowing from the steep forested headwaters of the Hakarimata Range to the Waikato River. They provide important habitat for native fish species such as shortfin eel, longfin eel, kōkopu and īnanga, and could be further enhanced to provide more extensive and better quality fish habitat. Not all of the streams are fully fenced to exclude stock and there are large sections that lack riparian vegetation. There are also known barriers (perched culverts and crossings) that prevent passage of native migratory fish. The Hakarimata Range and its peaks are recognised as children of Taupiri and Pirongia. The pae maunga (range) is culturally significant to Waikato-Tainui and marae. The Hakarimata is named as such in recognition of a significant event at Puke-i-ahua (Havelock Hill), which restored a disagreement between Maniapoto and Waikato. The food to celebrate the birth of a common mokopuna (grandchild) was so large it stretched from Puke-i-ahua to Te Huinga o ngā Wai (the point). However, it was not fully cooked, it was raw. The name Hākari (feast) - mata (raw) was then given to the mountain range.	
Desired state to meet Vision & Strategy	- Waterways are fenced to exclude stock from their entire length. - Waterways have riparian margins that are vegetated with native plants to provide stream shading and cover for fish. Vegetated riparian margins are at least 5m wide. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - There are no manmade barriers to native migratory fish. - The streams are swimmable, fishable and have access for recreation. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the streams flowing from the Hakarimata Range to the Waikato River would have a high impact on giving	VS = 40

<table>
<tr><td></td><td>effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td></td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- All of the waterways are 100% fenced to exclude stock.
- There is a planted riparian margin (at least 5 metres wide) that provides stream shade and enhances habitat for adult native fish.
- There are no manmade barriers to native migratory fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence – 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 95% (18km of streambank) requires fencing or fence upgrade/moving at a cost of $8 per metre ($144,000).

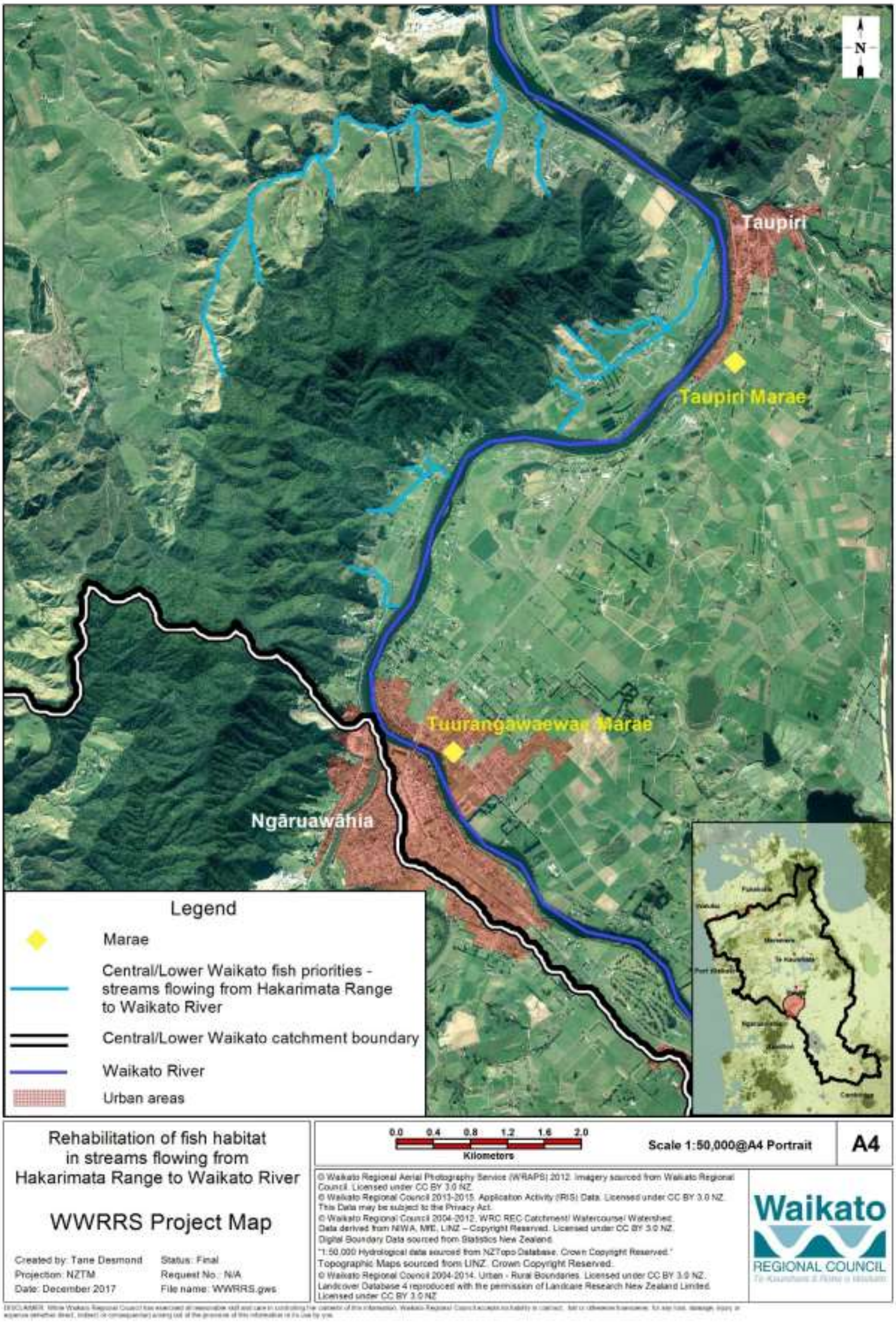
Undertake native riparian planting (within appropriately fenced areas) and associated weed control and maintenance for native plant establishment.
- Assume 95% (17km of streambank/8.5ha) requires planting on both sides ($319,192).

Remedy of fish barriers
Determine the location and type of barriers to fish passage.

Cost estimates are based on remedying six barriers to native fish at $5000 each ($30,000). Remediation actions will depend on the type of barrier present but could include installation of mussel ropes, fish ramps, baffles and/or culvert reconstruction.</td><td></td></tr>
</table>

	Project management/staffing/incidentals Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 1-2 years after project completion.	L = 6.5
Effectiveness of works	When compared to the Vision & Strategy desired state, these streams currently vary from good condition near the forested headwaters to moderate condition in the lower reaches. Overall, there is not expected to be significant change in condition of these streams over the next 20 years in the absence of this project. Works included here are expected to substantially increase fish habitat availability and quality. Although they won't address catchment land use, the wide riparian setbacks should contribute to protection and restoring water quality through shading, stock exclusion and reduction of nutrients and pathogens entering the streams. It is anticipated that if the project is fully completed, in 20 years' time the streams will be in good to very good condition and closer to the Vision & Strategy state being achieved.	W = 0.15
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.	F = 0.87
Adoptability	It is estimated that approximately three-quarters of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake.	A = 0.75
Information quality	Poor – estimates for most sites are largely based off aerial photography and some local knowledge.	
Knowledge gaps	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. If there is already a large amount of fencing close to the streambank (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.	
Socio-political risks	Very risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (18km)</td><td>144,000</td></tr>
<tr><td>Planting (8.5ha) including plant establishment</td><td>319,192</td></tr>
<tr><td>Remediation of barriers to native fish</td><td>30,000</td></tr>
<tr><td>Project management/staffing/incidentals (25% of project cost)</td><td>123,298</td></tr>
<tr><td>Total</td><td>616,490</td></tr>
</table>
</td>
<td>C = 0.62</td>
</tr>
</table>



N
Taupiri
Taupiri Marae
Tuurangawaewae Marae
Ngāruawāhia
Legend
Marae
Central/Lower Waikato fish priorities - streams flowing from Hakarimata Range to Waikato River
Central/Lower Waikato catchment boundary
Waikato River
Urban areas
Rehabilitation of fish habitat in streams flowing from Hakarimata Range to Waikato River
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.4 0.8 1.2 1.6 2.0
Kilometers
Scale 1:50,000@A4 Portrait
A4
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The stream flowing through centre of this photo would benefit from fencing and planting.

CLW 21 Priority: medium	Mangatea Stream integrated catchment programme	BCR value
Relevant unit goal(s)	Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species. Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Mangatea sub-catchment	
Brief description of feature	The Mangatea catchment is a small (2086ha) catchment with the stream itself being a tributary to the Mangawara. The catchment headwaters are in indigenous vegetation. Of the approximately 36km stream network, 24km lie in pastoral areas. The catchment extends from the west of the Hapuakohe summit, downstream to its confluence with the Mangawara. Land use in the catchment is a mix of dairy and dry stock farming. There have been some historic willow and poplar plantings on the stream margins which have been successful in stabilising banks along planted reaches. However, there is significant bank instability where banks are de-vegetated and therefore scope remains to undertake similar works throughout. The stream has been identified through modelling as a priority for prevention and management of bank erosion. Fish experts have identified waterways within this catchment as being important habitat for native fish species (including īnanga, giant kōkopu, kōura, shortfin eel and longfin eel) and there are opportunities to increase native fish abundance by remediating barriers and providing increased and higher quality fish habitat. The Mangatea catchment, Hapuakohe Range and Mangawara Stream provided significant resources to marae, including kōura (freshwater crayfish), tuna (eels), kōkopu and bird species. There are many historic pā sites and marae within the area.	

<table>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing.
- Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish.
- Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangatea sub-catchment would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 40</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Mangatea Stream, Mangawara Stream and lower Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The main channel and tributaries of the Mangatea Stream are stable and fenced to exclude stock with a minimum 5 wire (2 electric) fence.
- Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.
- There are no manmade barriers to native fish on the Mangatea Stream or tributary streams.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Riparian management of rivers/streams in pasture for soil conservation purposes and fish habitat** Carry out riparian fencing with a minimum 5m setback from the top of the streambank (preferably 5 wire with 2 electric wires at $8 per metre) along an estimated 13km of streambank (6.5km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 5ha of planting and associated weed control and maintenance. 1200 poplar poles are estimated to be required for river and stream erosion control. The main reach of the Mangatea is 10km long and it is estimated that erosion control structures would be required at a frequency of 2 per km of bank length ($10,000 per km of stream). **Remediation of fish barriers** Determine the location of barriers to fish passage (on the mapped watercourses as well as side tributaries) and carry out remediation work. It is estimated that there are at least 6 barriers (or partial barriers) to fish passage in the catchment. Field work associated with investigating the location of barriers to fish passage is covered as part of the project management costs. The cost estimates below allow for remediation of 6 fish barriers. - Remediation of 6 barriers at $5000 each ($30,000) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen 2-3 years after project completion.	L = 7.5
Effectiveness of works	When compared to the Vision & Strategy desired state, the Mangatea sub-catchment is in a moderate condition with some of the Vision & Strategy aspirations already being partly met. There is not expected to be significant change in condition over the next 20 years in the absence of this project. Works included here address	W = 0.1

	many of the threats to the feature and it is anticipated that if the project is fully completed, the stream will be in good condition and closer to the Vision & Strategy state being achieved. The project does not address catchment land use, however the steepest parts of the catchment are already vegetated and the proposed fencing and planting works will assist in protecting and restoring water quality at this site.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 5m, and by planting sterile willow poles to stabilise banks while native plantings establish.	F = 0.82
Adoptability	It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature.	A = 0.5
Information quality	Average – estimates are based on modelled information, aerial photographs, Lower Waikato catchment riparian surveys and input from catchment officers who are familiar with the sub-catchment. Fish habitat enhancement recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers and location and design of instream woody debris structures would need to be determined in the early stages of the project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (13km)</td><td>104,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (1200 poles)</td><td>16,803</td></tr>
<tr><td>Native riparian planting (5ha)</td><td>187,760</td></tr>
<tr><td>Erosion control structures</td><td>100,000</td></tr>
<tr><td>Remediation of fish barriers</td><td>30,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>87,712</td></tr>
<tr><td>Total</td><td>526,276</td></tr>
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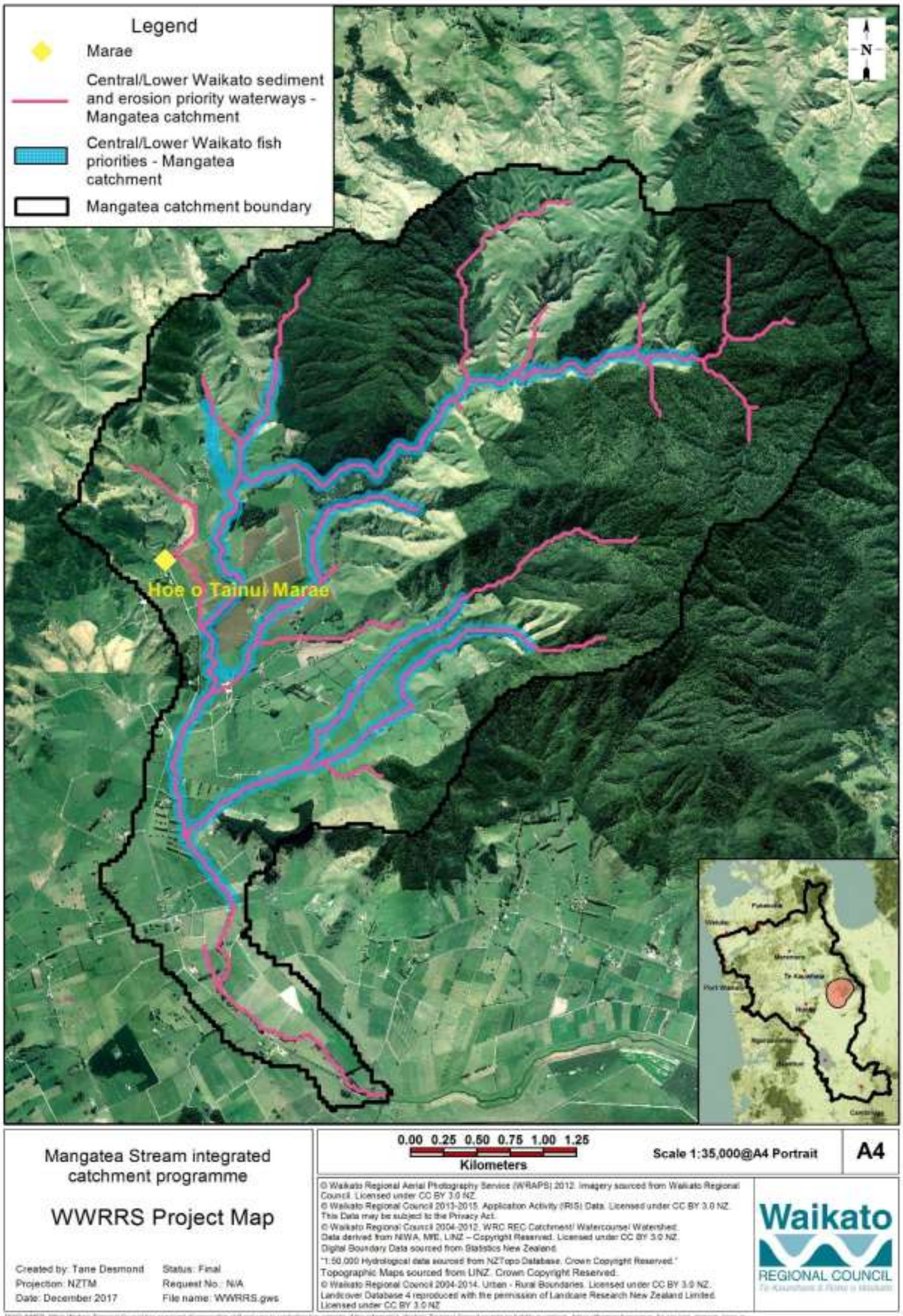
</td>
<td>C = 0.53</td>
</tr>
</table>


Legend
Marae
Central/Lower Waikato sediment and erosion priority waterways - Mangatea catchment
Central/Lower Waikato fish priorities - Mangatea catchment
Mangatea catchment boundary
N
Hoe o Tainui Marae
0.00 0.25 0.50 0.75 1.00 1.25
Kilometers
Scale 1:35,000@A4 Portrait
A4
Mangatea Stream integrated catchment programme
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Examples of erosion along the Mangatea Stream.

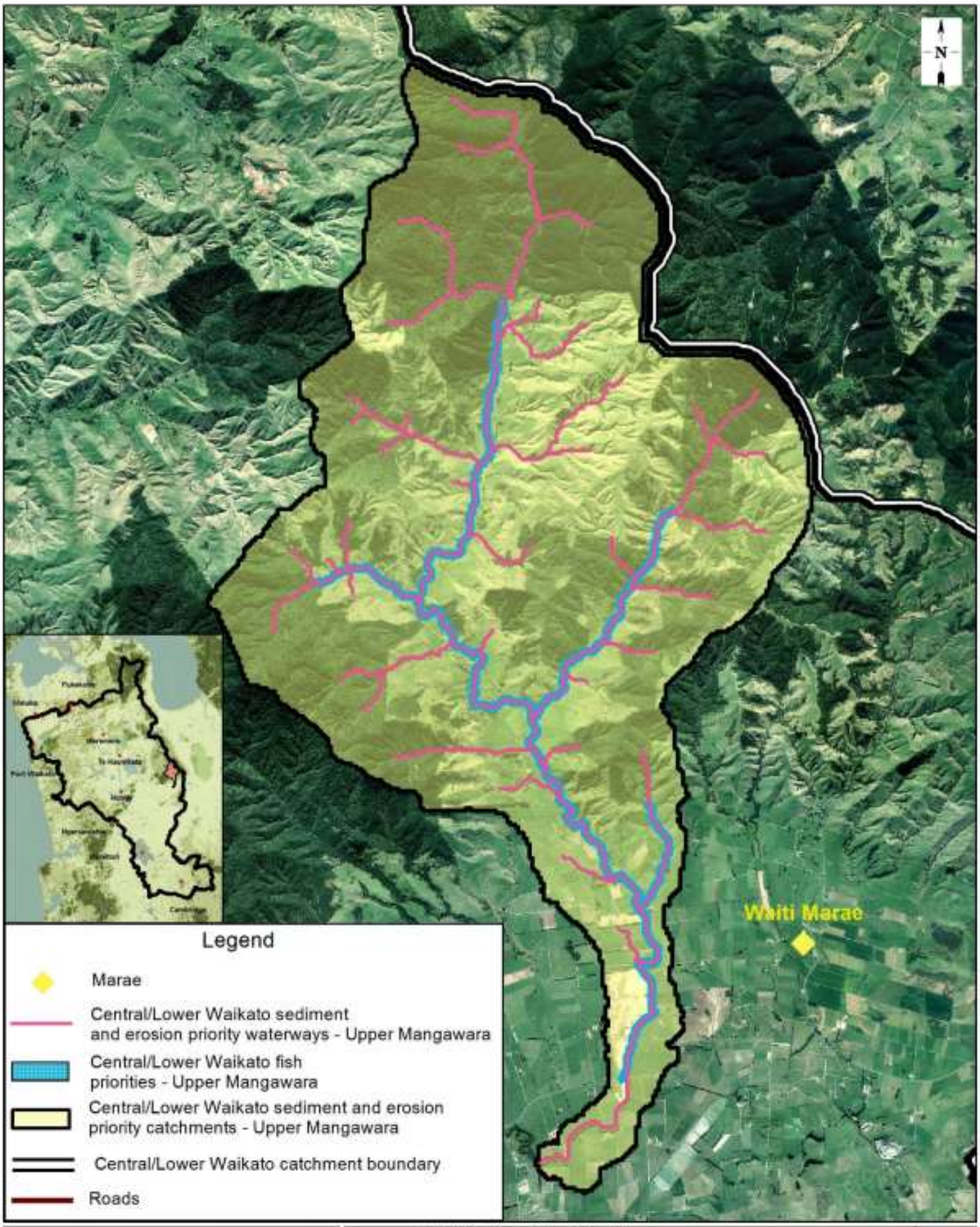
CLW 22 **Priority: medium**	**Upper Mangawara integrated catchment programme**	**BCR value**
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species. Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Mangawara sub-catchment	
Brief description of feature	The upper Mangawara is a relatively small (3562ha) catchment lying at the southern end of the Hapuakohe Range and along the eastern boundary of the Lower Waikato catchment. The catchment is estimated to have an approximately 50km stream network including the Mangawara Stream itself. This stream heads south down the catchment turning west and through the much larger middle Mangawara before entering the Waikato River at the base of Taupiri mountain. The lower extent of the upper catchment is where the stream crosses under Tahuna Road. Catchment land use is predominantly a mixture of dry stock and dairy. Waikato Regional Council has undertaken some river stabilisation works in the upper Mangawara Stream, including willow and poplar planting, vegetation/rock groynes, fencing and weir construction. Fencing and retirement of bush blocks has also been undertaken by landowners. Modelling undertaken in 2016 indicates that the upper Mangawara catchment is a high priority for hill country and streambank erosion prevention and management. Fish experts have identified waterways within this catchment as being important habitat for native fish species (including īnanga, crans bully, kōura, shortfin eel and longfin eel) and there are opportunities to increase native fish abundance by remediating barriers and providing increased and higher quality fish habitat. The Mangatea catchment, Hapuakohe Range and Mangawara Stream provided significant resources to marae, including kōura (freshwater crayfish), tuna (eels), kōkopu and bird species. There are	

<table>
<tr><td></td><td>many historic pā sites and marae within the area. It is said that one of the hoe (paddles) of the Tainui waka sits near the top of the Mangawara.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- Catchment where land use matches capability and with a stable stream network that has fenced and well vegetated riparian margins along their entire length (at least 5m wide).
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing.
- Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish.
- Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The streams are swimmable, fishable and have access for recreation.
- Iwi and community have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangawara sub-catchment would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 50</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Streambank erosion</td><td>Increased sediment in the catchment streams and loss of streambank vegetation, habitat for fish.</td></tr>
<tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams and to the lower Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- LUC class 7 soils are managed within their capabilities and are retired from heavy stock grazing.</td><td></td></tr>
</table>

	- Within 15 years of project commencement there is a 30% reduction in suspended sediment in the Mangawara Stream. - Within 10 years of project commencing, all of the waterways are 100% fenced to exclude stock, and a vegetated riparian margin provides stream shade and enhances habitat for adult native fish. - There are no manmade barriers to native migratory fish.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 124ha LUC 6e land managed with open space pole planting at $3000 per hectare - 124ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare - 30km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten) - 145ha LUC 7 land managed with plantation species (pine or mānuka at $3000 per hectare - 20km of fencing the managed LUC 7 land at $25 per metre (8-wire and batten) - 4ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $8000 per hectare (e.g. dewatering, retiring seepages, etc) - 17km fencing existing indigenous forest cover at $25 per metre (8-wire and batten). **Riparian management of rivers/streams in pasture for soil conservation purposes and for fish habitat** *Costs for fencing are based on a 5-wire (2 electric) fence, however, in these flood prone streams a 3-wire electric fence would also be acceptable.* Carry out riparian fencing with a minimum 5m setback from the top of the streambank along an estimated 17km of streambank (8.5km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 6ha of planting and associated weed control and maintenance. 1478 willow poles are estimated to be required for river and stream erosion control. It is estimated that a further 2km of main channel will require vegetation groynes at a frequency of 5 structures per km ($12,500	

	per km). These should be focused upstream of the regional council weirs. **Remediation of fish barriers** Determine the location of barriers to fish passage (on the mapped watercourses as well as side tributaries) and carry out remediation work. It is estimated that there are at least 6 barriers (or partial barriers) to fish passage in the catchment. Field work associated with investigating the location of barriers to fish passage is covered as part of the project management costs. The cost estimates below allow for remediation of 6 fish barriers. - Remediation of 6 barriers at $5000 each ($30,000) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	The upper Mangawara sub-catchment is in relatively poor condition compared with the desired state, with few of the Vision & Strategy aspirations currently being met. It is not expected to significantly decline or improve over the next 20 years in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy. However, works included in this project address many of the threats to the feature and it is anticipated that if the project is fully completed it would make significant progress with respect to achieving the Vision & Strategy state in 20 years' time.	W = 0.3
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.82
Adoptability	It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment recently. The extent of the fencing setbacks may also provide some challenge in terms of uptake. There are large sections of river that are erosive in	A = 0.25

<table>
<tr><td></td><td>nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information, aerial photographs, Lower Waikato catchment riparian surveys and input from catchment officers who are familiar with the sub-catchment. Fish habitat enhancement recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e and 7 come from a desktop exercise. Farm scale information will need to be gathered as part of this project. It is unknown specifically how much riparian fencing already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>124ha LUC 6e managed with pole planting</td><td>372,000</td></tr>
<tr><td>124ha LUC 6e managed with plantation species</td><td>372,000</td></tr>
<tr><td>Fencing managed LUC 6e land (30km)</td><td>750,000</td></tr>
<tr><td>145ha LUC 7 managed with plantation species</td><td>435,000</td></tr>
<tr><td>Fencing managed LUC 7 land (20km)</td><td>500,000</td></tr>
<tr><td>Reducing sediment outside LUC 6e, 7 and 8 (4ha)</td><td>32,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (17km)</td><td>425,000</td></tr>
<tr><td>Riparian fencing 5-wire, 2 –electric (17km)</td><td>136,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (1478 poles)</td><td>20,692</td></tr>
<tr><td>Native riparian planting (6ha)</td><td>225,312</td></tr>
<tr><td>Erosion control structures</td><td>25,000</td></tr>
<tr><td>Remediation of fish barriers</td><td>30,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>996,901</td></tr>
<tr><td>Total</td><td>4,319,905</td></tr>
</table>
</td><td>C = 4.3</td></tr>
</table>



Upper Mangawara integrated catchment programme

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:55,000@A4 Portrait

A4

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Hill country in the upper Mangawara.


Erosion along the Mangawara Stream.


Streambank erosion along the Mangawara Stream.

CLW 23 Priority: very high	Water quality improvement in the middle Mangawara catchment	BCR value
Relevant Unit Goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Waterways in the middle Mangawara catchment	
Brief description of feature	The middle Mangawara Stream catchment covers 14,219ha and drains the Mangatea, upper Mangawara and Tauhei catchments. The stream itself eventually flows through the lower Mangawara and into the Waikato River at Taupiri. 90% of the catchment is in pastoral cover, with 8% still retaining native vegetation. The main waterways in the catchment are the Mangakawau Stream, Mangawara Stream (including Orini Canal), Sludge Creek and Paranui Drain. These are highly modified and maintained as part of the Mangawara Flood Protection Scheme. Waikato Regional Council water quality monitoring of the stream at Rutherford Road bridge indicates that levels of TN, TP and E. coli are unsatisfactory 100% of the time. Modelling undertaken in 2016 indicates that the middle Mangawara catchment is a high priority for actions that assist in nitrogen and E. coli reduction. The Mangatea catchment, Tauhei catchment, Hapuakohe Range and Mangawara Stream provided significant resources to marae, including kōura (freshwater crayfish), tuna (eels), kōkopu and bird species. There are many historic pā sites and marae within the area. Wāhi tapu are scattered within the project area.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter. - Forest remnants and wetlands are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - The streams are swimmable, fishable and have access for recreation.	

<table>
<tr><td></td><td>- Iwi and community have a strong connection to the catchment streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the waterways in the middle Mangawara catchment would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 30</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100% of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 5 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

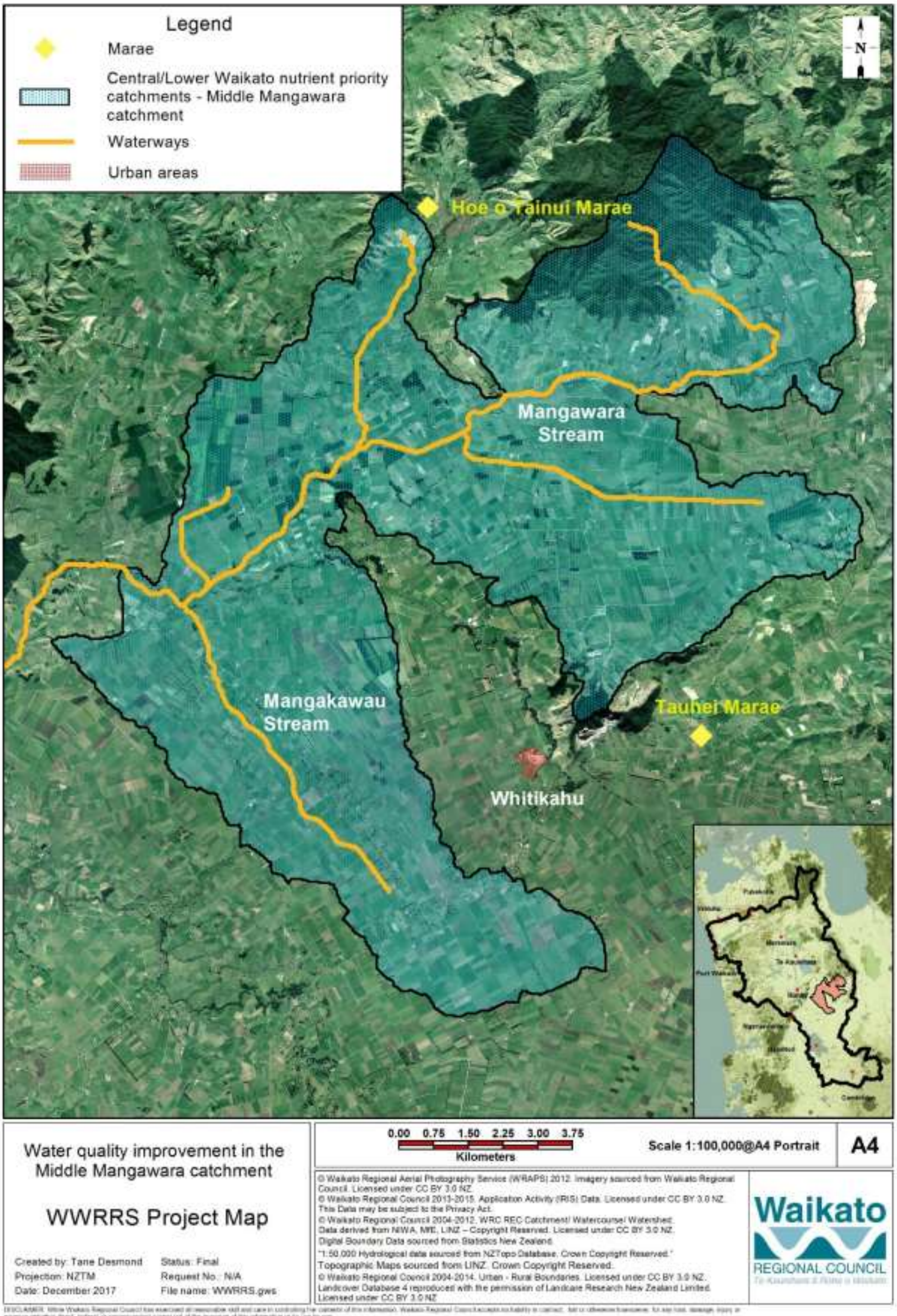
Wetland and ephemeral stream protection
11km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8 per metre. Fence should be 5 wire – 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within a year following project commencement.</td><td>L = 5.5</td></tr>
<tr><td>Effectiveness of works</td><td>When compared with the Vision & Strategy desired state, the waterways and wetlands in the middle Mangawara sub-catchment are currently in a poor condition, with few of the Vision & Strategy aspirations being met. Water quality is poor and not safe for swimming and waterways are highly modified. It is anticipated that there may be a slight decline in state over the next 20 years in the absence of this project, due to further peat loss. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to offset decline and contribute to slight improvement in overall condition. However, it is acknowledged that achieving the desired state will take longer than the 20 year horizon used for the</td><td>W = 0.03</td></tr>
</table>

	purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.	
Risk of technical failure	There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.	F = 0.97
Adoptability	It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.	A = 0.5
Information quality	Poor – estimates based on modelled information and examination of aerial photographs.	
Knowledge gaps	Estimates of wetland location and perimeter come from a desktop exercise. It is uncertain how many wetlands and seeps retain natural hydrology. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.62
Project duration (years)	5 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 0.11

Task	**Cost ($)**
Fencing wetlands and ephemeral streams (11km)	88,000
Project management/staffing/incidentals (25%)	22,000
Total	**110,000**



Legend
Marae
Central/Lower Waikato nutrient priority catchments - Middle Mangawara catchment
Waterways
Urban areas
N
Hoe o Tainui Marae
Mangawara Stream
Mangakawau Stream
Tauhei Marae
Whitikahu
0.00 0.75 1.50 2.25 3.00 3.75
Kilometers
Scale 1:100,000@A4 Portrait
A4
Water quality improvement in the Middle Mangawara catchment
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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An example of a seep in the Mangawara catchment that would be a candidate for re-establishing hydrology and fencing/retiring (Photo: Waikato RiverCare).


Wetland in the Mangawara catchment suitable for fencing and retiring (Photo: Waikato RiverCare).


Wetland in the Mangawara catchment that would be suitable for fencing and retiring (Photo: Waikato RiverCare).

CLW 24 / Priority: high	Water quality improvement in the Tauhei catchment	BCR value
Relevant Unit Goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Waterways and wetlands within the Tauhei catchment	
Brief description of feature	The Tauhei catchment extends over 11,600ha from west of Morrinsville and drains into the Mangawara Stream at Orini. 94% of the catchment is in pastoral cover with the predominant land use being dairy farming. There is an estimated 162km stream network in pasture within the catchment. The Tauhei Stream itself is highly modified and stopbanked along much of its length. The catchment is largely peat and forms part of the Tauhei drainage scheme and flood protection scheme. Modelling undertaken in 2016 indicates that the Tauhei catchment is a high priority for actions that assist in nitrogen and E.coli reduction. The Tauhei area and the Mangawara Stream provided significant resources to marae, including kōura (freshwater crayfish), tuna (eels), kōkopu and bird species. There are many historic pā sites within the area, and existing marae.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter. - Forest remnants and wetlands are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the catchment streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, waterways in the Tauhei catchment would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.	VS = 30

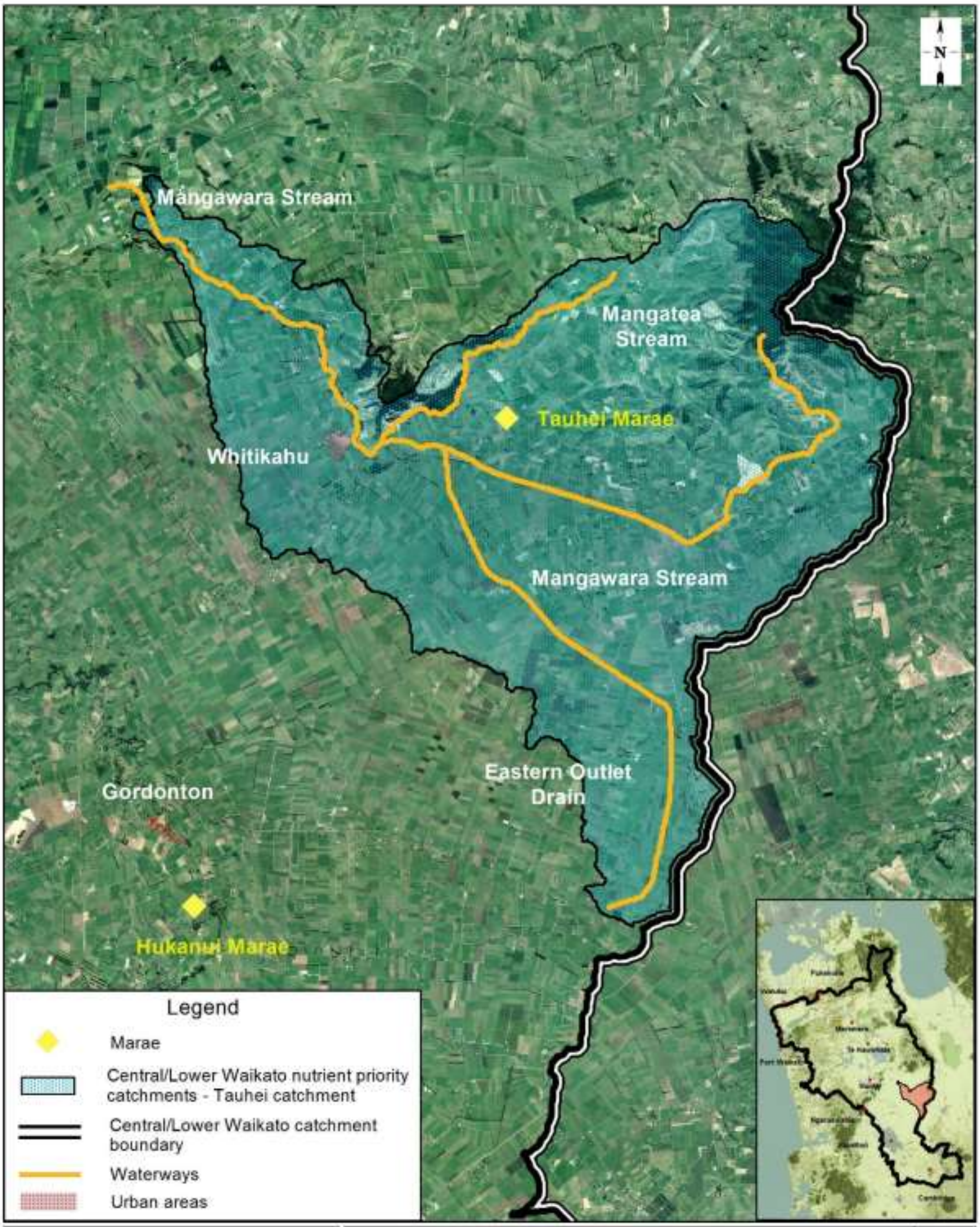
<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100 % of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 5 years of project commencement.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Wetland and ephemeral stream protection
8km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8 per metre. Fence should be 5 wire – 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately within 1 year following project commencement.</td><td>L = 5.5</td></tr>
<tr><td>Effectiveness of works</td><td>When compared with the Vision & Strategy desired state, the waterways and wetlands in the Tauhei sub-catchment are currently in a poor condition with few of the Vision & Strategy aspirations being met. Water quality is poor and not safe for swimming and waterways are highly modified. It is anticipated that there may be a slight decline in state over the next 20 years in the absence of this project due to further peat loss. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to slightly offset decline. However it is acknowledged that achieving the desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.</td><td>W = 0.01</td></tr>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
</table>

<table>
<tr><td>Works by private citizens – likelihood of adoption and adoption circumstances</td><td>It is estimated that approximately one quarter of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.</td><td>A = 0.25</td></tr>
<tr><td>Information quality</td><td>Poor – estimates based on modelled information and examination of aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desktop exercise. It is uncertain how many wetlands and seeps retain natural hydrology. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><td>Task</td><td>Cost ($)</td></tr><tr><td>Fencing wetlands and ephemeral streams (8km)</td><td>64,000</td></tr><tr><td>Project management/staffing/incidentals (25%)</td><td>16,000</td></tr><tr><td>Total</td><td>80,000</td></tr></table></td><td>C = 0.08</td></tr>
</table>



Water quality improvement in the Tauhei catchment

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:110,000@A4 Portrait

A4

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An example of a small wetland area that would be suitable for fencing and protecting.

CLW 25 Priority: high	Water quality improvement in the Kōmakorau and Mangatoketoke catchments	BCR value
Relevant Unit Goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Waterways and wetlands within the Kōmakorau and Mangatoketoke catchments	
Brief description of feature	This large catchment covering 19,143ha lies to the east of Hamilton and Ngāruawāhia and has streams entering the Waikato River at Taupiri. The land cover is more than 95% pastoral, and land use is predominantly dairy with a mix of lifestyle blocks. There are an estimated 247km of streams in pasture within this catchment. Many of the Horsham Downs peat lakes lie within the catchment, including lakes Whakatangi, Tunawhakaheke, Kaituna and Kainui. The key waterways are Kōmakorau and Mangatoketoke streams. This catchment sits on peat soils and contains the Kōmakorau and Freshfield drainage schemes, therefore many of the waterways are highly modified and regularly maintained with spraying or mechanical removal of silt and vegetation. This limits the ability to undertake riparian plantings so, before works are undertaken, consideration needs to be given to regulations that enable ongoing access for drain maintenance. The Kōmakorau Stream contains high numbers of indigenous fish, including black mudfish, banded kōkopu, giant kōkopu, shortfin eel and longfin eel. The Kōmakorau catchment and associated lakes historically provided significant resources to marae, including kōura (freshwater crayfish), tuna (eels), kōkopu, kāeo and bird species. The names of the lakes reflect the nature of their service to tangata whenua, i.e. to provide food with kupu (words) such as kai (food), tuna (eels) and kōmako (bellbird) in their historic names. Waikato Regional Council water quality monitoring of the Kōmakorau Stream at Henry Road indicates that levels of nitrogen, phosphorus and E. coli are unsatisfactory 100% of the time. Modelling undertaken in 2016 indicates that the Kōmakorau and Mangatoketoke catchment is a high priority for actions that assist in nitrogen, phosphorus and E. coli reduction.	

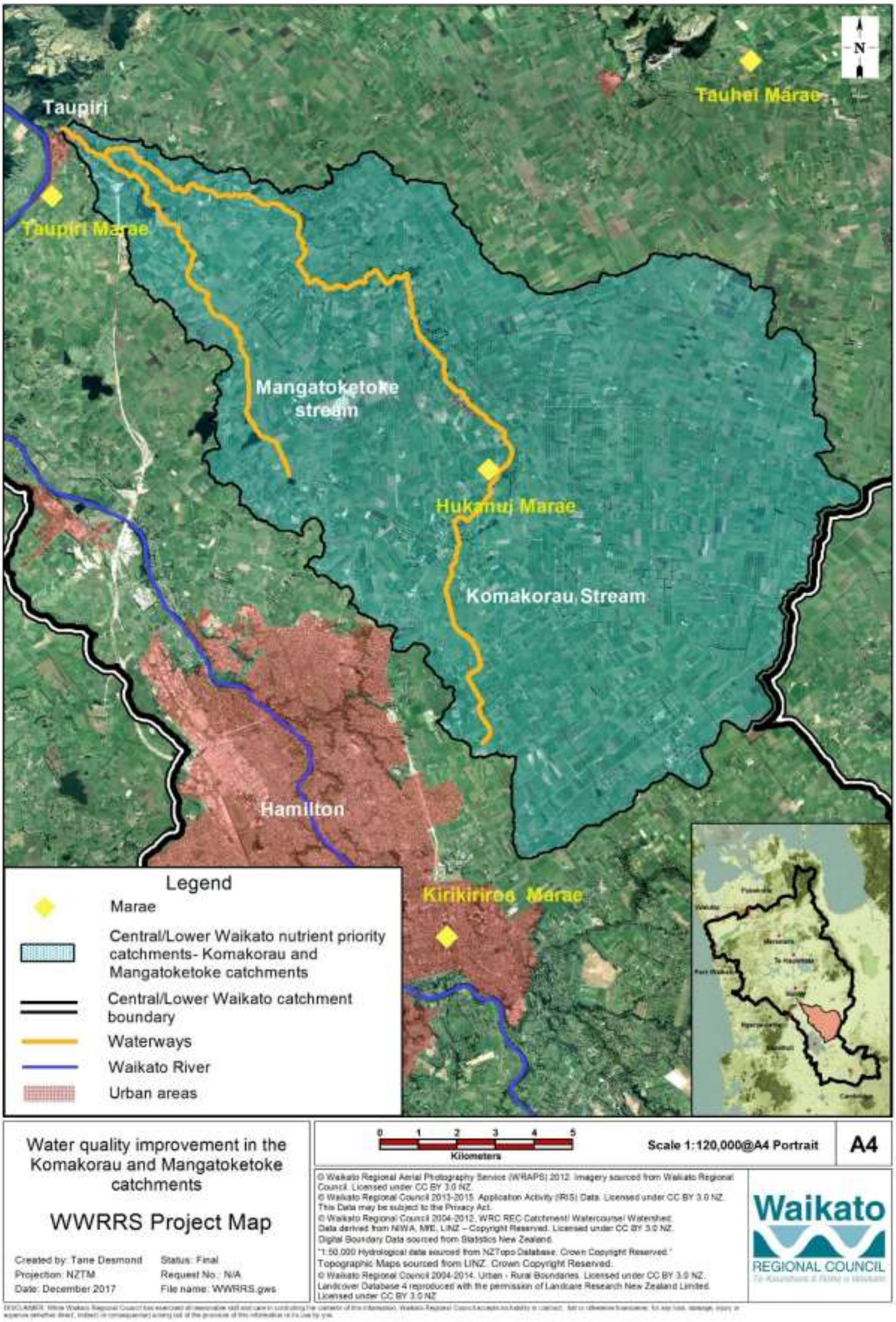
<table>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.
- Forest remnants and wetlands are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing.
- Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish.
- Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The streams are swimmable, fishable and have access for recreation.
- Iwi and community have a strong connection to the catchment streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, waterways within the Kōmakorau and Mangatoketoke catchments would have a high impact on giving effect to the Vision & Strategy at central and lower Waikato catchment level.</td><td>VS = 50</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100% of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Wetland and ephemeral stream protection
44km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8 per metre. Fence should be 5 wire – 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
</table>

<table>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.</td><td>L = 8</td></tr>
<tr><td>Effectiveness of works</td><td>When compared with the Vision & Strategy desired state, the waterways and wetlands in these sub-catchments are currently in a poor condition, with few of the Vision & Strategy aspirations being met. Water quality is poor and not safe for swimming and waterways are highly modified. It is anticipated that there may be a decline in state over the next 20 years in the absence of this project due to further catchment peat loss. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to offset decline in overall condition. However, it is acknowledged that achieving the desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.</td><td>W = 0.05</td></tr>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately one quarter of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.</td><td>A = 0.25</td></tr>
<tr><td>Information quality</td><td>Poor – estimates based on modelled information and examination of aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desktop exercise. It is uncertain how many wetlands and seeps retain natural hydrology. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing wetlands and ephemeral streams (44km)</td><td>352,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>88,000</td></tr>
<tr><td>Total</td><td>440,000</td></tr>
</table></td><td>C = 0.44</td></tr>
</table>


Taupiri
Tauhei Marae
N
Taupiri Marae
Mangatoketoke
stream
Hukanui Marae
Komakorau Stream
Hamilton
Kirikiriroa Marae
Legend
Marae
Central/Lower Waikato nutrient priority catchments- Komakorau and Mangatoketoke catchments
Central/Lower Waikato catchment boundary
Waterways
Waikato River
Urban areas
Water quality improvement in the Komakorau and Mangatoketoke catchments
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale 1:120,000@A4 Portrait
A4
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An example of a wetland area that would be suitable for fencing and protecting.

CLW 26 Priority: medium	Biodiversity enhancement of Kukutaaruhe Stream and associated gully ecosystem	BCR value
Relevant Unit Goal(s)	Wetlands are protected, enhanced and where feasible expanded and re-established. Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded. Connections between significant places are provided for. A platform for tourism along the river is created and connects to inland opportunities. Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Kukutaaruhe Stream and associated 23 hectare (ha) gully ecosystem (from Fairfield College to the Waikato River)	
Brief description of feature	The greater Kukutaaruhe Stream catchment is approximately 148ha with about 36ha of that being urban gully directly connected to the stream system. Kukutaaruhe Stream and associated gully ecosystem is approximately 23ha in total area. This comprises 6.2ha of gully in the upper reach which is owned and managed by Ministry of Education/Kukutaaruhe Trust, 12.4ha of Donny Park stream/park reserve (Hamilton City Council owned and managed) as well as adjoining privately owned gully areas (approximately 1.6ha). The Kukutaaruhe Stream and catchment are directly connected to the Waikato River and the stream is a confirmed spawning site for native fish species giant kōkopu. NIWA have been GPS tracking and monitoring native fish species here since the installation of a constructed fish passage in 2006. The stream is predominantly cobble and sandy bottomed, with partial riparian vegetation (predominantly weeds) providing some spawning and stream habitat shading and protection. The gully catchment now has resident tūī (at least 2 pairs), small remnant wetland areas and representative native gully vegetation species. Historically, gullies were an important resource for Māori providing food and medicinal herbs. In pre-European times the area was known to Māori as Kukutaruhe (pigeon flight) and the gully system had considerable significance to Ngāti Wairere. It was an important area for growing crops and renowned as an	

	area for hunting native pigeons. There was a number of significant pa and papakāinga settlements overlooking the gully (the largest being Te Tupari situated near what is now Waikato Diocesan School for Girls). A number of significant artefacts associated with pre-European Māori habitation of the area have been recovered from the gully and surrounding area (Source: Donny Park Operative Management Plan, 2004). The gully and stream have a public path from the river to the head of a gully arm near the school boundary. The gully is also connected to the Aratiatia marae bordering Fairfield College. This site was selected for inclusion in the Restoration Strategy due to its urban location, significance for fish spawning and opportunity for multiple outcomes including education, biodiversity, recreation and fish habitat enhancement.	
Desired state to achieve Vision & Strategy	- Streams have riparian buffers to provide habitat for native fish spawning and cooler waters (improved native fish habitat). These extend from the upper Kukutaaruhe catchment to the Waikato River. - The gully is predominantly weed free and vegetated with native species (ecological communities) characteristic of the local environment, including restored remnant wetlands, gully forest species and upland forest species. - There are no manmade barriers to native migratory fish. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - The stream is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Kukutaaruhe Stream and associated gully would have a high impact on giving effect to the Vision & Strategy at a local level.	VS = 2

<table>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes to poor water quality and affects fish.</td></tr>
<tr><td>People become disconnected from the waterway</td><td>Waterway areas become more degraded and people see the area more as a wasteland than something that needs to be nurtured and cared for.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Land drainage</td><td>Lowers water levels, reduces the extent and/or quality of wetlands and causes adverse changes in ecosystems.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 20 years of project commencement:
- The gully vegetation over the upper area of the gully (approximately 6ha) is restored back to native species, including a 0.5ha area of upland native forest being established to provide a complete topographic sequence example of the original native flora.
- The stream has a predominantly native vegetation riparian buffer for the entire stream length.
- Sites of cultural significance are protected.
- The stream continues to provide spawning habitat for giant kōkopu and has an abundance of native fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>This project has been split into 3 areas:
- 6.2ha of gully upstream of Donny Park (managed by Kukutaaruhe Trust)
- 12.4ha Donny Park
- 1.6ha of private land.

The entire project has potential to be part of a wider project called the Fairfield Project. The Fairfield Project involves development of an ecological restoration centre and education programme at Fairfield College. It is envisaged that it will be recognised nationally as the face of environmental sustainability and restoration education. Implementation of this gully restoration project should also involve dialogue with the Fairfield Project.

Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This</td><td></td></tr>
</table>

	project could be undertaken as a whole, or in multiple smaller components. **Restoration plan** Developing a restoration plan will be essential. This project has opportunities to link with the Fairfield Project and be used as an open classroom for education, cultural development and research to connect the schools, marae and greater community with the stream, catchment and the Waikato River. The restoration plan should detail the tasks required, timing, planting plan, weed management plan, monitoring plan and protocols for working and studying in the gully to ensure minimal impact on the surrounding environment. The plan should build on and connect with the Donny Park Reserves Act Management Plan (2004). The estimated cost of this is $25,000 (including a general ecological condition assessment of the gully and stream). <u>Upstream of Donny Park (on Kukutaaruhe Trust managed land)</u> **Connecting pathways:** - Complete the remainder of the gully pathway from Donny Park to the Trust site (~250m gravel/boardwalk path). This will require design drawings suitable for resource consent as well as material and labour to build. There may be opportunity to include students as a training opportunity and community volunteers. The estimated cost of this is $37,500. - Establish a knowledge trail with at least 6 interpretive signs identifying areas of ecological or cultural interest in the gully area. This will require material and labour to build and there is opportunity to include students as a training opportunity and community volunteers. The estimated cost of this is $10,000. **Weed removal (vegetation clearance)** Weed removal is required throughout the restoration areas. Weeds are mostly climbing or groundcover (e.g. honeysuckle, jasmine, convolvulus, *Tradescantia*) and will require multiple applications with herbicide and/or clearing equipment and labour. There is an opportunity to involve students in this work as a training opportunity and community volunteers.	

	A comprehensive weed control plan will be essential to ensure success of this project and should be undertaken as part of the management plan for the site. Exact costs associated with undertaking weed control are unknown but the following estimates have been made for the 6.2ha area: - $2800 per hectare 3 times per year over 2 years in order to establish weed free areas in preparation for native planting ($104,160). - Cost estimates for native planting allow for releasing of native plants and associated weed control for approximately 3 years following planting. Additional weed control following native plant establishment is estimated at $700 per hectare every year for 13 years ($58,420). **Native revegetation** Native revegetation is required over an area of approximately 6.2ha. The gully vegetation over the upper area of the gully (approximately 6ha) is already restored back to native species. There is opportunity to include students as a training opportunity and community volunteers. The estimated cost of native revegetation is $39,552 per hectare. This includes some site preparation, plant purchase, planting labour and 5 releasing events. Additional weed control will be required on top of this cost and this has been allowed for in the weed control section. - Native planting cost estimates are 6.2ha at $39,552 per hectare ($245,222). <u>Private land</u> **Native revegetation** Some native planting and weed control is required on private land within the gully. The total area of this land is approximately 1.6ha and it is estimated that 30% of the area requires native planting. The estimated cost of this work is $18,984. **Weed removal (vegetation clearance)** Weed control will be important for the success of this project. Exact costs associated with undertaking weed control are unknown but the following estimates have been made. - $2800 per hectare 3 times per year over 2 years in order to establish weed free areas in preparation for native planting ($26,880).	

	- Cost estimates for native planting allow for releasing of native plants and associated weed control for approximately 3 years following planting. Additional weed control following native plant establishment is estimated at $700 per hectare every year for 13 years ($700 x 1.6ha x 13 years is $14,560). Donny Park Within the Donny Park area, Hamilton City Council have made recommendations for riparian planting along Kukutaaruhe Stream and remediation of barriers to native fish. Some of these recommendations have come from the development of a Stormwater Master Plan that also includes potential projects to improve stormwater management within the city. A summary of the riparian and fish passage remediation recommendations are as follows: **Donny Park riparian improvement** - Undertake native planting along a 1000m length of Kukutaaruhe Stream to provide a 5m wide riparian margin (0.5ha in total). Riparian planting should be ecologically sensitive, reflecting ecological district and historical vegetation. The estimated cost of native planting is $19,776 (including plant purchase, planting labour, 5 releasing events). - A comprehensive weed control programme will also be required within the 0.5ha planted area. It is estimated that 3 weed control events will be required per year over a period of 3 years ($7500 per year x 3 years is $22,500) **Fish passage remediation** A partial fish barrier exists on Kukutaaruhe Stream at Wymer Terrace (twin culvert). This should be remediated through redesign of the culvert or installation of appropriate remediation measures (e.g. spat rope, fish ladders, low flow channels, fish baffles). The remediation measures adopted should follow the recommendation of an experienced fish ecologist. - A cost estimate of $5,000 has been provided for this work. **Animal pest control** Possum control may be required during native plant establishment (over a 3 year period). Costs are based on using A12 Goodnature kill traps at a rate of one trap per hectare (across 20ha) - $175 per hectare for set up ($3500) - $90 per hectare each year for three years thereafter ($5400)	

	This site would benefit from mustelid and rat control to protect and enhance native bird populations. This work has not been costed as ongoing because animal pest control is out of scope for the restoration strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs. Project implementers are also encouraged to work closely with the Fairfield Project, students, community and experts to establish baseline and ongoing monitoring protocols and collect data to measure the success of the restoration project.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 10-11 years after project commencement.	L = 10.5
Effectiveness of works	Kukutaaruhe Stream and its associated gully ecosystem are currently in a moderate condition when compared to desired state. The stream retains some very good native fish values and the location is used by the local community for recreation. Condition is not expected to substantially change over the next 20 years in the absence of this project. If this project is successfully completed, then it is expected that the feature will move closer to Vision & Strategy desired state across many of the aspirations, with the proposed work addressing some key threats. Condition is therefore expected to be very good in 20 years' time if this work is undertaken.	W = 0.3
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels until native plants dominate.	F = 0.82
Adoptability	A community group is already operating in this area and has a strong interest in this project. They have recently taken on the	A = 0.6

<table>
<tr><td></td><td>lease for a large part of the land covered by this project. There is some uncertainty around adoptability on private land.</td><td></td></tr>
<tr><td>Information quality</td><td>Good – information about the site and estimates of works have come from a local expert and examination of aerial photography.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Further work is required to determine the specific quantities of planting and weed control required. This should be undertaken in the early stages of project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P= 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Restoration Plan</td><td>25,000</td></tr>
<tr><td>Upstream of Donny Park (on Kukutaaruhe Trust managed land)</td><td></td></tr>
<tr><td>- Construct 250m pathway</td><td>37,500</td></tr>
<tr><td>- Signage</td><td>10,000</td></tr>
<tr><td>- Weed removal</td><td>162,580</td></tr>
<tr><td>- Native revegetation</td><td>245,222</td></tr>
<tr><td>Private Land</td><td></td></tr>
<tr><td>- Native revegetation</td><td>18,984</td></tr>
<tr><td>- Weed removal</td><td>41,440</td></tr>
<tr><td>Donny Park</td><td></td></tr>
<tr><td>- Riparian planting and weed control</td><td>42,276</td></tr>
<tr><td>- Remediation of fish barrier</td><td>5000</td></tr>
<tr><td>Animal pest control</td><td>8900</td></tr>
<tr><td>Project management/staffing/incidentals (30% of project cost)</td><td>179,071</td></tr>
<tr><td>Total</td><td>775,973</td></tr>
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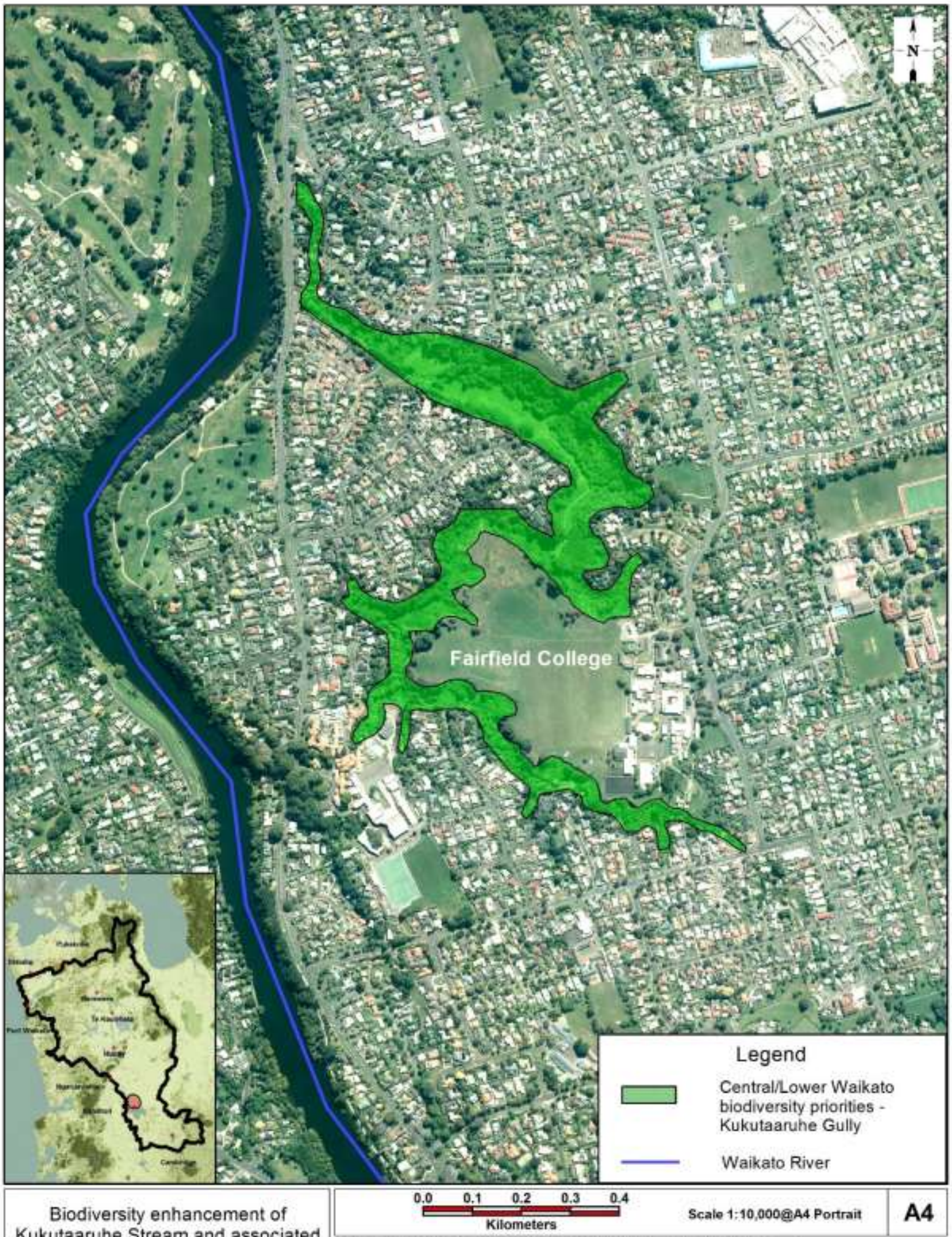
</td><td>C = 0.78</td></tr>
</table>



Biodiversity enhancement of Kukutaaruhe Stream and associated gully ecosystem

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Scale 1:10,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL


Cobble stream bed in the upper gully catchment.


Remnant native vegetation with weeds in the upper gully.


Remnant native vegetation with weeds in the upper gully.

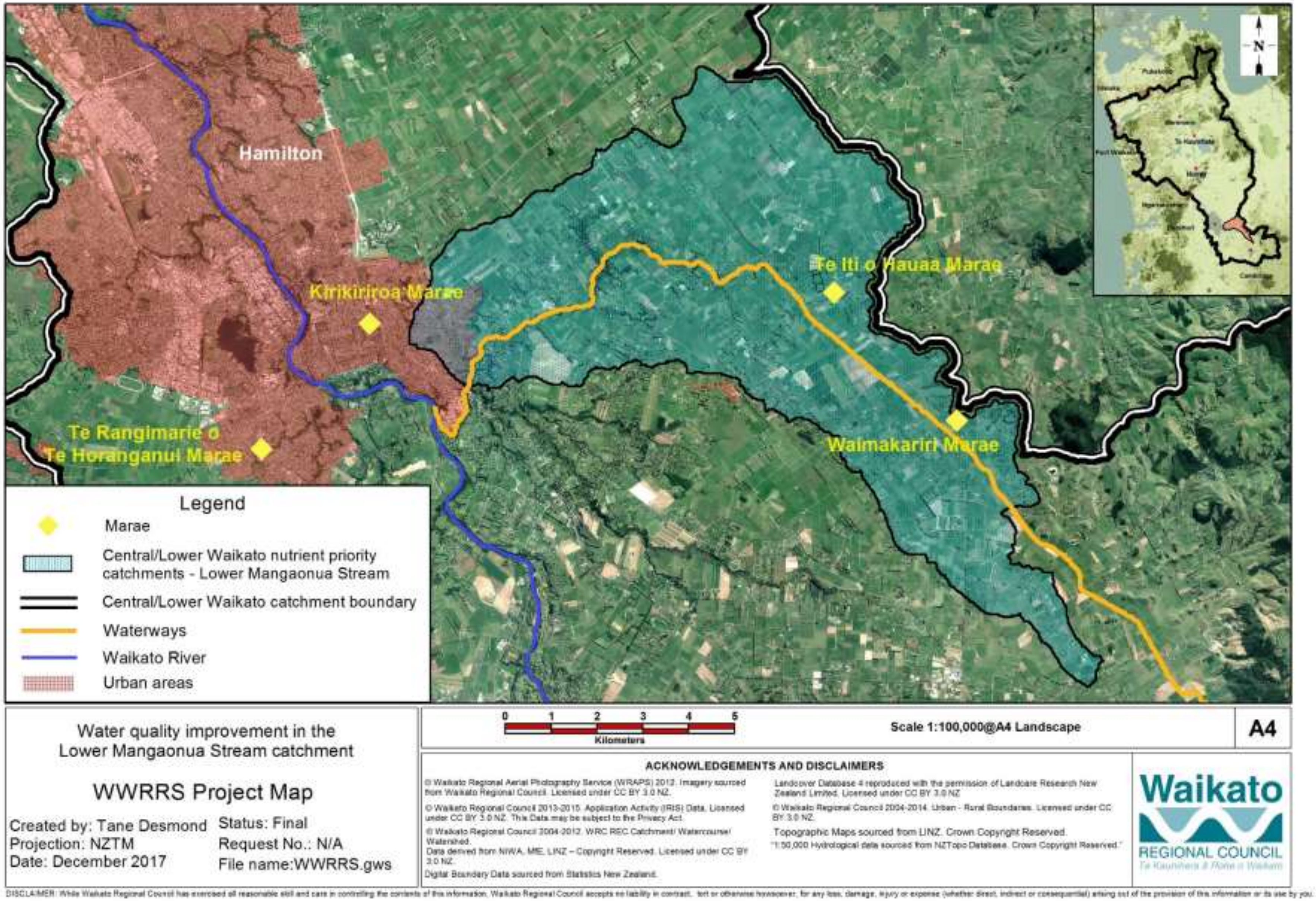

The uncompleted path through the gully that links the Kukutaaruhe Trust site and Donny Park.


This significant natural area shows a native raupō swamp area with some willow infestation.

CLW 27 Priority: very high	Water quality improvement in the lower Mangaonua Stream catchment	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Mangaonua sub-catchment streams and wetlands	
Brief description of feature	The Mangaonua is an 11,346ha catchment that lies southeast of Hamilton city. The lower catchment makes up 6615ha of this. 86% of this lower catchment is pastoral and there is only 2% indigenous vegetation cover remaining. Approximately 73km of streams run through pastoral areas. This catchment contains a number of drainage schemes including the Fencourt scheme. Through historic land development practices the natural Mangaonua Stream channel has been altered to facilitate land drainage. Therefore segments of the stream in the middle-lower reaches are formed in straight drain configurations. After flowing through intensively farmed areas the stream enters a large gully network prior to flowing into the Waikato River on the south fringe of Hamilton city at Riverlea. The Mangaonua Stream was well known for its tuna (eels) and was a mahinga kai (food resource) of the local iwi. A historic track alongside the stream was taken by local iwi into Te Au o Waikato, which is now known as the Piako district. There are old pā and mahinga kai sites within the area. Karipukahu was once a forest of mainly kahikatea trees and was populated with kererū. Wetland restoration projects are currently underway in the Mangaonua catchment, particularly through the work of Ngāti Hauā Mahi Trust. However, scope remains for further work. Modelling undertaken in 2016 indicates that the lower Mangaonua catchment is a high priority for actions that assist in nitrogen and E.coli reduction.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native	

	plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Mangaonua sub-catchment streams and wetlands would have a high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.	VS = 30
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table>	
Project goal/s	100% of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 10 years of project commencement.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Wetland and ephemeral stream protection** 24km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8 per metre. Fence should be 5 wire – 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within a year after project completion.	L = 5.5

<table>
<tr><td>Effectiveness of works</td><td>When compared with desired state, the waterways and wetlands in the Mangaonua sub-catchment are currently in a poor to moderate condition with few of the Vision & Strategy aspirations being met. Condition is not expected to change significantly in the next 20 years in the absence of this project. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to facilitate improvement in condition. However, it is acknowledged that achieving the overall desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.</td><td>W = 0.05</td></tr>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately one-third of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.</td><td>A = 0.3</td></tr>
<tr><td>Information quality</td><td>Below average – based on modelled information and some local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of this project. It is uncertain how many wetlands and seeps retain natural hydrology.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing wetlands and ephemeral streams (23km)</td><td>184,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>46,000</td></tr>
<tr><td>Total</td><td>230,000</td></tr>
</table></td><td>C = 0.23</td></tr>
</table>


Hamilton
Kirikiriroa Marae
Te Iti o Hauaa Marae
Waimakariri Marae
Te Rangimarie o Te Horanganui Marae
Legend
Marae
Central/Lower Waikato nutrient priority catchments - Lower Mangaonua Stream
Central/Lower Waikato catchment boundary
Waterways
Waikato River
Urban areas
Water quality improvement in the Lower Mangaonua Stream catchment
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale 1:100,000@A4 Landscape
A4
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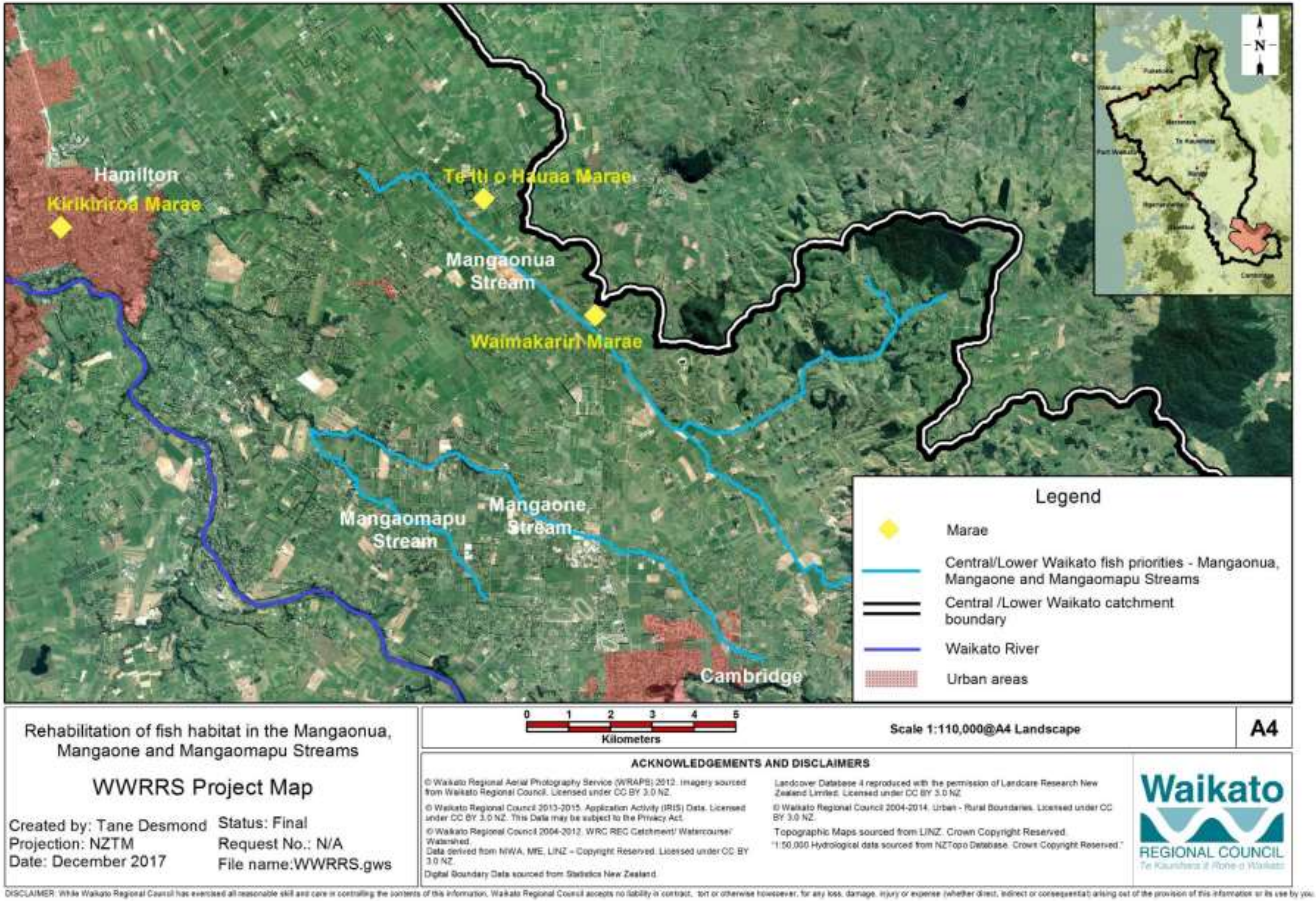
CLW 28	Rehabilitation of fish habitat in the Mangaonua, Mangaone and Mangaomapu streams	
Priority: medium		BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Mangaonui, Mangaone and Mangaomapu streams	
Brief description of feature	The total length of streams covered by this project is 50km. Mangaonoua Stream: This project includes the reach of Mangaonua Stream upstream of State Highway 1B near Matangi (approximately 22km) and a 7km tributary. The stream originates in the steep semi-forested headwaters near Te Miro and flows through lifestyle properties and intensively farmed pasture. It enters a gully system near State highway 1B and flows out to the Waikato River at Riverlea. The middle reaches of the stream are highly modified, having been straightened and managed for land drainage purposes. Mangaomapu Stream: This project includes the Mangaomapu Stream between Racecourse Road (near Cambridge), downstream to its confluence with Mangaone Stream, approximately 7km in length. The headwaters of the stream are a network of artificial drains in the Hautapu/Cambridge area. A more natural stream channel then meanders through intensively farmed pasture for approximately 3.5km before entering a gully system and flowing for another 3.5km to join the Mangaone Stream near Tamahere. Mangaone Stream: This project includes 14km of the Mangaone Stream from its headwaters near St Kilder, Cambridge, to the confluence with Mangaomapu Stream near Tamahere. The stream flows through a highly modified channel through lifestyle blocks and farmland before entering a gully system near its confluence with Mangaomapu Stream at Tamahere. All of the waterways appear to be well fenced from stock but are sparsely vegetated and there are likely to be barriers to fish migration in the form of incorrectly installed culverts and crossings. These waterways are important habitat for native fish species (including īnanga, giant kōkopu, banded kōkopu and smelt) and there are opportunities to increase native fish	

<table>
<tr><td></td><td>abundance by remediating barriers and providing increased and higher quality fish habitat.

These streams were well known for their tuna (eels) and birds and were a mahinga kai (food resource) of iwi. Alongside the streams there are old travelled paths to old pā sites – they can scarcely be identified but reflect the significance of the area to tangata whenua.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>The streams are fenced to exclude stock from its entire length. They have a vegetated riparian margin (at least 5m wide) to provide stream shading and cover for fish.
There are no manmade barriers to native migratory fish. Native fish are abundant and the full range of species expected to be found in the waterway can be found there, e.g. kōkopu, kōura, īnanga, tuna.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, these streams would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 15</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencing:
- Streams are 100% fenced to exclude stock.
- Streams have a riparian margin that is a minimum of 5m wide and vegetated with plant species that provide stream shade and enhance habitat for adult native fish.
- There are no manmade barriers to native migratory fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.
The project manager will need to work closely with Waikato Regional Council to ensure planting does not negatively impact land drainage. Resource consent will be required where planting is undertaken within drainage districts. $5000 has been estimated for resource consent costs.
This project could be undertaken as a whole, or in components.</td><td></td></tr>
</table>

	Riparian management Carry out or upgrade riparian fencing so that it has a minimum 5m setback from the top of the streambank (5 wire fence – 2 electric wires). Include adjoining wetland areas within the riparian fencing. - Assume 70% (68km) requires fencing or fence upgrade/relocation at an estimated cost of $8 per metre ($544,000). Undertake native riparian planting and carry out associated weed control and maintenance for native plant establishment. - Assume 80% (78km) of streambanks require native planting with a 5m wide margin (39ha) at a cost of $37,552 per hectare ($1,464,528). **Remediation of barriers to native migratory fish** Determine the location and type of barriers to fish passage. Cost estimates allow for the remediation of 6 barriers (at $5000 per barrier) to native migratory fish on these waterways ($35,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year before project completion.	L = 9
Effectiveness of works	When compared to the Vision & Strategy desired state, these streams are currently in poor to moderate condition. Overall, there may be some improvement along some stretches over the next 20 years even in the absence of this project. This is due to fencing and planting work that has recently been undertaken in places. Works included here are expected to substantially increase fish habitat availability and quality. Although it won't address catchment land use, the wide riparian setbacks should contribute to protecting and restoring water quality through shading, stock exclusion and reduction of nutrients and pathogens entering the streams. It is acknowledged that achieving the Vision & Strategy desired state will take longer than	W = 0.13

<table>
<tr><td></td><td>the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would contribute to making progress towards achieving the Vision & Strategy state in 20 years’ time.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately 70% of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake and if there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. However, there are already good examples of this type of work along these streams and they provide a good example of what can be achieved with larger riparian margins.</td><td>A = 0.7</td></tr>
<tr><td>Information quality</td><td>Average – recommendations are based on the judgement of fish experts with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>It is unknown specifically how much fencing and planting already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (68km)</td><td>544,000</td></tr>
<tr><td>Riparian planting (93ha)</td><td>1,464,528</td></tr>
<tr><td>Remediation of fish barriers</td><td>35,000</td></tr>
<tr><td>Resource consent</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (30% of total works cost)</td><td>614,559</td></tr>
<tr><td>Total</td><td>2,663,086</td></tr>
</table>
</td><td>C = 2.7</td></tr>
</table>


Hamilton
Kirikiriroa Marae
Te Iti o Hauaa Marae
Mangaonua Stream
Waimakariri Marae
Mangaone Stream
Mangaomapu Stream
Cambridge
Legend
Marae
Central/Lower Waikato fish priorities - Mangaonua, Mangaone and Mangaomapu Streams
Central /Lower Waikato catchment boundary
Waikato River
Urban areas
Rehabilitation of fish habitat in the Mangaonua, Mangaone and Mangaomapu Streams
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The Mangaomapu Stream where riparian fencing and planting is recommended.


Mangaone Stream where riparian planting and fencing is recommended

Mangaone Stream where riparian planting is recommended, along with some fence relocation to make space for the planting.

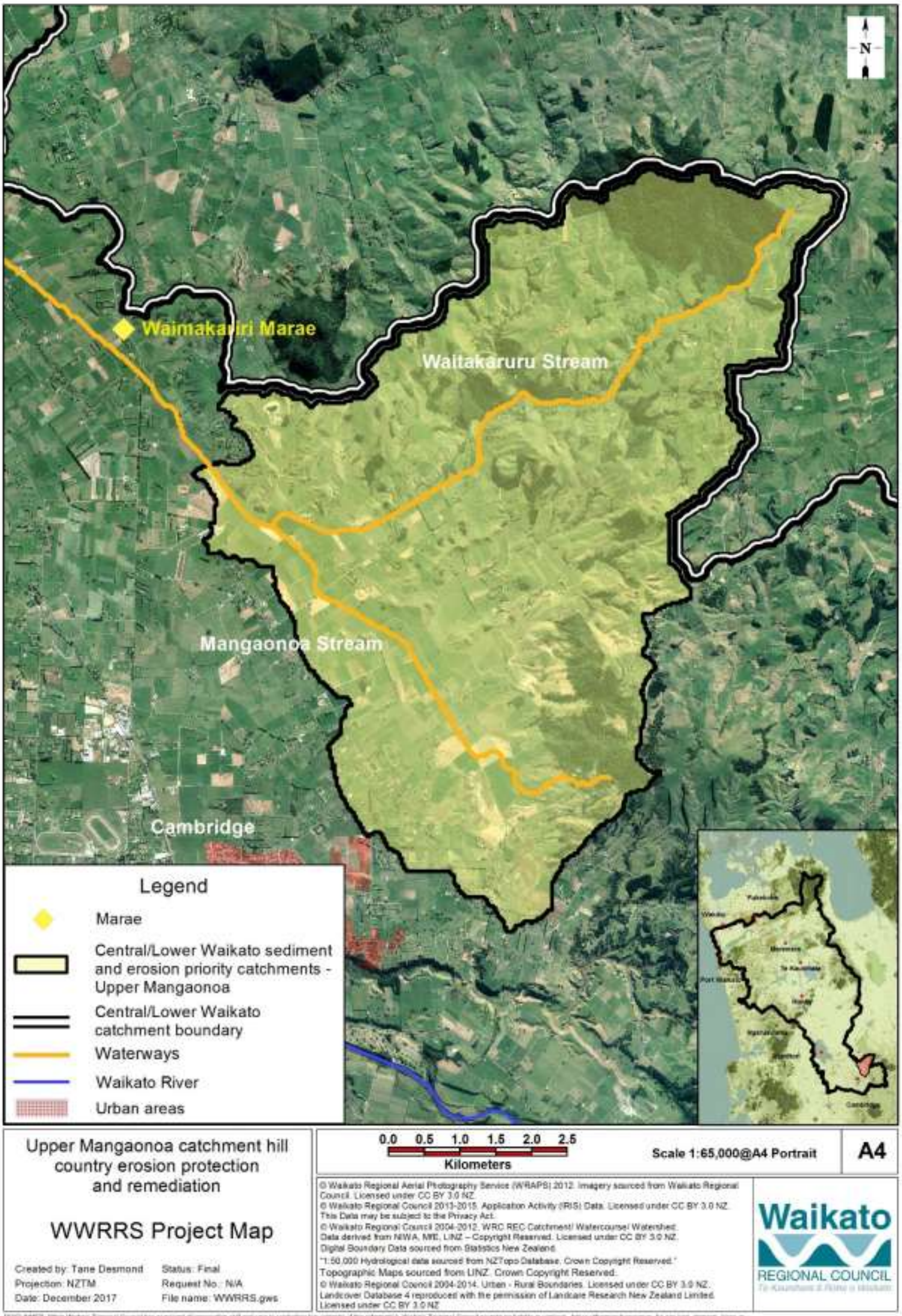
Mangaone Stream where riparian planting is recommended, along with some fence relocation to make space for the planting.

CLW 29 Priofity: medium	Upper Mangaonua catchment hill country erosion protection and remediation	BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Mangaonua sub-catchment	
Brief description of feature	The Mangaonua is an 11,346ha catchment that lies southeast of Hamilton city. The upper Mangaonua makes up around 40% of the total catchment and contains the Pukemoremore and Te Miro areas. Approximately 82% of this catchment is in pasture with the remainder being native vegetation. 1678ha of this catchment is 6e in pasture. Through historic land development practices the natural Mangaonua Stream channel has been altered to facilitate land drainage. Therefore segments of the stream in the middle reaches are formed in straight drain configurations. After flowing through intensively farmed areas the stream enters a large gully network prior to flowing into the Waikato River on the south fringe of Hamilton city at Riverlea. The Mangaonua Stream was well known for its tuna (eels) and was a mahinga kai (food resource) of the local iwi. Alongside the stream, an old track took local iwi into Te Au o Waikato, which is now known as the Piako district. There are old pā and mahinga kai sites in the area. Karipukahu was once a forest of mainly kahikatea trees and was populated with kererū. Pukemoremore is also of significance to the Ngāti Hauā iwi. Modelling undertaken in 2016 indicates that the upper Mangaonua is a high priority for erosion and sediment management.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide). - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian	

<table>
<tr><td></td><td>corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangaonua sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 100</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Contributes significant sediment to the central/lower Waikato River, impacting on both the water quality in Mangaonua Stream and the Waikato River. Soil is lost from farmland.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 20% reduction in suspended sediment in the upper Mangaonua Stream within 10 years of project commencement.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 210ha LUC 6e land managed with open space pole planting at \$3000 per hectare - 210ha LUC 6e land managed with plantation species (pine or mānuka) at \$3000 per hectare - 40km of fencing the managed LUC 6e land at \$25 per metre (8-wire and batten) - 13km fencing existing indigenous forest cover at \$25 per metre (8-wire and batten). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 10
Effectiveness of works	The upper Mangaonua sub-catchment is in moderate condition compared with the desired state, with few of the Vision & Strategy aspirations currently being met. Condition is not expected to significantly change over the next 20 years in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives of the longer term needed. However, works included in this project address some key threats to the feature and it is anticipated that if the project is fully completed it would contribute to progress towards achieving the Vision & Strategy state in 20 years' time.	W = 0.05
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.87

<table>
<tr><td>Adoptability</td><td>It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e land may be low and we are not aware of significant similar works being undertaken recently in this catchment. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.45</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information, central Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC class 6e come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>210ha LUC 6e managed with pole planting</td><td>630,000</td></tr>
<tr><td>210ha LUC 6e managed with plantation species</td><td>630,000</td></tr>
<tr><td>Fencing managed LUC 6e land (40km)</td><td>1,000,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (13km)</td><td>325,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>646,250</td></tr>
<tr><td>Total</td><td>3,231,250</td></tr>
</table></td><td>C = 3.2</td></tr>
</table>


N
Waimakariri Marae
Waitakaruru Stream
Mangaonoa Stream
Cambridge
Legend
Marae
Central/Lower Waikato sediment and erosion priority catchments - Upper Mangaonoa
Central/Lower Waikato catchment boundary
Waterways
Waikato River
Urban areas
Upper Mangaonoa catchment hill country erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.5 1.0 1.5 2.0 2.5
Kilometers
Scale 1:65,000@A4 Portrait
A4
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Hill country in the upper Mangaonua.

CLW 30	Karāpiro catchment hill country and streambank erosion protection and remediation	
Priority: medium		BCR value
Relevant unit goal(s)	Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands. Sediment inputs to wetlands and waterbodies are reduced by 50%. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Karāpiro catchment	
Brief description of feature	The Karāpiro is an 8920ha catchment with an approximately 150km stream network within it. According to Waikato Regional Council data, 81% of the catchment is in pasture, 9% is indigenous vegetation and 5% forestry. The pastoral area includes approximately 3985ha of Land Use Capability (LUC) 6e and 7. Headwaters for this catchment arise southeast of Cambridge in the vicinity of Whitehall, extending northward toward Te Miro. Predominant land use in the upper catchment is a mix of dry stock farming and dairying, with rural lifestyle blocks common through the lower part of the catchment. The topography is moderately steep to rolling in the upper reaches to undulating flats in the lower reaches. Water for the Karāpiro Stream mostly originates from natural groundwater systems in the upper catchment areas. Flows progressively increase as the stream travels through to the confluence with the Waikato River at Cambridge. Karāpiro is very significant to the Ngāti Hauā and Ngāti Koroki Kahukura iwi. Known as 'Te rohe o te Tuna', or the area renowned for eel abundance, it was a rich source of food for tangata whenua. There are many historic pā, wāhi tapu and mahinga kai sites within the project area. The catchment has previously been subject to a range of hill country, riparian and river protection and enhancement works and this work continues up to the present time. Modelling undertaken in 2016 indicates that the Karāpiro catchment is a high priority for erosion and sediment management from both hill country and streambanks.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, habitat and shade. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - There are no manmade barriers to native migratory fish.	

<table>
<tr><td></td><td>- Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Karāpiro sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a central and lower Waikato catchment level.</td><td>VS = 150</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>One of the largest contributors of sediment to the central Waikato River, impacting on both the water quality in Karāpiro Stream and the Waikato River. Soil is lost from farmland.</td></tr><tr><td>Riverbank erosion</td><td>Increased sediment in the catchment streams and within the central and lower reaches of the Waikato River.</td></tr><tr><td>Stock access to the streams</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- LUC class 7 soils are managed within their capabilities and are retired from heavy stock grazing.
- There is a 30% reduction in suspended sediment in the Karāpiro Stream within 20 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 460ha LUC 6e land managed with open space pole planting at $3000 per hectare

- 460ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare

- 80km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten)

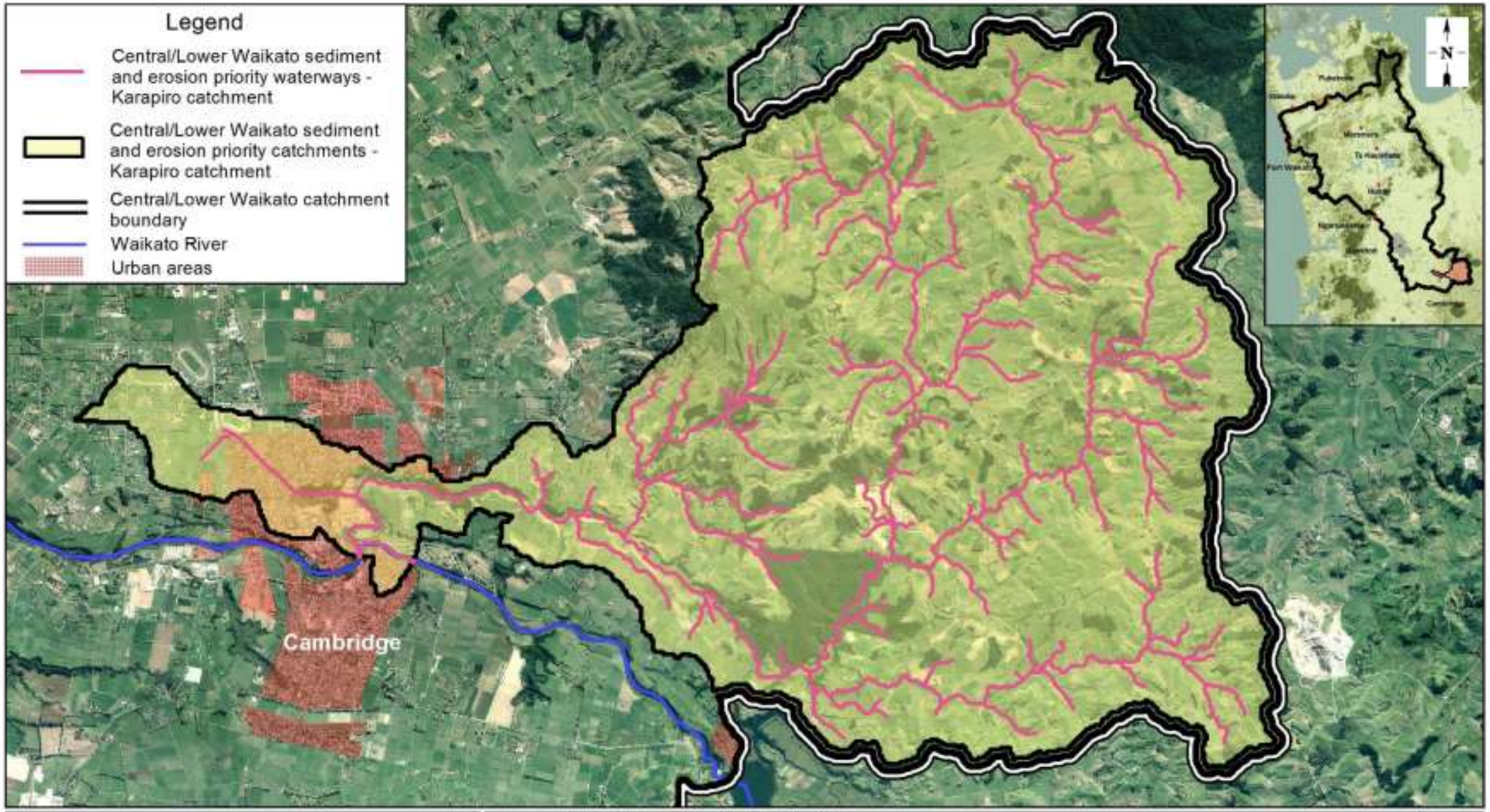
- 303ha LUC 7 land managed with plantation species (pine or mānuka) at $3000 per hectare

- 40km of fencing the managed LUC 7 land at $25 per metre (8-wire and batten)

- 4ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $8000 per hectare (e.g. dewatering, retiring seepages, etc)</td><td></td></tr>
</table>

	- 20km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) **Riparian management of rivers/streams in pasture for soil conservation purposes** Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5-wire with 2 electric wires at $8 per metre) along an estimated 52km of streambank (26km of stream length). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 19ha of planting and associated weed control and maintenance. 5528 poplar poles are estimated to be required for river and stream erosion control. It is estimated that approximately 2km of main channel still requires soft and hard erosion control structures at a cost of $20,000 per km. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 15 years after project commencement.	L = 15
Effectiveness of works	The Karāpiro sub-catchment is in moderate condition when compared to the Vision & Strategy desired state. It is not considered safe for swimming due to high levels of E. coli and low water clarity. Over the next 20 years it is expected that some aspects will deteriorate and some improve in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed, the catchment will move measurably closer to the Vision & Strategy desired state in areas such as land use meeting capability and streambank stability. The project will assist in protecting and improving water quality, facilitate a reduction in sediment in waterways and have benefits for native fisheries. It is, however, acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.	W = 0.15
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.87

<table>
<tr><td>Adoptability</td><td>It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken recently in this catchment. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.45</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information, Central Waikato riparian surveys and input from catchment officers who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e and 7, and stream lengths come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>460ha LUC 6e managed with pole planting</td><td>1,380,000</td></tr>
<tr><td>460ha LUC 6e managed with plantation species</td><td>1,380,000</td></tr>
<tr><td>Fencing managed LUC 6e land (80km)</td><td>2,000,000</td></tr>
<tr><td>303ha LUC 7 managed with plantation species</td><td>909,000</td></tr>
<tr><td>Fencing managed LUC 7 land (40km)</td><td>1,000,000</td></tr>
<tr><td>Reducing sediment outside LUC 6e, 7 and 8 (4ha)</td><td>32,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (20km)</td><td>500,000</td></tr>
<tr><td>Riparian fencing (52km)</td><td>416,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (5528 poles)</td><td>77,387</td></tr>
<tr><td>Native riparian planting (19ha)</td><td>713,418</td></tr>
<tr><td>Stream erosion protection structures</td><td>40,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>2,534,341</td></tr>
<tr><td>Total</td><td>10,982,146</td></tr>
</table>
</td><td>C = 11</td></tr>
</table>



Karapiro catchment hill country and stream bank erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:78,500@A4 Landscape

A4

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Active erosion in the Karāpiro catchment.

Areas of steep land and an unfenced waterway in the Karāpiro catchment.

An example of a wetland/seep outside of LUC 6e/7 that would benefit from fencing.

Erosion prone sites adjacent to a stream that could be fenced and planted.


Steep erosion prone land in the Karāpiro catchment.

CLW 31 Priority: medium	Water quality improvement in the Mangakōtukutuku catchment	BCR value
Relevant unit goal(s)	Wetlands are protected, enhanced, created and able to perform their water purification role. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.	
Name of feature	Streams and wetlands within the Mangakōtukutuku catchment	
Brief description of feature	The 2644ha Mangakōtukutuku catchment lies south of Hamilton city, originating in agricultural land before entering the suburbs of Glenview, Bader, Melville, Sunnyhills and Fitzroy. The majority of the catchment (78%) is pastoral (dairy and lifestyle) whilst only 2% retains indigenous vegetation. Most of the remainder of the catchment is residential. Much of the pastoral land within this catchment sits on peat soils that have been heavily drained. The main waterway in the catchment is the Mangakōtukutuku Stream which enters the Waikato River opposite Hamilton Gardens. There are three main tributaries to this stream. Significant riparian fencing and planting and gully restoration has already been undertaken in this catchment by landowners, Hamilton City Council and the Mangakōtukutuku Care Group. Ten species of indigenous fish are known to live in the Mangakōtukutuku Stream, including threatened giant kōkopu and longfin eel. Waikato Regional Council water quality monitoring of the stream at Peacock Road indicates that levels of nitrogen, phosphorus and E. coli are unsatisfactory 100% of the time. Modelling undertaken in 2016 indicates that the Mangakōtukutuku Stream catchment is a high priority for actions that assist in nitrogen and E. coli reduction.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter. - Forest remnants and wetlands are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. - Native fish are abundant and there is a wide diversity of species present, including non-climbing native fish. - The stream is swimmable, fishable and has access for recreation.	

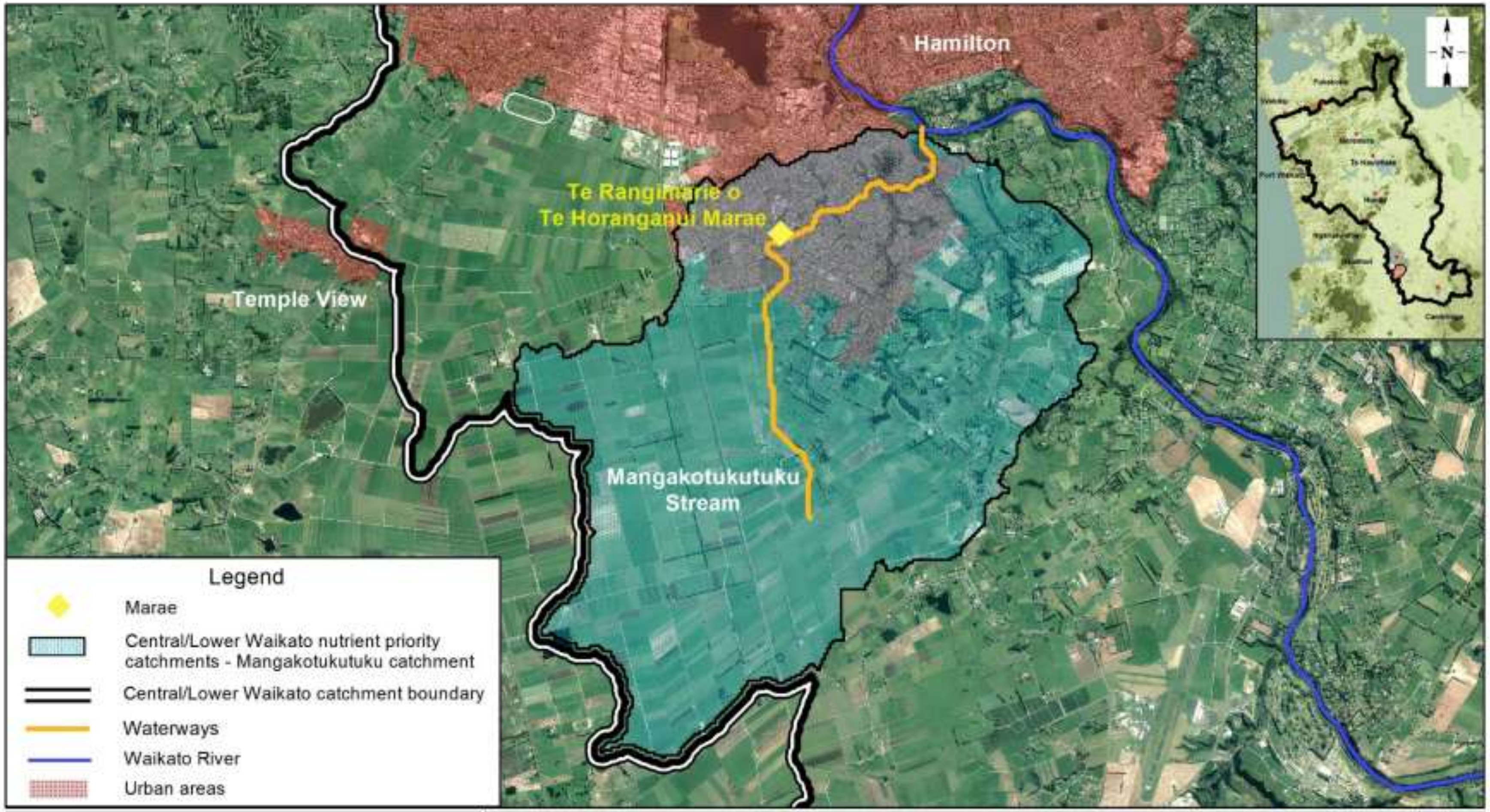
<table>
<tr><td></td><td>- Iwi and community have a strong connection to the catchment streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the streams and wetlands within the Mangakōtukutuku sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 8</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100% of wetlands and seeps greater than 0.1ha are fenced to exclude stock within 5 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Wetland and ephemeral stream protection
6km of fencing wetlands and seeps >0.1ha and ephemeral streams at $8 per metre. Fence should be 5 wire – 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 3-year period, it is estimated that the majority of the project benefits would be seen approximately 1-2 years after project completion.</td><td>L = 4.5</td></tr>
<tr><td>Effectiveness of works</td><td>The waterways and wetlands in the Mangakōtukutuku sub-catchment are currently in a poor to moderate condition with few of the Vision & Strategy desired state aspects being met. It is anticipated that there may be decline in state over the next 20 years in the absence of this project. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to very slightly offset decline. However, it is acknowledged that achieving the desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term will be needed.</td><td>W = 0.01</td></tr>
</table>

<table>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however, generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td>A = 0.5</td></tr>
<tr><td>Information quality</td><td>Below average – estimates are based on modelled information and some local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of this project. It is uncertain how many wetlands and seeps retain natural hydrology.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>3 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost</th></tr>
<tr><td>Fencing wetlands and ephemeral streams (6km)</td><td>48,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>12,000</td></tr>
<tr><td>Total</td><td>60,000</td></tr>
</table></td><td>C = 0.06</td></tr>
</table>



0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:60,000@A4 Landscape

A4

Water quality improvement in the Mangakotukutuku catchment

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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APPENDIX 6 - Upper Waikato Project Assessments

Contents

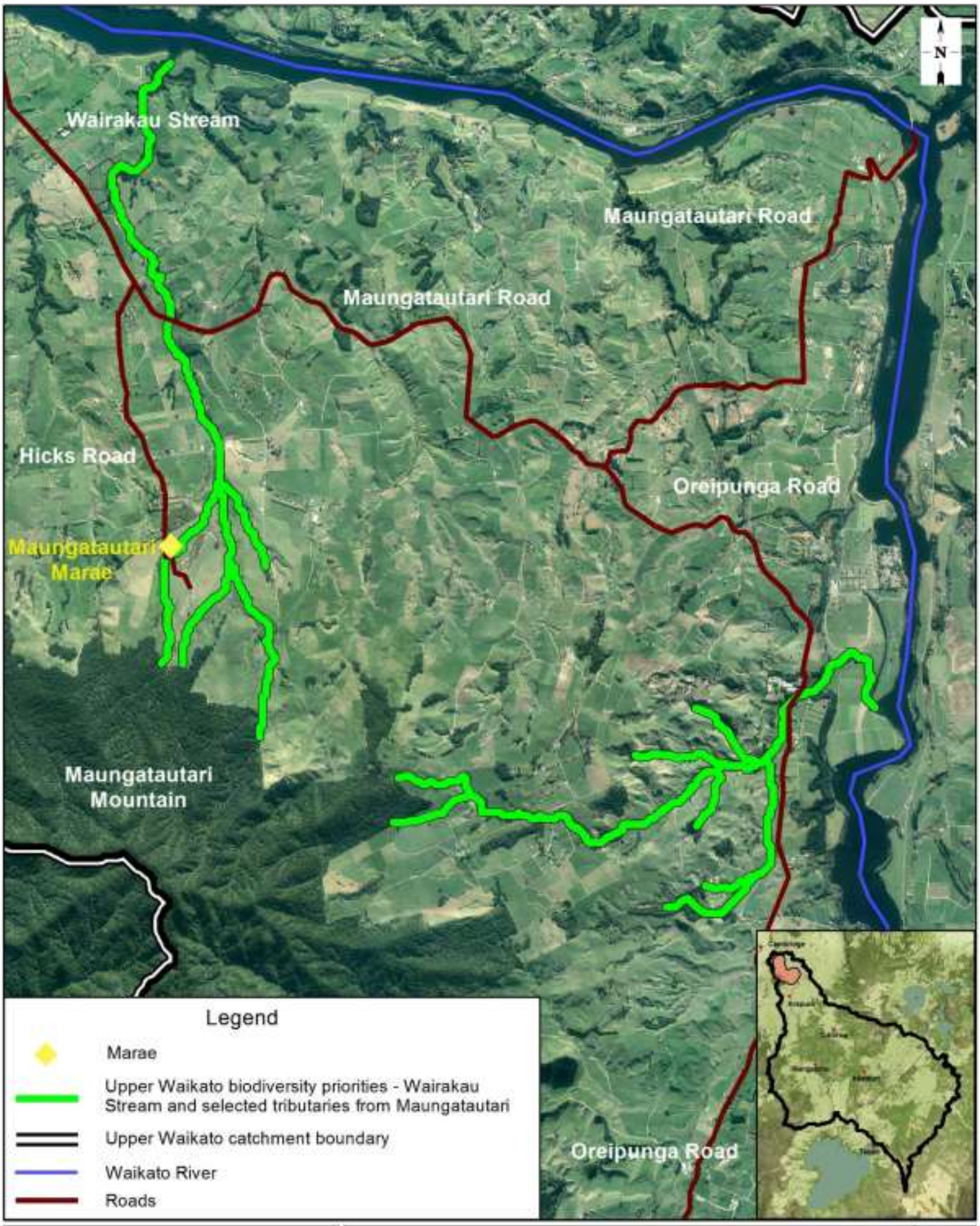
UW 1 Priority: medium	Riparian management along selected tributaries flowing from Maungatautari into Lake Karāpiro	BCR value
Relevant unit goal(s)	Ecological networks include the full range of fresh water and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work, including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Two stream networks totalling 23km flowing from Maungatautari into Lake Karāpiro	
Brief description of feature	The two stream networks include Wairakau Stream and an unnamed tributary to Lake Karāpiro directly upstream of Finlay Park camp. The Wairakau Stream system originates on the northern flanks of Maungatautari mountain, flowing approximately 10km downstream through agricultural land and an incised gully system before entering Lake Karāpiro approximately 4km upstream of Karāpiro Dam. The lower 2.5km of this waterway is a well fenced and vegetated gully ecosystem and is ranked in the top 15% of biodiversity sites in the Waikato catchment. The unnamed tributary originates on the northeastern flanks of Maungatautari mountain and flows for approximately 13km downstream through predominantly agricultural land before entering Lake Karāpiro directly upstream of Finlay Park camp. The lower 1.6km of this waterway is a well fenced and vegetated gully ecosystem and is ranked in the top 20% of sites for biodiversity in the Waikato catchment. Waterways and wetlands between the ecologically significant Maungatautari mountain and downstream gully ecosystems require further riparian fencing and planting to create an ecological corridor and sequence of habitat types. Maungatautari is historically and cultural significant to surrounding iwi. The maunga has three main peaks: Maungatautari (797m), Pukeatua (752m) and Te Akatarere (727m). Its name was conferred by Rakataura, who was a tohunga on the Tainui canoe. He first saw the mountain hanging over the fog that often lies in the lower areas of the Waikato Valley. The name is therefore interpreted as	

<table>
<tr><td></td><td>‘suspended’ or ‘hanging mountain’. Maungatautari Marae sits at the foot of the mountain.

Karāpiro is also very important to local Iwi. It is from the Battle of Taumatawiwi that Karāpiro gets its name. Kara means rocks, and piro means smell, or odour. After the battle Te Waharoa was worried about a counterattack from the Ngāti Marutuahu, so that night he burnt the bodies of his dead warriors “lest they fall into the enemy’s hands”‘ — which would indeed cause a very strong smell. This took place on a large outcrop of rocks, near the edge of the river (now just below the water ski club). http://www.maungatautarimarae.co.nz/hitori/1800-2</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The full 23km network of waterways and adjacent wetlands and forest remnants are fenced to exclude stock.
- Forest remnants and wetlands adjacent to waterways are densely vegetated with native plant species, and native plant regeneration occurs naturally within the native bush remnants.
- Fenced riparian margins are a minimum of 5m wide on either side of the streams and in pasture areas the margins are well vegetated with native plant species.
- Iwi and communities have a strong connection to the streams and are active in their protection, use and restoration.
- The streams are swimmable and fishable.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition this stream network would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Existing native riparian vegetation is cleared or destroyed by grazing.</td><td>Reduced cover, habitat and food (invertebrates) for native fish species and birds.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>People become disconnected from the waterway and see the area more as a resource than something that needs to be nurtured and cared for.</td><td>Waterway areas become more degraded.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 8 years of project commencement, the waterways identified and their adjoining wetlands and forest fragments are 100% fenced to exclude stock.
- Newly fenced riparian margins are at least 5m wide on either side and vegetated with native plants, thus creating a corridor of native vegetation between Maungatautari and the Waikato River.
- Native bird species found on Maungatautari utilise the riparian corridors.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Riparian management** Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas within the riparian fencing. Undertake native riparian planting along both sides of the waterway and associated weed control and maintenance for native plant establishment. - Assume that 80% (37km) of waterways require fencing and planting at a cost of $8 per metre ($296,000). - Revegetation (including site prep, plant purchase, planting labour and 5 releasing events) of 18.5ha of riparian margin at $37,552 per hectare ($694,712). **Animal pest control** Possum control may be required for native plant establishment (over a 3 year period). This should be undertaken using ground based methods such as trapping or bait stations. - $200/ha x 18.5ha x 3 years is $11,100. This site would benefit from mustelid and rat control to protect and enhance native bird populations. This work has not been costed as ongoing as animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over an 8-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year after project completion.	L = 9
Effectiveness of works	These stream networks are currently in moderate to good condition, with some of the Vision & Strategy desired state aspects being partly met. Condition is not expected to either significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then these streams are expected to improve and be closer to the desired state in 20 years' time, particularly in relation to fish habitat, biodiversity and connectivity.	W = 0.15

<table>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately half of the landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake however landowners in this catchment have to date been very proactive with restoration works.</td><td>A = 0.50</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on aerial photographs and some local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Unknown specifically how much fencing and vegetation already exists. This would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>8 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (37km)</td><td>296,000</td></tr>
<tr><td>Revegetation (18.5ha)</td><td>694,712</td></tr>
<tr><td>Possum control</td><td>11,100</td></tr>
<tr><td>Project management/staffing/incidentals (25% of total project cost)</td><td>250,453</td></tr>
<tr><td>Total</td><td>1,252,265</td></tr>
</table>
</td><td>C = 1.24</td></tr>
</table>



Riparian management along selected tributaries flowing from Maungatautari into Lake Karapiro

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:50,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato


A stream flows from Maungatautari.

UW 2 Priority: high	Development of Aniwaniwa Reserve (Lake Karāpiro)	BCR value
Relevant Unit Goal(s)	Rivers and waterways are widely used by the community and are a place to relax, play, exercise, recreate and gather kai. River restoration activities enhance the economic wellbeing of the Upper Waikato.	
Name of feature	Waikato River at Lake Karāpiro	
Brief description of feature	Lake Karāpiro is a manmade lake on the Waikato River created by the development of Karāpiro Dam. It is renowned as a world-class rowing venue. The lake is popular for recreation including waka ama, yachting, powerboating, canoeing and water skiing. During recent times, water quality in Lake Karāpiro has been declining with algal blooms and nuisance aquatic weed now a regular occurrence. The Aniwaniwa Reserve is located on Horahora Road on the eastern banks of Lake Karāpiro immediately north of the Pōkaiwhenua Stream. Access is from Horahora Road which is approximately 5km south of State Highway 1. The reserve is situated on a flat to easy rolling grassed river terrace approximately 6m elevation above Lake Karāpiro. The embankments to the lake, wetlands and stream are steep with an average 1:1 slope, and vegetated with a mix of native and exotic species. Significant wetlands surround the site. Currently the reserve is unavailable for public use due to its inaccessibility. **History** Aniwaniwa Reserve was formerly known as Pōkaiwhenua Reserve due to its location adjacent to the Pōkaiwhenua Stream. The name change occurred in 1976 in recognition of the name Aniwaniwa appearing on old maps of the area. Aniwaniwa was a crossing place of the Waikato River and was used frequently by Māori and European settlers. The river was originally spanned by a single tree; subsequently a bridge was erected in 1880. The reserve later became the site of the Horahora Village and the now submerged power station lies immediately offshore from the reserve. The Horahora Power Station was constructed and operated by the Waihi Gold Company in 1913 and was the first hydroelectric power station in New Zealand. The station's	

<table>
<tr><td></td><td>capacity was 6400kW and this was subsequently increased after government purchase in 1919.

Horahora remained operational until it was submerged on the 4 April 1947, with the flooding of Lake Karāpiro. Today, only a large concrete reservoir and scattered pieces of turbines reflect this history.

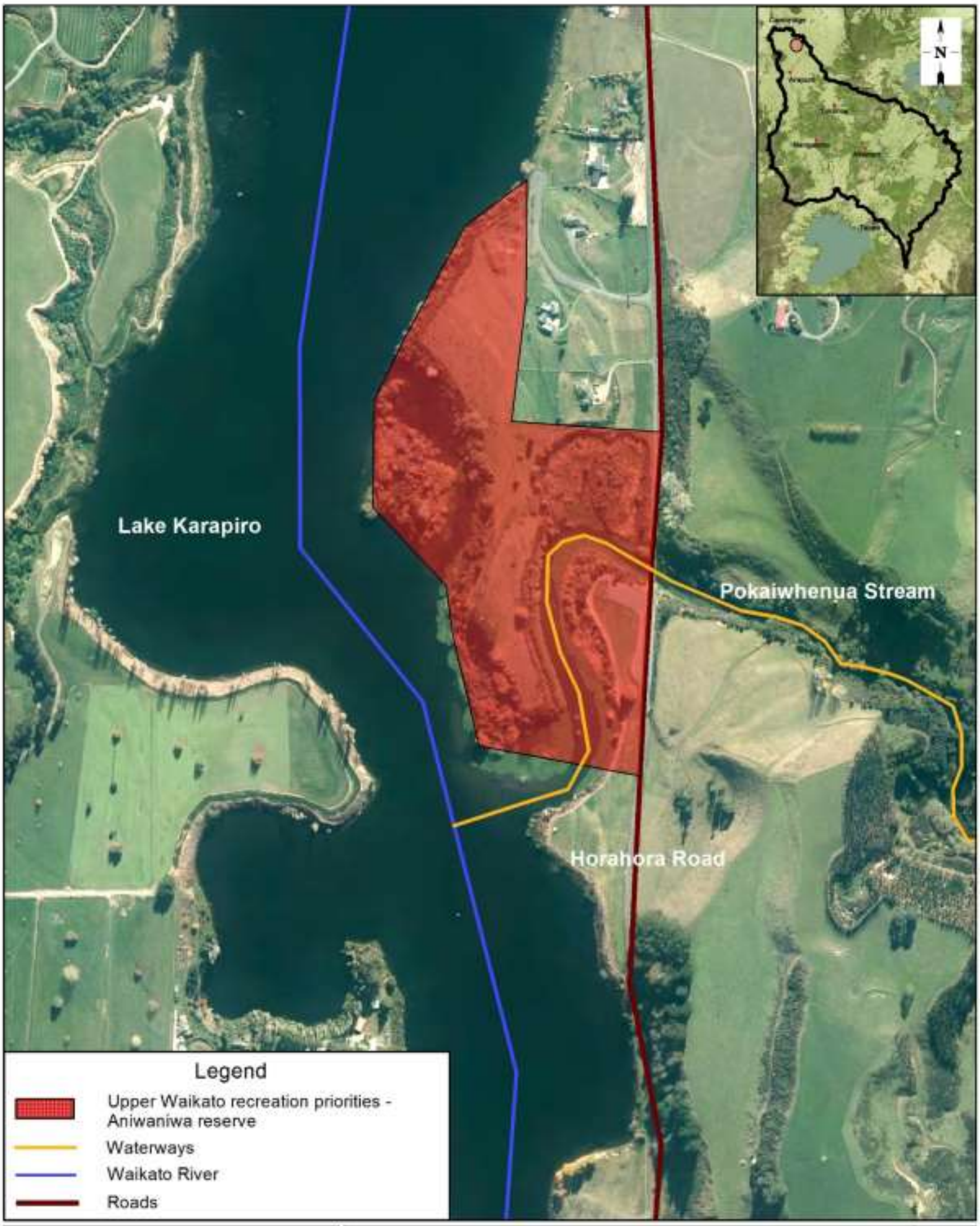
Karāpiro is very important to local iwi. It is from the Battle of Taumatawiwi that Karāpiro gets its name. Kara means rocks, and piro means smell, or odour. After the battle Te Waharoa was worried about a counterattack from the Ngāti Marutuahu, so that night he burnt the bodies of his dead warriors “lest they fall into the enemy’s hands”‘ — which would indeed cause a very strong smell. This took place on a large outcrop of rocks, near the edge of the river (now just below the water ski club). http://www.maungatautarimarae.co.nz/hitori/1800-2</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy of feature</td><td>- The Waikato River at Lake Karāpiro has riparian margins that are excluded from stock, are stable and well vegetated.
- The river is swimmable and fishable and has access for recreation.
- Iwi and community have a strong connection to the river and are active in its protection, use and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Waikato River at Lake Karāpiro would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 250</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>People become disconnected from the waterway</td><td>Waterway areas become more degraded.

Historic significance of the area is not well known to the community.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- This project aims to connect people to the Waikato River through providing access for recreation at the Aniwaniwa Reserve and educational information about the history of the area.
- Within 5 years of the project commencing, a recreational area is developed in accordance with the concept plan already developed for the site.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens with experience in managing similar projects. This project could be undertaken as a whole or in multiple smaller components, but needs to be done in collaboration with South Waikato District Council.

A concept plan has been developed for this area by the South Waikato District Council but was not implemented due to the project not being awarded funding through the annual plan process.</td><td></td></tr>
</table>

	Proposed development would include: - cultural history assessment undertaken by iwi ($20,000) - development of an environmentally friendly vault toilet ($70,000) - park furniture (bins and tables) ($8000) - further development of car park and road access ($150,000) - earthworks and development of a flat area for camping as well as walkways around the reserve ($25,000) - boat ramp ($90,000) - native planting and landscaping ($18,000) - interpretation panels/plaza area with information on the history of the area and its significance for Māori and for power generation ($20,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 12-18 months before project completion.	L = 3.5
Effectiveness of works	The Waikato River at Lake Karāpiro is currently in good condition with some of the Vision & Strategy desired state aspects being met or partly met, including being swimmable and fishable. In the absence of this project it is expected that over the next 20 years this feature could slightly decline in condition. The proposed project would provide further opportunities for recreation and community connection to the lake. However, other aspects of the desired state will not be addressed through this work. It is therefore anticipated that if the project is fully completed, this feature may still decline in relation to desired state over the next 20 years.	W = 0.005
Risk of technical failure	There is a very low risk of project failure due to technical feasibility if works are undertaken by experienced contractors/practitioners.	F = 0.97
Adoptability	The project is located on South Waikato District Council land and they are very supportive of the works, however, there may be some resistance from neighbouring landowners.	A = 1
Information quality	Very good – project scoping has already been undertaken by South Waikato District Council.	

<table>
<tr><td>Knowledge gaps</td><td>More information is required about the cultural history of the site. This has therefore been included as part of the project costs.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>There is a moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Surrounding landowners may have an aversion to the work being undertaken and therefore early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Cultural history assessment</td><td>20,000</td></tr>
<tr><td>Vault toilet</td><td>70,000</td></tr>
<tr><td>Park furniture</td><td>8000</td></tr>
<tr><td>Car park and road access</td><td>150,000</td></tr>
<tr><td>Earthworks and development of camping area</td><td>25,000</td></tr>
<tr><td>Boat ramp</td><td>90,000</td></tr>
<tr><td>Native planting and landscaping</td><td>18,000</td></tr>
<tr><td>Interpretation panels/plaza area</td><td>20,000</td></tr>
<tr><td>Project management/staffing/incidentals (20% of works costs)</td><td>80,200</td></tr>
<tr><td>Total</td><td>481,200</td></tr>
</table>
</td><td>C = 0.515</td></tr>
</table>



Development of Aniwaniwa Reserve (Lake Karapiro)

WWRRS Project Map

0.00 0.05 0.10 0.15 0.20 0.25
Kilometers

Scale1:6,500@A4 Portrait

A4

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Waikato
REGIONAL COUNCIL

Aniwaniwa Reserve site.

UW 3 Priority: high	Waione Stream erosion protection and riparian enhancement	BCR value
Relevant unit goal(s)	Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Significant 'hotspots' (e.g. sub-catchments, or tributaries) have been identified and targeted cleanup activity progressed. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Waione Stream	
Brief description of feature	The Waione is a small (1356ha) catchment extending from the slopes of Mount Maungatautari. The Waione Stream rises on the northern flank of Maungatautari and flows north-northeast to Lake Karāpiro. Terrain throughout much of the catchment is rolling, with meandering stream channels in broad gully floors having potential for streambank erosion. There is an estimated 21km stream network within pasture in the catchment. Historical soil conservation works are uncommon in the catchment although there are a number of more recent riparian protection sites within the wider district. There is considerable scope for further riparian and minor wetland protection works throughout the catchment, with potential to eventually create a riparian corridor connecting Maungatautari and Lake Karāpiro. Maungatautari is historically and cultural significant to surrounding iwi. The maunga has three main peaks: Maungatautari (797m), Pukeatua (752m) and Te Akatarere (727m). Its name was conferred by Rakataura, who was a tohunga on the Tainui canoe. He first saw the mountain hanging over the fog that often lies in the lower areas of the Waikato Valley. The name is therefore interpreted as 'suspended' or 'hanging mountain'. Maungatautari Marae sits at the foot of the mountain. Karāpiro is also very important to local iwi. It is from the Battle of Taumatawiwi that Karāpiro gets its name. Kara means rocks, and piro means smell, or odour. After the battle, Te Waharoa was worried about a counterattack from the Ngāti Marutuahu, so that night he burnt the bodies of his dead warriors "lest they fall into the enemy's hands"' — which would indeed cause a very strong smell. This took place on a large outcrop of rocks, near the	

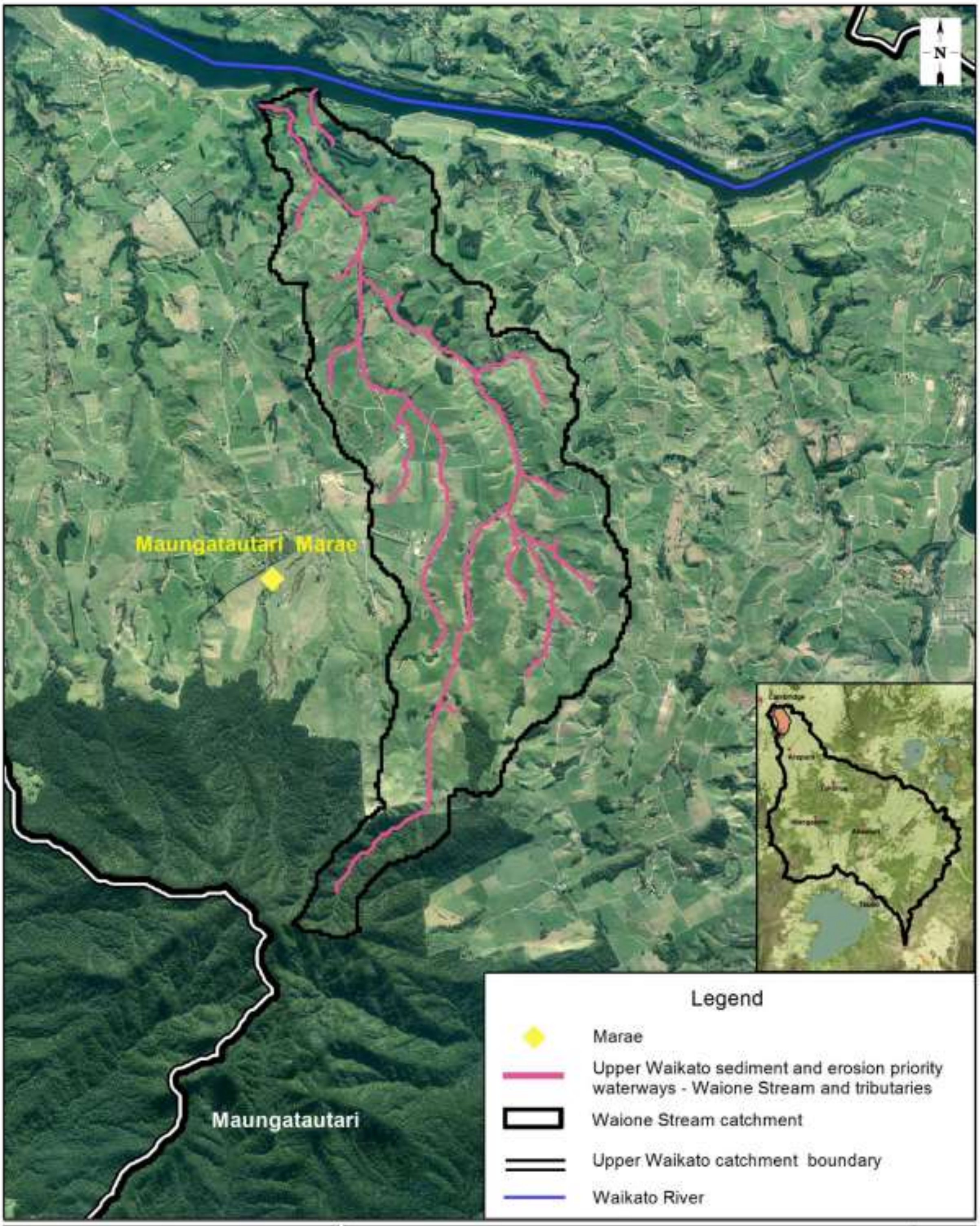
<table>
<tr><td></td><td>edge of the river (now just below the water ski club). http://www.maungatautarimarae.co.nz/hitori/1800-2</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A stream network with stable, vegetated banks and where major erosion events are limited.
- A riparian margin that is fenced to exclude stock with a minimum 5m setback, and that is well vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present.
- Waterways are swimmable, fishable, safe for gathering kai and has access for recreation.
- Iwi and communities have a strong connection to the waterways and active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waione Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 15</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Bank erosion</td><td>Contributes significant sediment load to the Waione Stream.</td></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- The main channel and tributaries of the Waione Stream are stable and fenced to exclude stock with a minimum 5 wire (2 electric) fence.
- Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian Management of rivers/streams in pasture for soil conservation purposes
- Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 10km of streambank ($80,000). Include adjoining wetland areas within the riparian fencing.
- Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 3ha of planting and associated weed control and maintenance ($97.847).
- 260 poplar poles are estimated to be required for river and stream erosion control ($3640). These should be planted at 10m spacing where required.

Project management/staffing/incidentals</td><td></td></tr>
</table>

<table>
<tr><td></td><td>Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3-4 years after project completion</td><td>L = 8.5</td></tr>
<tr><td>Effectiveness of works</td><td>The Waione Stream is currently in moderate to good condition, with some of the Vision & Strategy desired state aspects already being met. Condition is not expected to significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then this feature is expected to improve and be closer to the desired state in 20 years' time, with anticipated improvements in water quality and stock exclusion.</td><td>W = 0.1</td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding, however, this is mitigated somewhat by the use of sterile willow poles to stabilise banks more quickly.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature. Landowners in this catchment have to date been very proactive with restoration works.</td><td>A = 0.50</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and estimates based on Upper Waikato catchment wide surveys of riparian fencing.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (10km)</td><td>80,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (260 poles)</td><td>3640</td></tr>
<tr><td>Native riparian planting (3ha)</td><td>97,847</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>54,446</td></tr>
<tr><td>Total</td><td>235,933</td></tr>
</table></td><td>C = 0.24</td></tr>
</table>



Waione Stream erosion protection and riparian enhancement

WWRRS Project Map

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale1:50,000@A4 Portrait

A4

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

Waikato REGIONAL COUNCIL

UW 4 Priority: high	Fish habitat rehabilitation within Waiteti Stream catchment, Arapuni	BCR value
Relevant unit goal(s)	The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.	
Name of feature	Waiteti Stream Catchment	
Brief description of feature	A 27km long stream network consisting of various streams flowing from headwaters on Maungatautari mountain to the Waikato River immediately downstream of Arapuni Dam. The network of streams include Te Umutawa Stream and Otautora Stream which enter Waitete Stream and flow into the Waikato River. These streams have been selected for inclusion in the Waikato River Restoration Strategy because of their connectivity to Maungatautari mountain and their native fish values. The waterways are known to have populations of shortfin and longfin eel and there are opportunities to further protect and enhance these. Waterways in the catchment are not fully fenced and lack continuous vegetation. It is estimated that approximately 50% of the streambanks require fencing and/or native planting. Maungatautari is historically and cultural significant to surrounding Iwi. The maunga has three main peaks: Maungatautari (797m), Pukeatua (752m) and Te Akatarere (727m). Its name was conferred by Rakataura, who was a tohunga on the Tainui canoe. He first saw the mountain hanging over the fog that often lies in the lower areas of the Waikato Valley. The name is therefore interpreted as 'suspended' or 'hanging mountain'. Pohara Marae sits at the southern side of the mountain, within this project area. The Waikato River and its streams continue to sustain the marae.	
Desired state to achieve the Vision & Strategy	- The stream is fenced to exclude stock from its entire length. It has a riparian margin (at least 5m wide) that is planted on both sides with native plants to provide stream shading and cover for fish. - Eels are abundant and the full range of fish and kai species expected to be found in the waterway can be found there, e.g. kōura, eels, bullies, freshwater mussels. - The stream is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the streams and are active in their protection, use and restoration.	

<table>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waiteti Stream sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 10 years of project commencement, the full length of the identified waterways are fenced to exclude stock.
- At least one side of the waterway (preferably the northern or eastern side) has a riparian margin that is at least 5m wide and vegetated with plant species that provide stream shade and enhance habitat for adult native fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence with 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 50% (26km of streambank) requires fencing or fence upgrade at a cost of $8 per metre ($208,000).

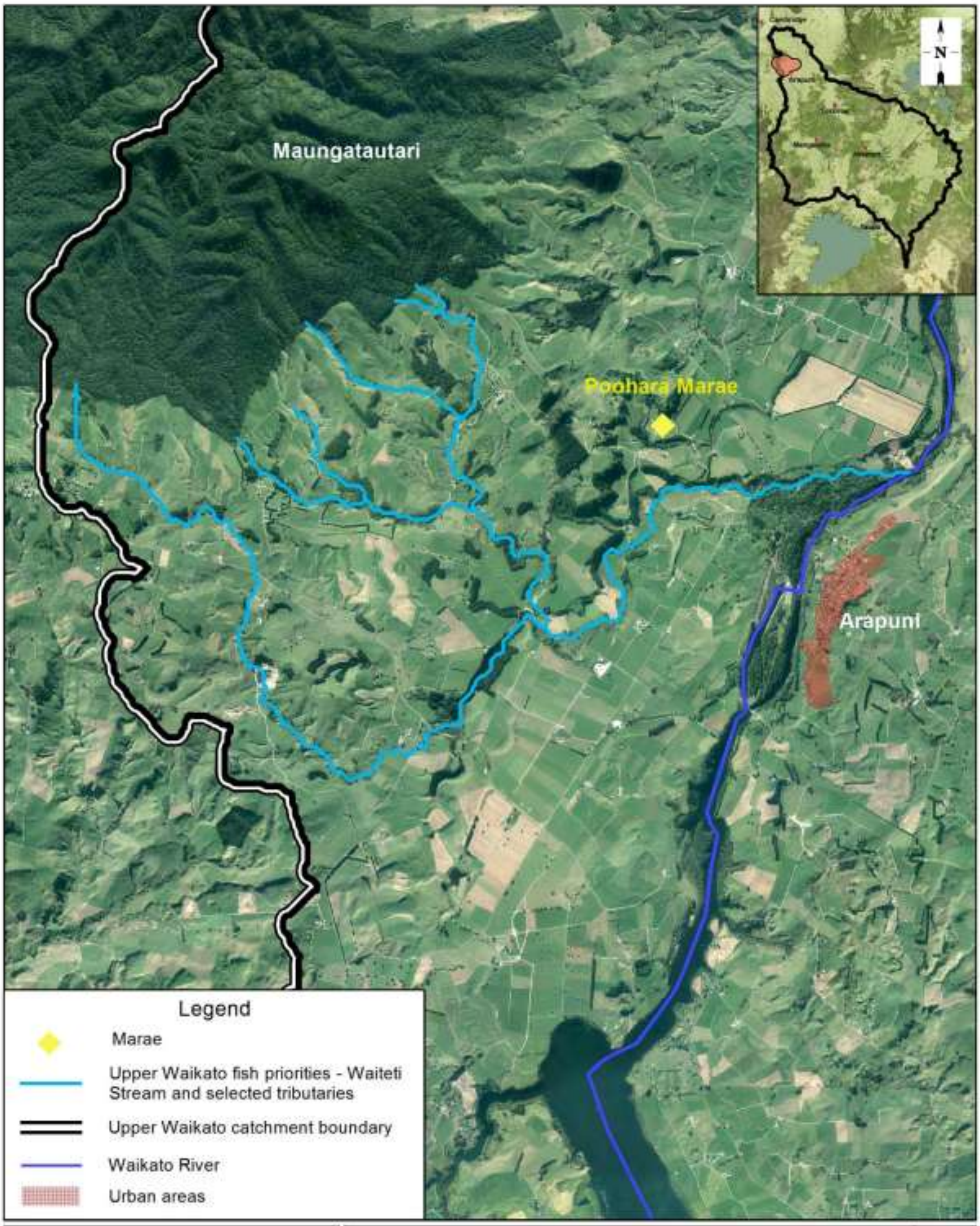
Undertake native riparian planting along the waterway and associated weed control and maintenance for native plant establishment.
- Native planting a minimum 5m wide margin along 26km of streambank (13ha) is $514,176.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
</table>

Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 10
Effectiveness of works	This stream is currently in good condition with some of the Vision & Strategy desired state aspects already being partly met. There is not expected to be a significant change to this over the next 20 years in the absence of this project given existing measures already in place such as the Dairy Water Accord, and the fact that the headwaters are in native forest cover. Works included here are expected to improve aspects related to fish habitat, biodiversity, connectivity and stock access. Consequently, if this project is completed, the stream is expected to be closer to the Vision the Strategy desired state and in improved ecological condition in 20 years' time. The project does not address catchment land use or recreation at this site.	W = 0.2
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.	F = 0.87
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks is likely to be the main challenge in terms of uptake.	A = 0.50
Information quality	Average – recommendations are based on expert judgement. Quantities of work required are based on estimates made from aerial photographs.	
Knowledge gaps	Unknown specifically how much fencing already exists. If there is already a large amount of fencing close to the streambank (i.e. with a narrow riparian margin), landowners may be unwilling to move fences back to allow room for native planting. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 0.9

Task	Cost ($)
Fencing (26km of streambank)	208,000
Planting (13ha)	514,176
Project management/staffing/incidentals (25% of project cost)	180,544
Total	**902,720**



Fish habitat rehabilitation within Waiteti Stream catchment, Arapuni

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale1:50,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of streams flowing from Maungatautari mountain.

<table>
<tr><th>UW 5
Priority: high</th><th>Water quality improvement in the lower Pōkaiwhenua catchment</th><th>BCR value</th></tr>
<tr><td>Relevant unit goal(s)</td><td>Significant ‘hotspots’ (e.g. sub-catchments, or tributaries) have been identified and targeted cleanup activity progressed.

Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread.

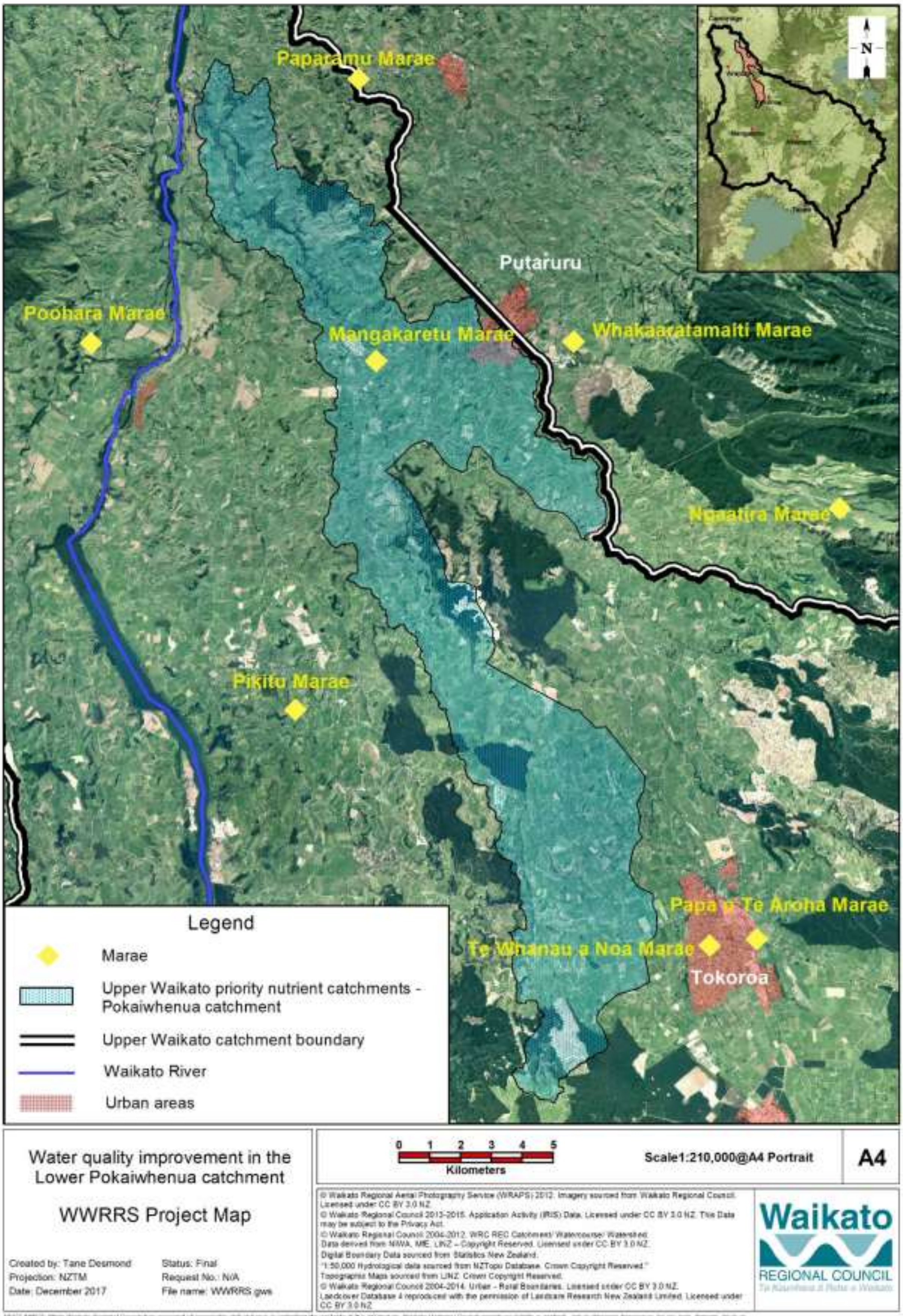
Fresh water quality enables habitats for plants and animals to thrive.</td><td></td></tr>
<tr><td>Name of feature</td><td>Pōkaiwhenua sub-catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The lower Pōkaiwhenua catchment (below Arapuni Road) consists of 13,558ha of moderately steep land draining westward from the upper catchment and Mamaku plateau and entering the Waikato River at Lake Arapuni. 86% of the catchment is in pasture which the majority of the remainder in forestry. Just 1.5% has indigenous vegetation cover.

The catchment falls within the area of interest for at least 8 marae. It is an area of strong cultural significance to iwi and hapū, historically known for its abundance of tuna (eels), bird life and flora.

Water quality monitoring information on the Waikato Regional Council website indicates that nitrogen and phosphorus levels are ”unsatisfactory” 100% of the time in the Pōkaiwhenua Stream at the Arapuni-Putaruru Road site. Modelling undertaken in 2016 indicates that the lower Pōkaiwhenua catchment is a high priority for actions that assist in nitrogen reduction.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Pōkaiwhenua sub-catchment would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 300</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100 % of wetlands and seeps greater than 0.25ha are fenced to exclude stock within 10 years of project commencement.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Wetland and ephemeral stream protection** - 58km of fencing wetlands and seeps >0.25ha and ephemeral streams at $8 per metre ($464,000). Fence should be 5 wire, 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	When compared with desired state, the Pōkaiwhenua sub-catchment is currently in a poor to moderate condition, with few of the Vision & Strategy aspirations being met. It is anticipated that there may be decline in desired state over the next 20 years in the absence of this project. The project encourages fencing wetlands/seeps and ephemeral streams and is expected to slightly offset decline. However, it is acknowledged that achieving desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. There would be benefits to this project being carried out in alignment with project UW 12.	W = 0.01
Risk of technical failure	There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.	F = 0.97
Adoptability	It is estimated that approximately one-third of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.	A = 0.36
Information quality	Average – estimates are based on modelled information and examination of aerial photographs.	
Knowledge gaps	Estimates of wetland location and perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	

<table>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Fencing wetlands and ephemeral streams (58km)</td><td>464,000</td></tr><tr><td>Project management/staffing/incidentals (25%)</td><td>116,000</td></tr><tr><td>Total</td><td>580,000</td></tr></table></td><td>C = 0.58</td></tr>
</table>


Paparamu Marae
Putaruru
Poohara Marae
Mangakaretu Marae
Whakaaratamaiti Marae
Ngaatira Marae
Pikitu Marae
Papa o Te Aroha Marae
Te Whanau a Noa Marae
Tokoroa
Legend
Marae
Upper Waikato priority nutrient catchments - Pokaiwhenua catchment
Upper Waikato catchment boundary
Waikato River
Urban areas
N
Water quality improvement in the Lower Pokaiwhenua catchment
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale1:210,000@A4 Portrait
A4
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Examples of wetland seeps that would benefit from fencing to exclude cattle.

<table>
<tr><td>UW 6

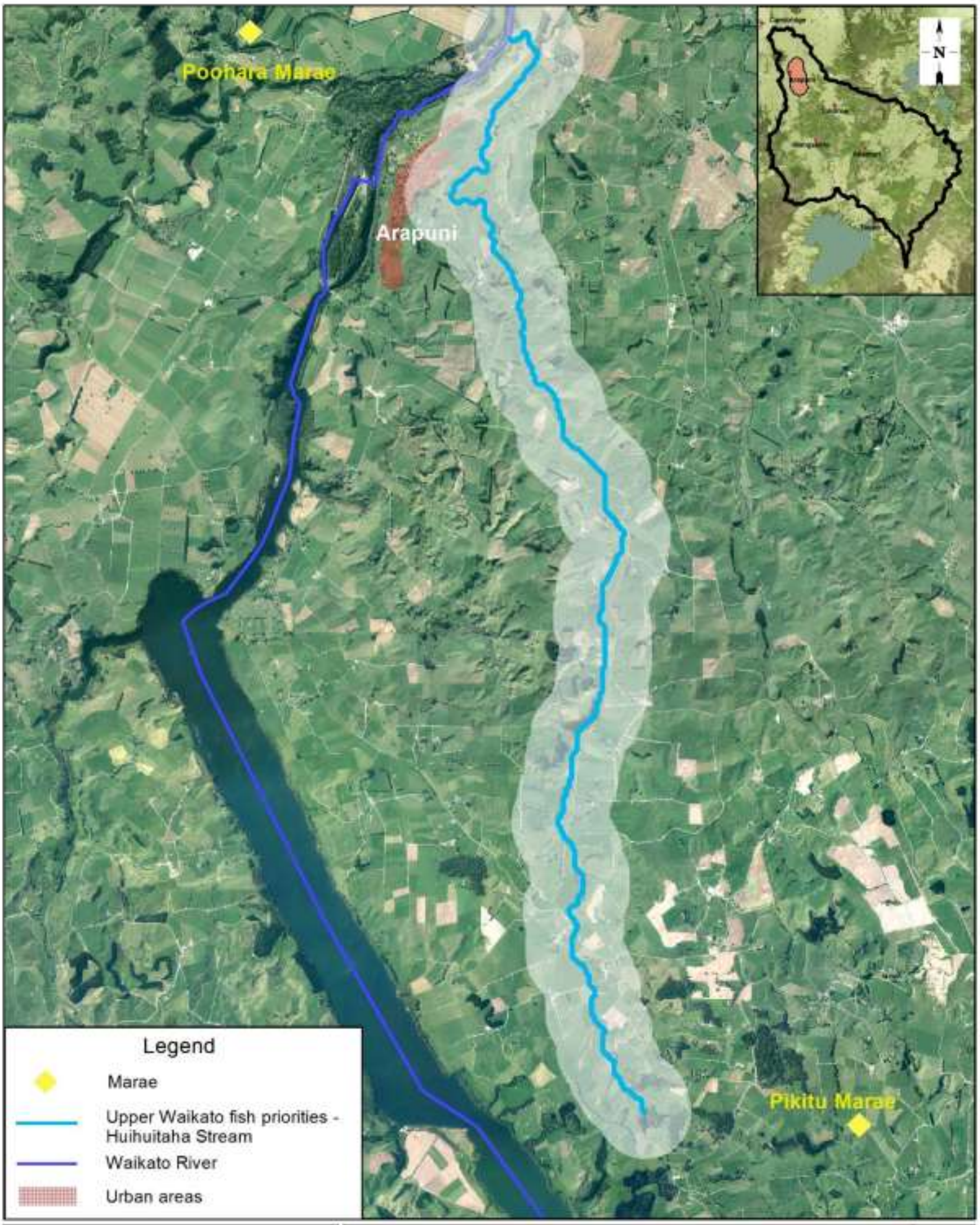
Priority: medium</td><td>Fish habitat rehabilitation in Huihuitaha Stream</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.</td><td></td></tr>
<tr><td>Name of feature</td><td>Huihuitaha Stream</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 15km stream flowing from headwaters near Waotu to enter the Waikato River immediately downstream of Arapuni Dam. The Huihuitaha Stream has been identified as having stretches where there are good populations of longfin and shortfin eels and no barriers to migration (other than Karāpiro Dam, where there is an eel transfer programme). The stream has been selected for inclusion in the Restoration Strategy as there is opportunity to protect existing eel habitat and increase eel populations through creating more high quality habitat.

The Huihuitaha Stream was also a traditional eel fishing area for local iwi and is located near several marae.

The catchment is predominantly pastoral farming. The stream is not fully fenced from livestock and lacks continuous riparian vegetation. It is estimated that 80% of the stream is un-vegetated (except for pasture grass and/or weeds).</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a riparian margin (at least 5m wide) that is vegetated on both sides with native vegetation to provide stream shading and cover for fish.
- Eels are abundant and the full range of fish and kai species expected to be found in the waterway can be found there, e.g. kōura, eels, bullies, freshwater mussels.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its protection, use and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Huihuitaha Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 10</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities.</td></tr>
</table>
</td><td></td></tr>
</table>

Project goal/s	- Within 10 years of project commencing, 100% of the waterway is fenced to exclude stock. - Newly fenced banks have a riparian margin that is at least 5m wide, and at least one side is vegetated with plant species that provide stream shade and enhance habitat for adult native fish.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Riparian management** Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas within the riparian fencing. - Assume 80% of the stream (24km of streambank) requires fencing or fence upgrade ($192,000). Undertake native riparian planting along both sides of the waterway and associated weed control and maintenance for native plant establishment. - Native planting a minimum 5m wide margin along both sides of the stream (24km of streambank, 12ha area) is $474,624. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 10
Effectiveness of works	The Huihuitaha stream is currently in moderate condition, with some of the Vision & Strategy desired state aspects being partly met. There is not expected to be a significant change to this over the next 20 years in the absence of this project given existing measures in place, such as the Dairy Water Accord. Works included here are expected to improve aspects related to fish habitat and will have some secondary benefits in reducing contaminant load. Consequently, if this project is completed, the stream is expected to be closer to the Vision & Strategy desired state and in improved ecological condition in 20 years' time. The project does not address catchment land use or recreation at this site.	W = 0.15

<table>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks is likely to be the main challenge in terms of uptake.</td><td>A = 0.5</td></tr>
<tr><td>Information quality</td><td>Average – recommendations are based on expert judgement. Quantities of work required are based on estimates made from aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>It is unknown specifically how much fencing already exists. If there is already a large amount of fencing close to the streambank (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. This would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (24km of streambank)</td><td>192,000</td></tr>
<tr><td>Native Planting (12ha)</td><td>474,624</td></tr>
<tr><td>Project management/staffing/incidentals (25% of project cost)</td><td>166,656</td></tr>
<tr><td>Total</td><td>833,280</td></tr>
</table>
</td><td>C = 0.83</td></tr>
</table>



Fish habitat rehabilitation on Huihuitaha Stream

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale1:55,000@A4 Portrait

A4

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A section of Huihuitaha Stream where weed control and native planting would be required. Fences on the left of the stream may need to be moved further back if planting both sides.

A section of Huihuitaha Stream where fences would need to be moved back to provide room for native planting.

<table>
<tr><td>UW 7

Priority: medium</td><td>Water quality improvement in the Huihuitaha catchment</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>Significant ‘hotspots’ (e.g. sub-catchments, or tributaries) have been identified and targeted cleanup activity progressed.

Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread.

Fresh water quality enables habitats for plants and animals to thrive.</td><td></td></tr>
<tr><td>Name of feature</td><td>Huihuitaha sub-catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Huihuitaha Stream lies within a 2007ha catchment, 95% of which is pastoral and mostly flat to rolling. There is an approximately 31km stream network lying within this pastoral area. The main stream enters the Waikato River below Lake Arapuni.

The Huihuitaha Stream is historically and culturally significant to local iwi, in particular Pikitu Marae. The stream was accessed for mahinga kai, including fishing, and also fresh water to sustain the marae.

Modelling undertaken in 2016 indicates that the Huihuitaha catchment is a high priority for actions that assist in nitrogen reduction.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable, safe for accessing kai, and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Huihuitaha sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
</table></td><td></td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>100% of wetlands and seeps greater than 0.25ha are fenced to exclude stock within 10 years of project commencement</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Wetland and ephemeral stream protection
- 5km of fencing wetlands and seeps >0.25ha and ephemeral streams at $8 per metre ($40,000). Fence should be 5 wire, 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 1-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.</td><td>L = 3.5</td></tr>
<tr><td>Effectiveness of works</td><td>When compared to desired state, the Huihuitaha sub-catchment is currently in a poor to moderate condition with few of the Vision & Strategy aspirations being met. The condition is not expected to either decline or improve over the next 20 years in the absence of this project. The project addresses wetland and ephemeral stream protection and is expected to contribute to a small improvement towards desired state. However, it is acknowledged that achieving desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term.</td><td>W = 0.005</td></tr>
<tr><td>Risk of technical failure</td><td>There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>It is estimated that approximately one-third of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.</td><td>A = 0.36</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and examination of aerial photographs.</td><td></td></tr>
</table>

<table>
<tr><td>Knowledge gaps</td><td>Estimates of wetland location and perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>1 year</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing wetlands and ephemeral streams (5km)</td><td>40,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>10,000</td></tr>
<tr><td>Total</td><td>50,000</td></tr>
</table></td><td>C = 0.05</td></tr>
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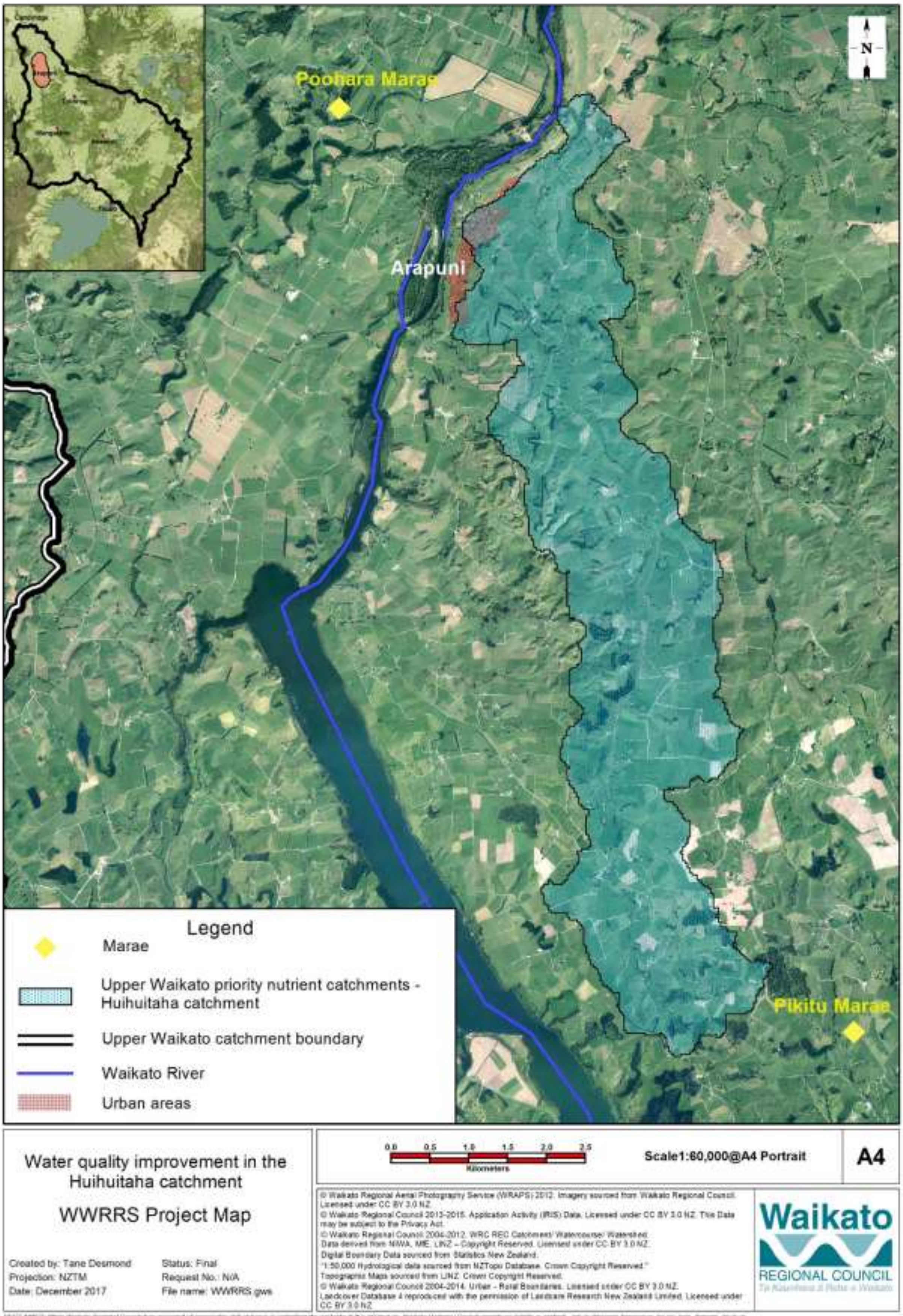

N
Poohara Marae
Arapuni
Pikitu Marae
Legend
Marae
Upper Waikato priority nutrient catchments - Huihuitaha catchment
Upper Waikato catchment boundary
Waikato River
Urban areas
Water quality improvement in the Huihuitaha catchment
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.5 1.0 1.5 2.0 2.5
Kilometers
Scale1:60,000@A4 Portrait
A4
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UW 8 Priority: medium	Fish habitat rehabilitation in Little Waipā Stream	BCR value
Relevant unit goal(s)	The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.	
Name of feature	Little Waipā Stream	
Brief description of feature	A 23km stream flowing from headwaters near Waotu to enter the Waikato River at Lake Arapuni, approximately 5km downstream of Arapuni Dam on the east side of the river. The catchment is predominantly pastoral farming and a considerable amount of effort has gone into stream fencing and planting over the past 20 years. There is an active Little Waipā Stream care group and the Waikato Regional Council and local landowners have committed a significant amount of funding towards fencing and planting within the catchment. The Little Waipā Stream has been identified as having stretches where there are good populations of longfin and shortfin eels and no barriers to migration (other than Karāpiro Dam, where there is an eel transfer programme). The stream has been selected for inclusion in the Restoration Strategy as there is opportunity to protect existing eel habitat and increase eel populations through creating more high quality habitat. The Little Waipā Stream was a traditional eel fishing area for local iwi and is located near several marae including Pikitu, Mangakaretu and Pohara. Approximately 25% of streambanks remain to be planted and/or fenced with an appropriately sized riparian margin to allow for native planting. Waikato Regional Council monitoring data indicates that the Little Waipā Stream at Arapuni-Putaruru Road is not swimmable, and has unsatisfactory levels of E. coli, nitrogen and phosphorus.	
Desired state to achieve the Vision & Strategy	- The stream is fenced to exclude stock from its entire length. It has a riparian margin (at least 5m wide) that is planted with native plants to provide stream shading and cover for fish. - Eels are abundant and the full range of fish and kai species expected to be found in the waterway can be found there, e.g. kōura, tuna, bullies, freshwater mussels. - The stream is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the stream and are active in its protection, use and restoration.	
Impact on Vision & Strategy	In a restored condition the Little Waipā Stream would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 30

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr><tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 10 years of the project commencing, the full length of the Little Waipā Stream is fenced to exclude stock.
- Newly fenced areas have a riparian margin that is at least 5m wide and vegetated with plant species that provide stream shade and enhance habitat for adult native fish.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

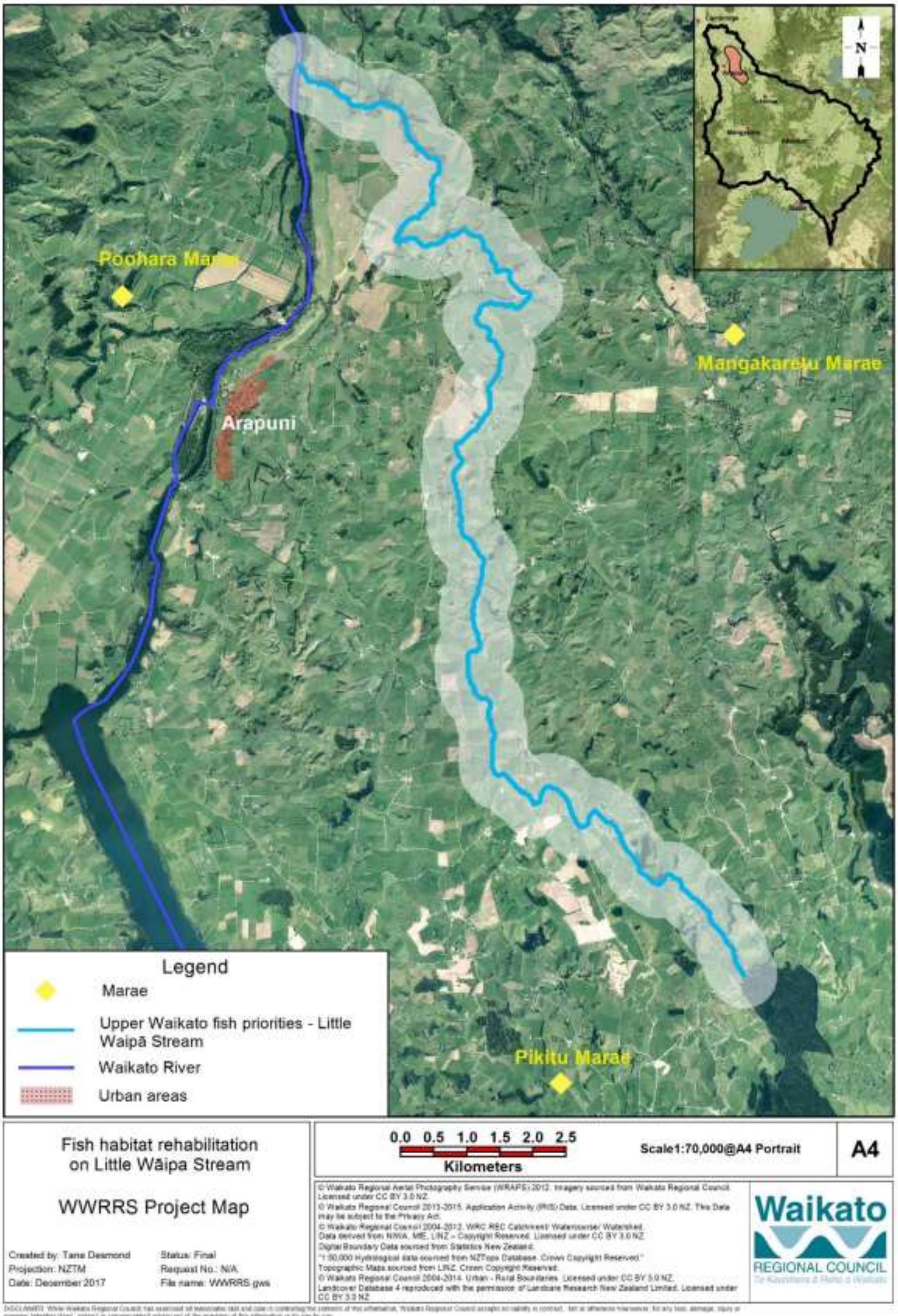
Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 25% (11.5km of streambank) requires fencing or fence upgrade ($92,000).

Undertake native riparian planting within the fenced area and associated weed control and maintenance for native plant establishment.
- Planting 11.5km of streambank (5.75ha) is $227,424.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 20% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.</td><td>L = 7.5</td></tr>
<tr><td>Effectiveness of works</td><td>Little Waipā Stream is currently in moderate condition with some of the Vision & Strategy desired state aspects being partly met, in particular with having stretches where there are good populations of longfin and shortfin eels and no barriers to migration (other than Karāpiro Dam, where there is an eel transfer programme).</td><td>W = 0.025</td></tr>
</table>

<table>
<tr><td></td><td>Condition is not expected to either significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Little Waipā Stream is expected to improve in aspects related to fish habitat and biodiversity and be slightly closer overall to the desired state in 20 years’ time.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. However, landowners in this catchment have to date been very proactive with restoration works.</td><td>A = 0.65</td></tr>
<tr><td>Information quality</td><td>Average – recommended management actions based on expert knowledge. Quantities of work required are estimated, based on aerial photography and Upper Waikato catchment riparian surveys.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. If there is already a large amount of fencing close to the stream edge (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (11.5km)</td><td>92,000</td></tr>
<tr><td>Planting (5.75ha)</td><td>227,424</td></tr>
<tr><td>Project management/staffing/incidentals (20% of project cost)</td><td>63,885</td></tr>
<tr><td>Total</td><td>383,309</td></tr>
</table></td><td>C = 0.38</td></tr>
</table>



Poohara Marae
Mangakareu Marae
Arapuni
Pikitu Marae
N
Legend
Marae
Upper Waikato fish priorities - Little Waipā Stream
Waikato River
Urban areas
Fish habitat rehabilitation on Little Wāipa Stream
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Kilometers
Scale1:70,000@A4 Portrait
A4
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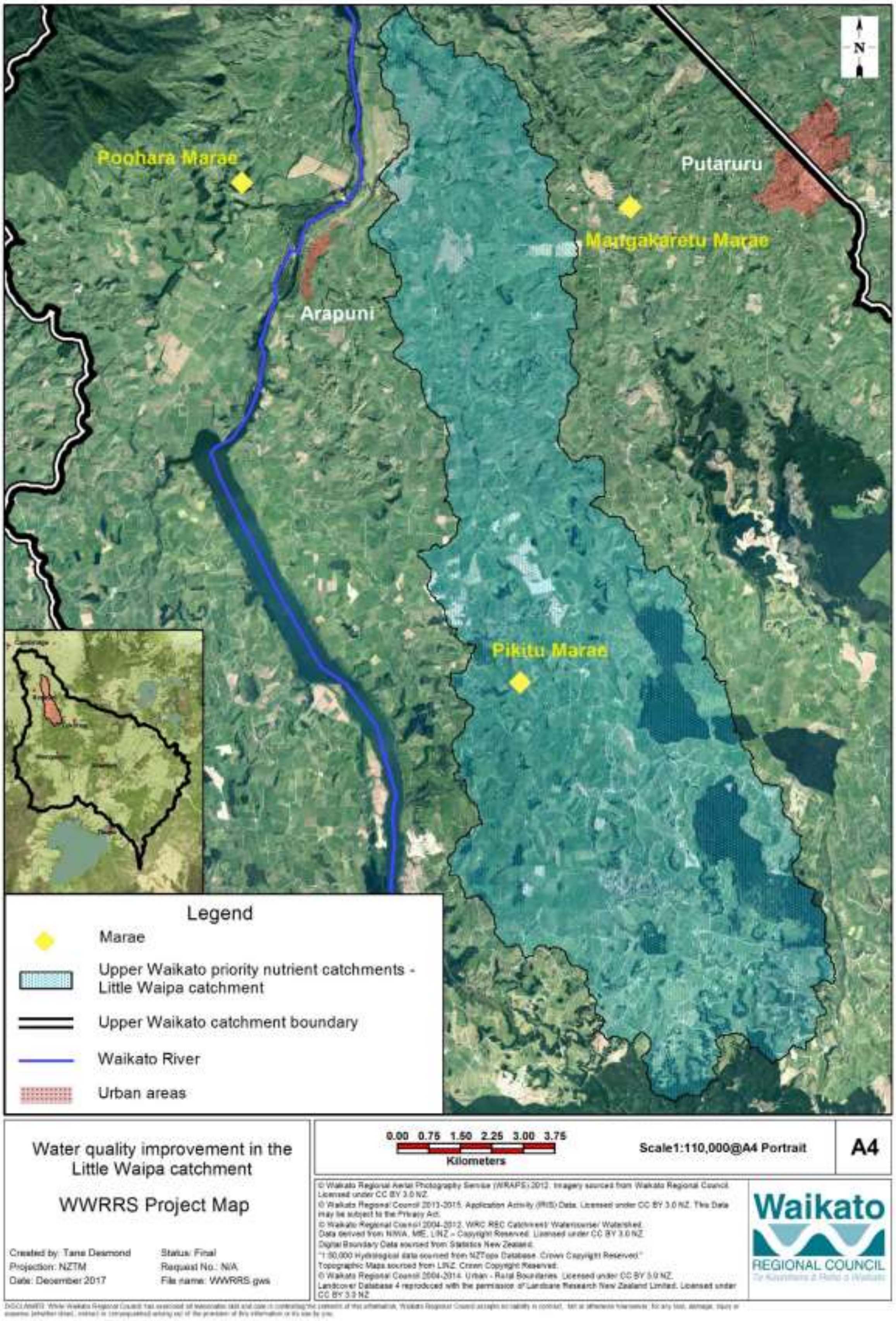
UW 9 Priority: high	**Water quality improvement in the Little Waipā catchment**	**BCR value**
Relevant unit goal(s)	Significant 'hotspots' (e.g. sub-catchments, or tributaries) have been identified and targeted cleanup activity progressed. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive.	
Name of feature	Little Waipā sub-catchment	
Brief description of feature	The Little Waipā is a 12,152ha catchment that lies adjacent and to the west of the Huihuitaha. The main stream enters the Waikato River at Lake Karāpiro. The catchment is predominantly pastoral (86%) with some areas of forestry (11%) and indigenous vegetation (2%). 15% of the catchment is LUC Class 6e, 7 or 8 in pasture. The Little Waipā Stream was a traditional eel fishing area for local iwi and is located near several marae including Pikitu, Mangakaretu and Pohara. In 2006 Environment Waikato began a pilot Integrated Catchment Management (ICM) project within the Little Waipā. This process used policy tools – education, incentives (e.g. Clean Streams), enabling compliance and enforcing regulations – to work with farmers to change or improve agricultural practices that contribute to rising nitrogen levels within the Waikato hydro-lakes. It was a voluntary project involving farm planning to prepare landowners for eventual policy change. The ICM pilot project took place over three years (2006-2009) and had a large focus on nitrogen. Water quality monitoring information on the Waikato Regional Council website indicates that nitrogen, phosphoris and E. coli levels are "unsatisfactory" 100% of the time in the Little Waipā Stream at the Arapuni-Putaruru Road site. Modelling undertaken in 2016 indicates that the Little Waipā catchment is a high priority for actions that assist in nitrogen reduction.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the native bush remnants.	

	- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present. - The stream is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Little Waipā sub-catchment would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 80
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr></table>	
Project goal/s	100% of wetlands and seeps greater than 0.25ha are fenced to exclude stock within 10 years of project commencement.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Wetland and ephemeral stream protection** - 88km of fencing wetlands and seeps > 0.25ha and ephemeral streams at $8 per metre ($704,000). Fence should be 5 wire, 2 electric. The focus should be on wetlands that retain relatively natural hydrology, i.e. water is flowing in and out through the wetland (not via a drain through or around), water is held back and the wetland is functioning year round. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	When compared to desired state, the Little Waipā sub-catchment is currently in a poor to moderate condition with few of the Vision & Strategy aspirations being met. The condition is not expected to either decline or improve over the next 20 years in the absence of this project. The project encourages significant quantities of fencing wetlands/seeps and ephemeral streams and is expected to contribute to an overall improvement towards desired state. However, it is acknowledged that achieving desired state will take longer than the 20 year horizon used for the purposes of the	W = 0.075

	Restoration Strategy, and a fuller range of initiatives over the long term.	
Risk of technical failure	There is a negligible risk of project failure due to technical feasibility. The project consists solely of fencing wetland areas.	F = 0.97
Adoptability	It is estimated that approximately one-third of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas. Although generally the benefits of avoiding loss of stock in wetlands and protection of nutrient attenuation areas are becoming better recognised, this kind of work has not yet become as widely supported as riparian protection.	A = 0.315
Information quality	Average – estimates are based on modelled information and examination of aerial photographs.	
Knowledge gaps	Estimates of wetland location and perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	
Up-front cost – total for implementation phase/project duration	<table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Fencing wetlands and ephemeral streams (88km)</td><td>704,000</td></tr><tr><td>Project management/staffing/incidentals (25%)</td><td>176,000</td></tr><tr><td>Total</td><td>880,000</td></tr></table>	C = 0.88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Poohara Marae
Putaruru
Mangakaretu Marae
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Water quality improvement in the Little Waipa catchment
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Examples of wetland seeps that would benefit from fencing to exclude cattle.

<table>
<tr><td>UW 10

Priority: medium</td><td>Longfin eel habitat rehabilitation in Mangare Stream catchment</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.

Collaborative education and research opportunities increase knowledge and understanding of fisheries in the Upper Waikato.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangare Stream sub-catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Mangare sub-catchment is located on the western side of the Waikato River near Lake Arapuni. The Mangare Stream is 18km long, flowing from its headwaters near Arohena north to the downstream end of Lake Arapuni. There are more than 40km of waterways in the catchment. Large sections of waterways, particularly in the middle and upper reaches have little or no riparian margin and livestock are able to access the waterway in some places. Other sections are vegetated with native forest remnants or exotic forestry. As the Mangare Stream approaches Lake Arapuni it becomes wider and enters a steep sided gully. There are a small number of ponds present on tributary streams, including the peat lake Lake Rotongata.

The Mangare Stream catchment is known to have good populations of longfin eel in the upper reaches so this project represents an opportunity to protect existing populations and provide further habitat in downstream reaches. Longfin eels are unique to New Zealand and although still relatively common they are ranked as ‘at risk – declining’ in DOC’s threatened species classification and there are concerns about the scarcity of very large specimens. The very large eels are females that are capable of producing large numbers of eggs, and so are important in sustaining the population. The Mangare Stream is known to have good numbers of large female longfin eels.

Tuna (eels) are very significant taonga species to local iwi, in particular Waotu and Pohara marae who sit within the project vicinity. This stretch of the river catchment was historically known as “te rohe o te tuna” or the place of eels. Historic features such as the old pā site, known as piraunui, are still visible.

Eels must migrate to the ocean to complete their lifecycles. However, upstream of Karāpiro Dam this is not possible as large migrating females do not survive passage through hydro dam turbines. (Note: Juvenile eels, elvers, are transported from the base of Karāpiro Dam to the upstream hydro reservoirs and associated catchments through an elver trap and transfer programme.)</td><td></td></tr>
</table>

<table>
<tr><td></td><td>Mangare Stream is therefore considered an excellent catchment site to carry out trap and transfer of migrating female longfin eels to below Karāpiro Dam.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a riparian margin (at least 5m wide) that is planted on both sides with native plants to provide stream shading and cover for fish.
- There are no manmade barriers to native migratory fish.
- Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to Mangare Streams and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Mangare Stream sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Reduced water quality.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality, erosion and destruction of riparian vegetation, and increased nutrient load.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish, reduced fish abundance, and increased solar heat.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 10 years of project commencing, the full length of the identified waterway is fenced to exclude stock.
- Both sides of the waterway has a riparian margin that is at least 5m wide and vegetated with plant species that provide stream shade and enhance habitat and food for longfin eel.
- There is an annual programme to trap migrant longfin eels in Mangare Stream and transfer them downstream of Karāpiro Dam.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian Management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires) to allow for native planting. Include adjoining wetland areas within the riparian fencing.
- Assume 70% (30km of streambank) requires fencing or fence upgrade ($240,000).

Undertake native riparian planting and carry out associated weed control and maintenance for native plant establishment.</td><td></td></tr>
</table>

- Native planting of a minimum 5m wide riparian margin along 40km of streambank (20ha area) at an estimated cost of $39,552 per hectare ($791,040).
- Willow pole planting may be required in some locations along the stream for erosion control purposes. Where this is undertaken, less native planting will be required. The above cost estimate should be sufficient to cover both native planting and pole planting.

Downstream migrant longfin eel trap and transfer
Trap migrant longfin eels in Mangare Stream and/or Lake Arapuni for transfer downstream (as is done for a number of hydro schemes, including Manapouri and Waikaremoana)

Construct eel weirs or pā tuna (see example in photo below).


Pā tuna in the Ngāti Hine Rohe, Northland (Photo J Boubée)

For health and safety reasons, at least two people will be needed to implement and operate a pā tuna.

Implementation cost estimates:

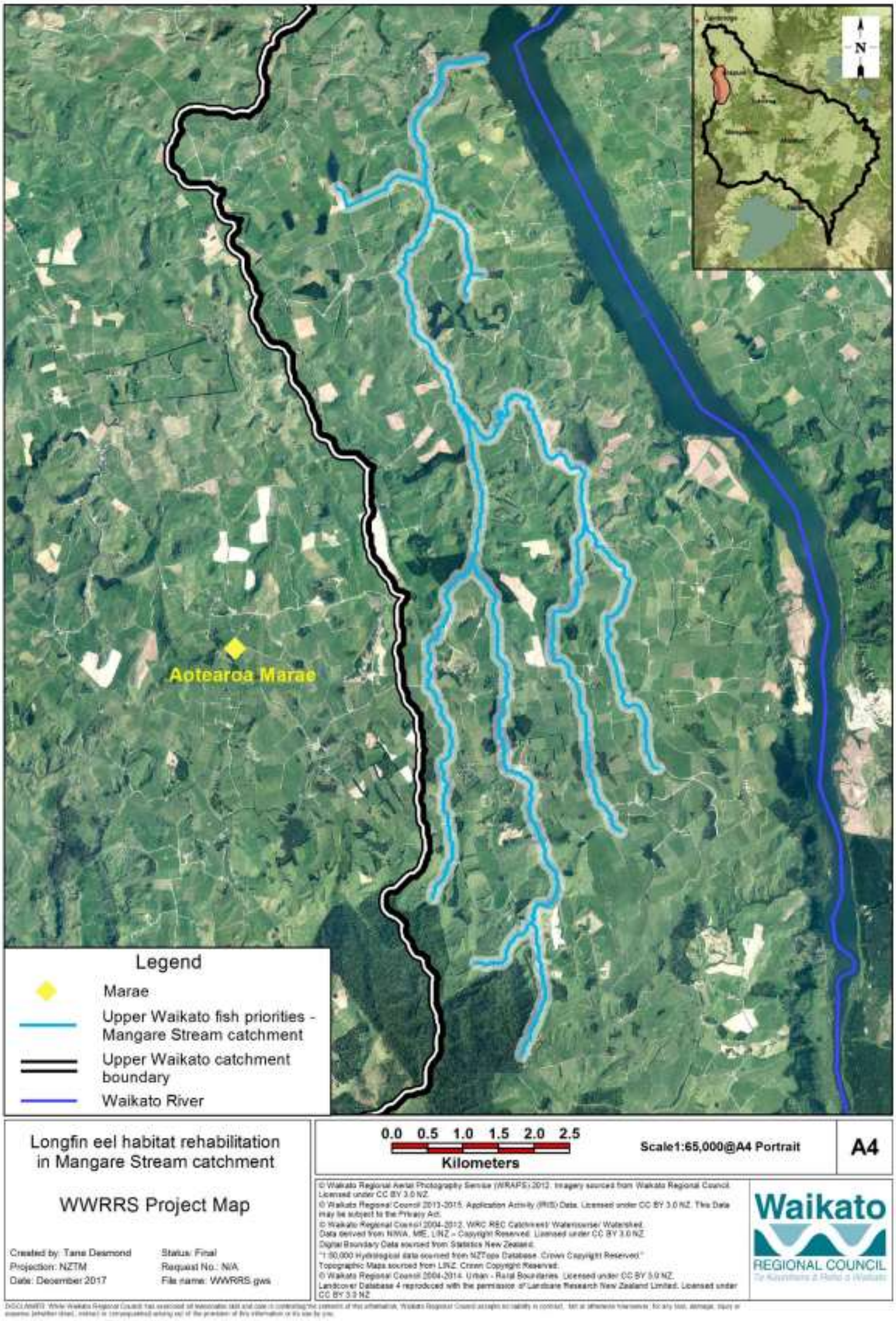
Year 1
- Site visits – 2 people for 6 days plus travel and accommodation ($10,000)
- Construction materials ($5000)
- Construction - 5 days, 2 people ($6000)
- Operation of trap – 10 days, 2 people plus vehicle ($15,000)

YEAR 1 TOTAL: $36,500

Maintenance and operation during year 2-10:
- Repairs 2 days, 2 people plus vehicle ($3,000)
- Operation of trap 10 days, 2 people ($15,000)

	YEARS 2-10 TOTAL: $162,000 ($18,000/year x 9 years) **Additional sites x 3. Assume three additional pā tuna are constructed at different sites on the stream during year 4:** - Materials and construction: ($10,000 x 3 traps is $30,000) - Annual operation cost ($15,000 x 3 traps x 7 years is $315,000) ADDITIONAL SITES TOTAL: $345,00 **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct riparian related costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 10
Effectiveness of works	The Mangare Stream sub-catchment is currently in moderate condition with some of the Vision & Strategy desired state aspects already being met, including having good populations of longfin eel in the upper reaches. This project represents an opportunity to protect existing populations and provide further habitat in downstream reaches. Overall condition is not expected to significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Mangare Stream sub-catchment is expected to improve and be substantially closer to the desired state in 20 years' time, with aspects relating to riparian condition, fisheries and use/connection to the site all being addressed. Secondary benefits to water quality and biodiversity are also expected.	W = 0.25
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is some uncertainty around the logistics of operating the downstream transfer of migrant tuna.	F = 0.82
Adoptability	It is estimated that approximately one-third of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. There are also large sections of stream that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be less willing to erect 5-wire fences in these locations due to maintenance costs. However, as plantings establish this risk should be reduced. There may also be aversion to allowing the access required over private land to operate pā tuna.	A = 0.36
Information quality	Average – recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	

<table>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks. Early engagement with iwi is required to ensure that appropriate protocols are in place for a trap and transfer programme.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian Fencing (30km)</td><td>240,000</td></tr>
<tr><td>Native planting (20ha)</td><td>791,040</td></tr>
<tr><td>Eel trap and transfer (excl project management)
- Year 1 costs
- Maintenance and operation during year 2 to 10
- Costs associated with an additional 3 sites</td><td>
36,500
162,000
345,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>472,362</td></tr>
<tr><td>Total</td><td>2,046,902</td></tr>
</table>
</td><td>C = 2.05</td></tr>
</table>



N
Aotearoa Marae
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Upper Waikato catchment boundary
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Longfin eel habitat rehabilitation in Mangare Stream catchment
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Mangare Stream showing areas where riparian fencing and planting for fish habitat enhancement is recommended.

UW 11 Priority: very high	Biodiversity enhancement at Jack Henry Wetland	BCR value
Relevant unit goal(s)	Ecological networks include the full range of fresh water and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work, including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Jack Henry Wetland	
Brief description of feature	This site is 19.96ha and comprises a relatively large area of indigenous vegetation that includes an ecological sequence between freshwater wetland and terrestrial vegetation on river flats bordering the Waikato River. The site is within the top 15% of sites for biodiversity protection and enhancement within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type. Wetland habitat is under represented regionally and nationally (1% of the 1840 freshwater wetlands extent remains in the South Waikato district; Leathwick et al 1995). Wetlands are significant as they provide specific resources for iwi and marae including rongoā (medicinal plants), soils for dyes and strengthening of woods, birdlife and other mahinga kai habitat. The Jack Henry Wetland vegetation is dominated by flaxland/sedgeland with emergent tī kōuka, whekī and karamū and occasional kahikatea. The dense scrub and forest area comprise three vegetation types: - Mahoe dominated scrub with emergent kānuka, grey willow, tī kōuka and kahikatea. Rārahu forms a dense ground cover and understorey in places. - Common mānuka with some grey willow, tutu, karamū, koromiko, Spanish heath and mingimingi with emergent radiata pine. - Māhoe dominated forest with whekī and kahikatea common. Jack Henry Road bisects the western third of the site creating a narrow band of scrub beside the Waikato River. This area is dominated by kōwhai, tutu, karamū and mamaku, with Spanish heath, buddleia, willow, pine, blackberry, gorse and Japanese honeysuckle on the road side.	

<table>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The wetland is densely vegetated with native plant species, connected to the riparian corridor and protected from stock grazing.
- Native plant regeneration occurs naturally.
- Iwi and communities have a strong connection to the wetland and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Jack Henry Wetland would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 7</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Wilding conifers</td><td>Compete with native plant communities and continue to spread.</td></tr>
<tr><td>Willows</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>People become disconnected from the wetland site and see the area as a resource rather than something that needs to be nurtured and cared for</td><td>Wetland area becomes more degraded.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 4 years of project commencement the wetland/waterways are free from willow, pine and other plant pests and have regenerating native vegetation.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works should be implemented by an organisation in collaboration with the landowner. This project could be undertaken as a whole, or in multiple smaller components.

Management plan
A site assessment and management plan should be prepared prior to undertaking work on the site ($10,000).

Further investigation is required to determine the amount of weed control required. However, based on an aerial photo, a brief site visit and the Significant Natural Area report the following estimates and assumptions have been made:

Weed control
Most of the wetland and bush ecosystems identified have a range of weed species present that will require ground based control. The estimate cost of this is $42,000 (16ha at $2800 per ha).

Animal pest control
This site would benefit from wild pig control to protect the wetland/bush vegetation. However, this work has not been</td><td></td></tr>
</table>

<table>
<tr><td></td><td>costed as ongoing as animal pest control is out of scope for the Restoration Strategy.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 15% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 4-year period, it is estimated that the majority of the project benefits would be seen at project completion.</td><td>L = 4</td></tr>
<tr><td>Effectiveness of works</td><td>Jack Henry Wetland is currently in excellent condition, with almost all of the Vision & Strategy desired state aspects already being met. It is expected that over the next 20 years the wetland could decline as a result of spread of exotic plants species. Works included here address this threat and it is anticipated that if the project is fully completed, the feature will be at the Vision & Strategy state in 20 years’ time.</td><td>W = 0.03</td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure weed control is effective.</td><td>F = 0.92</td></tr>
<tr><td>Adoptability</td><td>Full adoption of works would be anticipated if the project was fully incentivised. There is a single owner for this wetland and they are expected to be supportive of the work.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Good – judgement of a local expert based on a site visit, and examination of aerial photography</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Further investigation is required to determine the specific amount of weed control required. This should be done as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>4 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Management plan</td><td>10,000</td></tr>
<tr><td>Weed control</td><td>44,800</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>8220</td></tr>
<tr><td>Total</td><td>$63,020</td></tr>
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</td><td>C = 0.06</td></tr>
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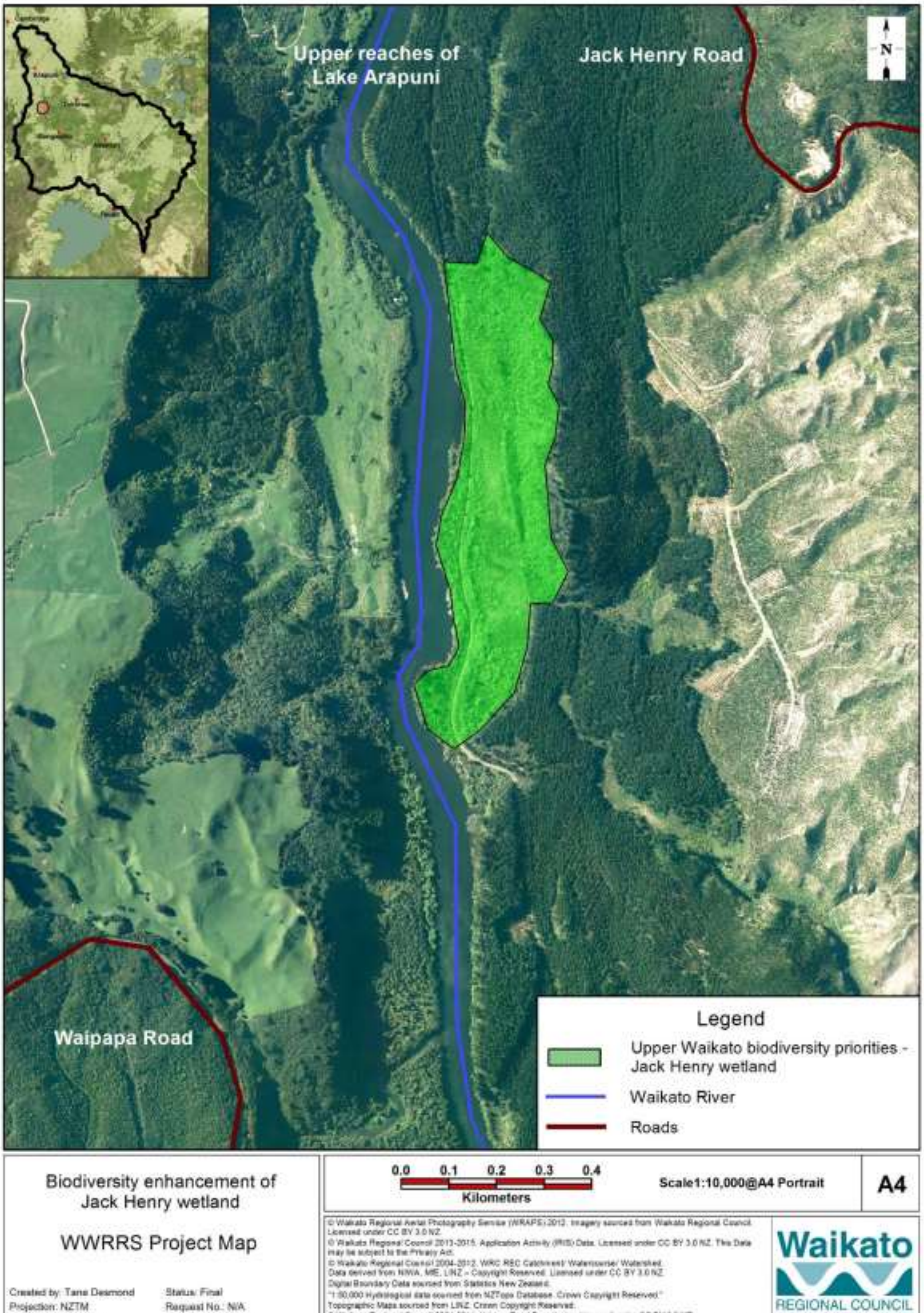
Upper reaches of Lake Arapuni
Jack Henry Road
N
Waipapa Road
Legend
Upper Waikato biodiversity priorities - Jack Henry wetland
Waikato River
Roads
Biodiversity enhancement of Jack Henry wetland
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.1 0.2 0.3 0.4
Kilometers
Scale1:10,000@A4 Portrait
A4
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Examples of the indigenous wetland vegetation at Jack Henry Wetland.

Example of indigenous vegetation at Jack Henry Wetland.

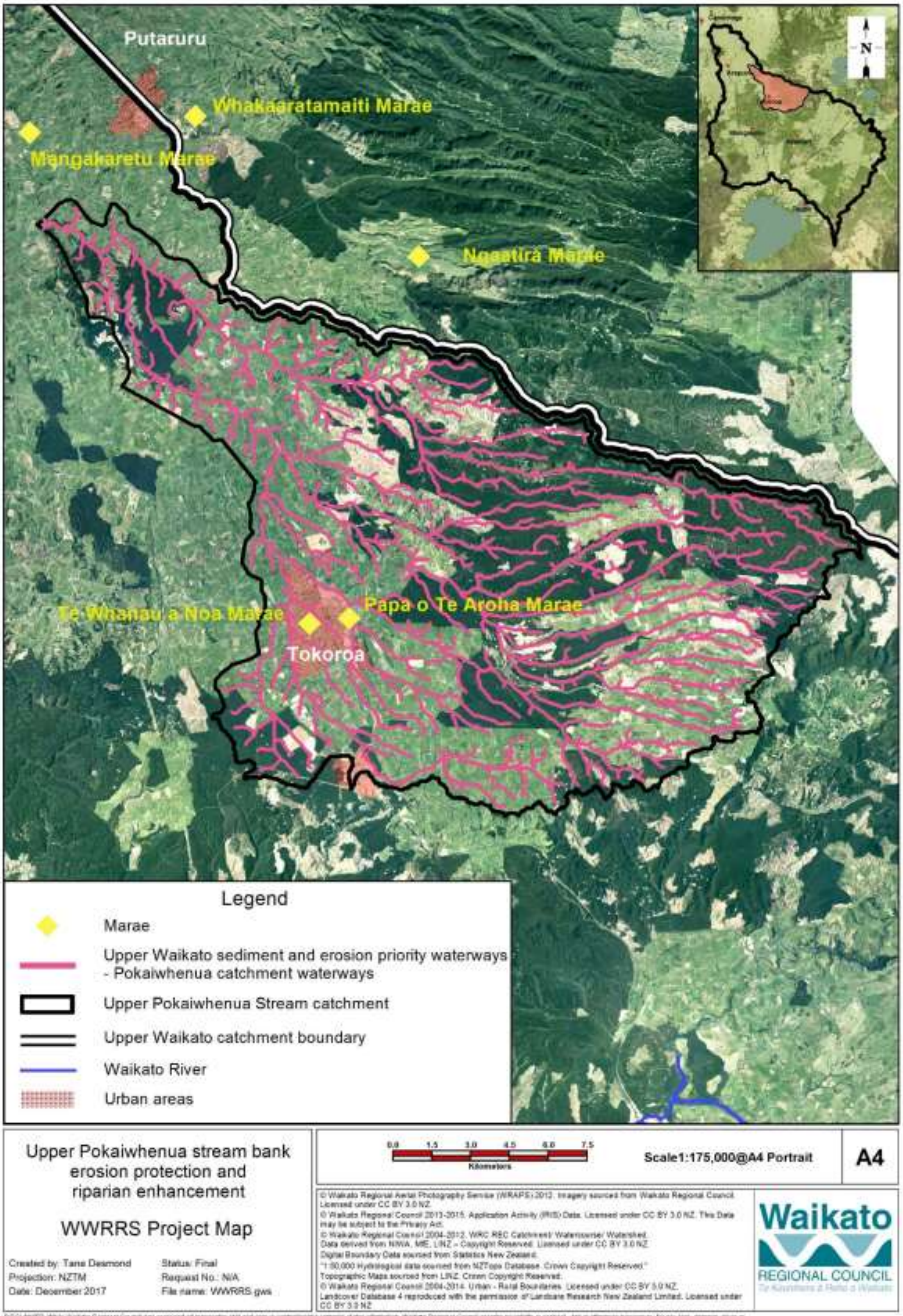
Japanese honey suckle on side of Jack Henry Road/Waikato cycle trail.

UW 12 Priority: very high	Upper Pōkaiwhenua streambank erosion protection and riparian enhancement	BCR value
Relevant Unit Goal(s)	Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Significant 'hotspots' (e.g. sub-catchments, or tributaries) have been identified and targeted clean up activity progressed. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Pōkaiwhenua Stream	
Brief description of feature	The upper part of the Pōkaiwhenua Stream catchment (above Arapuni Road) is 33,464ha, of which 48% is in pasture. There is an estimated 255km stream network within this pastoral area. The southeastern corner of the catchment comprises a series of at least six headwater streams flowing west and then turning north to converge into the main Pōkaiwhenua Stream channel near Tokoroa. The channels are moderately incised into the Taupō pumice geology. As a long-established forestry plantation area, no historical soil conservation works are located in these headwater catchments. Extensive forest conversion development within the upper catchment in recent years has resulted in widespread soil disturbance and altered the storm runoff hydrology in the absence of the buffering effect of a mature forest canopy. This development has been staged over time and has generally followed the Forest to Farming (2007) guidelines for riparian management. Vegetation cover in riparian margins is often a mix of regenerating native and exotic species, and deep pumice soils have ongoing potential for severe erosion, such as lateral gully development. The Pōkaiwhenua is culturally important to the iwi of the rohe (area). There were significant mahinga kai (food gathering) sites including for tuna (eels) and watercress, and historic pā sites within the upper catchment. There are many marae with interests in this area. Waikato Regional Council monitoring data indicate that the Pōkaiwhenua Stream at Arapuni-Putaruru Road is not swimmable. Modelling has identified the catchment as a high priority for management of streambank erosion.	

Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present. - The stream is swimmable, fishable, safe for gathering kai, and has access for recreation. - Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Pōkaiwhenua Stream would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 300
Key threats to the feature that this project addresses	**Key threat** – **Impact on feature** Bank erosion – Contributes significant sediment load to the Pōkaiwhenua Stream and upper Waikato River. Stock access to the stream – Reduced water quality and destruction of riparian vegetation.	
Project goal/s	- Within 15 years of project commencement, the main channel and tributaries of the upper Pōkaiwhenua Stream are stable and fenced to exclude stock with a minimum 5 wire (2 electric) fence. - Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Riparian management of rivers/streams in pasture for soil conservation purposes** - Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 127km of streambank (63.5km of stream length) ($1,016,000). Include adjoining wetland areas within the riparian fencing. - Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 32ha of planting and associated weed control and maintenance ($1,201,664).	

	- 3187 willow poles are estimated to be required for river and stream erosion control. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 1-2 years before project completion.	L = 13.5
Effectiveness of works	When compared with desired state, the Pōkaiwhenua Stream is in a poor to moderate condition with few of the Vision & Strategy desired state aspirations currently being met. Over the next 20 years it is expected that there could be a slow deterioration in condition. Works included address mainly sedimentation from streambank erosion but would have benefits in reducing E.coli and nutrients to waterways and improving fisheries and catchment biodiversity. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to offset potential decline and move the catchment streams towards this state if fully completed.	W = 0.1
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to streambank erosion. The nature of recent conversions in the catchment and resultant material moving downstream has increased the erosion risk while the stream reaches a new equilibrium.	F = 0.82
Works by private citizens – likelihood of adoption and adoption circumstances	It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. However, there are landowners in the catchment who are currently undertaking similar works and there is a growing awareness in the catchment of the benefits of riparian protection.	A = 0.5
Information quality	Average – based on modelled information, and estimates based on catchment wide surveys of riparian fencing.	
Knowledge gaps	Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (127km)</td><td>1,016,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (3187 poles)</td><td>44,618</td></tr>
<tr><td>Native riparian planting (32ha)</td><td>1,201,664</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>565,570</td></tr>
<tr><td>Total</td><td>2,827,852</td></tr>
</table>
</td>
<td>C = 2.83</td>
</tr>
</table>


Putaruru
Whakaaratamaiti Marae
Mangakaretu Marae
Ngaatira Marae
Te Whanau a Noa Marae
Papa o Te Aroha Marae
Tokoroa
N
Legend
Marae
Upper Waikato sediment and erosion priority waterways - Pokaiwhenua catchment waterways
Upper Pokaiwhenua Stream catchment
Upper Waikato catchment boundary
Waikato River
Urban areas
Upper Pokaiwhenua stream bank erosion protection and riparian enhancement
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 1.5 3.0 4.5 6.0 7.5
Kilometers
Scale1:175,000@A4 Portrait
A4
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Examples of streambank erosion along the Pōkaiwhenua Stream

UW 13 Priority: high	Kōura habitat rehabilitation in Uanui Stream	BCR value
Relevant unit goal(s)	The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use. Collaborative education and research opportunities increase knowledge and understanding of fisheries in the Upper Waikato,	
Name of feature	Uanui Stream	
Brief description of feature	A 2.6km long stream flowing into the western side of Lake Whakamaru. NIWA electric fishing on this watercourse has found that there are populations of kōura present in the upper reaches of the stream. This waterway is one of the few waterways in the Upper Waikato catchment where there are known to be good populations of kōura. It is largely unknown why kōura populations have declined/disappeared from other waterways so this project represents an opportunity to protect and increase the size of remaining populations. From aerial photographs, the stream appears to have good vegetative cover across most (but not all) of its length but it is unknown whether it is fenced to exclude stock. Whakamaru is significant in the history of iwi. Whakamaru was a mountain, alongside Tūaropaki, and they were known as the bird mountains. There are many pā sites within the region where the Ngāti Kahu pungapunga were attacked and defeated. The area was valued for its bird life and abundance of food. There would be efficiencies in this project being carried out in conjunction with Project UW 14.	
Desired state to achieve Vision & Strategy	- The stream is fenced to exclude stock from its entire length and a riparian margin of at least 5m is well vegetated with native plant species. - Native fish are abundant and there is a wide diversity of species present. - Kōura are abundant and the stream is fishable. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Uanui Stream has a high impact on giving effect to the Vision & Strategy at a local level.	VS = 1.5

<table>
<tr><td>Key threats to the feature that this project addresses</td><td>

Key threat	Impact on feature
Stock access to the stream	Reduced water quality and destruction of riparian vegetation.
Lack of riparian cover and associated fish habitat	Reduced habitat for adult fish.
Vegetation clearance	Reduced cover, habitat and food (invertebrates) for native fish species.

</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The Uanui Stream is 100% fenced to exclude stock.
- Instream habitat for kōura has increased and stream users report an increase in the numbers of kōura encountered.
- Cobbles and/or woody debris structures are installed at 10 locations.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Site evaluation and planning
Identify locations within the Uanui Stream where there are barriers to kōura predators (e.g. waterfalls), and where instream works have been undertaken that would limit habitat enhancement opportunities (e.g. Tirohanga Water Scheme).

A technical specialist ($6000) to:
- identify locations upstream of barriers within the Uanui Stream where instream habitat enhancement in the form of addition of cobbles and/or woody debris can take place
- develop a basic design plan.

Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank. Include adjoining wetland areas within the riparian fencing. Undertake native riparian planting within the fenced area and associated weed control and maintenance for native plant establishment.
- Assume 10% (520m) of the streambank requires fencing at an estimated cost of $8 per metre ($4150).
- Assume 0.3ha requires planting at an estimated cost of $39,552 per hectare ($11,865).

Instream works
Install instream habitat such as cobbles and/or woody debris structures as required. The purpose of this is to create more habitat complexity and provide habitat heterogeneity by having a mix of instream structure types.</td><td></td></tr>
</table>

	It is estimated that this would occur at 10 locations with one new structure at each location. The estimated cost per 10 structures is $10,000. Resource consent may be required for this work depending on the proposed method and design ($2500) **Liaison with landowners** Engage with landowners and community (e.g. Waipāmu Station) within the catchment to plan for best practice forest harvesting to maintain or improve instream values in the downstream section of the catchment. 20 hours of a technical specialist/project manager talking with forest managers ($2000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year after project commencement.	L = 3
Effectiveness of works	This stream is currently in good condition with some of the Vision & Strategy desired state aspects already being met. There is not expected to be a significant change to this over the next 20 years in the absence of this project. Works included here are expected to improve aspects related to fish habitat and biodiversity. Consequently, the streams will be closer to Vision & Strategy state being achieved in 20 years' time if these works are undertaken. The project does not address any threats related to catchment land use.	W = 0.1
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is still uncertainty around the causes of kōura decline and best practice for habitat restoration.	F = 0.82
Adoptability	There are a small number of landowners along the stream and it is estimated that about two thirds would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge for some in terms of uptake, however, there is only a small amount of fencing and planting to be carried out and landowners in the catchment have previously been supportive of environmental projects. The majority of the stream is already fenced and vegetated.	A = 0.7
Information quality	Average – management recommendations based on input from practitioner with some local knowledge. Quantities of work	

<table>
<tr><td></td><td>required are predominantly based on estimates made from aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Site evaluation and planning</td><td>6,000</td></tr>
<tr><td>Riparian management (520m & 0.3ha)</td><td>16,015</td></tr>
<tr><td>In-stream works (incl. consent)</td><td>12,500</td></tr>
<tr><td>Liaison with landowners and community</td><td>2,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>7,303</td></tr>
<tr><td>Total</td><td>43,818</td></tr>
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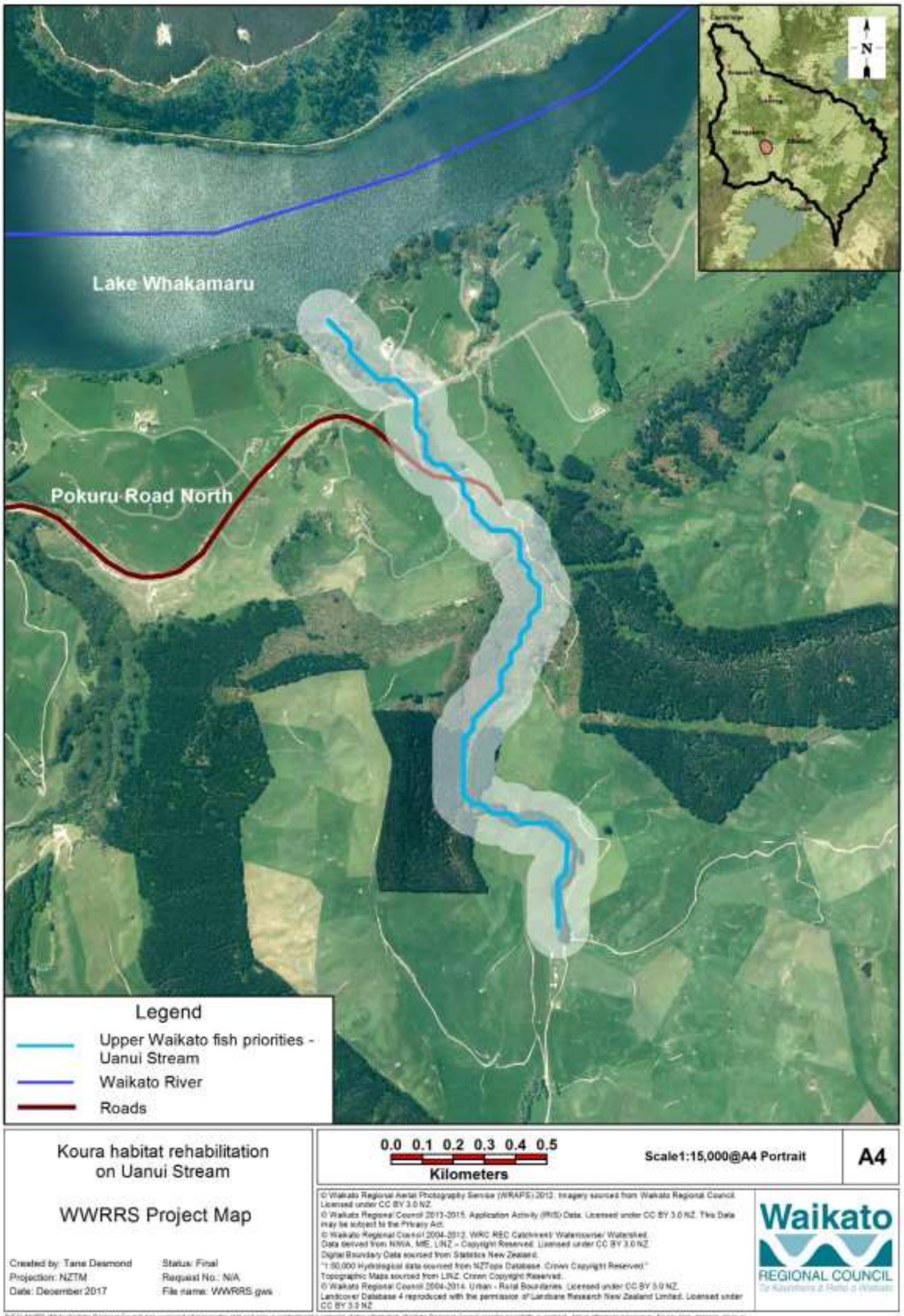

Lake Whakamaru
Pokuru Road North
Legend
Upper Waikato fish priorities - Uanui Stream
Waikato River
Roads
Koura habitat rehabilitation on Uanui Stream
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.1 0.2 0.3 0.4 0.5
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UW 14 Priority: very high	Hill country erosion protection and remediation in the Maraemanuka, Ōkama and Uanui catchments	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7 and 8) land and gully heads. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Maraemanuka, Ōkama and Uanui streams	
Brief description of feature	This suite of catchments sits on the northeastern flank of the Mangakōwhiriwhiri catchment (also included in the strategy) and contains some steep, deeply incised gully terrain along the northern margins. It has a combined area of 5314ha of which 3423ha is 6e, 7 or 8 in pasture. 12% of the total catchment area is in indigenous forest cover and 6% is in forestry. The Maraemanuka catchment is a narrow north-south catchment lying parallel to the Mangakōwhiriwhiri catchment, but is not so extensive and has a less developed stream gully system. The Uanui catchment is small and localised, in close proximity to Lake Whakamaru. The Ōkama Stream system is the easternmost catchment and comprises three main channel systems draining the Tirohanga district. Across the central Maraemanuka/Ōkama catchment area, terrain generally varies from steep to gently rolling. Whakamaru is significant in the history of iwi. Whakamaru was a mountain, alongside Tūaropaki, and they were known as the bird mountains. There are many pā sites within the region where the Ngāti Kahu pungapunga were attacked and defeated. These pā were located all around the area, including Te Whetū, Piraunui, Puke Tōtara and Hōkio. The area was valued for its bird life and abundance of food. Some historic soil conservation works are distributed throughout these catchments, established under the Whakamaru Soil Conservation Scheme, along with sites of more recent riparian protection works. Historic Farm Plan and isolate works (addressing specific localised erosion issues) are aged and are likely due for some refurbishment.	

	Ephemeral flow paths discharging to incised stream channels present some potential for lateral gully development, and there is scope for some further protection work in the upper catchments. Modelling undertaken in 2016 indicates that these catchments are a high priority for hill country erosion management.	
Desired state to achieve Vision & Strategy	- Catchments where land use matches capability and stable stream networks have fenced and well vegetated riparian margins (at least 5m wide) along their entire length. - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present. - The streams are swimmable, fishable and have access for recreation. - Iwi and community have a strong connection to the streams and are active in their protection and restoration.	
Impact on Vision & Strategy	In a restored condition, this group of catchments would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 70
Key threats to the feature that this project addresses	**Key threat**: Hill country erosion — **Impact on feature**: Contributes significant sediment to the catchment streams and upper Waikato River.	
Project goal/s	- 100% of LUC class 8 land is retired from grazing. - LUC class 7 land is managed within its capabilities and retired from heavy stock grazing. - There is a 30% reduction in suspended sediment across the three streams within 10 years.	
Priority works for funding	- Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 11 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures, etc) ($165,000). - 268ha LUC 6e managed with plantation species (e.g. pine or manuka) at $2500 per hectare including fencing ($670,000). - 184ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($460,000). - 22km fencing retired LUC 8 land ($550,000) - 17ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($85,000)	

	- 5.6km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($140,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 10
Effectiveness of works	When compared to desired state, this group of sub-catchments is currently in a moderate condition but does have some of the Vision & Strategy desired state aspects being met or partly met. There is not expected to be significant deterioration in the condition of the catchments over the next 20 years in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to these catchments and their waterways over a 20-year period. The project does not directly address aspirations related to riparian or biodiversity enhancement, however, there would be some secondary benefit in these areas as a result of retirement and revegetation being undertaken.	W = 0.2
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.87
Adoptability	It is estimated that approximately one third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment recently. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.3
Information quality	Average – based on modelled information and local expert knowledge.	
Knowledge gaps	Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>11 erosion control structures on LUC class 6e land</td><td>165,000</td></tr>
<tr><td>268ha LUC class 6e land managed with plantation species</td><td>670,000</td></tr>
<tr><td>184ha LUC class 7 land managed with plantation species</td><td>460,000</td></tr>
<tr><td>Fencing retired LUC class 8 land (22km)</td><td>550,000</td></tr>
<tr><td>Erosion control outside LUC class 6e, 7 and 8 land (17ha)</td><td>85,000</td></tr>
<tr><td>Fencing existing indigenous forest remnants (5.6km)</td><td>140,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>621,000</td></tr>
<tr><td>Total</td><td>2,691,000</td></tr>
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<td>C = 2.69</td>
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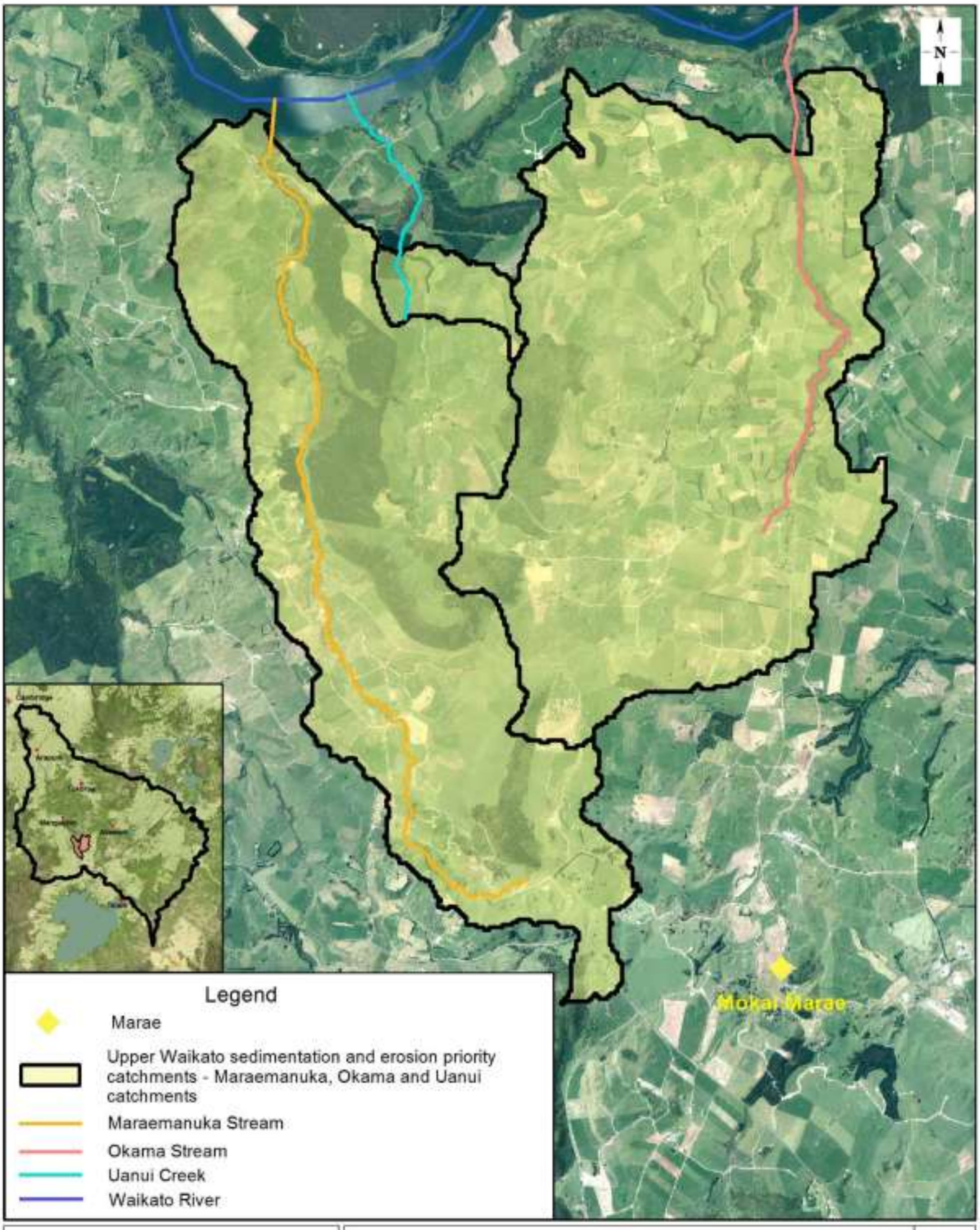

Hill country erosion protection and remediation in the Maraemanuka, Okama and Uanui catchments

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: February 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:60,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL

Example of hill country in the Maraemanuka, Ōkama and Uanui catchments.

Example of hill country in the Maraemanuka, Ōkama and Uanui catchments.


Example of gully head erosion in the Maraemanuka, Ōkama and Uanui catchments.

UW 15 Priority: medium	Mangakōwhiriwhiri catchment hill country erosion protection and remediation	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7, 8) land and gully heads. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Mangakōwhiriwhiri Stream sub-catchment	
Brief description of feature	The Mangakōwhiriwhiri is a 6934ha catchment draining into the Waikato River near the small town of Whakamaru. 84% of the catchment is in pasture, of which 4523ha (78%) is 6e, 7 or 8 in pasture. Whakamaru is significant in the history of iwi. Whakamaru was a mountain, alongside Tūaropaki, and they were known as the bird mountains. There are many pā sites within the region where the Ngāti Kahu pungapunga were attacked and defeated. These pā were located all around the area, including Te Whetū, Piraunui, Puke Tōtara and Hōkio. The area was valued for its bird life and abundance of food. The Mangakōwhiriwhiri catchment is relatively narrow and lies on the north-south orientation. It is characterised by a deeply incised central channel gully system in the mid and lower reaches, with moderately incised minor channels in the upper reaches. Rolling terrain in the upper (southern) catchment grades into strongly rolling to steep terrain in the lower catchment. Rocky outcrops occur throughout the catchment. A marginal strip reserve is established along a section of the central/upper channel and sections of channel are contained within other types of riparian reserve in the central and lower reaches. Historical soil conservation works are spread throughout the catchment, established through Farm Plans under the Whakamaru Soil Conservation Scheme and as isolated works (addressing specific site erosion issues). Ephemeral flow paths discharging to incised stream channels present ongoing potential for lateral gully development, and there is scope for some further riparian protection work in the upper (southeastern) catchment.	

<table>
<tr><td></td><td>Modelling has identified the catchment as a high priority for management of hill country erosion.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability, and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and community have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Mangakōwhiriwhiri Stream sub-catchment would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 70</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams and upper Waikato River.</td></tr>
<tr><td>Stock access to streams</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- 100% of LUC class 8 Land is retired from grazing.
- LUC class 7 land is managed within its capabilities and is retired from heavy stock grazing.
- There is a 20% reduction in suspended sediment in the Mangakōwhiriwhiri Stream within 20 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 16 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures etc) ($240,000).
- 412ha LUC 6e managed with plantation species (e.g. pine or manuka) at $2500 per hectare including fencing ($1,030,000).
- 96ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare ($240,000).
- 24km of fencing retired LUC 8 land at $25 per metre (8-wire and batten) ($600,000).</td><td></td></tr>
</table>

	- 32ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($160,000). - 4km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($100,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	When compared to desired state, this sub-catchment is currently in a moderate condition but does have some of the Vision & Strategy desired state aspects being met or partly met. There is not expected to be significant deterioration in the condition of the catchment over the next 20 years in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to the Mangakōwhiriwhiri catchment over a 20-year period, particularly with respect to water quality and land use matching capability.	W = 0.2
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.	F = 0.87
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.5
Information quality	Average – based on modelled information and local knowledge.	
Knowledge gaps	Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
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<table>
<tr><td>Task</td><td align="right">Cost ($)</td></tr>
<tr><td>16 erosion control structures on LUC class 6e land</td><td align="right">240,000</td></tr>
<tr><td>412ha LUC class 6e land managed with plantation species</td><td align="right">1,030,000</td></tr>
<tr><td>96ha LUC class 7 land managed with plantation species</td><td align="right">240,000</td></tr>
<tr><td>Fencing retired LUC class 8 land (24km)</td><td align="right">600,000</td></tr>
<tr><td>Erosion control outside LUC class 6e, 7 and 8 land (32ha)</td><td align="right">160,000</td></tr>
<tr><td>Fencing existing indigenous (4km)</td><td align="right">100,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td align="right">711,000</td></tr>
<tr><td>Total</td><td align="right">3,081,000</td></tr>
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<td>C = 3.08</td>
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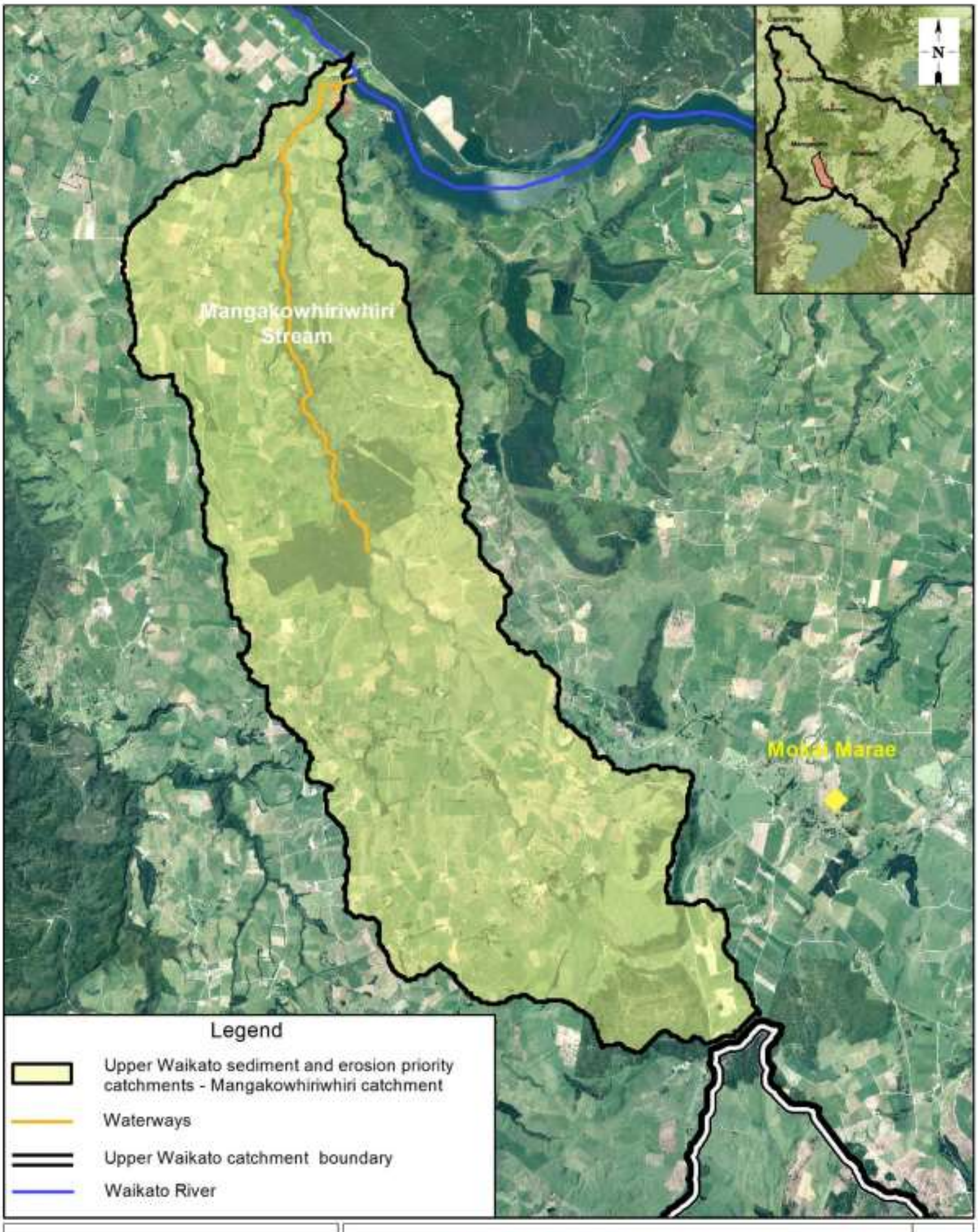

Scale1:85,000@A4 Portrait

A4

Mangakowhiriwhiri catchment hill country erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Waikato REGIONAL COUNCIL

UW 16 Priority: very high	Kōura habitat rehabilitation in Waipapa, Mokauteure and Ongarahu streams	BCR value
Relevant unit goal(s)	The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use. Collaborative education and research opportunities increase knowledge and understanding of fisheries in the Upper Waikato.	
Name of feature	Waipāpa Stream, Mokauteure and Ongarahu streams	
Brief description of feature	The feature includes approximately 45km of waterways consisting of Waipāpa Stream below Tirohanga Road, and Mokauteure and Ongarahu streams below Forest Road. Mokauteure Stream is a tributary to Waipāpa Stream which has headwaters east of Mokai and flows into the Waikato River immediately downstream of Tram Road Bridge (downstream of Ātiamuri Dam). Ongarahu Stream is in a neighbouring catchment to the east and flows into the Waikato River upstream of Waipāpa Stream. These waterways are some of the few in the Upper Waikato catchment that are known to sustain good populations of kōura. It is largely unknown why kōura populations have declined/disappeared from other waterways so this project represents an opportunity to protect and increase the remaining populations. Riparian margins are largely well managed but there are other opportunities to further enhance kōura habitat. The vicinity of Ātiamuri was explored by Tia, the older brother of the captain of the Arawa canoe, who "turned back" here when he encountered the since-flooded Ātiamuri Falls on the river. This area is very significant to the iwi and hapū who would have accessed these waters and forests for kai (food) and established settlements to take advantage of the resources the area provided.	
Desired state to achieve the Vision & Strategy	- The stream is fenced to exclude stock from its entire length, particularly in the upper reaches above barriers to predatory fish, and there is a riparian margin well vegetated with native plant species that is a minimum of 5m wide. - Kōura are abundant, particularly in the upper reaches and the stream is fishable. - Iwi and communities have a strong connection to the streams and are active in their protection and restoration.	

<table>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, these streams would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 50</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated kōura habitat</td><td>Reduced habitat for juvenile and adult kōura – cover increases refuge from predation, especially fish. Cover also reduces water temperatures and increases resilience to climate change. Protecting riparian buffers of native vegetation will also reduce use of pesticides and herbicides near waterways that may negatively affect aquatic life.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for kōura and native fish species, increased sedimentation and increased scouring high flow events.</td></tr>
<tr><td>Removal of downstream barriers to fish passage</td><td>Natural barriers should not be unduly altered (e.g. by culverts fitted with fish passage allowances). Altering these barriers will increase the predation of kōura by other fish species (e.g. trout, tuna).</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The identified waterways are 100% fenced to exclude stock.
- Instream habitat for kōura has increased and stream users report an increase in the numbers of kōura encountered.
- Cobbles and/or woody debris structures are installed at 20 locations.
- Forest harvest activities are undertaken using best practice methods to avoid negative impacts on kōura habitat.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Site evaluation and planning
Identify locations within the Waipāpa, Mokauteure and Ongarahu Stream catchments where there are barriers to kōura predators and no stocking of predatory fish (e.g. trout). These will be potential areas for kōura habitat enhancement.

Identify locations where instream habitat enhancement in the form of addition of cobbles and/or woody debris can take place and develop a design plan.</td><td></td></tr>
</table>

	The estimated cost for this work is $14,400. This allows for 4 days of site scoping with 2 people and preparation of a brief plan identifying key sites for installation of structures and design specifications. **Riparian management** Carry out riparian fencing with a minimum 5m setback from the top of the streambank. Include adjoining wetland areas within the riparian fencing. Undertake native riparian planting within the fenced area and associated weed control and maintenance for native plant establishment. Estimated costs assume that 95% of waterways are well fenced and vegetated. - Fencing (at least 5 wire fence with 2 electric wires) of 4500m of streambank at $8 per metre ($36,000) - Native revegetation and weed control of 2.25ha of fenced riparian margin at $39,552 per hectare ($88,992). **Instream works** Carry out work to install instream habitat such as cobbles and/or woody debris structures as required. It is estimated that this would occur at 20 locations with one structure per location. The estimated cost per 20 structures is $20,000. Resource consent may be required for this work depending on the design and method proposed ($2500). **Liaison with forest managers** Engage with forest managers within the catchment to plan for best practice harvesting to maintain or improve instream values in the downstream section of the catchment. This could involve improving what is currently working well (e.g. if kōura are abundant in the upper catchment then ensure that barriers, etc. are maintained post-harvest). 20 hours of a technical specialist/project manager talking with forest managers ($2000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs. Tuaropaki Farm is located in the head of Waipāpa catchment and has undertaken some excellent riparian planting and has	

	waterways with very high kōura densities (off Tirohanga Road). Tuaropaki should be approached to gauge their interest for supporting initiatives in the catchment to enhance native species. Potential projects should also be discussed with Mokai Marae.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	These streams are currently in good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable. There is not expected to be a significant change to this over the next 20 years in the absence of this project given existing measures in place, such as the Dairy Water Accord. Works included here are expected to improve aspects related to fish habitat, biodiversity and stock access. Consequently, the streams should be somewhat closer to Vision & Strategy state being achieved in 20 years' time if these works are undertaken. The project does not address catchment land use and the high nitrogen and phosphorus levels in these streams.	W = 0.05
Risk of technical failure	There is a moderate to risk of project failure due to technical feasibility. There is still uncertainty around the causes of kōura decline and best practice for habitat restoration.	F = 0.82
Adoptability	It is estimated that about 80% of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge for some in terms of uptake, however, there is only a small amount of fencing and planting to be carried out and landowners in the catchment have previously been supportive of environmental projects.	A = 0.8
Information quality	Average – kōura are known to be found within these waterways, particularly in the upper reaches. Riparian management costs are based solely off aerial photography. Instream work cost estimates are based off similar work undertaken by NIWA.	
Knowledge gaps	It is unknown exactly how much fencing already exists and estimates are based on aerial photography and some on-the-ground knowledge. The location of specific sites where habitat enhancement could be undertaken needs to be determined during the site evaluation and planning phase of the project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Site evaluation and planning</td><td>14,400</td></tr>
<tr><td>Fencing (4.5km)</td><td>36,000</td></tr>
<tr><td>Planting and weed control (2.25ha)</td><td>88,992</td></tr>
<tr><td>In-stream works (including resource consent)</td><td>22,500</td></tr>
<tr><td>Liaison with forest managers</td><td>2000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>32,778</td></tr>
<tr><td>Total</td><td>196,670</td></tr>
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<td>C = 0.2</td>
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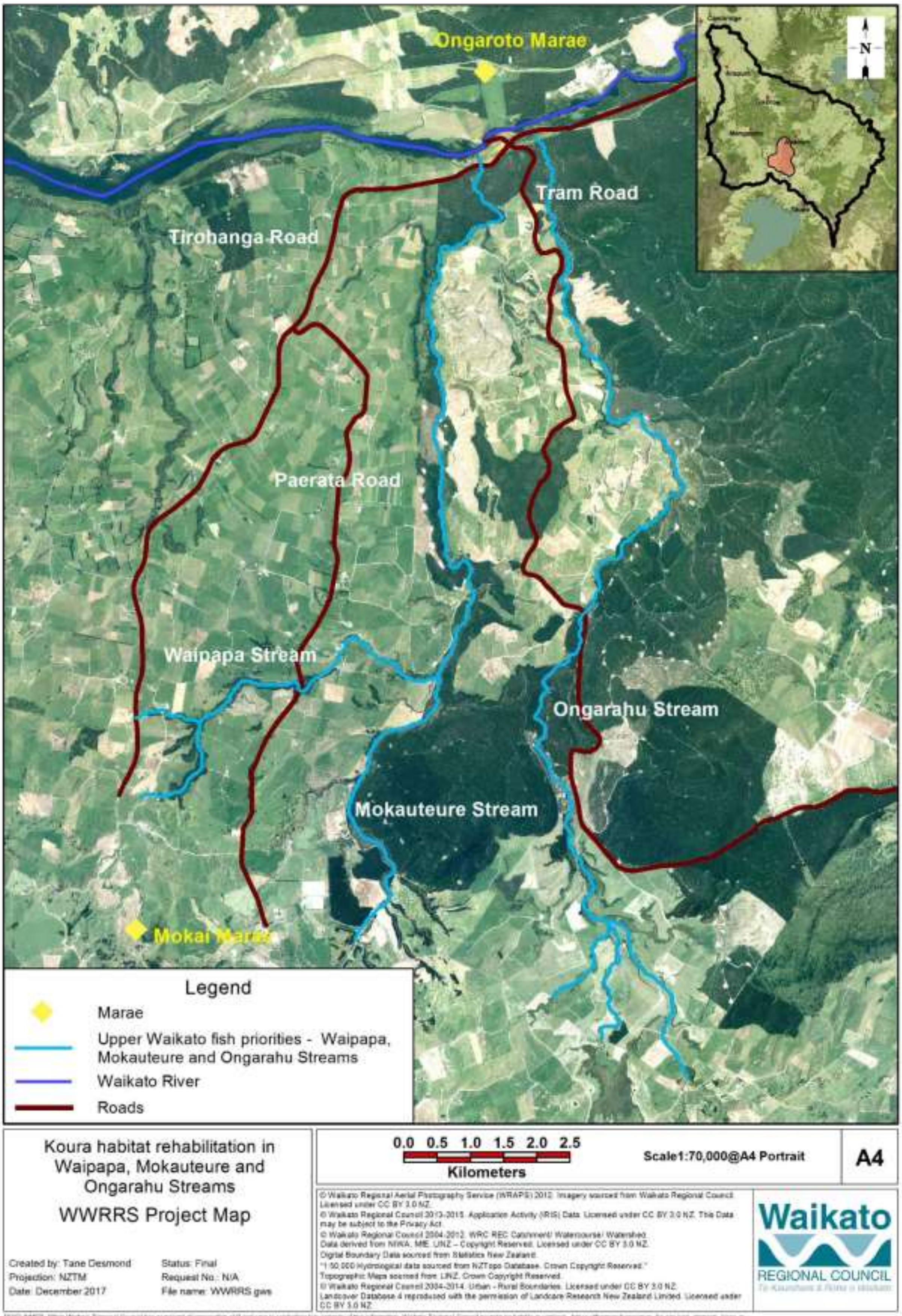

Ongaroto Marae
Tram Road
Tirohanga Road
Paerata Road
Waipapa Stream
Ongarahu Stream
Mokauteure Stream
Mokai Marae
N
Legend
Marae
Upper Waikato fish priorities - Waipapa, Mokauteure and Ongarahu Streams
Waikato River
Roads
Koura habitat rehabilitation in Waipapa, Mokauteure and Ongarahu Streams
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS gws
0.0 0.5 1.0 1.5 2.0 2.5
Kilometers
Scale1:70,000@A4 Portrait
A4
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Waikato
REGIONAL COUNCIL

UW 17 Priority: high	Biodiversity enhancement at Forest Road Wetland	BCR value
Relevant unit goal(s)	Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work, including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Forest Road Wetland	
Brief description of feature	A very large 196ha wetland complex including riverine wetland (DOC 1998a) and extensive flax and sedge areas. It is located in the Ātiamuri Ecological District, where less than 7% of indigenous vegetation remains. The wetland is surrounded by farmland used for dairy grazing. A wide range of species are present with 29 indigenous plants and 11 introduced plants. Native broom (*Carmichaelia australis*) occurs here, along with indigenous buttercup (*Ranunculus macropus*) and marsh willow herb (*Epilobium chionanthum*). Also present are native grasses *Hierochloe redolens* and *Rytidosperma gracile.* Plant pest species including pine occur in drier areas and willow in the wetter areas. A number of bird species are present including fernbird (sparse), spotless crake (sparse), tūī, bellbird, whitehead and brown quail. The vicinity of Ātiamuri was explored by Tia, the older brother of the captain of the Arawa canoe, who "turned back" here when he encountered the since-flooded Ātiamuri Falls on the river. This area is very significant to the iwi and hapū who would have accessed these waters and forests for kai (food) and established settlements to take advantage of the resources. The Forest Road Wetland is within the top 15% of sites for biodiversity protection and enhancement within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type. Wetland habitat is critically under-represented in the Waikato region (less than 10% of the wetlands that existed prior to human settlement remain today).	
Desired state to achieve Vision & Strategy	- The wetland is densely vegetated with native plant species and protected from stock grazing. - Native plant regeneration occurs naturally and the wetland is free from pest willow and wilding conifers. - Other weed species inhabit less than 5% of the wetland area.	

<table>
<tr><td></td><td>- Iwi and communities have a strong connection to the gully wetlands and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Forest Road wetland would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 35</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Wilding conifers</td><td>Compete with native plant communities and continue to spread.</td></tr>
<tr><td>People become disconnected from the wetland and see the area as a resource rather than something that needs to be nurtured and cared for</td><td>Wetland becomes more degraded.</td></tr>
<tr><td>Stock access to wetland</td><td>Reduce water quality and destruction of wetland vegetation.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 4 years of project commencement the identified wetlands are 100% fenced (5 wire, 2 electric) to exclude stock.
- Within 8 years, the willows, wilding pines and other weeds within and on the buffers of the identified wetlands areas have been eliminated or contained and there is regenerating native vegetation.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the extent of fencing, planting and weed control required. However, based on aerial photography, a brief site visit and the SNA/wetland inventory information the following estimates and assumptions have been made:

Management Plan Development
The Forest Road Wetland would need a thorough site assessment and management plan, to prioritise the wetland into working blocks and to include a plant survey. The estimated cost of this is $15,000.

Fencing
Upgrade 53km of existing fencing from 2 wire electric to 5 wire</td><td></td></tr>
</table>

	(2 electric). Cost estimates assume full replacement of existing fences at a cost of $8 per metre ($424,000.00). **Weed control** The wetland has a range of weed species present, including willows, blackberry, broom, wilding pines and Spanish heath. Most of these weeds are present around the perimeter of the wetland so ground control around the perimeter is recommended as a priority. It is estimated that weed control will be required over an area of 41ha at a cost of $1400 per hectare per year for 3 years ($172,200.00) using a combination of ground based methods (e.g. knapsack and vehicle). **Willow control** Control 60ha of dense willow infestations by aerial boom spraying at a cost of $400 per hectare ($24,000). This control can be done in stages or at once but the project manager will need to work closely with landowners and neighbours and follow Waikato Plan Rule 6.2 "The discharge of Agrichemicals". Aerial spot spraying of scattered willow trees is recommended. This is estimated to take 18 hrs per year for 8 years ($27,000) using a Hughes 500 helicopter plus $6000 for agrichemical ($33,000 per year x 8 years is $198,000). **Planting** Native planting should be carried out within open areas around the wetland to create a native plant dominated ecosystem over the long-term. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed in the wetland buffer e.g. cabbage tree, flax, toetoe, Manuka, *Carex* etc. An 8ha are of planting is likely to be required at a cost of $39,518 per hectare ($316,416). **Animal pest control** *Possums* Carry out possum control while native plants are establishing. Costs are based on establishing a network of bait stations, however other methods could also be explored. Approximate cost: 198ha x $200/ha is $39,600 per year. Control for 3 years is $118,800. This site would benefit from mustelid, cat and rat control to protect and enhance native bird populations. This work has not been costed as ongoing animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting),	

	project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over an 8-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year before project completion.	L = 7
Effectiveness of works	The Forest Road Wetland is currently in good to very good condition with high biodiversity values. In the absence of this project it is expected that there will be some decline in wetland condition over the next 20 years as weeds continue to spread and impact on ecological integrity. It is anticipated that if this project is fully completed, the wetland will be in excellent condition and close to the Vision & Strategy desired state in 20 years' time, with stock access, weed control and establishment of further areas of native planting all being addressed through the proposed works.	W = 0.12
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plants and success of weed control. Weed control will need to be led by experienced practitioners.	F = 0.82
Adoptability	There are only a few landowners at this site and it is estimated that most would adopt the works if they were fully incentivised. Waikato Regional Council is already working with one of the landowners to protect and restore the wetland.	A = 0.675
Information quality	Average – recommended management actions are based on the judgement of an expert with local knowledge. Quantity of work required is based on measurements and estimates taken using aerial photography.	
Knowledge gaps	Further investigation is required to determine the specific amount of fencing, planting and weed control required. This will need to be undertaken during the project planning phase.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	8 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing upgrade and some new fencing (53km)</td><td>424,000</td></tr>
<tr><td>Planting (8ha)</td><td>316,416</td></tr>
<tr><td>Weed control - ground</td><td>172,200</td></tr>
<tr><td>Aerial control - Boom spray</td><td>24,000</td></tr>
<tr><td>Aerial control – spot spray</td><td>198,000</td></tr>
<tr><td>Possum control</td><td>118,800</td></tr>
<tr><td>Management plan includes plant survey</td><td>15,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>253,683</td></tr>
<tr><td>Total</td><td>1,522,099</td></tr>
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<td>C = 1.52</td>
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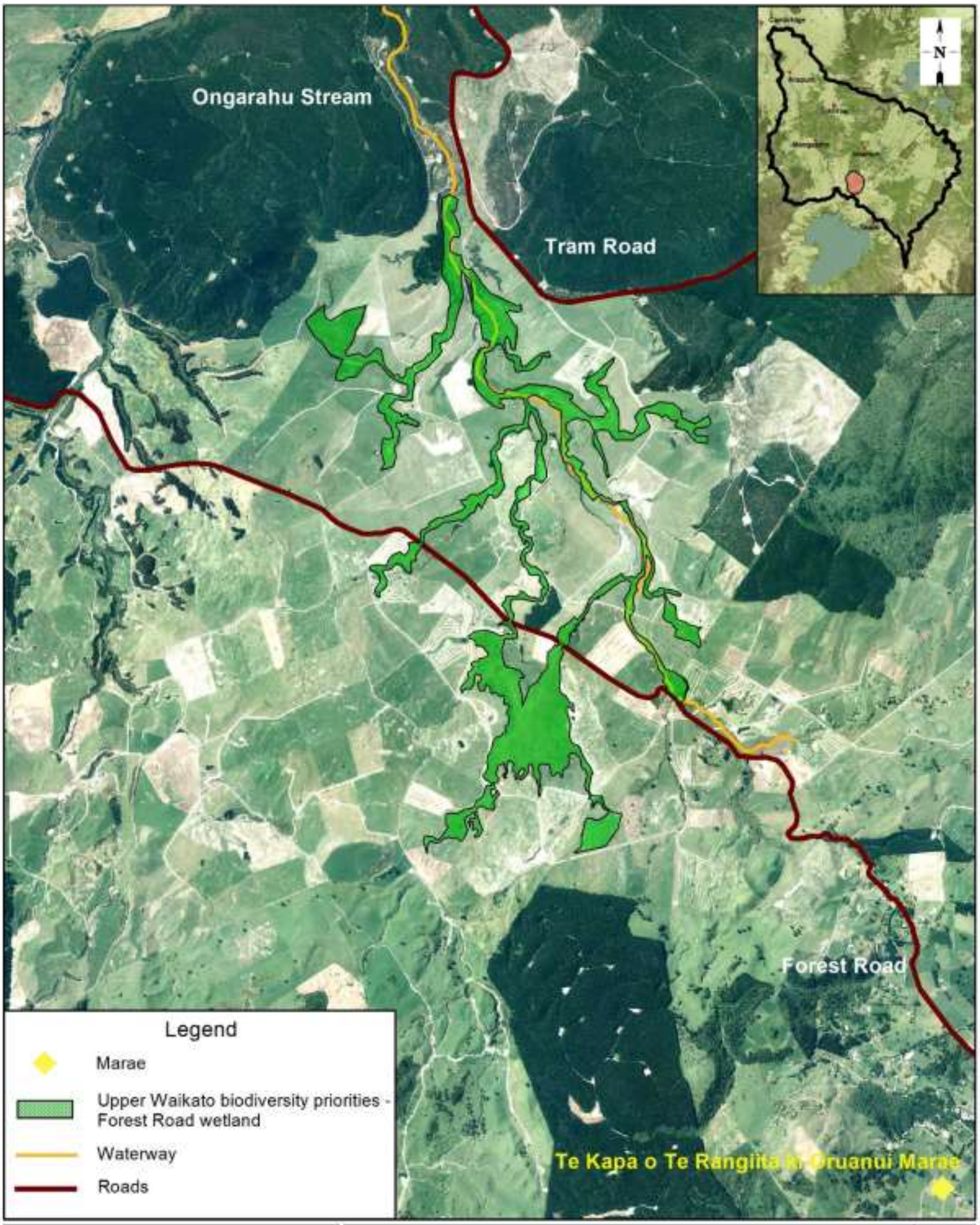


Biodiversity enhancement at Forest Road wetland

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale1:40,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Example of the wetland buffer and weeds present.

Example of indigenous species present.

Photo showing wilding pine and willow invasion.

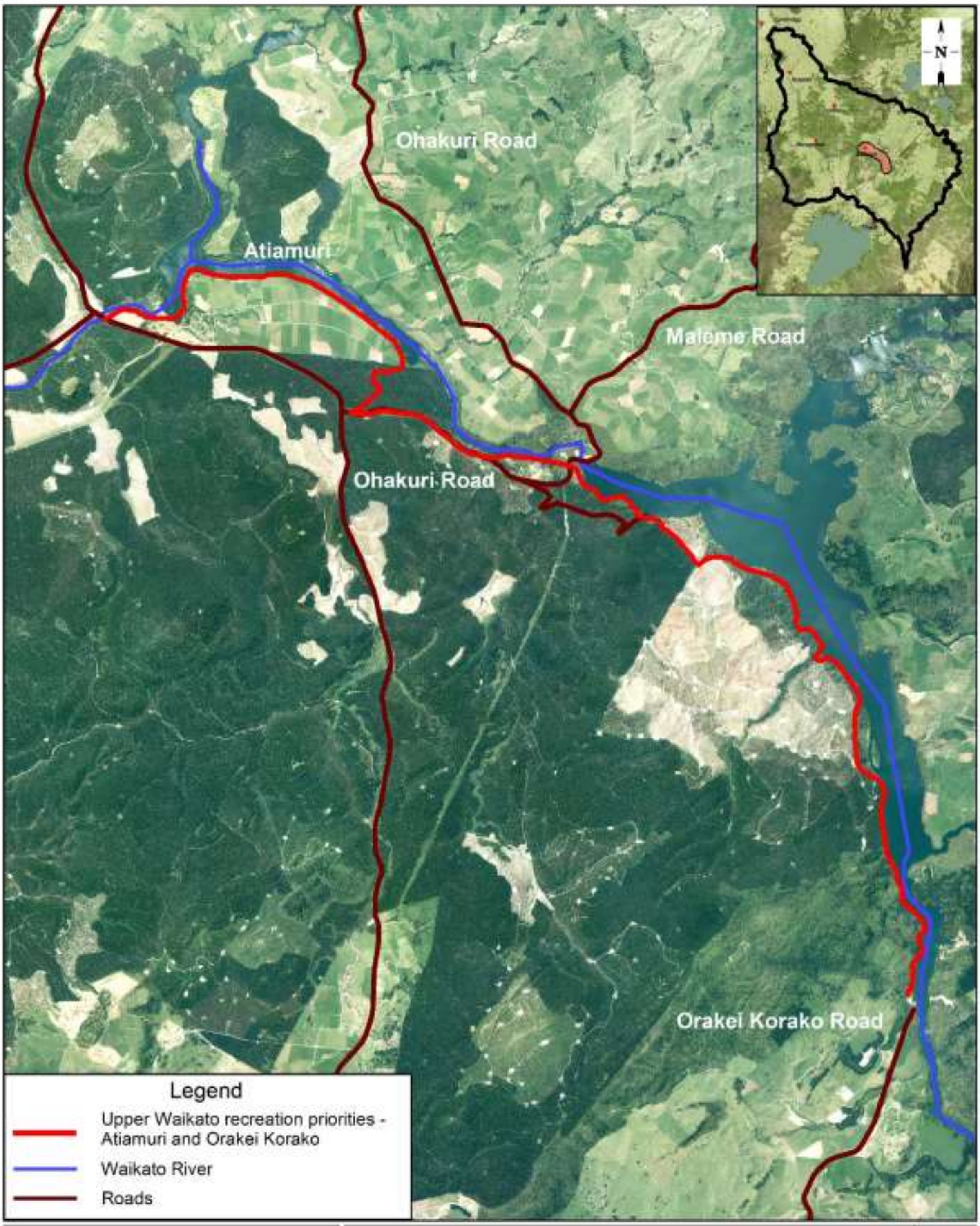
UW 18 Priority: high	Cycleway/walkway along the Waikato River between Ātiamuri and Ōrākei Kōrako	BCR value
Relevant unit goal(s)	Rivers and waterways are widely used by the iwi and the community and are a place to relax, play, exercise, recreate and gather kai. River restoration activities enhance the economic wellbeing of the Upper Waikato.	
Name of feature	Waikato River between Ātiamuri and Ōrākei Kōrako	
Brief description of feature	This section of the river stretches for approximately 20km between Ātiamuri in the north and Ōrākei Kōrako in the south. Areas of the main river stem are incised in many places with steep banks and cliff edges. There are areas of geothermal activity in close proximity to the river which include Ōrākei Kōrako, Akatarewa and Waihunuhunu. The river has a riparian margin that is generally a mixture of native and exotic vegetation, including some weed species. Some larger native forested areas remain in the vicinity including Tutukau Forest, the base of the Paeroa Range and around the Whirinaki Arm confluence. The catchment land use is predominantly pastoral farming with recent large scale land use conversions from forestry to dairy farming. Two hydro dams – Ātiamuri and Ohakuri – are located on this stretch of the Waikato River. This section of Waikato River is relatively inaccessible with very few public access points. This part of the river has a lot of history and is of significant cultural and historical importance to river iwi. For iwi, the river provides physical and spiritual sustenance and was a critical source of food, including tuna and other fish and plants. Historically, the river in this area was fast flowing with many rapids and falls. Extensive geothermal areas were present around Ōrākei Kōrako and northwards. With the creation of Lake Ohakuri for hydro dam purposes, much of the river has been flooded, geothermal features drowned and the original character of the river lost. The original Ngati Tahu-Ngati Whaoa settlement at Ōrākei Kōrako was also lost with dam development. Most of the time this section of the river is safe for swimming, however, water quality is declining due to increasing nutrient inputs, particularly nitrogen from catchment land use. Of particular concern is the occurrence of algal blooms and the	

	excessive growth of the aquatic weed hornwort. In particular, the Whirinaki Arm which feeds into Lake Ohakuri has ongoing water quality issues. A cycleway along this stretch of the river links to the existing cycle trails at Ātiamuri and Ōrākei Kōrako and provides a link to the existing tourist facilities at Ōrākei Kōrako. It also provides links to existing projects which share cultural Sites of Significance to Ngati Tahu-Ngati Whaoa along the river and cultural history. Ōrākei Kōrako is central to the identity of Ngati Tahu-Ngati Whaoa iwi as it was their original settlement and ūkaipō. The trail would also provide an opportunity to connect to areas of the Waikato River further south (upstream) and the associated cultural values (including iPou and kōhatu) at other sites along the river up to Huka Falls. There is already a kōhatu and iPou at Ōrākei Kōrako and an opportunity to also install one at Ātiamuri.	
Desired state to achieve the Vision & Strategy of feature	- Iwi and community have a strong connection to the river and are active in its protection, use and restoration. - Cultural history is shared and iwi, community and visitors experience the history of this area and its importance. - The river has a riparian margin that is well vegetated with native plants. - The river is swimmable, fishable and has access for recreation.	
Impact on Vision & Strategy	In a restored condition, the Waikato River between Ātiamuri and Ōrākei Kōrako would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 175
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Lack of access</td><td>People see the waterway more as a resource than something that needs to be nurtured and cared for. Cultural history is lost. River becomes more degraded.</td></tr><tr><td>Missed opportunity to create economic benefits for communities along the river</td><td>Less investment in improving the river environment. River becomes more degraded.</td></tr></table>	
Project goal/s	Within 4 years of the project commencing: - A metal track is constructed that is approximately 22km long, 2m wide, adjacent to the Waikato River between Ātiamuri and Ōrākei Kōrako and connected to the existing Waikato River trails at Ātiamuri and Ōrākei Kōrako. - Track is vegetated with native vegetation along its entire length and approximately 85,000 plants are planted.	

	- Public are able to access this section of the river at no cost. - Interpretation panels share the cultural history of Ngati Tahu-Ngati Whaoa iwi and associated iwi and enhance the appreciation of this stretch of river.	
Priority works for funding	This work is best implemented by a professional organisation with previous experience in cycleway/walkway development. It is envisaged that a project manager would be required to manage the project. **Project planning** This component of the project would include a range of tasks: - Scoping the trail route including undertaking landowner consultation, discussion with Ngati Tahu-Ngati Whaoa Runanga Trust and landowners, identification and engineering advice on structures required (e.g. bridges, culverts, retaining walls). This phase clearly identifies the feasibility, real expected costs of the project and expected time frames for development. - Undertaking cultural impact assessment ($20,000). - Securing project funding. The estimated cost of this phase is $50,000. **Legal requirements and procurement** This phase of the project involves: - preparation and lodgement of consent applications - formalising land access agreements. - development and distribution of project tender documents - engaging services of appropriate contractor. The estimated cost of this phase is $13,500. **Construction** This phase of the project includes: - trail construction including installation of informational (including Ngati Tahu-Ngati Whaoa cultural signage), directional and interpretive signage (estimated cost $1,250,000) - riparian planting of approximately 85,000 plants over 5 years ($680,000 including planting labour, plant purchase, 5 releasing events). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

	This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 4-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year after project completion.	L = 3
Effectiveness of works	The Waikato River between Ātiamuri and Ōrākei Kōrako is currently in good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable and fishable. In the absence of this project there is potential that over the next 20 years this feature will slightly decline in condition. Works proposed here address aspirations for access, recreation and reconnection opportunities along this stretch. The project does not address catchment land use or biodiversity aspirations, however, it is anticipated that if this work is fully completed, this feature overall will move closer to the Vision & Strategy desired state in 20 years' time.	W = 0.05
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure track is well designed and safe.	F = 0.97
Adoptability	It is estimated that about 80% landowners would adopt the works if they were fully incentivised. Similar tracks in other part of the catchment have been well supported and preliminary work along this stretch has indicated a high level of support.	A = 0.8
Information quality	Good – based on the local knowledge of Waikato River Trails whom have managed the construction of over 100km of trails. Works required and cost estimates for track development are based on information provided by Waikato River Trails.	
Knowledge gaps	Costs provided are indicative. To establish more accurate costs, detailed scoping of specific trail route needs to be completed.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	4 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 2.6

Task	**Cost ($)**
Project planning	50,000
Legal requirements and procurement	13,500
Track construction (22km) and planting (85,000 plants)	1,930,000
Project management/staffing/incidentals (30%)	598,050
TOTAL	**2,591,550**



Cycleway/Walkway along the Waikato River between Atiamuri and Orakei Korako

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale1:70,000@A4 Portrait

A4

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An example of a previously completed river trail. Photo: Waikato River Trails

UW 19 Priority: high	Upper Tahunaatara Stream erosion protection and riparian enhancement	BCR value
Relevant unit goal(s)	Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Pokaitu and upper Tahunaatara catchments	
Brief description of feature	The upper Tahunaatara catchment (Pokaitu Stream) has an area of approximately 15,645ha and contains some 569km of streams. It is estimated that 115km of these streams are in pastoral areas. Overall the catchment is characterised by a relatively high density of small waterways and wetlands, and contains some steep, elevated terrain on its western margin which is largely in plantation forestry. The remainder of the catchment features a central valley with steep elevated terrain in the southeast corner. Downstream of the Apirana Road bridge, the margins of the Pokaitu Stream are generally reserved as marginal strips or esplanade reserves, and this extends along the Tahunaatara Stream downstream of its confluence with the Pokaitu Stream, joining up with (Ohakuri) lake reserve margins on the Whangapoa Stream below the Ohakuri Road bridge. Steep elevated terrain in the southeastern catchment has high to moderate erosion potential, while extensive channels and wetlands in the northern catchment are susceptible to livestock impacts and streambank erosion. At the southern end of the catchment, terrain grades into elevated terraces in close proximity to the Whangapoa Stream (Lake Ohakuri), similar to the southern end of the adjacent Ātiamuri Catchment. These terrace formations largely comprise highly erodible pumice alluvium with potential for severe gully and tunnel gully erosion. Historical erosion controls works are relatively uncommon in the wider catchment and a number of streambank protection sites are spread throughout the catchment. There is scope for more streambank (and wetland) protection work, particularly in the northeastern catchment. Located south of Reporoa on the Waikato River, the manmade island of Tahunaatara was formed after a trench was dug across the headland of the river. Tahunaatara was formerly a raupo reserve situated on the Waikato River, where it flows through Broadlands. Both kōkopu and ducks were caught at Tahunaatara,	

<table>
<tr><td></td><td>kumara and other crops were also grown and the first willow trees in the area were planted there.
http://www.tahu-whaoa.iwi.nz/lands/wahitapu

Modelling undertaken in 2016 indicates that the upper Tahunaatara catchment is a high priority for management of streambank erosion.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A stream network with stable, vegetated banks and where major erosion events are limited.
- A riparian margin that is fenced to exclude stock with a minimum 5m setback, and that is well vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Pokaitu and upper Tahunaatara sub-catchments would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 100</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Tahunaatara Stream and upper Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 10 years of project commencement the streams of the upper Tahunaatara catchment are stable and fenced with a minimum 5 wire (2 electric) fence to exclude stock.
- The entire stream network is vegetated.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian fencing and planting
- Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 57km of streambank (24.5km of stream length). Include adjoining wetland areas within the riparian fencing ($456,000).
- Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 14.25ha of planting and associated weed control and maintenance ($535,116).</td><td></td></tr>
</table>

	- 1425 poplar poles are estimated to be required for river and stream erosion control. These should be planted at 10m spacing where required ($19,950). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 1 year after project completion.	L = 11
Effectiveness of works	The Pokaitu and upper Tahunaatara catchments are currently in a moderate condition with few of the Vision & Strategy desired state aspects being met. The condition is not expected to either significantly decline or improve over the next 20 years in the absence of this project. The project focuses on riparian management and streambank erosion control which would impact positively on reducing sediment and E. coli to the waterways, and have secondary benefits in biodiversity and fisheries enhancement. It is acknowledged that achieving the Vision & Strategy desired state for these catchments will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, if this project is successfully completed then the Pokaitu and upper Tahunaatara catchments are expected to show some improvement in condition and be closer to desired state in 20 years' time.	W = 0.1
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.82
Works by private citizens – likelihood of adoption and adoption circumstances	It is estimated that approximately half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be the biggest challenge in terms of uptake, however, significant riparian works have already been completed in this catchment.	A = 0.50
Information quality	Average – based on modelled information and riparian surveys of the Upper Waikato.	
Knowledge gaps	Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (57km)</td><td>456,000</td></tr>
<tr><td>Native planting (14.25ha)</td><td>535,116</td></tr>
<tr><td>Pole planting (1425 poles)</td><td>19,950</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>252,766</td></tr>
<tr><td>Total</td><td>$1,263,832</td></tr>
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</td>
<td>C = 1.26</td>
</tr>
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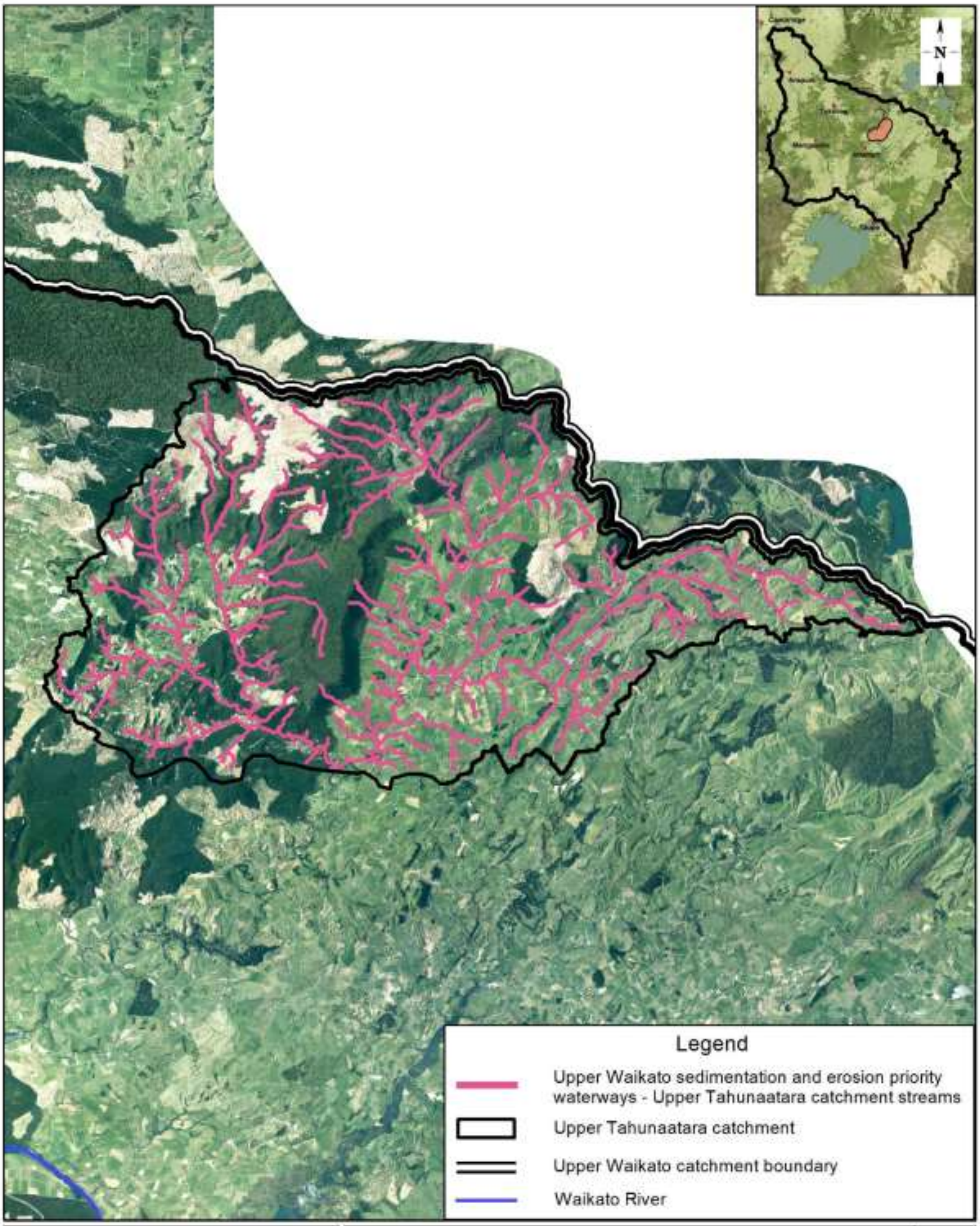

Upper Tahunaatara Stream erosion protection and riparian enhancement

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0 1 2 3 4 5
Kilometers

Scale 1:140,000@A4 Portrait

A4

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UW 20 Priority: medium	Ātiamuri catchment hill country erosion protection and remediation	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7, 8) land and gully heads. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Ātiamuri sub-catchment	
Brief description of feature	This is a relatively small catchment of 1709ha with 96% of the catchment being in pasture. 1395ha is estimated to be LUC 6e or 7 in pasture. The catchment is distinguished by steep, dissected terrain with rock outcrops on ridges in the northern and central areas of the catchment. Numerous minor stream channels are present in the central catchment and are often associated with small localised wetlands. In the southern section of the catchment, terrain grades into elevated terraces in close proximity to Lake Ohakuri, similar to the southern end of the adjacent Tahunaatara catchment. These terrace formations largely comprise highly erodible pumice alluvium with potential for severe gully and tunnel gully erosion. The central and upper catchment has been subject to intensified land use over the last 10 years, notably the removal of eucalyptus plantations for conversion to pastoral use. A number of historical erosion control works are distributed throughout the catchment along with some streambank protection sites. This entire catchment is culturally important to Ngati Tahu-Ngati Whaoa as an area for gathering kokowai and kai, in particular kokopu and ducks. Ngawapurua pa was flooded when the Ohakuri Dam was built. There were cultivations along the Waikato River, at the south side of Ohakuri Dam. With regards to the cultural significance of Ātiamuri, according to legend, Tia, the older brother of the captain of the Arawa canoe, "turned back" here when he encountered the since-flooded Ātiamuri Falls on the river. Modelling undertaken in 2016 indicates that the Ātiamuri catchment is a high priority for hill country erosion. management.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide). - Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors	

<table>
<tr><td></td><td>and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The waterways are swimmable, fishable, safe for gathering kai, and have access for recreation.
- Iwi and communities have a strong connection to the waterways and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the streams within the Ātiamuri sub-catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 18</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams and upper Waikato River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- 100% of LUC Class 8 land is retired from grazing.
- LUC class 7 land is managed within its capabilities and is retired from heavy stock grazing.
- There is a 25% reduction in suspended sediment in the Ātiamuri streams within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 4 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures etc.) ($60,000).
- 99ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($247,500).
- 122ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($305,000).
- 7ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($35,000).
- 1km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($25,000).

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.</td><td>L = 7.5</td></tr>
</table>

<table>
<tr><td>Effectiveness of works</td><td>The Ātiamuri sub-catchment is in a moderate state with few of the Vision & Strategy desired state aspirations being met. Over the next 20 years it is anticipated that some aspects could deteriorate and others could improve in the absence of this project. Works included here will contribute to aspirations around land use matching capability and improvement in water quality, with secondary benefits to biodiversity through revegetation. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, if completed this project is expected to make a measurable difference to the Ātiamuri sub-catchment over the next 20 years.</td><td>W = 0.2</td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about a third of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment recently. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.3</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>4 erosion control structures on LUC class 6e land</td><td>60,000</td></tr>
<tr><td>99ha LUC class 6e managed with plantation species</td><td>247,500</td></tr>
<tr><td>122ha LUC class 7 land managed with plantation species</td><td>305,000</td></tr>
<tr><td>7ha erosion control outside LUC class 6e, 7 and 8 land</td><td>35,000</td></tr>
<tr><td>1km fencing existing indigenous forest remnants</td><td>25,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>168,125</td></tr>
<tr><td>Total</td><td>840,625</td></tr>
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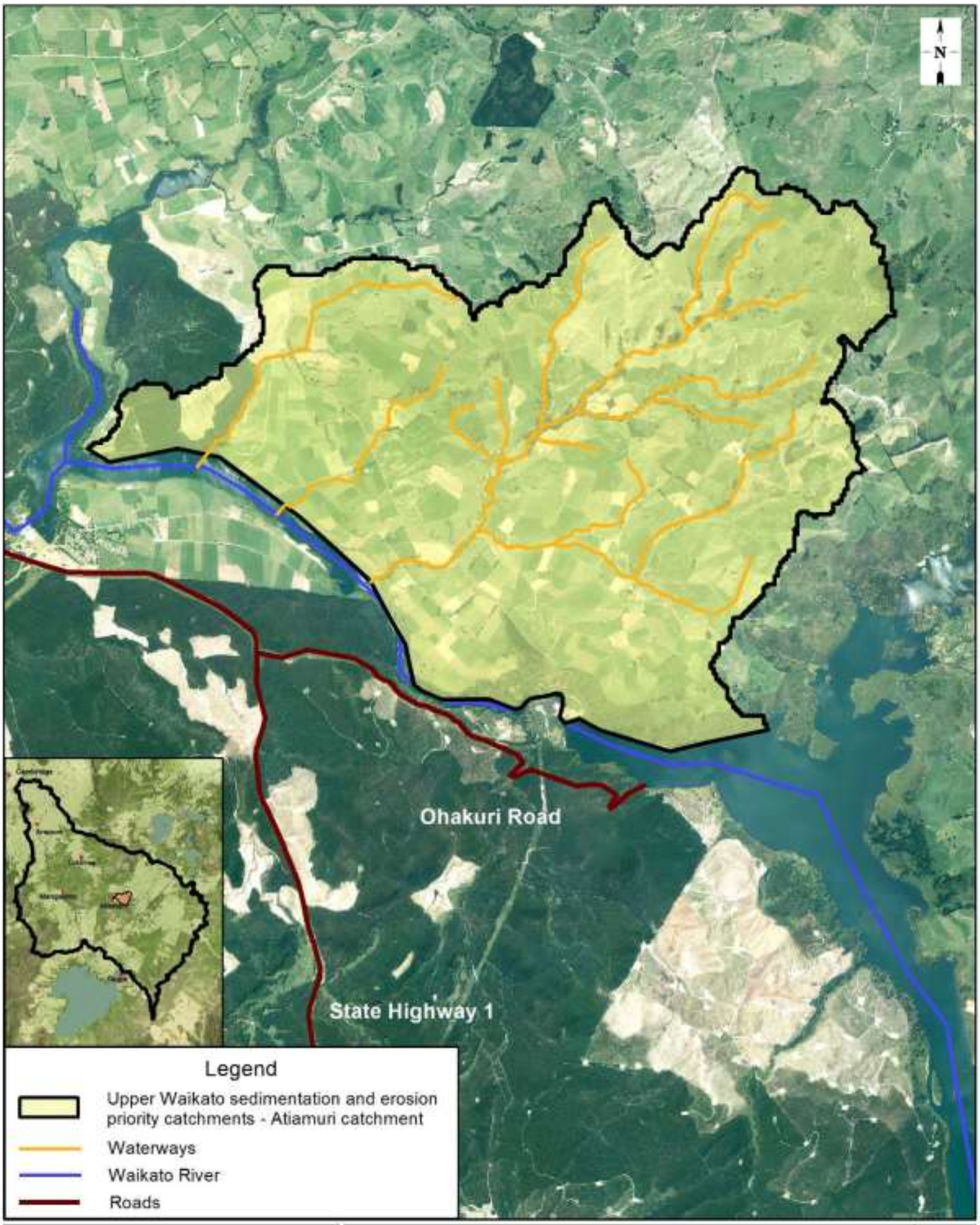
</td><td>C = 0.84</td></tr>
</table>



Atiamuri catchment hill country erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:55,000@A4 Portrait

A4

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Example of sedimentation risk outside LUC 6e, 7 and 8 in the Ātiamuri catchment.

UW 21 **Priority: high**	**Biodiversity enhancement of Kapenga Wetland and nearby Hamills Wetland**	**BCR value**
Relevant unit goal(s)	Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Kapenga Wetland (105ha) and Hamills Wetland (26ha)	
Brief description of feature	When combined, these sites form the largest wetland in the Ātiamuri Ecological District (131ha). They have extensive areas of sedge (*Carex secta*) and flax, and mānuka shrubland. These have recovered following extensive ongoing grey willow control. The wetland also contains some areas of open water at the northern end. Fauna values include populations of spotless crake and fernbird. Kapenga was renowned for its ability to sustain the local iwi with a vast range of resources. Birds, fish and fern roots provided food, alongside a plethora of soil and plant types to clothe and adorn the people. This area is particularly important to Te Arawa and its affiliates. The wetland is currently managed by DOC who over the past 15 years have undertaken an extensive willow control programme. The site is leased from Kapenga M Trust and the lease expires in 2019, meaning future management is uncertain. However, Kapenga M Trust representatives have expressed their support for the restoration and protection of the site. The site is within the top 15% of sites for biodiversity protection within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type. Biodiversity values are under threat from a range of factors, but particularly invasion from weeds. There is potential for further restoration work at this site and opportunity to extend the size of the managed area.	
Desired state to achieve Vision & Strategy	- Stock are excluded from the site and it is dominated by native vegetation, including within the riparian margins. - Iwi and community have a strong connection to the wetland and are active in its protection, use and restoration.	
Impact on Vision & Strategy	In a restored condition, the Kapenga and Hamills wetlands would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 35

<table>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Weed species (particularly blackberry)</td><td>Compete with native plant communities.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Stock</td><td>Graze on native plant species and cause pugging of the wetland.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 5 years of project commencement, 100% of wetland margins are fenced to exclude stock and are planted with a buffer of native plant species.
- 100% of willow are removed from the site.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Unfenced areas of the wetland should be fenced to exclude stock with an 8 wire post and batten fence. Ideally this would be followed immediately by native planting and associated weed control.
- Project costs assume that fencing is only required at the unmanaged wetland site next to Hamills wetland – 1.4km of fencing at $17 per metre ($23,800).

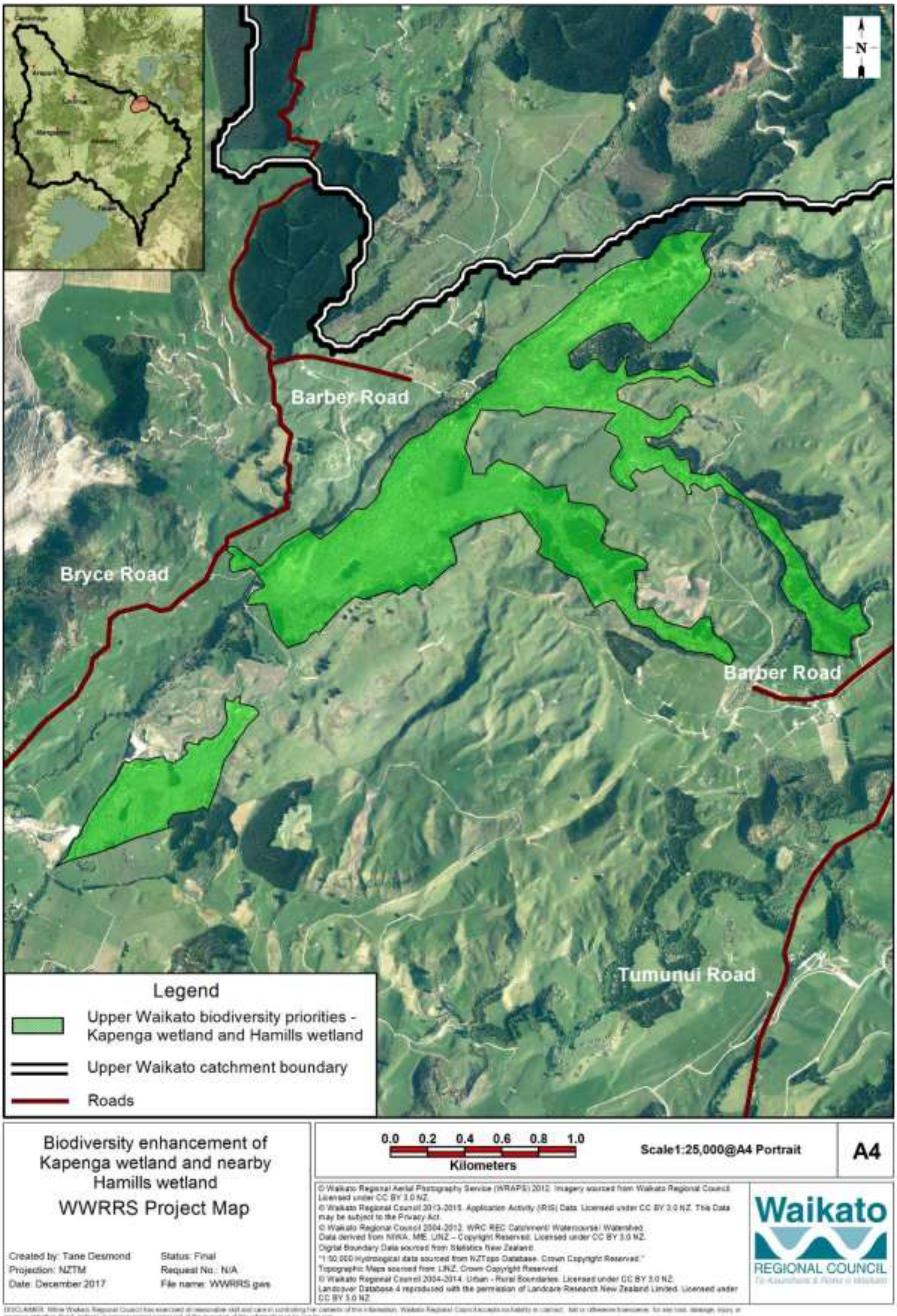
Willow removal
Aerial based willow control should be undertaken to allow the native understorey to flourish. The main area where this is required is in the 7ha area of unmanaged wetland next to Hamills Wetland. The estimated cost of this is $400 per hectare ($2800). Some ground based follow-up maintenance may also be required and the cost of this is estimated at $4000.

Planting
Weed control and native planting should be carried out around the perimeter of the wetlands to form a planted buffer. The size of the area between the existing fence and wetland varies but costings are based on an average size of 10m. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed within the ecological district. Costs below account for site preparation, plant purchase, planting labour and 5 releasing events.
- The riparian margin is approximately 22km so a 10m side planted area equates to a total planting area of 22ha. Planting of this area is recommended to cost $39,552 per hectare ($870,144).

Within the large Kapenga Wetland there is a 4.1ha area that is currently in pasture grass which also requires native planting. Plants are recommended to be planted at 1.5m spacing ($153,963).</td><td></td></tr>
</table>

	Weed Control Extensive weed control will be required at the site as there are a range of weed species present (the main one being blackberry) and so a comprehensive weed control programme will be required to ensure the success of native plantings. - Additional weed control in and around planted areas for 3 years (22ha at $2800/ha x 3 years is $184,800). - 3 years of additional weed control in and around site where willow removal is undertaken (7ha at $2,800 x 3 years is $58,800). **Animal Pest Control** This site would benefit from mustelid and rat control to protect and enhance native bird populations. This work has not been costed as ongoing as animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen soon after project completion.	L = 5.5
Effectiveness of works	Kapenga Wetland and Hamills Wetland are currently in very good condition, with many of the Vision & Strategy desired state aspects close to being met. It is expected that over the next 20 years these features will remain in this condition even in the absence of this project. Works included here address the ongoing threat of willows which threaten the ecological integrity of the sites. It also includes stock exclusion, planting and weed control. It is anticipated that if the project is fully completed, these features will be very close to the Vision & Strategy desired state in 20 years' time. Access and recreation is not addressed through this project.	W = 0.09
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to weed control – to minimise this the work should be carried out by experienced practitioners to ensure it is effective.	F = 0.87
Adoptability	Landowners are supportive of the project and full adoption would be anticipated if the works were fully incentivised.	A = 1
Information quality	Good – advice of local expert/s with a history of association to selected sites.	
Knowledge gaps	Further work is required to determine the specific amount of fencing, planting and weed control required. This would need to be established during project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (1.4km)</td><td>23,800</td></tr>
<tr><td>Willow control</td><td>6800</td></tr>
<tr><td>Native riparian planting (22ha)</td><td>870,144</td></tr>
<tr><td>Infill planting (4.1ha)</td><td>153,963</td></tr>
<tr><td>Weed control</td><td>243,600</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>194,746</td></tr>
<tr><td>Total</td><td>1,493,053</td></tr>
</table>
</td>
<td>C = 1.5</td>
</tr>
</table>


N
Barber Road
Bryce Road
Barber Road
Tumunui Road
Legend
Upper Waikato biodiversity priorities - Kapenga wetland and Hamills wetland
Upper Waikato catchment boundary
Roads
Biodiversity enhancement of Kapenga wetland and nearby Hamills wetland
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS gws
0.0 0.2 0.4 0.6 0.8 1.0
Kilometers
Scale1:25,000@A4 Portrait
A4
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Kapenga Wetland, where willow control has been undertaken. Note the weeds in the foreground.

UW 22 Priority: high	Whirinaki integrated catchment programme	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7, 8) land and gully heads. Constructed wetlands are created to reduce sub-catchment scale sediment discharges. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Whirinaki catchment	
Brief description of feature	The Whirinaki is a 23,403ha catchment with an approximately 400km stream network. According to Waikato Regional Council data, 78% of the catchment is in pasture, 12% is indigenous vegetation and 7% forestry. The pastoral area includes approximately 11,280ha of LUC 6e, 7 and 8. The catchment's stream channel systems all drain to the Whirinaki Arm, a hydro lake formed in 1961. The main Whirinaki Stream channel extends into the northeastern catchment and includes the northern tributaries of the Rotohauheu and Karapiti streams, and the southern tributary of the Otamakokere Stream which drains a geothermal wetland area. The northwestern catchment is drained by the Rehi and Tōtara streams, while the southwestern catchment is largely drained by the Mangatete Stream system which rises on the western flank of the Paeroa Range. The lake is a popular recreational area and is the focus of community concern regarding bathing quality and sediment deposition at the northern end, which is periodically exposed by draw down at the Ohakuri Dam. A riparian reserve area is established around the lake and a section of it is managed as a district reserve. The riparian reserve extends northward along the Rehi and Whirinaki Stream channels, and in the case of the Rehi Stream an additional riparian strip area extends as far as the Rehi Road bridge. Marginal strips are continuous along the Whirinaki Stream to its confluence with the Otamakokere Stream, and then along the length of the Otamakokere Stream to the (DOC) geothermal wetland. Within the Otamakokere Stream reach there is also a riparian section of Māori reservation (on Rotomahana Parerarangi 6A2No2b2B). Extensive historical erosion control works and a number of riparian protection sites are established throughout the northern and eastern sections of the catchment, and around the lake itself. There is high risk of erosion in the northeastern and southeastern parts of the catchment, reflecting the prevalence of steep elevated terrain and deeply incised gullies in these areas, and there is	

<table>
<tr><td></td><td>scope for ongoing erosion control works to address issues such as gully erosion and streambank erosion.

Waikato Regional Council data indicates that the Whirinaki Stream at Corbett Road is satisfactory for swimming but has unsatisfactory levels of nitrogen and phosphorus 100% of the time. Modelling undertaken in 2016 indicates that the Whirinaki catchment is a high priority for nutrient, E.coli and sediment management.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the catchment waterways and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Whirinaki catchment would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 250</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>One of the largest contributors of sediment to the upper Waikato River.</td></tr>
<tr><td>Riverbank erosion</td><td>Increased sediment in the catchment streams and within the Whirinaki Arm.</td></tr>
<tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian and wetland vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- 100% of LUC class 8 land is retired from grazing.
- LUC class 7 land is managed within its capabilities and is retired from heavy stock grazing.
- There is a 30% reduction in suspended sediment in the Whirinaki Stream within 20 years.
- 100% of wetlands and seeps greater than 0.25ha are fenced to exclude stock.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 33 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures and others) ($495,000).
- 834ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($2,085,000).</td><td></td></tr>
</table>

	- 797ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($1,992,500). - 76km of fencing retired LUC 8 land at $25 per metre (8-wire and batten) ($1,900,000). - 107ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($535,000). - 13km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($325,000). - 25 sediment traps constructed within the upper catchment at an average of $20,000 per trap including fencing ($500,000). - 97km of fencing wetlands >0.25ha and ephemeral streams at $8 per metre ($776,000). **Riparian management of rivers/streams in pasture for soil conservation purposes** - Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 124km of streambank (62km of stream length). Include adjoining wetland areas within the riparian fencing ($992,000). - Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 31ha of planting and associated weed control and maintenance ($1,164,112). - 3093 poplar poles are estimated to be required for river and stream erosion control ($43,302). These should be planted at a 10m spacing where required. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 15 years after project commencement.	L = 15
Effectiveness of works	The Whirinaki catchment retains some important values and the stream and associated reserves are still used for recreational activities. When compared to desired state, the overall condition of the catchment is poor to moderate with few of the Vision & Strategy aspirations being met. Over the next 20 years it is expected that some aspects could deteriorate and some could improve in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed, the catchment will move substantially closer to the Vision & Strategy desired state in areas such as land use meeting capability, riparian condition, biodiversity, and streambank stability. The project will assist in protecting and improving water quality and facilitate a reduction in sediment in waterways. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to the Whirinaki catchment.	W = 0.3

<table>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that more than half of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low initially and the extent of fencing setbacks on streams may be challenging. There are, however, historical works in the catchment that provide an example of what can be achieved. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project. Creating flagship examples of works could help provide examples for others in the catchment.</td><td>A = 0.6</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from local experts who are familiar with the sub-catchment.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e, 7 and 8, riparian fencing and wetland perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>33 erosion control structures on LUC class 6e land</td><td>495,000</td></tr>
<tr><td>834ha LUC class 6e land managed with plantation species</td><td>2,085,000</td></tr>
<tr><td>797ha LUC class 7 land managed with plantation species</td><td>1,992,500</td></tr>
<tr><td>Fencing retired LUC class 8 land (76km)</td><td>1,900,000</td></tr>
<tr><td>Erosion control outside LUC class 6e, 7 and 8 land (107ha)</td><td>535,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (75km)</td><td>325,000</td></tr>
<tr><td>25 sediment traps</td><td>500,000</td></tr>
<tr><td>Fencing wetlands and ephemeral streams (97km)</td><td>776,000</td></tr>
<tr><td>Riparian fencing (124km)</td><td>992,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (3093 poles)</td><td>43,302</td></tr>
<tr><td>Native riparian planting (31ha)</td><td>1,164,112</td></tr>
<tr><td>Project management (30%)</td><td>3,242,374</td></tr>
<tr><td>Total</td><td>14,050,288</td></tr>
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</td><td>C = 14.05</td></tr>
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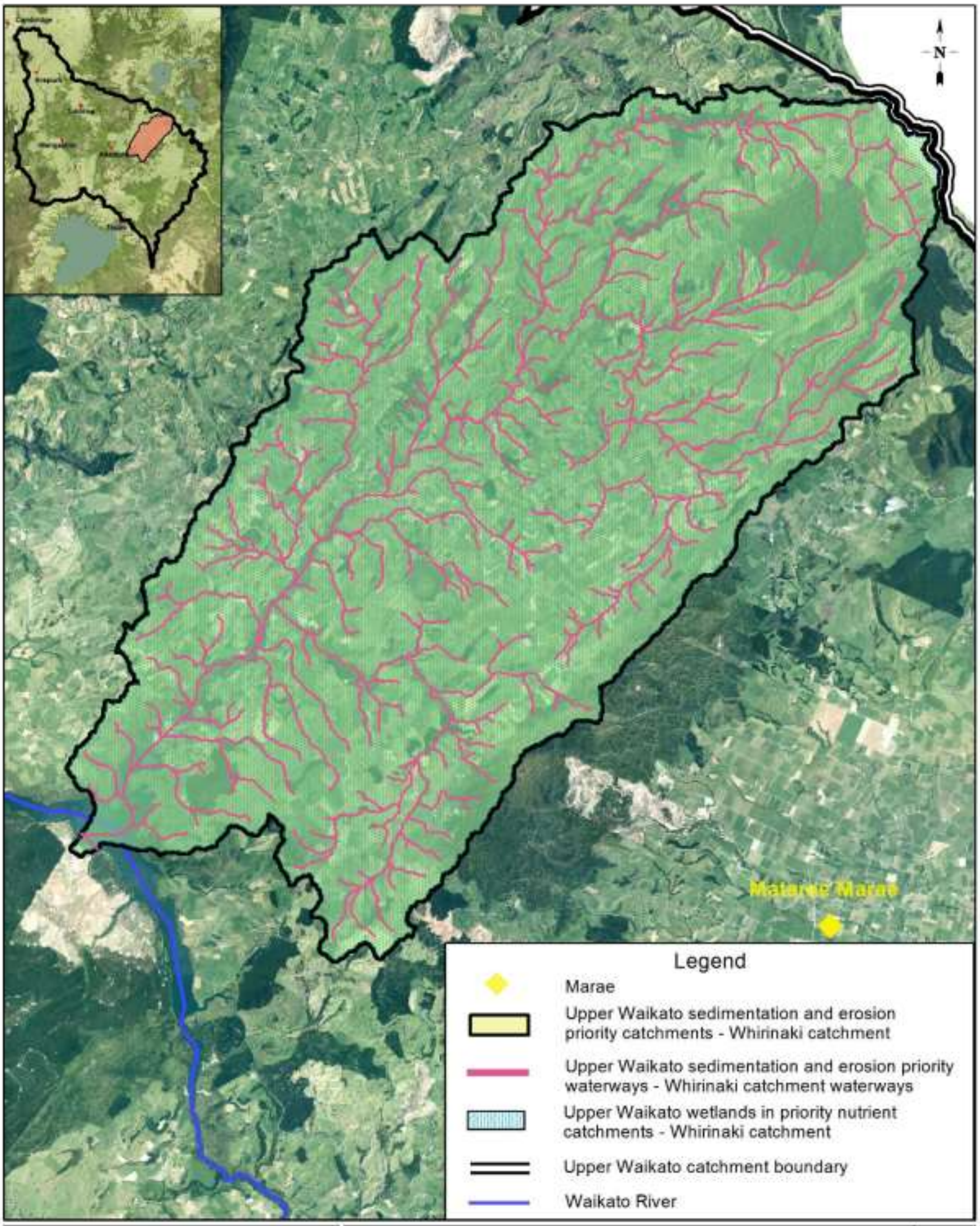

Whirinaki Integrated Catchment Programme

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0 1 2 3 4 5
Kilometers

Scale1:125,000@A4 Portrait

A4

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Hill country in the Whirinaki catchment.

Whirinaki hill country with wetland in the foreground.

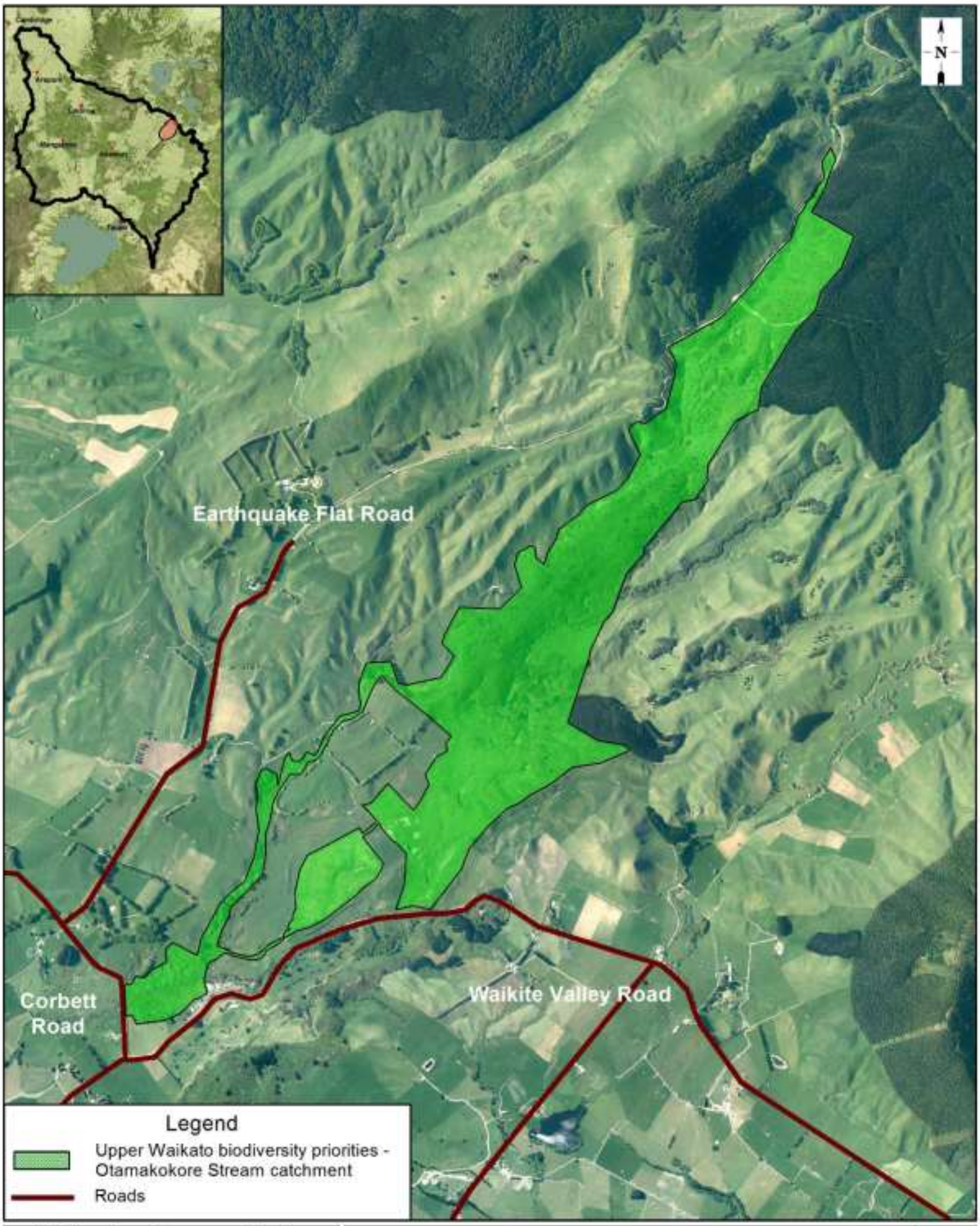
Wet areas suitable for fencing in the Whirinaki catchment.

UW 23 Priority: medium	**Biodiversity enhancement in the upper Otamakokore Stream catchment (above Corbett Road in the Waikite Valley)**	**BCR value**
Relevant unit goal(s)	Ecological networks include the full range of fresh water and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Biodiversity features in Otamakokore catchment	
Brief description of feature	Within the upper catchment of Otamakokore Stream there is a mosaic of habitat types from small tributary streams, geothermal lakes, steep escarpments, geothermal escarpments and geothermal wetlands. The site is within the top 15% of sites for biodiversity protection within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of ecosystem types. Within the 207ha project site is the largest population of the threatened species *Christella* 'thermal' fern which grows along steamy margins of the Otamakokore Stream and its upper tributaries. A large proportion of the stream's upper catchment is in DOC ownership with Waikite Valley Scenic Reserve and Wildlife Management Reserve and Otamakokore Stream marginal strip but most of the Otamakokore Stream riparian areas are in private ownership. Biodiversity values are under threat from a range of factors including invasive weeds. Riparian areas are currently dominated by blackberry and some areas are accessed by cattle. Escarpments are also dominated by weed species including broom and wilding conifers. DOC has been restoring DOC administered wetlands and geothermal areas in the catchment but there are still large areas of DOC land that are unmanaged due to funding restrictions. Ngati Tahu-Ngati Whaoa used this and a range of other nearby areas for different purposes including provision of food and materials, warmth, protection and refuge, and moved between areas on a seasonal basis or for different activities, rituals and occasions. Iwi travelled from the Paeroa Range to gather lowland kai and use the geothermal resources (at Waikite and Wai-O-Tapu). Those living in the lower reaches went to the pa sites for safety at times if needed. Large areas of flax and wetlands would have been historically present in and around the wetlands and lakes in this area and would have provided birds for food as well as flax for weaving.	

Desired state to achieve the Vision & Strategy	- Otamakokore Stream and the stream downstream of the geothermal wetland is fenced to exclude stock from its entire length. It has a riparian margin well vegetated with native plant species, and is a minimum of 5m wide. - Wetlands, escarpments and geothermal areas are dominated by native plant species. - There are opportunities for public access and recreation. - Iwi and communities have a strong connection to waterways and are active in their protection, use and restoration.	
Impact on Vision & Strategy	In a restored condition, the biodiversity features in Otamakokore catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 8
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Weed species – particularly blackberry</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr><tr><td>Stock access to the stream in a few places</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Wilding conifers</td><td>Compete with native plant communities and continue to spread.</td></tr></table>	
Project goal/s	- Within 10 years of project commencement the Otamakokore Stream is fenced to exclude cattle. Newly fenced areas have a riparian margin at least 5m wide that are planted with native plant species. - Where existing riparian margins are 5m wide or more they are dominated with native plant species. - Within 20 years the steep escarpments, wetlands and geothermal areas are dominated by native plant species.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing** Small sections of the stream still require fencing along the Landcorp farm boundary with Otamakokore Stream near Waikite Valley Thermal Pools, and re-fencing of a section of Waikite Wildlife Management Reserve is also required. Fencing cost estimates are as follows (based on a 7 wire post and batten fence): - DOC Otamakokore Marginal Strip (134m) – $2278. - DOC Waikite Wildlife Management Reserve reference (1300m) – $22,100. - Landcorp Waikite Station (3609m) – $61,353. **Revegetation** Native revegetation should be carried out following blackberry control and removal to recreate a native plant dominated ecosystem over the long term. This should occur in all riparian areas and other areas of the	

	Waikite Valley Scenic Reserve where dense blackberry dominates. This work should be carried out in stages over 5 to 10 years to reduce the risk of erosion. - DOC Otamakokore marginal strip/Waikite Scenic Reserve/Wildlife Management Reserve (37.4ha) – $1,479,250. - Landcorp Waikite Station **(**7.7ha) – $304,550. **Wilding conifer control** This is required on the northern hillslopes of Waikite Valley Scenic Reserve where wilding conifers are dominating regenerating kānuka forest. This is costed at $1000/ha over 7ha ($7000) and could be undertaken at any stage during the project. **Weed control** Control of several weed species including royal fern should be carried out and will be required on an ongoing basis (beyond the life of this project). Areas of grey willow remain along the Otamakokore Stream, downstream of the hot pools, should be poisoned using ground based methods. Ongoing control will be required (beyond the life of this project) to ensure new plants do not establish. An estimate of $100,000 has been provided for the control of weed species over a period of 5 years. Note: The costs in the revegetation section also include $4000 per hectare for weed control associated with site preparation for planting. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 10-11 years after project commencement.	L = 10.5
Effectiveness of works	Biodiversity features in Otamakokore catchment are currently in good condition. It is expected that over the next 20 years these features will remain in good condition even in the absence of this project. Works included here address the ongoing threat of wilding pine which threatens the ecological integrity of the sites. It also includes some stock exclusion, planting and general weed control. It is anticipated that if the project is fully completed, the feature will be significantly closer the Vision & Strategy desired state in 20 years' time. The project does not address access and recreation.	W = 0.2
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or inability to	F = 0.82

<table>
<tr><td></td><td>stay on top of weed control. Weed management should be undertaken by an experienced practitioner to reduce this risk.</td><td></td></tr>
<tr><td>Adoptability</td><td>There are very few landowners, and it is estimated that all would adopt the works if they were fully incentivised. The Department of Conservation is a major landowner and is supportive of the project.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Very good – based on detailed on-the-ground knowledge of DOC staff.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>No identified knowledge gaps.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks. This kind of work is generally well supported within local communities.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (5km)</td><td>85,731</td></tr>
<tr><td>Revegetation (45ha)</td><td>1,783,800</td></tr>
<tr><td>Wilding conifer control</td><td>7000</td></tr>
<tr><td>General weed control for 5 years</td><td>100,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>395,306</td></tr>
<tr><td>Total</td><td>2,371,837</td></tr>
</table>
</td><td>C = 2.37</td></tr>
</table>



Biodiversity enhancement in the upper Otamakokore Stream catchment (above Corbett Road in the Waikite Valley)

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale1:25,000@A4 Portrait

A4

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Photos of lower Otamakokore Stream immediately upstream of Corbett Road. Note the dense blackberry growth.

Photo showing the upper Otamakokore Stream catchment

UW 24 **Priority: medium**	**Walkway around Waikite geothermal wetland**	**BCR value**
Relevant unit goal(s)	Rivers and waterways are widely used by the community and are a place to relax, play, exercise, recreate and gather kai. River restoration activities enhance the economic wellbeing of the Upper Waikato.	
Name of feature	Waikite Wetland	
Brief description of feature	Waikite geothermal wetland is 13ha, about 30 minutes' drive south of Rotorua, in the upper reaches of the Otamakokore Stream. The wetland has a catchment of approximately 300ha. The geothermal areas which are part of Waikite have national threatened plant species including rare geothermal ferns and orchids. An area of soft fern (*Christella* sp. 'thermal') present around the Otamakokore Stream is considered to be one of the largest populations in New Zealand. The fern is ranked "at risk – naturally uncommon". Other thermal plants include prostrate kānuka (at risk – naturally uncommon), *Cyclosorus interruptus* (at risk – declining) and thermal ladder fern *(Nephrolepis flexuosa*) (at risk – declining). A range of waterfowl species frequently use the wetland, including threatened species such as North Island fernbird, spotless crake (pūweto) and pied stilt (poaka). The area is also of great significance to local iwi. Waikite wetland forms part of the landscape in which Ngati Tahu-Ngati Whaoa hold mana whenua. The iwi used this and a range of other areas for different purposes, including provision of food and materials, warmth, protection and refuge. They moved between these areas on a seasonal basis or for different activities, rituals and occasions. The wetland is administered by DOC who have been undertaking a restoration project at the site over the past 10 years	
Desired state to achieve the Vision & Strategy	- The wetland is fenced to exclude stock and dominated by native plant species. - There are opportunities for public access and recreation and appreciation of wetland and geothermal values. - Iwi and communities have a strong connection to waterways and are active in their protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Waikite Wetland would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 3

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Lack of access</td><td>People become disconnected from waterways and see the area more as a resource than something that needs to be nurtured and cared for.</td></tr><tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 2 years, construct a 2.25km loop walkway from the vicinity of Waikite hot pools around the wetland.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>An organisation or group wishing to undertake this project would be required to work closely with DOC, who administer the geothermal wetland, and with local iwi. Negotiations would also need to be undertaken with Rotorua District Council and Landcorp Waikite regarding access across private land and new carpark development.

Works include:
- design, consents and inspections ($7500)
- construction of a 2.1km gravel walkway ($157,500)
- construction of 0.16km of boardwalk across wetland ($104,000)
- construction of three 2m long wooden walking bridges ($4500)
- design and installation of interpretation signage ($5000)
- construction and installation of a picnic table ($750)
- re-fencing (post and batten fence) of a 20m section of the existing stream to accommodate the new track where there is insufficient width between track and fence ($350).

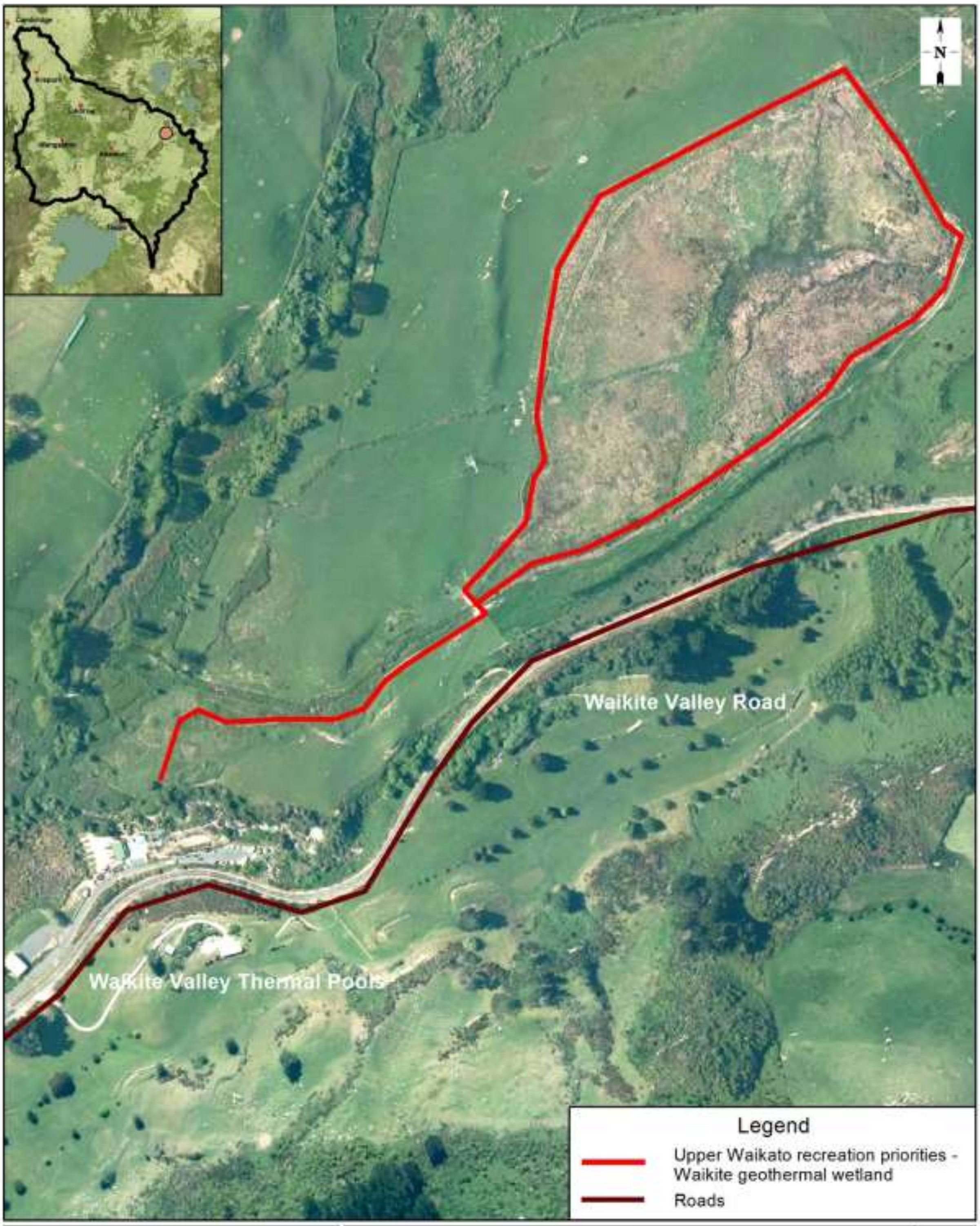
Ongoing maintenance is not provided for in the capital costings above and would need to be undertaken by an entity or landowner.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 20% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen near project completion.</td><td>L = 1.5</td></tr>
<tr><td>Effectiveness of works</td><td>Waikite Wetland is currently in very good condition with some of the Vision & Strategy desired state aspects close to being</td><td>W = 0.1</td></tr>
</table>

	met. It is expected that over the next 20 years these features will slightly improve in condition even in the absence of this project due to work currently being undertaken by Department of Conservation. It is anticipated that if the project is fully completed, the wetland will be very close to the Vision & Strategy desired state in 20 years.	
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Similar works have been successfully completed in other locations throughout the catchment.	F = 0.97
Adoptability	Although the landowner (DOC) is supportive of the project, it is unlikely that they will adopt this project without a formal undertaking from another organisation to be responsible for the ongoing maintenance of the works. A management agreement would need to be developed for the infrastructure and a commitment made for ownership and maintenance. This would need to be addressed and confirmed before this project could commence.	A = 0.585
Information quality	Very good – based on detailed on the ground knowledge of DOC staff.	
Knowledge gaps	The entity who takes on the project would be required to manage the asset including ongoing maintenance. It is unknown whether an organisation would be willing to take on this responsibility.	
Socio-political risks	High risk that the project will fail to meet its goals over the long term due to socio-political risks. This relates to organisations needing to agree on long term maintenance of the works.	P = 0.37
Project duration (years)	2 years	
Up-front cost – total for implementation phase/project duration	(see cost table below)	C = 0.3

Task	**Cost ($)**
Design and consents, inspections	7500
Construction of walkway	157,500
Construction of 160m of boardwalk	104,000
Wooden walking bridges x 2 at2m length	4500
Interpretation signage	5000
Picnic table	750
Re-fencing	350
Project management/staffing/incidentals (20%)	55,920
Total	**335,520**



Walkway around Waikite geothermal wetland

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.00 0.04 0.08 0.12 0.16 0.20
Kilometers

Scale1:5,000@A4 Portrait

A4

Waikato
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A track is proposed for around the perimeter of Waikite geothermal wetland. Photo: Department of Conservation

Waikite geothermal wetland. Photo: Department of Conservation

UW 25 Priority: medium	Lake Ngāhewa Walkway	BCR value
Relevant unit goal(s)	Rivers and waterways are widely used by the community and are a place to relax, play, exercise, recreate and gather kai. River restoration activities enhance the economic wellbeing of the Upper Waikato.	
Name of feature	Lake Ngāhewa	
Brief description of feature	Lake Ngāhewa is a volcanic lake located to the north of the Wai-O-Tapu thermal area. It has a depth of 5.5m, a surface area of 8.4ha and an estimated catchment area of 756ha. Lake Ngāhewa has been given a lake biodiversity ranking of 19th equal out of 73 shallow lakes within the Waikato Region (this includes lakes outside of the Waikato River catchment). Lake Ngāhewa lies within the Lake Ngāhewa Recreation Reserve (39.7ha) which is classified under Section 17 – Recreation Reserves of the Reserves Act 1977. The reserve is administered by DOC while the bed of the lake is owned and administered by Te Arawa Lakes Trust. In addition to the DOC administered reserve, there are several arms of the wetland on the northeastern side of SH5 that are on private land. The main inflow into the lake is associated with a small spring-fed stream system which meanders down the valley towards the lake, crossing back and forth across SH5. The stream and associated springs feed large areas of flax swamp located at the head of the lake and in other small tributaries. Lake Ngāhewa forms part of the landscape in which Ngati Tahu-Ngati Whaoa hold mana whenua. It is in close proximity to Maunga Kakaramea (Rainbow Mountain), the Paeroa Range, and the headwaters of both the Whirinaki and the Wai-O-Tapu streams. All of these areas were used for different purposes, including provision of food and materials, warmth, protection and for refuge. The iwi moved between these areas on a seasonal basis or for different activities, rituals and occasions. Situated on the Thermal Explorer Highway (SH5) between Rotorua and Taupō, Lake Ngāhewa and Lake Ngāhewa Recreation Reserve make a small scenic site that is easily accessible to the public. There is a small rest area that allows the public to stop and view the lake and existing interpretation that provides information about wetlands and their importance.	

<table>
<tr><td></td><td>Eastern Region Fish & Game Council annually stock Lake Ngāhewa with trout and the lake is suitable to be used by small dinghies, kayaks or float tubes.

Lake Ngāhewa is part of the 3 Lakes Action Plan – an interagency plan for the protection, enhancement and restoration of lakes Ngāhewa, Tutaeinanga and Ngāpouri.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing, and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Ngāhewa would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 24</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Lack of access</td><td>People become disconnected from waterways and see the area more as a resource than something that needs to be nurtured and cared for.</td></tr>
<tr><td>Willow trees in upstream waterways outside of reserve</td><td>Shade out native species and spread to other downstream sites.
Potential to impact areas within the recreation reserve which have had control of willow.</td></tr>
<tr><td>Weed species around the lake</td><td>Compete with native plant communities, landscape values and amenity values.</td></tr>
<tr><td>Stock access to upstream waterways</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Catchment land use</td><td>Reduction in lake water quality.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within two years of project commencement, a 1.42km gravel and boardwalk walkway is constructed around Lake Ngāhewa within the Recreation Reserve.
- At least two interpretation panels, two seating areas and one lookout point have been established along the walkway.
- Visitor experience at the lake is enhanced.
- Project goals are consistent with those contained within the three Lakes Action Plan (an interagency plan for the protection, enhancement, and restoration of Lakes Ngāhewa, Tutaeinanga and Ngāpouri).</td><td></td></tr>
</table>

Priority works for funding	An organisation or group wishing to undertake this project would need to work closely with DOC, Ngati Tahu-Ngati Whaoa, Te Arawa Lakes Trust and Eastern Fish & Game. Works include: - investigation, design and resource consenting ($20,000) - construction of a 920 metre gravel walkway – $100 per metre including access and site preparation ($92,000) - construction of 500m of boardwalk across wetland area at $650 per metre ($325,000) - design and installation of interpretation signage ($5,000) - build and install two seats ($1,000). Car park upgrade is not required as the existing layby/picnic area and the adjoining DOC Rainbow Mountain car park provides sufficient capacity for the expected user numbers. Ongoing maintenance is not provided for in the capital costings above and would need to be undertaken by an entity or landowner. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 2
Effectiveness of works	Lake Ngāhewa is currently in good condition with some of the Vision & Strategy desired state aspects already being met or partly met. Condition is not expected to either significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the feature is expected to move slightly closer to desired state based on improving access and use of the site. The project does not address other factors such as improving water quality or biodiversity.	W = 0.025
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Work should be carried out by experienced and qualified practitioners to ensure the safety of the boardwalk.	F = 0.97
Adoptability	Although the landowner (DOC) is supportive of the project, It is unlikely that they will adopt this project without a formal undertaking from another organisation to be responsible for the ongoing maintenance of the works. A management agreement would need to be developed for the infrastructure and a	A = 0.8

<table>
<tr><td></td><td>commitment made for ownership and maintenance. This would need to be addressed and confirmed before this project could commence.</td><td></td></tr>
<tr><td>Information quality</td><td>Good – information on terrain around lake is limited for the northwestern end in regards to track construction. Management requirements and costing were provided by staff from DOC and Ngati Tahu-Ngati Whaoa Runanga Trust who have very good knowledge of the site.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>The entity who takes on the project would be required to manage the asset including ongoing maintenance. It is unknown whether an organisation would be willing to take on this responsibility.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>High risk that the project will fail to meet its goals over the long term due to socio-political risks. This relates to organisations needing to agree on long term maintenance of the works.</td><td>P = 0.37</td></tr>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Design and consents, inspections</td><td>20,000</td></tr>
<tr><td>Construction of walkway</td><td>92,000</td></tr>
<tr><td>Boardwalk construction</td><td>325,000</td></tr>
<tr><td>Interpretation signage</td><td>5000</td></tr>
<tr><td>Install 2 seats</td><td>1000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>88,600</td></tr>
<tr><td>Total</td><td>531,600</td></tr>
</table></td><td>C = 0.53</td></tr>
</table>

Lake Ngāhewa Walkway

WWRRS Project Map

0.00 0.04 0.08 0.12 0.16 0.20
Kilometers

Scale1:5,000@A4 Portrait

A4

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Waikato
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Lake Ngāhewa. Photos: Ngati Tahu-Ngati Whaoa Runanga Trust

Lake Ngāhewa rest area next to SH5. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust

UW 26	Restoration of Wai-O-Tapu South Geothermal Area	
Priority: very high		**BCR value**
Relevant unit goal(s)	Ecological networks include the full range of fresh water and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Wai-O-Tapu South Geothermal Area	
Brief description of feature	The Wai-O-Tapu South Geothermal Area is located along SH5 between Rotorua and Taupō. The Wai-O-Tapu/Waimangu field is classified as a fully protected system within the Waikato Regional Plan. Land ownership of the site is mixed with parts being owned by DOC, Ngati Tahi-Ngati Whaoa Runanga Trust and Timberlands Limited and is part of the landscape in which Ngati Tahu-Ngati Whaoa hold mana whenua. The areas owned and administered by DOC and the Rūnanga are classified as scenic reserves (Wai-O-Tapu Scenic Reserve – DOC and Wai-O-Tapu Scenic Reserve – Runanga) and are considered as open to the public. The land owned by the Runanga is managed as a tourism venture (~125ha) which focuses on enabling visitors to experience the geothermal features (e.g. Champagne Pool and extensive sinter terraces). Wai-O-Tapu South comprises extensive geothermal features, large areas of geothermal vegetation, geothermal lakes and includes Orotu wetland, a geothermal/freshwater wetland area. Ngati Tahu-Ngati Whaoa used this site and a range of other nearby areas for different purposes, including provision of food and materials, warmth, protection and refuge, and moved between areas on a seasonal basis or for different activities, rituals and occasions. Large areas of flax and wetlands would have been historically present in and around Wai-O-Tapu (lakes Ngāhewa, Ngāpouri and Tutaeinanga) and in the nearby Waikite Valley/Otamakokore. These areas would have provided birds for food as well as flax for weaving. This site has components that are of international significance (the best representative example of a geothermal wetland and one of the best areas of terrestrial geothermal vegetation in New Zealand), regional significance (large, good quality	

<table>
<tr><td></td><td>examples of geothermal vegetation and habitats) and local significance (small degraded example of a geothermal wetland). However, the area is under threat from a range of factors, the largest being wilding conifer trees which displace native vegetation and alter the chemistry of the soil.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Wai-O-Tapu South has intact native geothermal, riparian and wetland vegetation sequences across the site. Ecosystem values (flora and fauna) are enhanced and protected.
- Iwi and communities have a strong connection to the Wai-O-Tapu geothermal area and are active in its protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Wai-O-Tapu South Geothermal Area would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 35</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Wilding conifers

These are a major threat at the site (up to 25% cover)</td><td>Compete with native plant communities. Potential to alter soil structure, shade out native flora and alter vegetation sequences, high reproductive capacity and ability to spread</td></tr>
<tr><td>Other invasive exotic plant species present include blackberry (5-25% cover), wattle, broom, cotoneaster, firethorn, ivy and grey willow

Chinese privet is present along the western boundary on private land.</td><td>Compete with native plant communities.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 20 years of this project commencing, wilding conifers have been managed to zero density.
- Key weed species are reduced by 95% in open geothermal habitat, geothermal vegetation habitat and within riparian (lakes and stream) and wetland areas and their margins.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>This project does not require work from private citizens. To achieve the desired condition the following would be required by the landowners/reserve administrators:

Hand pulling of wilding pine seedlings
A large proportion of the site contains active geothermal features. These areas require hand pulling of any wilding pine seedlings.
- Block 4 and 5 on the map (below) require two control operations 5 years apart ($4000).

Wilding pine control – maintenance</td><td></td></tr>
</table>

	The site has received some level of wilding pine control in the past. These areas require ongoing maintenance (5 yearly) to achieve a sustained zero density goal for wilding conifers. - Aerial basal control as follows: Block 1 and 1a (40ha) – $10,000 Block 2 (2.3ha) – $2000 Block 3 (13ha) – $8000 Block 6 (32ha) – $8000 Block 7 (29ha) – $7000 TOTAL COST $35,000 Note: Per hectare costs vary depending on the density of trees. These costs allow for two control operations (5 years apart). **Fell wilding pine** Approximately 83ha of the site requires removal of old growth wilding pine. It is proposed to fell to waste the majority of these areas and this is the basis of the costings. However, before this begins there should be an assessment undertaken of the potential feasibility of harvesting any of the old growth wilding pine stands that are not within geothermal areas. Regardless of whether these areas are felled to waste or harvested, there will be ongoing maintenance required to remove regenerating pine seedlings. - Block 2, fell to waste/drill and fill poison ($2500). - Block 3 (13ha), fell to waste ($9000). - Block 4 (3.15ha), drill and fill poison ($3000). - Block 5 (3ha), fell to waste ($3000). - Block 6 (32ha), fell to waste ($32,000). - Block 7 (29ha), fell to waste ($29,000). - TOTAL COST $78,500. **Other plant pest control** Carry out control of other plant pests. - Fell to waste/spray ($5,000). Ongoing maintenance will be required annually for 10 years and then 5 yearly thereafter. - Spraying/hand pulling weeds ($50,000 over 20 years). **Animal pest control** This site would benefit from control of rats, mustelids, feral cats, feral pigs and deer to help protect native flora and/or fauna. This work has not been costed as ongoing as animal pest control is out of scope for the Restoration Strategy.	

<table>
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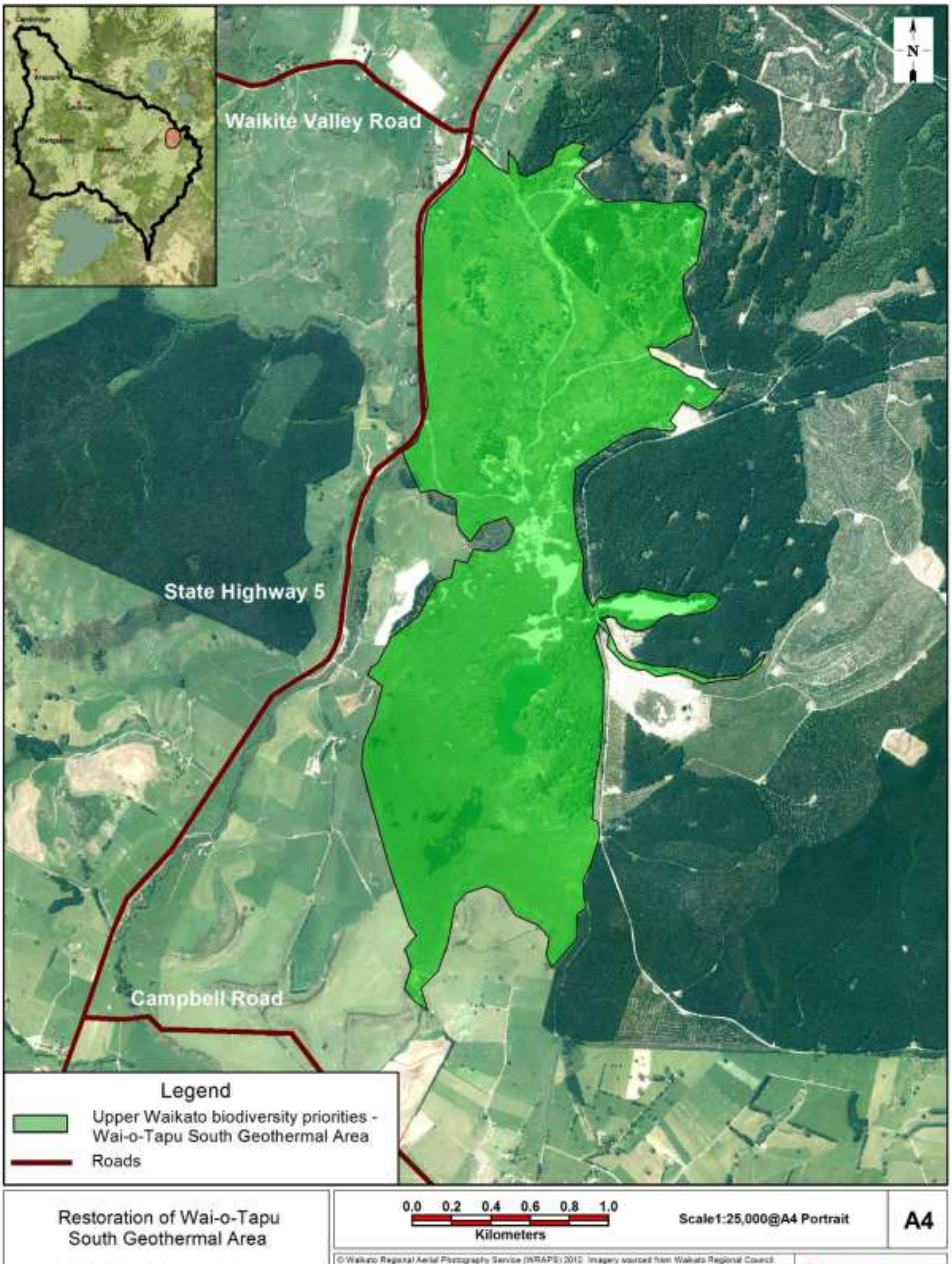
Map of suggested management areas.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 15% of the direct project costs.
</td>
<td></td>
</tr>
<tr>
<td>Time lag for benefits to be realised</td>
<td>If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen by the final year.</td>
<td>L = 20</td>
</tr>
<tr>
<td>Effectiveness of works</td>
<td>The Wai-O-Tapu South Geothermal Area is currently in very good condition and is expected to remain so over the next 20 years, even in the absence of this project. However, works included here address the ongoing threat of wilding pine which threatens the ecological integrity of the site. It is anticipated that if the project is fully completed, the wetland will be at the Vision & Strategy state in 20 years’ time.</td>
<td>W = 0.05</td>
</tr>
</table>

<table>
<tr><td>Risk of technical failure</td><td>There is a very low risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure wilding pine control is effective.</td><td>F = 0.92</td></tr>
<tr><td>Adoptability</td><td>It is estimated that all landowners would adopt the works if they were fully incentivised. There are three landowners and all are supportive of the project.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Very good – information for this site is well documented in various reports prepared on behalf of Waikato Regional Council. Management knowledge and issues are also well known within the Department of Conservation.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>There are few knowledge gaps. There is some uncertainty around cost estimates, particularly over the 20 year period. Some pine control may be cost recoverable if areas of pine are commercially viable for harvest in the first instance.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Hand pulling of wilding pine seedlings</td><td>4000</td></tr>
<tr><td>Wilding pine control – maintenance</td><td>35,000</td></tr>
<tr><td>Felling wilding pine</td><td>78,500</td></tr>
<tr><td>Other plant pest control</td><td>55,000</td></tr>
<tr><td>Project management/staffing/incidentals 15%</td><td>25,875</td></tr>
<tr><td>TOTAL</td><td>198,375</td></tr>
</table>
</td><td>C = 0.198</td></tr>
</table>



Scale1:25,000@A4 Portrait

A4

Restoration of Wai-o-Tapu South Geothermal Area

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Wai-O-Tapu geothermal area with wilding conifers in the background. Photo: Department of Conservation, Rotorua.

Wai-O-Tapu geothermal area with wilding conifers in the background. Photo: Ngati Tahu – Ngati Whaoa Runanga Trust

UW 27 Priority: very high	Biodiversity enhancement at Ōrākei Kōrako and Red Hills	BCR value
Relevant unit goal(s)	Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Ōrākei Kōrako and Red Hills	
Brief description of feature	A 162ha area consisting of geothermal ecosystems and native vegetation alongside the bank of the Waikato River. The geothermal areas of Red Hills are nationally significant and comprise very good quality examples of geothermal habitat, which includes nationally uncommon ecosystems. The site has extensive areas of prostrate kānuka shrubland and stable, relatively large, populations of *Christella dentata* (geothermal race) and *Dicranopteris linearis var. linearis* (both "at risk" species – naturally uncommon). Together with Ōrākei Kōrako, the site comprises one of the best examples of geothermal vegetation in the Waikato region, although it is under threat from a range of weed species including wilding conifers. The geothermal sequences are part of intact native riparian areas along the Waikato River at Ōrākei Kōrako/Red Hills. Ōrākei Kōrako is considered the Ukaipo o Ngati Tahu-Ngati Whaoa or the birth place of Ngati Tahu-Ngati Whaoa. The geothermal areas provided a microclimate that was utilised for growing food and there were urupā, island pa and kāinga associated with the area. The adjacent Tutukau Forest also provided food, rongoā and various other resources. Red ochre or kōkōwai was collected at the geothermal areas of both Red Hills and Ōrākei Kōrako. The main river and small tributary streams in the area provided mahinga kai resources. The Waikato River provided a source of water and a means for travel and trade.	
Desired state to achieve Vision & Strategy	- Geothermal ecosystems retain integrity. - Riparian corridors along the Waikato River are dominated by native species (weed species are controlled), and they provide a landscape of connectivity between the Waikato River and the geothermal features and vegetation. - Iwi and communities have a strong connection to the site and are active in its use, protection and restoration.	

<table>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Ōrākei Kōrako and Red Hills would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Wilding conifers</td><td>Colonise geothermal areas, compete with geothermal vegetation and have the potential to alter soil characteristics. Change landscape characteristics of geothermal areas.</td></tr><tr><td>Pampas, blackberry, privet, gorse, broom</td><td>Colonise geothermal margins and riparian areas. Compete with native species and have the ability to be easily spread to surrounding areas through bird and wind dispersal.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 20 years of the project commencing, the quality of the geothermal vegetation is improved and geothermal and riparian vegetation sequences restored and enhanced by:
- eradicating wilding pines
- reducing the cover of other plant pests by 90-100%.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. The project manager would be required to work with Ngati Tahu-Ngati Whaoa and tourist operators.

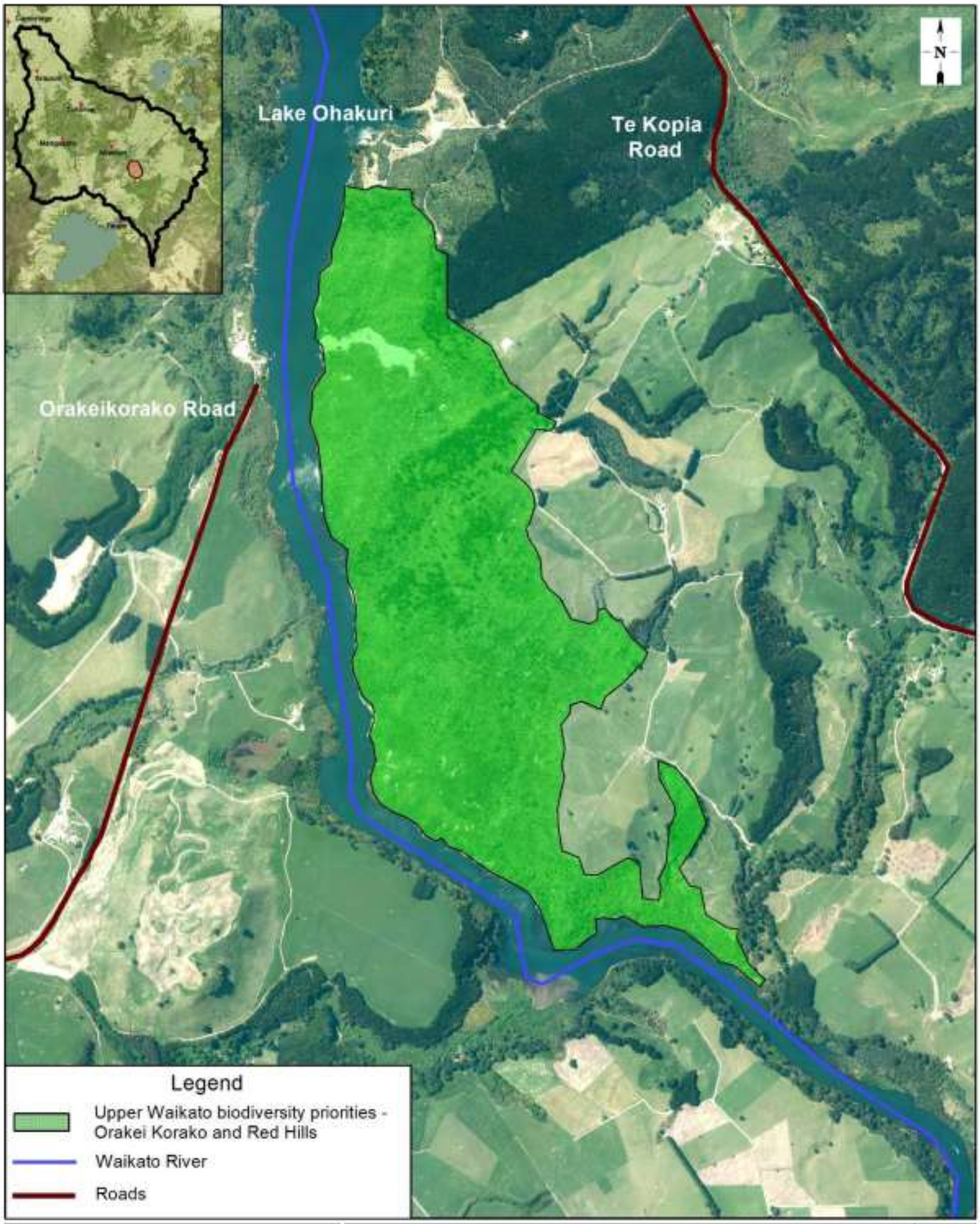
Wilding conifer control
- Felling of large mature wilding pines in northern section of block (owned by Tutukau East/tourist operator). Estimated cost: 5 days labour at $500 per day is $2500
- Hand removal of pine seedlings within northern section of block every 3 to 4 years (3-4 days at $500 per day is $2000). Cost for 5 seedling removal events is $10,000
- Every 4 years (before new pine seedlings reach maturity) carry out aerial basal spraying (2-3 hours at $1500 per hour plus chemical $2000 is $6500) across the entire block. Cost for 5 spray events is $32,500

General weed control
This will involve ground based control of weeds present on the site including blackberry, pampas, privet, broom, gorse and willow (2-3 days at $500 per day is $1,500). Six weed control events is $9000.

Fencing
Approximately 1.8km of fence requires maintenance/upgrade (e.g. rewiring and some batten/post replacement). Estimate cost: 1.8km x $17/m is $30,600.</td><td></td></tr>
</table>

	Surveillance - Assessment of extent of wilding pines every 3 years (by helicopter). GPS the location of infestations and create a plan for control. - Use helicopter assessment to GPS locations of weed infestations every 3 years (2 hours in helicopter every 3 years at $1500 per hour is $3000). Six surveillance events is $18,000. **Animal pest control** This site would benefit from wild pig control to native vegetation and geothermal areas. However, this work has not been costed as ongoing as animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20- year period, it is estimated that the majority of the project benefits would be seen approximately 13 years after project commencement.	L = 13
Effectiveness of works	Ōrākei Kōrako and Red Hills are currently in very good condition, with almost all of the Vision & Strategy desired state aspects already being met. It is expected that over the next 20 years these features will remain in this condition, even in the absence of this project. Works included here address the ongoing threat of wilding pine which threatens the ecological integrity of the sites. It is anticipated that if the project is fully completed, the features will be at the Vision & Strategy state in 20 years' time.	W = 0.05
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure wilding pine control is effective.	F = 0.92
Adoptability	It is estimated that all landowners would adopt the works if they were fully incentivised. There are two landowners and both are supportive of the project.	A = 1
Information quality	Very good – site is well known and has been part of previous assessment and work by Waikato Regional Council. Previous wilding pine and weed control at the site have enabled a good understanding of the issues. An on-the-ground assessment of the fencing has been undertaken.	
Knowledge gaps	None have been identified.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97

<table>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Wilding conifer control</td><td>45,000</td></tr>
<tr><td>General weed control</td><td>9,000</td></tr>
<tr><td>Fencing (1.8km)</td><td>30,600</td></tr>
<tr><td>Surveillance</td><td>18,000</td></tr>
<tr><td>Project management/staffing/incidentals (15% of project cost)</td><td>15,390</td></tr>
<tr><td>Total</td><td>117,990</td></tr>
</table>
</td><td>C = 0.118</td></tr>
</table>



Biodiversity enhancement at Orakei Korako and Red Hills

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.00 0.15 0.30 0.45 0.60 0.75
Kilometers

Scale1:17,500@A4 Portrait

A4

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Photo showing Red Hills on the far side of the river. Note the geothermal activity. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust

Ōrākei Kōrako geothermal area.

Looking down towards a wetland area at the Red Hills site. Note the blackberry requiring control in the foreground. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust

Some previous wilding pine control at the Red Hills site. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust

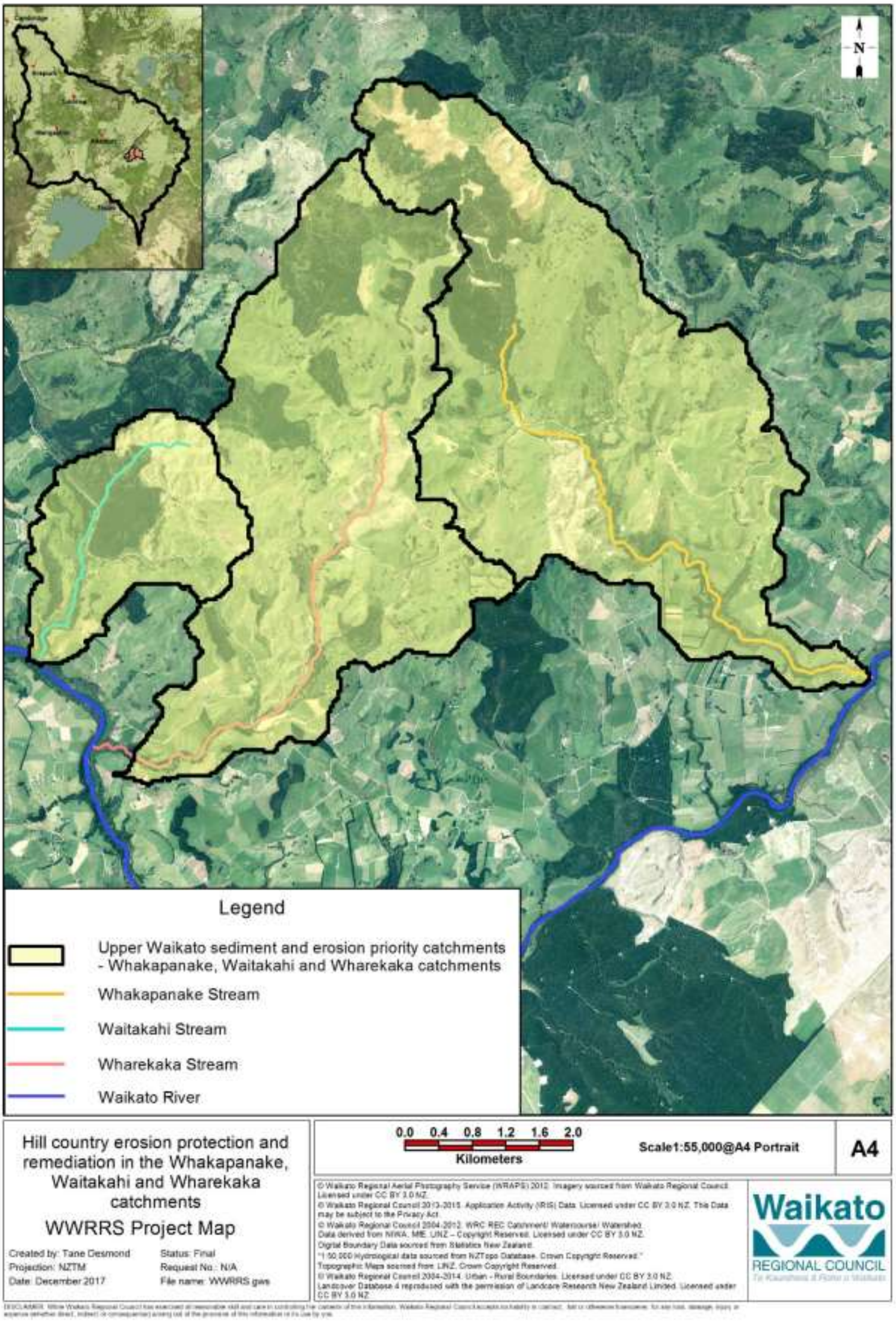

A boundary when fence upgrade and weed control is required. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust

UW 28 Priority: high	Hill country erosion protection and remediation in the Whakapanake, Waitakahi and Wharekaka catchments	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7, 8) land and gully heads. Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level	
Name of feature	Whakapanake, Waitakahi and Wharekaka Streams	
Brief description of feature	This suite of small adjacent catchments sits at the southern end of the Paeroa Range and generally comprises steep, elevated terrain grading into gently rolling and terrace terrain adjacent the Waikato River, dissected by deep watercourse gullies. According to Waikato Regional Council data, 69% of the total area is in pasture, 22% is indigenous vegetation and 9% forestry. There have been recent conversions of dry stock to dairy here. The catchments have a combined area of 4014ha of which an estimated 2487 is LUC 6e, 7 and 8 in pasture. There are approximately 65km of streams throughout these three catchments. Gully erosion is a common feature in these catchments and often occurs where storm runoff flows discharge from relatively easy contour terrain into deep, steep sided gullies. Associated sediment deposition in channels contributes to streambank erosion. Streambank erosion is also found along the main river channel. Historical erosion control works are distributed throughout the catchments. Most of these are aged and now require long term maintenance such as tree removal and fence replacement, along with erosion control structure repair and replacement in some cases. These catchments contain some high values to Ngati Tahu-Ngati Whaoa and the iwi strongly supports sustainable land use and riparian and wetland protection in this area. Modelling undertaken in 2016 indicates that these three catchments are a high priority for erosion and sediment management.	
Desired state to achieve Vision & Strategy	- A sub-catchment where land use matches capability and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide).	

	- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants. - There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present. - The streams are swimmable, fishable, safe for gathering kai, and have access for recreation. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, this group of sub-catchments would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.	VS = 70
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams and upper Waikato River.</td></tr></table>	
Project goal/s	- LUC class 7 land is managed within its capabilities and is retired from heavy stock grazing. - There is a 30% reduction in suspended sediment across the three streams within 15 years.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 5 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures etc.) ($75,000). - 134ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($335,000). - 336ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($840,000). - 10km of fencing retired LUC 8 land at $25 per metre (8-wire and batten) ($250,000). - 5ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($25,000). - 3km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($75,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

<table>
<tr><td></td><td>This is estimated to be 30% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen at project completion (year 10).</td><td>L = 10</td></tr>
<tr><td>Effectiveness of works</td><td>When compared to desired state, this group of sub-catchments is currently in a poor to moderate condition but do have some of the Vision & Strategy desired state aspects being met or partly met. There is not expected to be significant deterioration in the condition of the catchments over the next 20 years in the absence of this project. It is anticipated that if the project is fully completed it would make significant progress in achieving the Vision & Strategy state for water quality and land use matching capability in 20 years' time. The project does not directly address biodiversity aspirations however the proposed works provide secondary benefits to biodiversity.</td><td>W = 0.2</td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to weather events/erosion.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that just over half of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.54</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>5 erosion control structures on LUC class 6e land</td><td>75,000</td></tr>
<tr><td>134ha LUC class 6e land managed with plantation species</td><td>335,000</td></tr>
<tr><td>336ha LUC class 7 land managed with plantation species</td><td>840,000</td></tr>
<tr><td>Fencing retired LUC class 8 land (10km)</td><td>250,000</td></tr>
<tr><td>Management outside LUC class 6e, 7 and 8 land</td><td>25,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (3km)</td><td>75,000</td></tr>
</table></td><td>C = 2.08</td></tr>
</table>

	Project management/staffing/incidentals (30%)	480,000	
	Total	**$2,080,000**	


N
Legend
Upper Waikato sediment and erosion priority catchments - Whakapanake, Waitakahi and Wharekaka catchments
Whakapanake Stream
Waitakahi Stream
Wharekaka Stream
Waikato River
Hill country erosion protection and remediation in the Whakapanake, Waitakahi and Wharekaka catchments
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.4 0.8 1.2 1.6 2.0
Kilometers
Scale1:55,000@A4 Portrait
A4
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Steep land showing areas of erosion in the Wharekaka, Whakapanake and Waitakahi stream catchments.

UW 29 Priority: very high	Water quality improvement and riparian protection and enhancement in the Wai-O-Tapu catchment	BCR value
Relevant Unit Goal(s)	Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level. Education, farm planning and capacity building programmes assist communities in reducing erosion in the Upper Waikato. Education and innovation underpins best practice riparian and wetland management.	
Name of feature	Wai-O-Tapu catchment	
Brief description of feature	The Wai-O-Tapu is one of the largest catchments in the Upper Waikato at 33,145ha. There is an estimated 537km stream network within the Wai-O-Tapu, with approximately half of this sitting within pasture. The main stream channel emerges from the Wai-O-Tapu geothermal area and flows south through the central Reporoa Basin, with a distinct meander pattern in the central and southern reaches. The central reach has been channelised to some extent, creating a number of small oxbow lakes adjacent the main channel. Extensive historical erosion control works are established along the western flank of the catchment as part of the Paeroa Range Soil Conservation Scheme, plus other works under local soil conservation schemes (e.g. Torepatutahi) along the eastern flank of the Reporoa Basin. A number of riparian protection (Clean Streams) sites are also established throughout the central catchment. Similar works are in place on a number of oxbow lakes through a partnership between Eastern Fish & Game and the Environment Initiatives Fund. Scope remains for further riparian work to address streambank erosion and potential stock impact on some tributary channels, along with retirement of wetlands, seeps and ephemeral streams. This sub-catchment sustained significant damage in early 2017 due to three cyclone events. This has caused changes in stream morphology and further erosion is expected to occur as a result of this. The catchment is a very high priority for Ngati Tahu-Ngati Whaoa who are currently developing a scoping report for enhancing 3-	

<table>
<tr><td></td><td>4km of the lower reaches of the Mangahoanga Stream – a tributary of the Wai-O-Tapu.

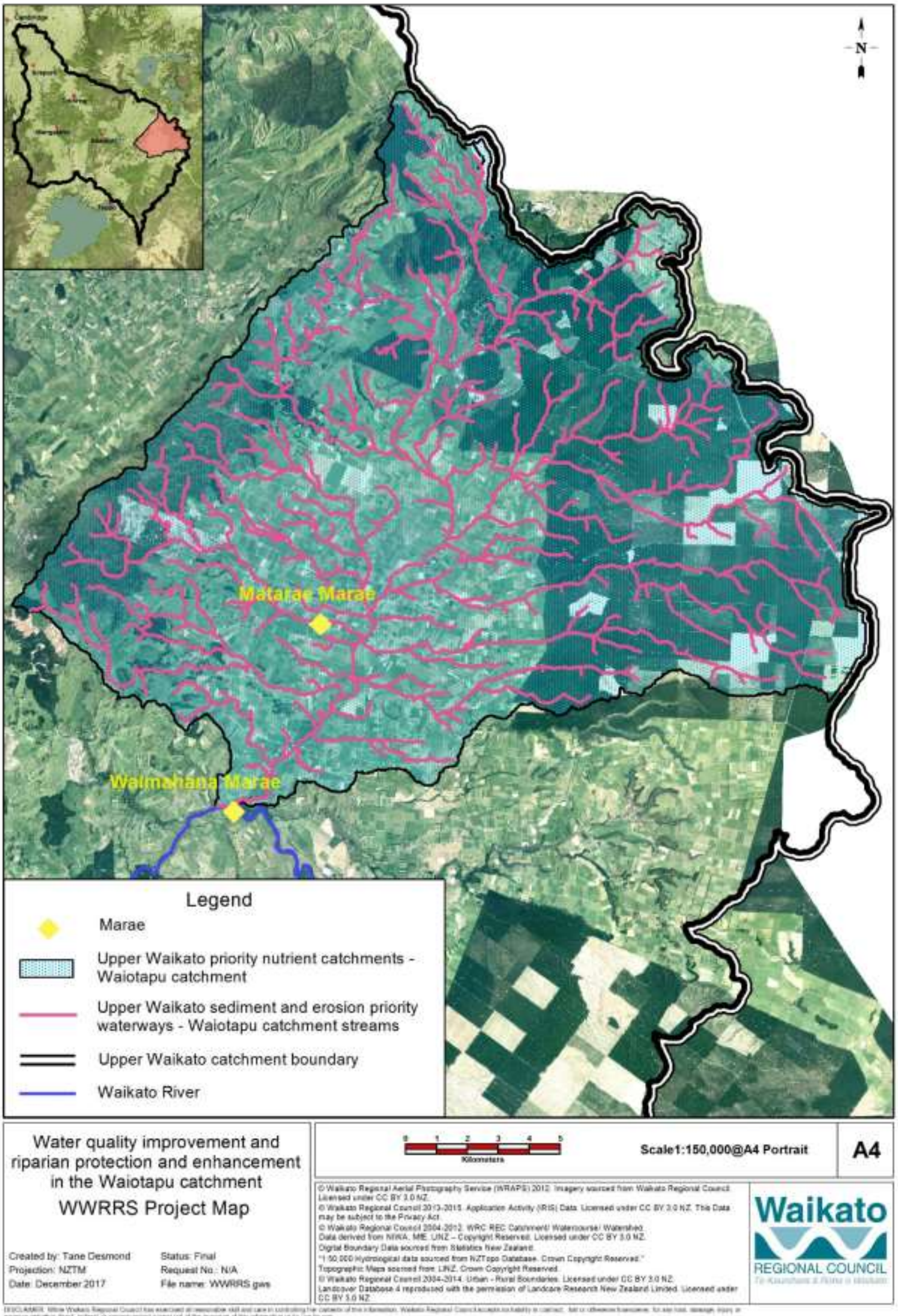
Modelling has identified the catchment as a high priority for management of E.coli and streambank erosion.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability, and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The streams are swimmable, fishable, safe for gathering kai, and have access for recreation.
- Iwi and community have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Wai-O-Tapu sub-catchment would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 300</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Wai-O-Tapu Stream and upper Waikato River.</td></tr>
<tr><td>Stock access to the streams and wetlands</td><td>Reduced water quality and destruction of riparian vegetation. Loss of wetland function.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 15 years of project commencement, the main channel and tributaries of the Wai-O-Tapu Stream are stable and fenced to exclude stock with a minimum 5 wire (2 electric) fence. Native and exotic planting (and associated weed control) is established within areas of the riparian margin most susceptible to erosion.
- 100% of wetlands and seeps greater than 0.25ha are fenced to exclude stock.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management of rivers/streams in pasture for soil conservation purposes
- Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 120km of streambank (60km of stream length). Include adjoining wetland areas within the riparian fencing ($960,000).</td><td></td></tr>
</table>

	- Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 30ha of planting and associated weed control and maintenance ($1,126,560). - 3010 poplar poles are estimated to be required for river and stream erosion control ($42,140). These should be planted at a 10m spacing where required. **Wetland protection** Carry out 135km fencing of wetlands/seeps greater than 0.5ha and in pasture, with a 5 wire (2 electric) fence at $8 per metre to exclude stock ($1,080,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	The Wai-O-Tapu sub-catchment retains some very important values and the stream is still swimmable and fishable, however, the overall condition of the catchment is below desired state for meeting the Vision & Strategy. Over the next 20 years it is expected that some aspects may deteriorate in the absence of this project as a result of recent conversions. Works included here address several threats to the feature and it is anticipated that if the project is fully completed, the catchment will move closer to the Vision & Strategy desired state. The project will assist in protecting and improving water quality and facilitate a reduction in sediment in waterways. Fish habitat and biodiversity values can also be expected to improve as secondary benefits to the works. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy and will require additional work outside the scope of this document, however, this project is expected to make a measurable difference to the Wai-O-Tapu catchment.	W = 0.15
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of riparian works due to flooding. The geology of the sub-catchment adds a greater challenge than at other sites.	F = 0.87
Adoptability	It is estimated that under half of landowners would adopt the works if they were fully incentivised. The extent of the fencing	A = 0.40

	setbacks may be a challenge in terms of uptake. The large catchment contains several discrete communities which may also make it more difficult to gain momentum. Establishing a number of flagship sites could help encourage greater uptake.	
Information quality	Average – estimates are based on modelled information and catchment wide surveys of riparian fencing.	
Knowledge gaps	Estimates of wetland perimeter come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	
Up-front cost – total for implementation phase/project duration	(see cost table below)	C = 4.171

Task	Cost ($)
Riparian fencing (120km)	960,000
Riparian willow/poplar pole planting (3010 poles)	42,140
Native riparian planting (30ha)	1,126,560
Wetland fencing (135km)	1,080,000
Project management/staffing/incidentals (30%)	962,610
Total	**4,171,310**


N
Matarae Marae
Waimahana Marae
Legend
Marae
Upper Waikato priority nutrient catchments - Waiotapu catchment
Upper Waikato sediment and erosion priority waterways - Waiotapu catchment streams
Upper Waikato catchment boundary
Waikato River
Water quality improvement and riparian protection and enhancement in the Waiotapu catchment
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS gws
0 1 2 3 4 5
Kilometers
Scale1:150,000@A4 Portrait
A4
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Waikato
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Examples of erosion and potential erosion on the outside bends of the Wai-O-Tapu Stream.

UW 30 Priority: very high	Biodiversity enhancement on the lower reach of Ruatawhiri Stream and part of Torepatutahi Stream	BCR value
Relevant unit goal(s)	Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. An active and engaged community is involved in biodiversity protection, enhancement and restoration work, including the incorporation of mātauranga Māori practices. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Lower reach of Ruatawhiri Stream and part of Torepatutahi Stream	
Brief description of feature	A 8.5km length of waterway encompassing the lower end of Ruatawhiri Stream (2km upstream of Allen Road downstream to the confluence with Torepatutahi Stream) and part of Torepatutahi Stream (a 1.3km length downstream of the Ruatawhiri tributary. This section of waterway encompasses over 50 hectares of wetland ecosystems and meandering channels. There are populations of the "at risk – declining" plant *Urtica perconfusa* (swamp nettle) present and significant raupo and *Carex* wetlands (currently under threat from grey willow). A number of rare bird species are also thought to be present – fernbird, black shag, dab chick, scaup, grey teal, New Zealand shoveler, grey duck, Australasian bittern and spotless crake. The site is within the top 15% of sites for biodiversity protection and enhancement within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type. These values are under threat from a range of factors including invasive weeds. Along the upper banks of the waterway, blackberry is prominent along with broom and other common weed species. A successful 30ha wetland restoration project has been undertaken downstream from this site (directly downstream from Broadlands Road) by Contact Energy. This has involved large scale control of pest willow to restore the native sedgeland and raupo wetlands beneath. Both the Torepatutahi Stream and the Ruatawhiri Stream are spring fed and have good water quality. As well as having high	

	terrestrial biodiversity they also provide spawning and juvenile trout habitat and the extensive marginal macrophyte beds are a food source for trout and other fish species. Ngati Tahu-Ngati Whaoa iwi traversed these streams/areas to reach the area now known as Kaingaroa Forest (towards the Rangataiki) and to travel to various caves within Kaingaroa. A pā kōkopu was historically present at the Torepatutahi Stream mouth and kōura and tuna were also harvested in the area. In later times, the site has become important as a watercress harvest area. Further north of these areas (in the general vicinity) are caves and old kāinga with evidence of cultivation and gardens. Approximately three quarters of the section of waterway identified has a DOC marginal strip but there is no active management of this area due to funding limitations.	
Desired state to achieve Vision & Strategy	- The section of waterway identified is fenced to exclude stock from its entire length. It has a riparian margin well vegetated with native plant species and is a minimum of 5m wide. - Native raupo wetlands and C*arex* sedgelands are free from pest willow and there are healthy populations of native wetland bird species. - The stream is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, these stretches of the Ruatawhiri and Torepatutahi streams would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 20
Key threats to the feature that this project addresses	<table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Weed species</td><td>Compete with native plant communities.</td></tr></table>	
Project goal/s	- Within 5 years of project commencing, the full 8.5km stretch of stream has a fenced riparian margin. Newly fenced riparian margins (i.e. fenced as part of this project) are at least 5m wide and vegetated with native plant species. - Existing wetland and riparian areas are free from pest willow species and dominated by native plant species. - There are healthy populations of native wetland bird species.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Management plan development** Develop a management plan for the project ($12,000). **Riparian management** Carry out riparian fencing with a minimum 5m setback from the	

	top of the streambank. Include adjoining wetland areas within the riparian fencing. Undertake native riparian planting within the fenced area and associated weed control and maintenance for native plant establishment. - Assume that 30% of the waterway requires fencing, fence upgrades or current fencing to be moved further back. The total length of streambanks is 17km (both sides), it is therefore assumed that 5.1km of fencing is required ($48,800). - Assume that 50% (8.5km) of the streambanks require native planting of a 5m wide riparian margin (4.2ha) at an average cost of $39,552 per hectare for a weedy site ($166,118). Note: The plant species mānuka should NOT be a large component of any planting plan as there have been difficulties establishing it in the Reporoa area. **Willow control** This would be undertaken in circumstances where there was a dense native understorey beneath the willow canopy. Any willow removal should be undertaken in stages using either ground based methods (such as treatment with x-tree basal) or aerial control (if recommended by an ecologist). This project does not promote the removal of willow for the purpose of creating areas of open water habitat, however, it is recognised that open water habitat may be desirable in some situations. For costing purposes it is assumed that willow control is required across an 18.6ha area (approximately 30% of the total area of willow). - 10% aerial control (3.1ha x $400 is $1240) - 20% ground based or aerial spot spray (6.2ha x $4000 is $24,800) - 3 years maintenance (9.3ha x $1400 x 3years is $39,060). Note: There are concerns that large scale willow control may result in water levels lowering and the stream becoming channelised. Therefore, willow control should be undertaken in stages so that after each stage any impacts on water level can be assessed and further work suspended if this occurs. **Weed control** This waterway has a range of weed species present so a comprehensive weed control plan (along with the native planting) will be essential to ensure success of the project. - Weed control, using a knapsack, within native planting areas (4.2ha x 3 years) is $35,280. **Animal pest control** This site would benefit from mustelid and rat control to protect and enhance native bird populations. This work has not been	

	costed as ongoing as animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately soon after project completion.	L = 5.5
Effectiveness of works	These sections of stream are currently in good condition, with some of the Vision & Strategy desired state aspects already being met or close to being met, including being fishable and containing healthy populations of native bird species. It is expected that over the next 20 years there will be a slow deterioration in the stream and surrounds in the absence of this project. This will be predominantly due to spread of existing weed species. Works included here address the plant biodiversity related threats to the stream and it is anticipated that if the project is fully completed, the feature will be in very good condition and close to the Vision & Strategy state being achieved in 20 years' time. The project does not address animal pests which are a threat to bird populations at the site, although there is some existing management currently being undertaken by private landowners.	W = 0.1
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are related to establishment of plantings and failure to control weeds. It will be essential that plant pest control is undertaken by experienced practitioners.	F = 0.82
Adoptability	It is estimated that approximately 80% of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide a challenge in terms of uptake.	A = 0.8
Information quality	Average – recommendations are based on some local knowledge of the streams. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps	Further work is required to determine the final totals of fencing, planting and weed control required. This will need to be undertaken in the early stages of project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost($)</th></tr>
<tr><td>Management plan</td><td>12,000</td></tr>
<tr><td>Riparian fencing (5.1km)</td><td>40,800</td></tr>
<tr><td>Riparian planting (4.2ha)</td><td>166,118</td></tr>
<tr><td>Willow control (18.6ha)</td><td>65,100</td></tr>
<tr><td>Weed control</td><td>32,280</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>79,075</td></tr>
<tr><td>Total</td><td>395,373</td></tr>
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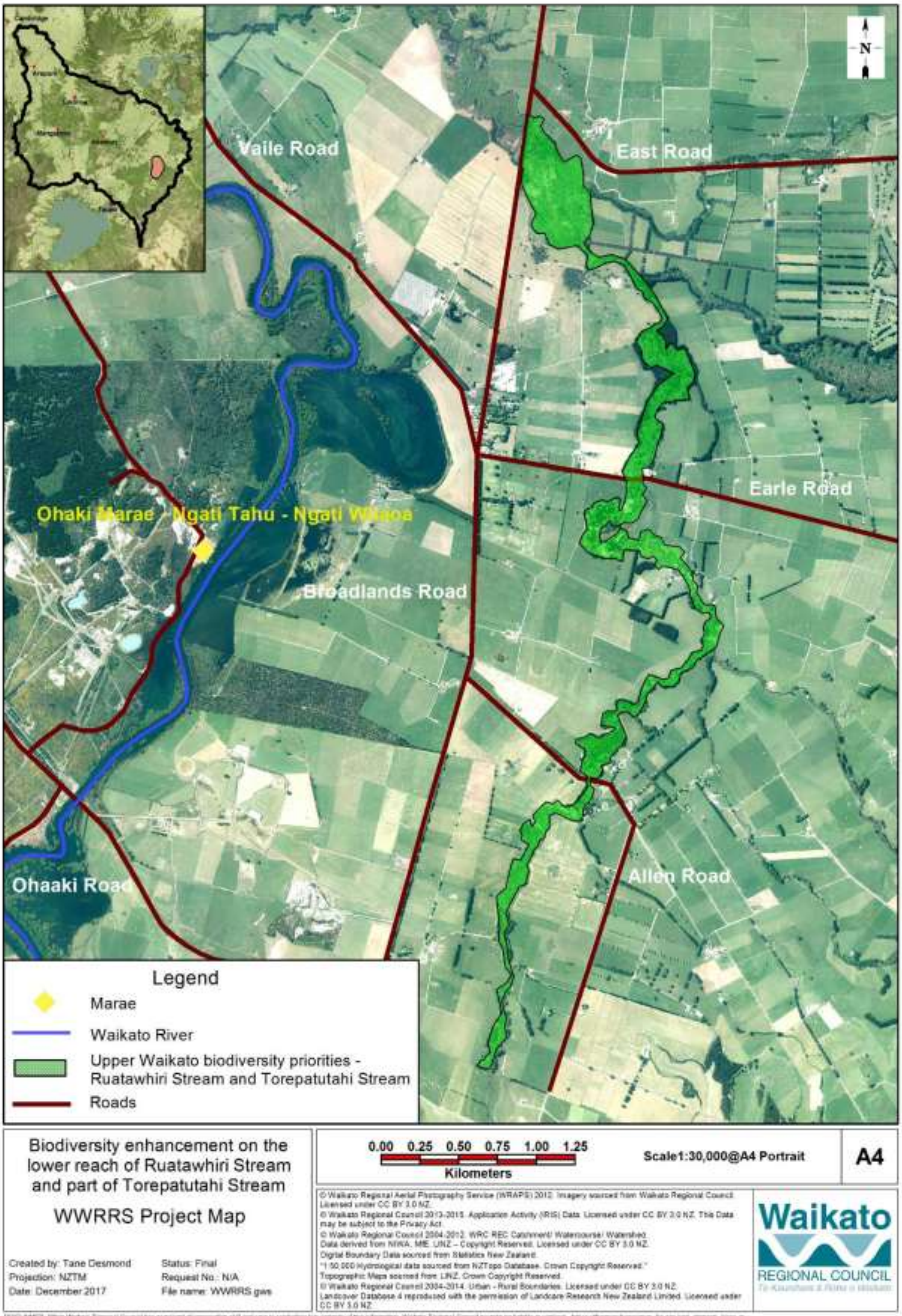
</td>
<td>C = 0.4</td>
</tr>
</table>



Vaile Road
East Road
Earle Road
Ohaki Marae - Ngati Tahu - Ngati Whaoa
Broadlands Road
Allen Road
Ohaaki Road
N
Legend
Marae
Waikato River
Upper Waikato biodiversity priorities - Ruatawhiri Stream and Torepatutahi Stream
Roads
Biodiversity enhancement on the lower reach of Ruatawhiri Stream and part of Torepatutahi Stream
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS gws
0.00 0.25 0.50 0.75 1.00 1.25
Kilometers
Scale1:30,000@A4 Portrait
A4
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A large wetland area next to Torepatutahi Stream, immediately upstream of Broadlands Road.

Native vegetation alongside the edge of Torepatutahi Stream with willow trees further back.

Torepatutahi Stream showing predominantly native vegetation (with some exotic pine and willow).

Ruatawhiri Stream showing willow growing along the riparian margin with native flax and sedge vegetation beneath.


Ruatawhiri Stream showing willow growing along the riparian margin with native flax and sedge vegetation beneath.

UW 31 Priority: very high	Biodiversity enhancement at Lake Rotokawa and Lake Rotokawa North	BCR value
Relevant unit goal(s)	Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy functioning state and support representative native flora and fauna. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate sites.	
Name of feature	Lake Rotokawa and Parakiri Stream	
Brief description of feature	Lake Rotokawa and the area to the north of the lake are a geothermal site located on the Rotokawa Geothermal Field. This site is of national significance because it comprises a large, relatively good quality area of geothermal vegetation, which includes nationally uncommon habitat types such as fumaroles, geothermally heated dry ground, geothermal stream margins and lake shore wetland. Geothermal kānuka, an “at risk – naturally uncommon” species found only in geothermal locations in the Central Volcanic Plateau, covers extensive areas. Small populations of a number of other at risk plant species are also present, e.g. the geothermal tangle fern (*Dicranopteris linearis* var. *linearis*), the red bearded orchid *(Calochilus robertsonii)* and native ladder fern *(Nephrolepis flexuosa*). The site provides for a number of rare bird species, including the New Zealand pipit (at risk – declining), North Island fernbird (at risk – declining), New Zealand falcon (threatened – nationally vulnerable), banded dotterel (threatened – nationally vulnerable) and pied stilts (at risk –declining). A leech, *Helobdella*, which is not known to be found anywhere else in New Zealand, can also be found at the lake. Rotokawa is part of the wider geographic area used by the Ngati Tahu-Ngati Whaoa people. Lake Rotokawa and Pakiri Stream mouth were used for catching birds and the site was also linked with other seasonal practices, kāinga and cultivations along the river. The Tahu-Whaoa people had a tuahu (site of religious ceremonies) at Rotokawa. Another name for the tuahu of this kind was mauri. Birds would not be harvested at Rotokawa until an inspection of the tuahu was made and a subsequent lifting of tapu from the lake. At the northern side of Lake Rotokawa, on the old track from Taupō, there also stood a rahui post of considerable mana. The post was called Parakai and was located above Tamarauhura. The purpose of the post was to prevent people going to Lake Rotokawa and taking birds.	

<table>
<tr><td></td><td>Tūwharetoa Māori Trust Board has also confirmed that it has ancestral interest in the ecosystem at this site.

Historic sulphur mining over 50 years has damaged Rotokawa's natural features through stripping large areas of hot ground, destroying natural contours and geothermal vegetation in the vicinity. The geothermal vegetation is now regenerating. Parts of the site have also been modified by forestry operations and pastoral farming, resulting in a reduction in extent of geothermal vegetation. Invasive exotic plant species are locally common, in particular wilding pines which in some areas dominate the canopy over a lower tier of indigenous vegetation. Geothermal vegetation remains intact in several areas, particularly to the northeast of the lake.

The site has been identified as a priority as it is within the top 30% of sites for biodiversity protection within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type.

The area identified for management is a total of 274ha comprising DOC reserve, private land to the north and northeast of the DOC reserve and riparian margin along Parakiri Stream flowing between Lake Rotokawa and the Waikato River.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- Geothermal ecosystems retain integrity.
- Riparian corridors are dominated by native species and provide a landscape of connectivity between the Waikato River and the geothermal features.
- Iwi and communities have a strong connection to the sites and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Rotokawa and Parakiri Stream would have a high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Wilding pines and other weeds</td><td>Compete with native plant communities and continue to spread. Within the DOC reserve there are some local patches of wilding pines that are a serious threat to indigenous plant communities on cooler ground. Outside the DOC reserve, wilding pines are more dominant (6-25% cover).</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities. A range of weed species are present at the site, including broom, pampas Himalayan honeysuckle, buddleia, gorse, blackberry, pampas, silver birch, Montpellier broom and grey willow.</td></tr>
<tr><td>Stock access</td><td>Destruction of vegetation and geothermal features.</td></tr>
</table>
</td><td></td></tr>
</table>

Project goal/s	Within 15 years of the project commencing, the quality of the geothermal vegetation is improved by: - excluding cattle from the site - eradicating wilding pines - reducing the cover of other plant pests by 90-100%.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing** Fence unfenced portions of the site to exclude stock, with a minimum 5 wire (2 electric) fence. - Approximately 4km x $8 is $32,000. **Wilding pine control** <u>DOC conservation area</u> Reduce wilding pines to a very low abundance. - Drill and poison or fell remaining wilding pines ($5,000). <u>10ha immediately north and adjoining DOC conservation area</u> (owned by Ngati Tahu-Ngati Whaoa) Reduce wilding pines to a very low abundance. - Drill and poison or fell wilding pines ($30,000). - Undertake seedling sapling wilding pine control on a 3 year rotation for 15 years ($6000 x 5 events is $35,000). <u>Private land to the northeast of the DOC conservation area and riparian areas of Parakiri Stream</u> - Drill and poison or fell remaining wilding pines (56ha at density of approximately 30%) – $67,200. - Undertake seedling sapling wilding pine control on a 3 year rotation for 15 years ($16,000 x 5 is $80,000). **General weed control – outside the DOC conservation area** A comprehensive weed control programme will also be required to allow native vegetation to regenerate. - Costs are based on use of a knapsack to treat approximately 22ha of vegetated ground where weeds are at a density of 10-20% cover ($61,600). **Animal pest control** This site may benefit from mustelid and cat control to protect native bird populations. This work has not been costed as ongoing as animal pest control is out of scope for the Restoration Strategy. **Project management/staffing/incidentals**	

	Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen between 10-11 years after project commencement.	L = 10.5
Effectiveness of works	Lake Rotokawa and the Parakiri stream are currently in very good condition with most of the Vision & Strategy desired state aspects already being met. It is expected that over the next 20 years these features will remain in good condition, even in the absence of this project. Works included here address the ongoing threat of wilding pine and other exotic plants which threaten the ecological integrity of the sites. It is anticipated that if the project is fully completed, the features will be in excellent condition and very close to the Vision & Strategy state being achieved in 20 years' time. The project does not address animal pests which are a threat to bird populations at the site.	W = 0.05
Risk of technical failure	There is a very low risk of project failure due to technical feasibility. Work should be carried out by experienced practitioners to ensure wilding pine control is effective.	F = 0.92
Adoptability	It is estimated that all landowners would adopt the works if they were fully incentivised. There is a small number of landowners and all are supportive of restoration and protection of the site.	A = 1
Information quality	Average – costings for DOC land are based on input from DOC staff, however, costings for neighbouring land are estimated based on aerial photography and standard cost rates.	
Knowledge gaps	Further work is required to determine the final total of fencing, weed control and wilding pine removal required. This should be undertaken in the early stages of project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks. Inter-agency co-operation is good and the works are not considered controversial in any way.	P = 0.97
Project duration (years)	15 years	

<table>
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<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (4km)</td><td>32,000</td></tr>
<tr><td>Wilding pine control</td><td>217,200</td></tr>
<tr><td>General weed control</td><td>61,600</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>46,620</td></tr>
<tr><td>Total</td><td>357,420</td></tr>
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</td>
<td>C = 0.357</td>
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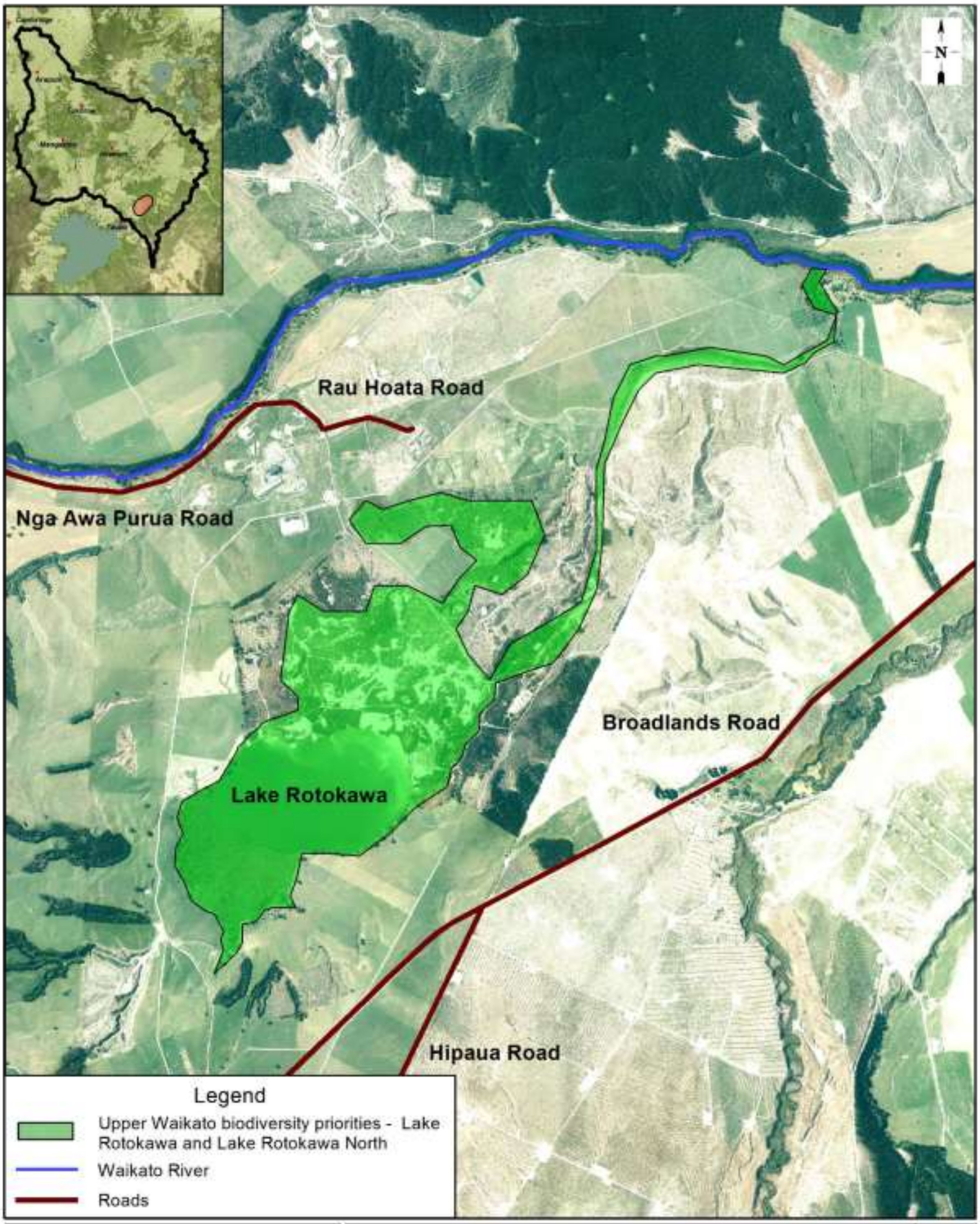

Biodiversity enhancement at Lake Rotokawa and Lake Rotokawa North

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.00 0.25 0.50 0.75 1.00 1.25
Kilometers

Scale1:30,000@A4 Portrait

A4

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Rotokawa geothermal area.


Rotokawa geothermal area. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust.


Rotokawa geothermal area. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust.


Parakiri Stream. Photo: Ngati Tahu-Ngati Whaoa Runanga Trust.

UW 32 Priority: very high	Pueto catchment hill country and streambank erosion protection and remediation	BCR value
Relevant unit goal(s)	Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (Land Use Capability Class 7, 8) land and gully heads. Significant 'hotspots' (e.g. sub-catchments, or tributaries) have been identified and targeted cleanup activity progressed Water quality across the Upper Waikato has improved, and areas where fresh water allows the taking of food, swimming, recreation are more widespread. Education, farm planning and capacity building programmes assist communities in reducing erosion in the Upper Waikato. Fresh water quality enables habitats for plants and animals to thrive. Land and water management is integrated and undertaken at a sub-catchment level.	
Name of feature	Pueto catchment	
Brief description of feature	This is a 19,900ha catchment lying east of Lake Taupō. Approximately 6% of the catchment retains indigenous vegetation, with the remainder being a mix of pasture and forestry. There is an estimated 128km of streams in pasture within Pueto catchment. The catchment contains areas of steep terrain, elevated terrace formations and large, deeply incised gullies. Extensive conversion development throughout the catchment in recent years created widespread soil disturbance and altered the storm runoff hydrology in the absence of the buffering effect of a mature forest canopy. While this development has been staged over time and most new pastures are well established, deep pumice soils have ongoing potential for severe erosion. Some historical soil conservation works are located in the catchment, although in some cases works such as retirement fencing were rendered defunct when the original pastoral land use was converted to plantation forestry and now require reinstatement with conversion back to pastoral use. The Pueto is a valuable trout spawning stream and has high cultural values. Protection and restoration of this feature is strongly supported by Ngati Tahu-Ngati Whaoa and Tūwharetoa.	

<table>
<tr><td></td><td>Water quality monitoring information on the Waikato Regional Council website indicates that phosphorus levels are ”unsatisfactory” 100% of the time in the Pueto Stream at the Broadlands Road bridge.

Modelling has identified the catchment as a high priority for management of hill country and streambank erosion.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A sub-catchment where land use matches capability, and with a stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection, shade and shelter.
- Forest remnants and wetlands adjacent to streams are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. Native plant regeneration occurs naturally within the native bush remnants.
- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The streams are swimmable, fishable, safe for gathering kai, and have access for recreation.
- Iwi and community have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Pueto sub-catchment would have a very high impact on giving effect to the Vision & Strategy at an Upper Waikato catchment level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Contributes significant sediment to the catchment streams and upper Waikato River.</td></tr>
<tr><td>Riverbank erosion</td><td>Contributes significant sediment load to the Pueto Stream and upper Waikato River.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- All LUC Class 7 and 8 land is retired from stock grazing.
- There is a 20% reduction in suspended sediment in the Pueto Stream within 20 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 7 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures etc.) ($105,000).</td><td></td></tr>
</table>

	- 181ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($452,500). - 596ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($1,490,000). - 55ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($275,000). - 2km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($50,000). **Riparian management of rivers/streams in pasture for soil conservation purposes** - Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires at $8 per metre) along an estimated 64km of streambank (32km of stream length). Include adjoining wetland areas within the riparian fencing ($512,000). - Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 16ha of planting and associated weed control and maintenance ($600,832). - 1603 sterile willow poles are estimated to be required for river and stream erosion control ($22,442). These should be planted at a 10m spacing where required. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen by approximately year 15 of the project.	L = 15
Effectiveness of works	The Pueto sub-catchment retains some very important values and the stream is still swimmable and fishable, however, the overall condition of the catchment is significantly below desired state for meeting the Vision & Strategy. Over the next 20 years it is expected that some aspects with deteriorate and some will improve in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed, the catchment will move substantially closer to the Vision & Strategy desired state in areas such as land use meeting capability and streambank stability. The project will assist in protecting and improving	W = 0.2

	water quality and facilitate a reduction in sediment in waterways. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, however, this project is expected to make a measurable difference to the Pueto catchment.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are fully established. This risk is exacerbated by the scale of conversion that has been undertaken in recent years and the nature of the sub-catchment soils. Being so close to Taupō, the soils are particularly uncemented and when failure occurs it can be massive in scale. This is fragile landscape that has and still is experiencing significant natural and induced geological changes. The adoption of effective soil conservation remedies to mitigate these changes will require a degree of experiential knowledge to achieve results that are integral to the overall health of the Pueto catchment.	F = 0.82
Adoptability	It is estimated that almost all landowners would adopt the works if they were fully incentivised. Erosion is recognised as a key issue in this catchment.	A = 0.9
Information quality	Average – estimates are based on modelled information and catchment wide surveys of riparian fencing.	
Knowledge gaps	Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. This relates mostly to sensitivities in the community about the cause of the erosion issues in the catchment. Early community engagement and project communications will be important to minimise risks.	P = 0.62
Project duration (years)	20 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>7 erosion control structures on LUC class 6e land</td><td>105,000</td></tr>
<tr><td>LUC class 6e land managed with plantation species (181ha)</td><td>452,500</td></tr>
<tr><td>LUC class 7 land managed with plantation species (596ha)</td><td>1,490,000</td></tr>
<tr><td>Erosion control outside LUC class 6e, 7 and 8 land (55ha)</td><td>275,000</td></tr>
<tr><td>Fencing existing indigenous vegetation (2km)</td><td>50,000</td></tr>
<tr><td>Riparian fencing (64km)</td><td>512,000</td></tr>
<tr><td>Riparian willow pole planting (1603 poles)</td><td>22,442</td></tr>
<tr><td>Native riparian planting (16ha)</td><td>600,832</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>1,052,332</td></tr>
<tr><td>Total</td><td>4,560,106</td></tr>
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<td>C = 4.56</td>
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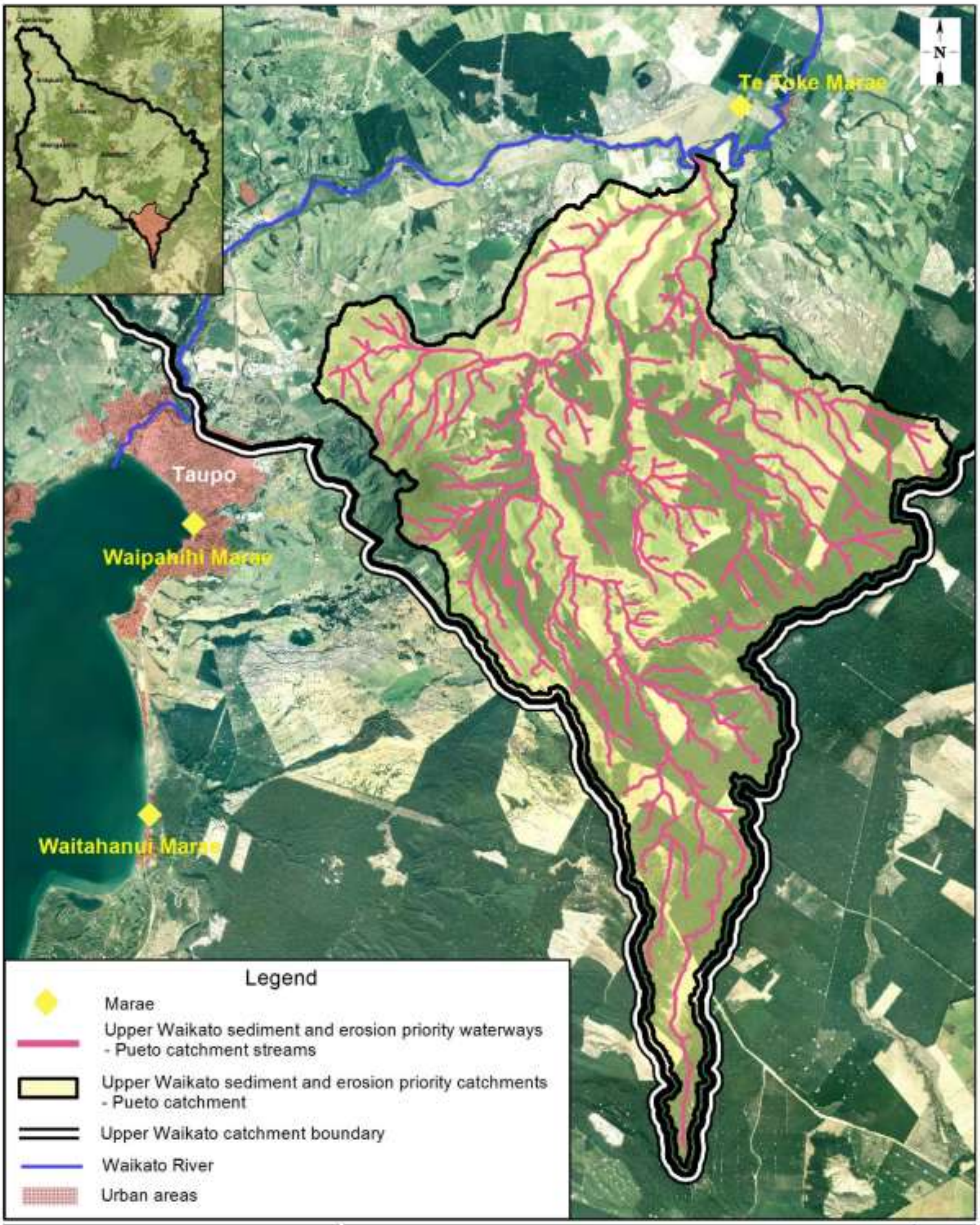

Pueto catchment hill country and streambank erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0 1 2 3 4 5
Kilometers

Scale1:150,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

APPENDIX 7 - Waipā Catchment Project Assessments

Contents

WP 1 Priority: High	Waipā River erosion protection and remediation – Pirongia to Ngāruawāhia	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Waipā River – Pirongia to Ngāruawāhia	
Brief description of feature	This reach consists of 30km of Waipā main stem from Pirongia to Whatawhata and 28km from the Whatawhata bridge to the confluence with the Waikato River at Ngāruawāhia. The river here is well incised with some bank slumping in areas. Margins are not fully fenced and lack continuous vegetation. There is increased incidence of bank collapse following high flow events, especially where there is a lack of stabilising vegetation. Pest willow species are throughout the extent of this reach. This stretch of the Waipā provides a pathway for patupaiarehe, or spiritual beings, who travel between various maunga along the Waipā to Taupiri and other significant areas. There are historic pā sites along the margins such as Tangirau and Moehaki. Taniwha also traverse the Waipā and have resting places along its banks. The Waipā is also a main stem of travel for significant fisheries and tribes. Based on regular monitoring undertaken by Waikato Regional Council, the Waipā River along this stretch (at Whatawhata Bridge) is not safe for swimming due to unsatisfactory levels of E. coli. Clarity, TN and TP are also considered unsatisfactory.	
Desired state to achieve the Vision & Strategy	- A 58km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin at least 10 metres wide that is well vegetated with native plants and exotic plants where required to prevent erosion. - The river is swimmable, fishable and has access for recreation. - Iwi and community have a strong connection to the river and are active in its use protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River – Pirongia to Ngāruawāhia reach – would have a very high impact on	VS = 350

<table>
<tr><td></td><td>giving effect to the Vision & Strategy at a Waipā catchment level.</td><td></td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 25,000 tonnes sediment per year to the Waipā River and lower Waikato River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years of project commencement:
- The river has stable banks and a continuous vegetated (native and exotic for erosion control) 58km margin along the reach from Pirongia to Ngāruawāhia.
- Stock is excluded from 100% of the river and new fencing is set back at least 15m from the riverbank.
- Sediment to the Waipā River over this stretch is reduced by 15%.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- Based on surveys of Waipā catchment waterways and assuming that all unfenced bank will require new fencing, it is estimated that 53km of new fencing will be required along this reach of the main channel. Fence should be setback at least 15m from the riverbank. Fencing costs (5-wire, 2 electric at $8 per metre) are estimated at $426,880.
- Pole planting for bank stabilisation is estimated to be required over 22km of riverbank. Poles should be planted every 10m over erosion prone sites. This equates to 2200 poles ($30,800).
- It is estimated that 75% of the margin will require new planting which equates to 112ha of native planting. Cost is estimated to be $4,429,824. This assumes that sites will be weedy and require weed control prior to planting.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project</td><td>L = 13.5</td></tr>
</table>

	benefits would be seen approximately 13-14 years after project commencement.	
Effectiveness of works	The Waipā River (Pirongia to Ngāruawāhia) is currently in poor condition with few of the Vision & Strategy desired state aspects being met. The river is not swimmable, the banks are unstable in many places and stock have access to the river at a number of locations. The riverbanks are not well vegetated with native plants. Some deterioration in the river is expected over the next 20 years in the absence of this project, with impacts of the upper catchment and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. This decline is expected to be offset by the outcomes of this project which will improve aspects related to bank stability, stock exclusion and extent of native vegetation along the margins. Secondary benefits in E. coli reduction, fish habitat and biodiversity can also be expected. Overall, however, the upper catchment impacts will still be the biggest factor in water quality through this reach and it is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 15m and by planting sterile willow poles to stabilise banks while native plantings establish.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake, however, there are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.	A = 0.45
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost</th></tr>
<tr><td>Native planting (112ha)</td><td>4,429,824</td></tr>
<tr><td>Poplar/willow poles (2200)</td><td>30,800</td></tr>
<tr><td>Fencing (53km)</td><td>426,880</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>1,221,876</td></tr>
<tr><td>Total</td><td>$6,109,380</td></tr>
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<td>C = 6.11</td>
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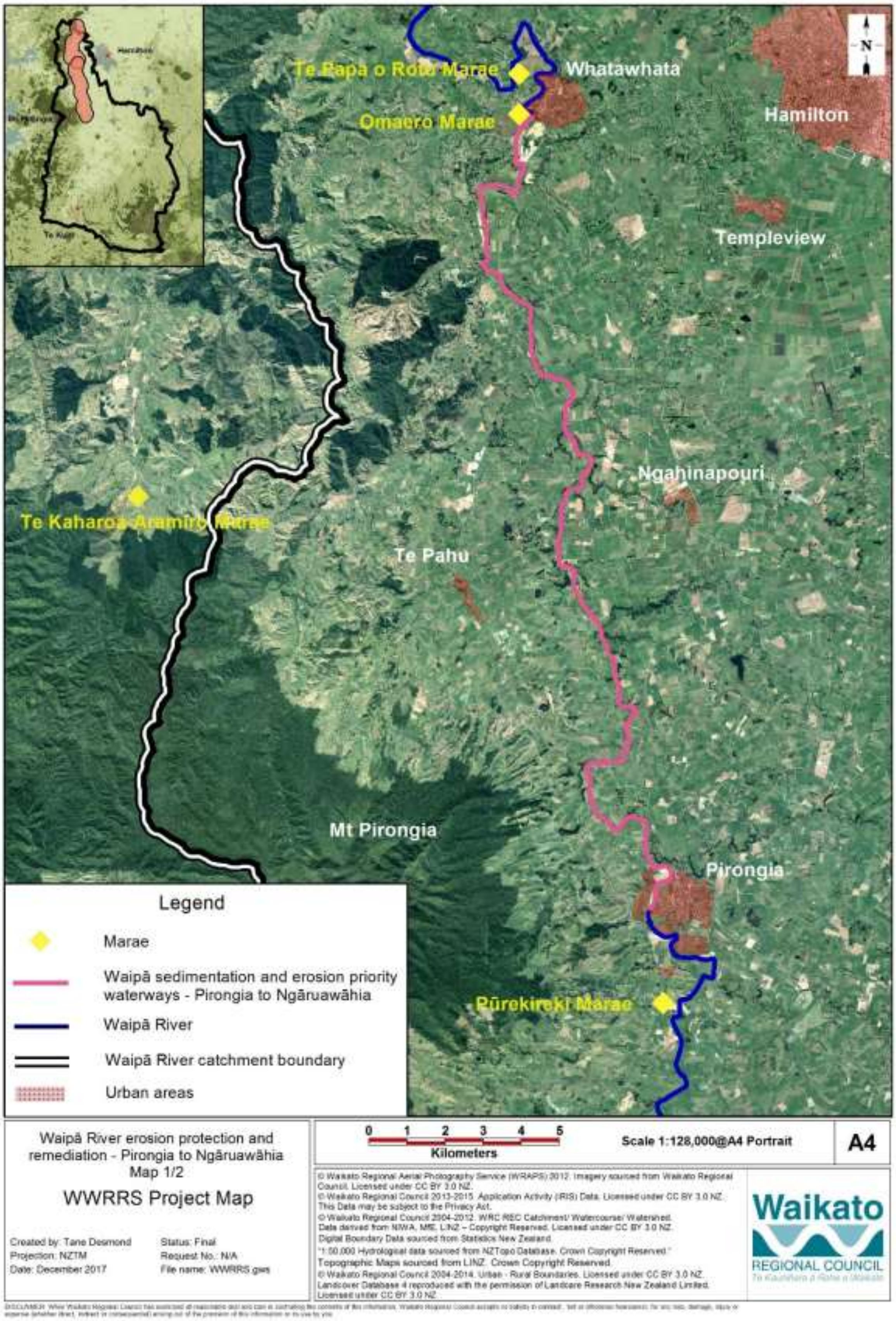
N
Te Papa o Rotu Marae
Whatawhata
Omaero Marae
Hamilton
Templeview
Ngahinapouri
Te Kaharoa-Aramiro Marae
Te Pahu
Mt Pirongia
Pirongia
Pūrekireki Marae
Legend
Marae
Waipā sedimentation and erosion priority waterways - Pirongia to Ngāruawāhia
Waipā River
Waipā River catchment boundary
Urban areas
Waipā River erosion protection and remediation - Pirongia to Ngāruawāhia
Map 1/2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale 1:128,000@A4 Portrait
A4
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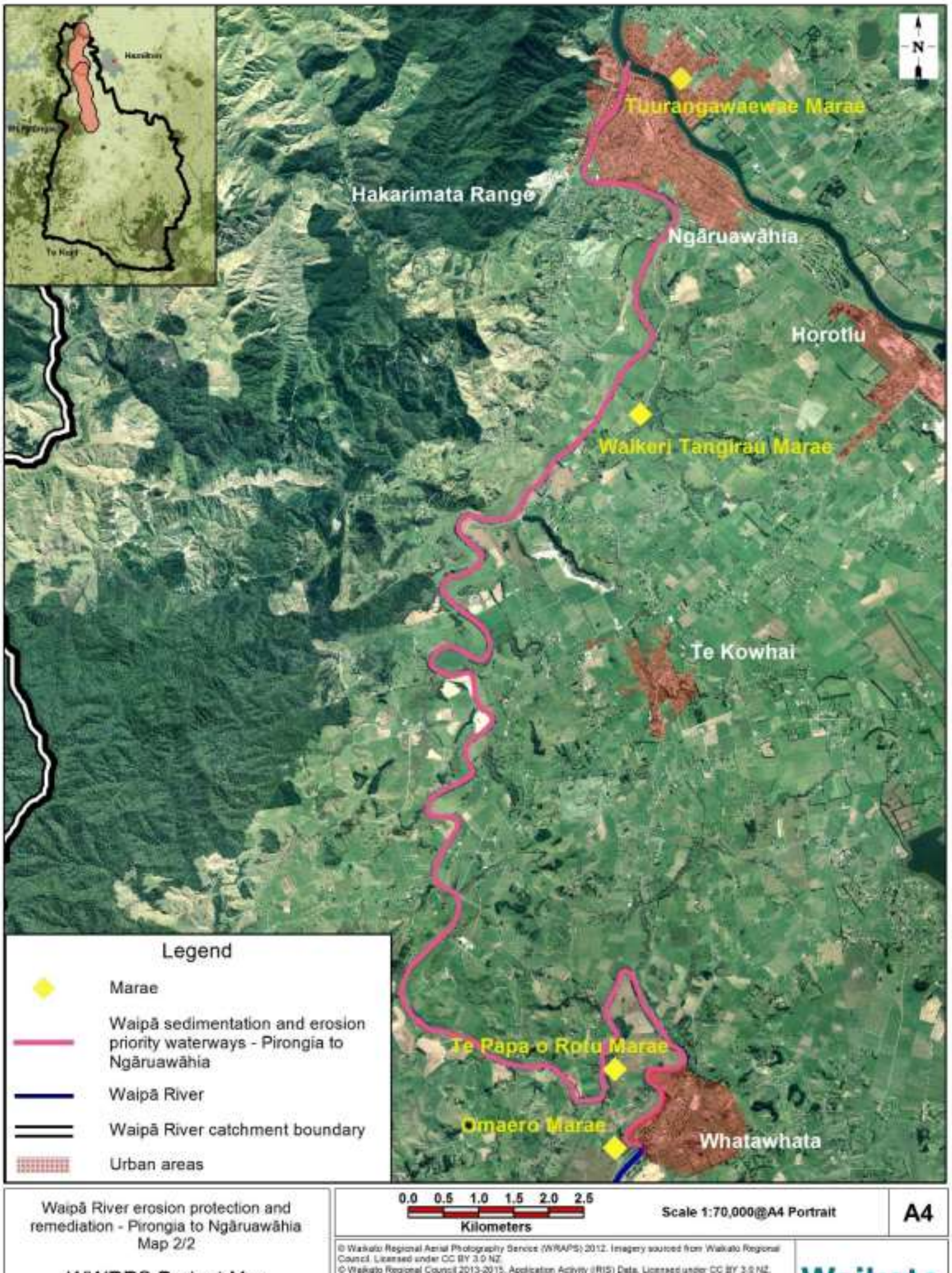
Waikato
REGIONAL COUNCIL



Waipā River erosion protection and remediation - Pirongia to Ngāruawāhia
Map 2/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gwe

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:70,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Waipā River at Pirongia showing eroding and mostly devegetated banks where stock have access to the river. This project proposes that a priority for funding would be fencing and planting of this margin.

Example of devegetated banks of Lower Waipā main stem.

Waipā River erosion prone banks.

Lower Waipā main stem with example of plantings.

WP 2 Priority: High	Walkway from Te Kōwhai to Ngāruawāhia township via Te Otamanui gully and along Waipā River	BCR value
Relevant unit goal(s)	The river provides for recreational use and social needs, is widely used by the community, and is a place to gather kai, relax, plan and exercise.	
Name of feature	Waipā River Te Kōwhai to Ngāruawāhia and Te Otamanui Lagoon and gully	
Brief description of feature	This feature includes the Te Otamanui gully ecosystem between Te Kōwhai Village and the Waipā River (in the vicinity of Bedford Road) and a 5.3km section of the lower Waipā River from the Te Otamanui Stream inflow downstream to Ngāruawāhia township. The upstream section of the gully ecosystem comprises predominantly willow wetland and the Te Otamanui Stream with small pockets of remnant and planted native vegetation. The stream flows into the Te Otamanui Lagoon in the lower reaches and enters the Waipā River at Bedford Road. The lower reach of the gully has pockets of remnant and planted native vegetation (e.g. kahikatea and cabbage trees). A partially completed walkway extends along the true right bank of the gully and the Te Otamanui community group has carried out native planting along the completed sections of walkway. The lagoon exits to the Waipā where an historic papakāinga (settlement) was situated known as Kaitarakihi. This signals the importance of the area for providing food to the people of the area. The 5.3km section of Waipā River is fenced to exclude stock in most places and predominantly vegetated with a narrow margin of willow trees. There is opportunity to increase the recreation opportunities within the gully ecosystem and along the river by extending Te Otamanui walkway along the Waipā River to Ngāruawāhia township.	
Desired state to achieve the Vision & Strategy	- Stock is excluded from the Waipā River and Te Otamanui Stream and gully. - Waterways have well vegetated riparian margins that provides erosion protection, shade and shelter. - Native fish are abundant and there is a wide diversity of species present. - The waterways are swimmable, fishable and have access for recreation. - Iwi and communities have a strong connection to the waterways and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Waipā River from Te Kōwhai to Ngāruawāhia and Te Otamanui Lagoon would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 40

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the asset</th></tr>
<tr><td>People become disconnected from the waterways and see the area more as a resource than something that needs to be nurtured and cared for.</td><td>The opportunity for people to access, recreate and connect with the waterways are not realised.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within five years of project commencement there is a gravel walkway from Te Kōwhai village to Ngāruawāhia township alongside the Te Otamanui Stream and Waipā River.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole or in multiple smaller components.

Works would need to be undertaken in accordance with the Waikato District Council Trails Strategy and should be done in collaboration with the Te Otamanui Community Group and Waikato District Council.

Works required for the Waipā River walkway between Ngāruawāhia and Te Otamanui Stream outlet include:
- project management – this includes liaison with landowners and obtaining landowner agreements as well as procurement of contractors (25% of overall project cost)
- construction of a 5.3km gravel at $150 per metre ($795,000)
- fencing 5.3km with post and batten fence at $25 per metre ($132,500)
- native planting alongside the track for aesthetic value (approximately 3000 plants ($26,500)
- development and erection of signage ($6,000)
- surveying ($20,000).

Works required for completion of the Te Otamanui walkway include:
- project management – this includes liaison with landowners and obtaining landowner agreements as well as procurement of contractors (25% of overall project cost)
- construction of the remaining track (3.6km) at $150 per metre ($540,000)
- fencing 3.6km with post and batten fence at $25 per metre ($90,000)
- native planting and releasing at least 2250 native plants ($18,000)
- signage ($3000)
- surveying ($10,000)

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.</td>
<td></td>
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</table>

	This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 3.5
Effectiveness of works	The Waipā River (Te Kōwhai to Ngāruawāhia) and Te Otamanui Lagoon are currently in poor condition with few of the Vision & Strategy desired state aspects being met. These waterways are not swimmable or 100% excluded from stock access, and access for recreation along this stretch of the Waipā River is limited. However, these sites still retain values with the river being of high cultural significance for iwi and the lagoon already being utilised by the Te Kōwhai community for walking. Some deterioration in these features are expected over the next 20 years in the absence of this project, with impacts of the upper catchment and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. Decline in values may still be expected even with the project proceeding as it will not address risks related to land use or habitat loss. However, this would be partially offset by an expected substantial improvement in recreation and education opportunities along the river and lagoon. The project outputs would be an asset for the communities providing a walking and biking track between Ngāruawāhia and Te Kōwhai. There would be benefits to this project being conducted in alignment with efforts to fence, stabilise and plant the Waipā River main channel (Project WP 1).	W = 0.05
Risk of technical failure	Similar walkways have been constructed along the Waikato and Waipā Rivers very successfully. Very low risk of project failure due to technical feasibility subject to the path being well set back from erosion prone parts of the riverbank.	F = 0.92
Adoptability	It is estimated that two thirds of landowners would adopt the works if they were fully incentivised. The key challenge is likely to be around getting agreement for a public track along private land, however, Te Otamanui Community Group has made good progress with this to date.	A = 0.675
Information quality	Very good – information provided by Te Otamanui Community Group and Waikato District Council	
Knowledge gaps and response	The exact route of the track along the Waipā River is yet to be determined.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
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<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Waipā River walkway</td><td></td></tr>
<tr><td>- Track construction (5.3km)</td><td>795,000</td></tr>
<tr><td>- Fencing (5.3km)</td><td>132,500</td></tr>
<tr><td>- Native planting (2250 plants)</td><td>26,500</td></tr>
<tr><td>- Signage</td><td>$6000</td></tr>
<tr><td>- Surveying</td><td>20,000</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Te Otamanui walkway</td><td></td></tr>
<tr><td>- Track construction (3.6km)</td><td>540,000</td></tr>
<tr><td>- Fencing (3.6km)</td><td>90,000</td></tr>
<tr><td>- Native planting (3000 plants)</td><td>18,000</td></tr>
<tr><td>- Signage</td><td>3000</td></tr>
<tr><td>- Surveying</td><td>10,000</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>410,250</td></tr>
<tr><td>Total</td><td>$2,051,250</td></tr>
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<td>C = 2.04</td>
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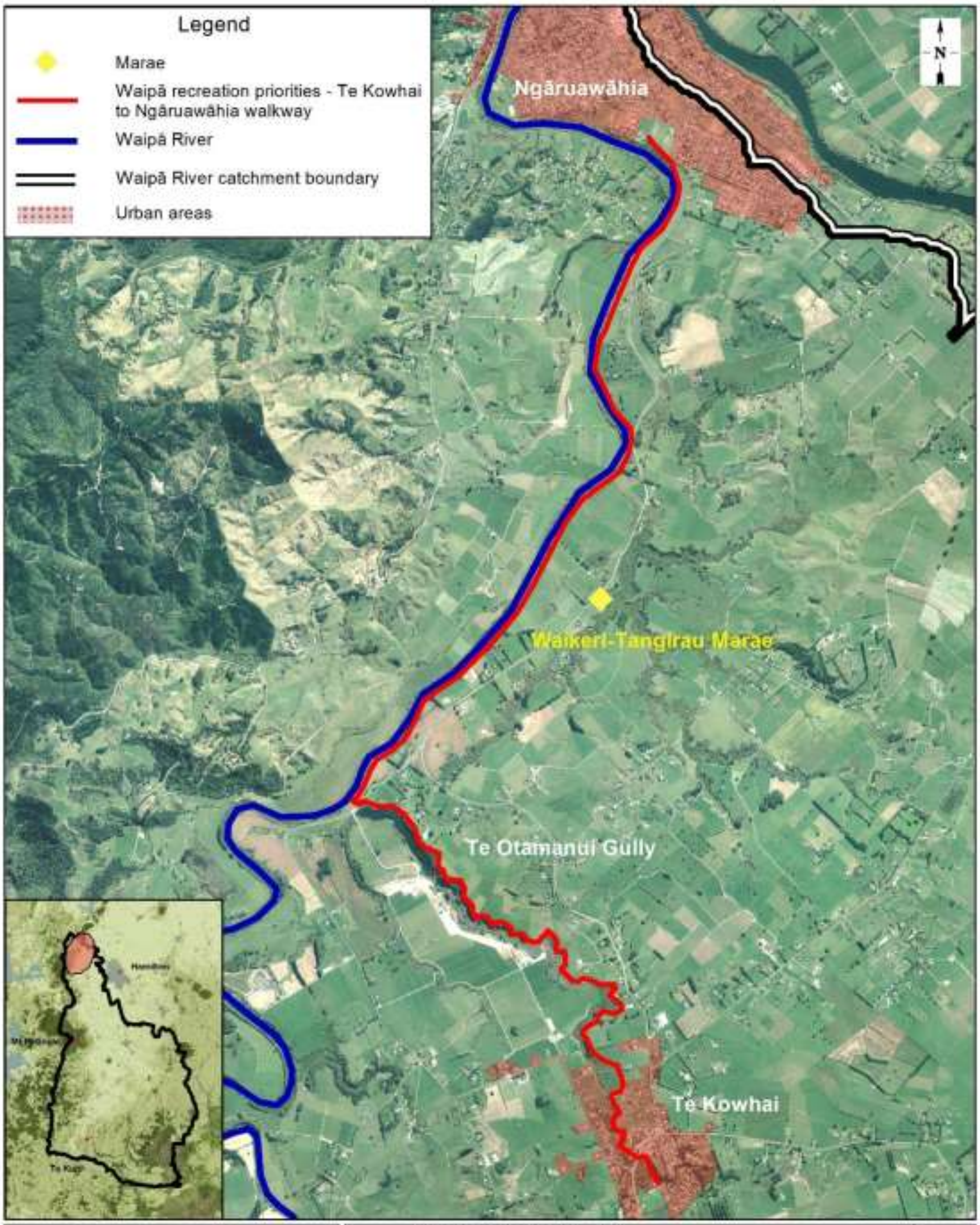


Walkway from Te Kowhai to Ngāruawāhia Township via Te Otamanui gully and along the Waipā River

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.25 0.50 0.75 1.00 1.25
Kilometers

Scale 1:35,000@A4 Portrait

A4

Te Otamanui Lagoon near Bedford Road (facing upstream). Proposed walkway is on the left side of the photo.

WP 3 Priority: Medium	Enhancement of Waipā wetlands in priority nutrient catchments (Waikato district)	BCR value
Relevant unit goal(s)	The quality and flow of water is maintained and enhanced. The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Waikato district gully wetlands greater than 10 hectares within Waipā catchment	
Brief description of feature	This feature consists of 11 lowland gully ecosystems larger than 10 hectares in size that collectively cover an area of 286 hectares. They are located on the true right bank of the Waipā River within the Waikato district and contain native wetland remnants and native forest remnants (e.g. kahikatea). Catchment modelling undertaken by Waikato Regional Council has identified priority nutrient subcatchments in the Waipā River catchment (lower Mangapiko, Mangawhereo, North west Hamilton). These 11 large gully systems have been identified within the priority nutrient subcatchments as important for water quality. In addition, many of these gully systems are home to rare and/or threatened species such as mudfish, bats, tuna and spotless crake so are also important for biodiversity. In most cases pest willow trees occupy more than 50% of sites but there is a healthy understorey of native plant species. Some sites also have pockets of remnant kahikatea forest. Lakes and wetlands in the Waipā are of high cultural significance providing sustenance, areas of recreation and resources to iwi, hapu and marae. Pā and Papakāinga are common to areas where food is accessible in particular the lakes, wetlands and freshwater springs.	
Desired state to achieve the Vision & Strategy	- Gully wetland ecosystems are protected from stock grazing. - They have healthy native plant communities and healthy populations of native fish. They are also valued by the wider community for their aesthetic and cultural values. - Iwi and communities have a strong connection to the gully wetlands and are active in their use, protection and restoration.	

<table>
<tr><td>Value of the feature</td><td>In a restored condition the Waikato district gully wetlands in the Waipā catchment would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 15 years of project commencement all identified gully wetland systems are 100% fenced to exclude stock.
- Gully systems are well vegetated with native species where practicable (species that would have been naturally occurring within the gully ecosystem).
- Known mudfish habitat sites within these gullies are protected from disturbance, and where bats are known to be present site management provides for their habitat requirements.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Gully wetland should be fenced at the top of the gully to exclude stock with a 5 wire (2 electric) wetland. Ideally this would be followed immediately by native planting and associated weed control.

Willow removal
This would be undertaken in circumstances where the willow trees were not providing habitat for a rare or threatened native species and where there was a dense native understorey beneath the willow canopy. Any willow removal should be undertaken in stages using ground based methods (such as treatment with x-tree basal).

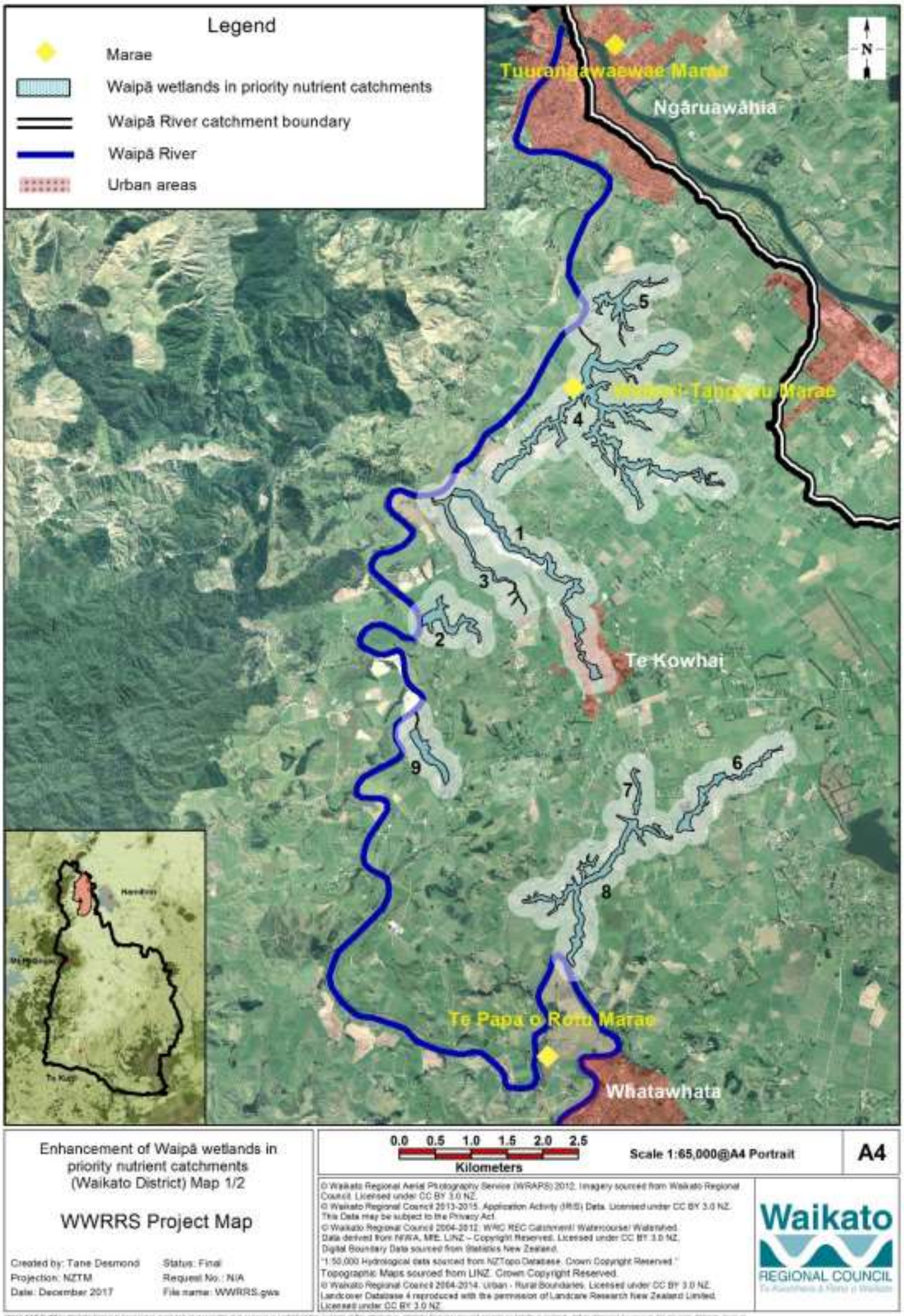
Planting
Native planting should be carried out within open areas to create a native plant dominated ecosystem over the long-term. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed within the gully ecosystem (e.g. cabbage tree, kahikatea, flax, kānuka). Native planting costs have been estimated at $39,552 per hectare and include site preparation, plant purchase, planting labour and five releasing events.</td><td></td></tr>
</table>

	Weed control Most of the gully ecosystems identified have a range of weed species present so a comprehensive weed control plan (along with the native planting) will be essential to ensure success of the project. **Management plan development** For sites where there is no current management plan a management plan should be developed. Cost estimates for each site can be found below: Mapped area 1: Te Otamanui gully wetland (34ha) - 1km fencing ($8000) - 8ha of planting along gully banks ($316,416) - Animal pest control during plant establishment is $200/ha for 3 years ($20,400) Mapped area 2: Collie Road Wetland (13ha) - Assume 25% of the perimeter (1000m) requires fencing at $8 per metre ($8000) - Assume 10m wide buffer planting (1ha) next to new fence ($39,552) - Additional weed control over 30% of the site for 3 years ($58,500) - Animal pest control during plant establishment is $200/ha for 3 years ($7800) - Management plan ($10,000) Mapped area 3: Gully wetland west of Te Otamanui Stream gully - Assume 50% of the perimeter (2750 m) requires fencing ($22,000) - 1.3ha of native planting within open areas ($48,817) - Animal pest control during plant establishment is $200/ha for 3 years ($6000) Mapped areas 4 and 5: Crawford Road Wetland and Saulbrey Wetland (total area 100ha) - Assume 50% of the perimeter (16,500 m) requires fencing ($132,000) - Assume willow control over 50% of the site ($200,000) - Assume planting over 28% of the site ($1,107,456) - Assume additional weed control for 3 years over 10% of the site ($150,000) - Animal pest control during plant establishment is $200/ha for 3 years ($60,000) Mapped Areas 6, 7 and 8: Ohote Stream gully system - Assume 20% (7.4ha) of gully requires willow control ($29,600)	

	- Assume 50% of the perimeter (5500 m) requires fencing ($44,000) - Planting perimeter with a 10m wide (5.5ha) buffer of native plants ($217,536) - Assume additional weed control for 3 years over 30% (3.7ha) of the site (55,500) - Animal pest control during plant establishment is $200/ha for 3 years ($22,200) - Management plan ($10,000) Mapped area 9: Collie Road Wetland (10ha) - 1.7km fencing ($13,600) - 10m planted margin is 1.7ha planting ($63,838) - 2ha weed control over 3 years ($30,000) - Animal pest control during plant establishment is $200/ha for 3 years ($6000) Mapped Area 10: Gully wetland south of Whatawhata (approximately 38 ha, 15km perimeter) - Assume 50% requires fencing, 7.5km ($60,000) - Assume 20% requires ground based willow control ($30,400) - Assume planting a buffer of native plants in a 5m strip around the perimeter ($296,640) - Additional weed control over 30% of the area over 3 years ($171,000) - Animal pest control (for plant establishment) over 3 years ($60,000) - Management plan ($10,000) Mapped Area 11: Houghton Road Swamp (21ha, 11km perimeter) - Assume 10% (1100m) requires fencing ($8800) - Assume 20% requires ground based willow control ($16,800) - Assume planting a buffer of native plants in a 10m strip around the perimeter ($435,072) - Additional weed control over 25% of the area over 3 years ($75,000) - Animal pest control (for plant establishment) over 3 years ($12,600) - Management plan ($10,000) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	

Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 2.5 years after project completion.	L = 17.5
Effectiveness of works	These wetlands are currently in a moderate condition when compared to desired state. It is not expected that this will change over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that wetland condition in 20 years will be closer to the desired Vision & Strategy state than it is currently. These gully wetlands have been identified as a priority due to their importance in attenuating nutrients in these intensively farmed catchments, however they will benefit from stock exclusion and the proposed planting programmes. This project does not address wide-scale and long term pest plant control.	W = 0.15
Risk of technical failure	Risks are mostly related to weed control. There is a moderate risk of project failure due to technical feasibility if weed control isn't well planned and implemented until such time that native plants are well established.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.45
Information quality	Poor – management requirements and cost estimates are based largely on aerial photography.	
Knowledge gaps and response	Costings for most sites are largely based off aerial photography combined with some local knowledge. Further work is required during project planning to determine specific amounts of fencing, planting and weed control required.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

Up-front cost – total for implementation phase/project duration	<table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Works at mapped areas 4 & 5</td><td>1,649,456</td></tr><tr><td>Works at mapped area 1</td><td>344,816</td></tr><tr><td>Works at mapped area 2</td><td>123,852</td></tr><tr><td>Works at mapped area 3</td><td>76,817</td></tr><tr><td>Works at mapped areas 6,7 & 8</td><td>378,836</td></tr><tr><td>Works at mapped area 9</td><td>113,438</td></tr><tr><td>Mapped Area 10</td><td>590,840</td></tr><tr><td>Mapped Area 11</td><td>558,272</td></tr><tr><td>Project management/staffing/incidentals (30% of total project cost)</td><td>1,150,898</td></tr><tr><td>Total</td><td>4,987,225</td></tr></table>	C = 5.0



Legend
Marae
Waipā wetlands in priority nutrient catchments
Waipā River catchment boundary
Waipā River
Urban areas
N
Tuurangawaewae Marae
Ngāruawāhia
Te Kowhai
Te Papa o Rotu Marae
Whatawhata
1
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9
Enhancement of Waipā wetlands in priority nutrient catchments (Waikato District) Map 1/2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Kilometers
Scale 1:65,000@A4 Portrait
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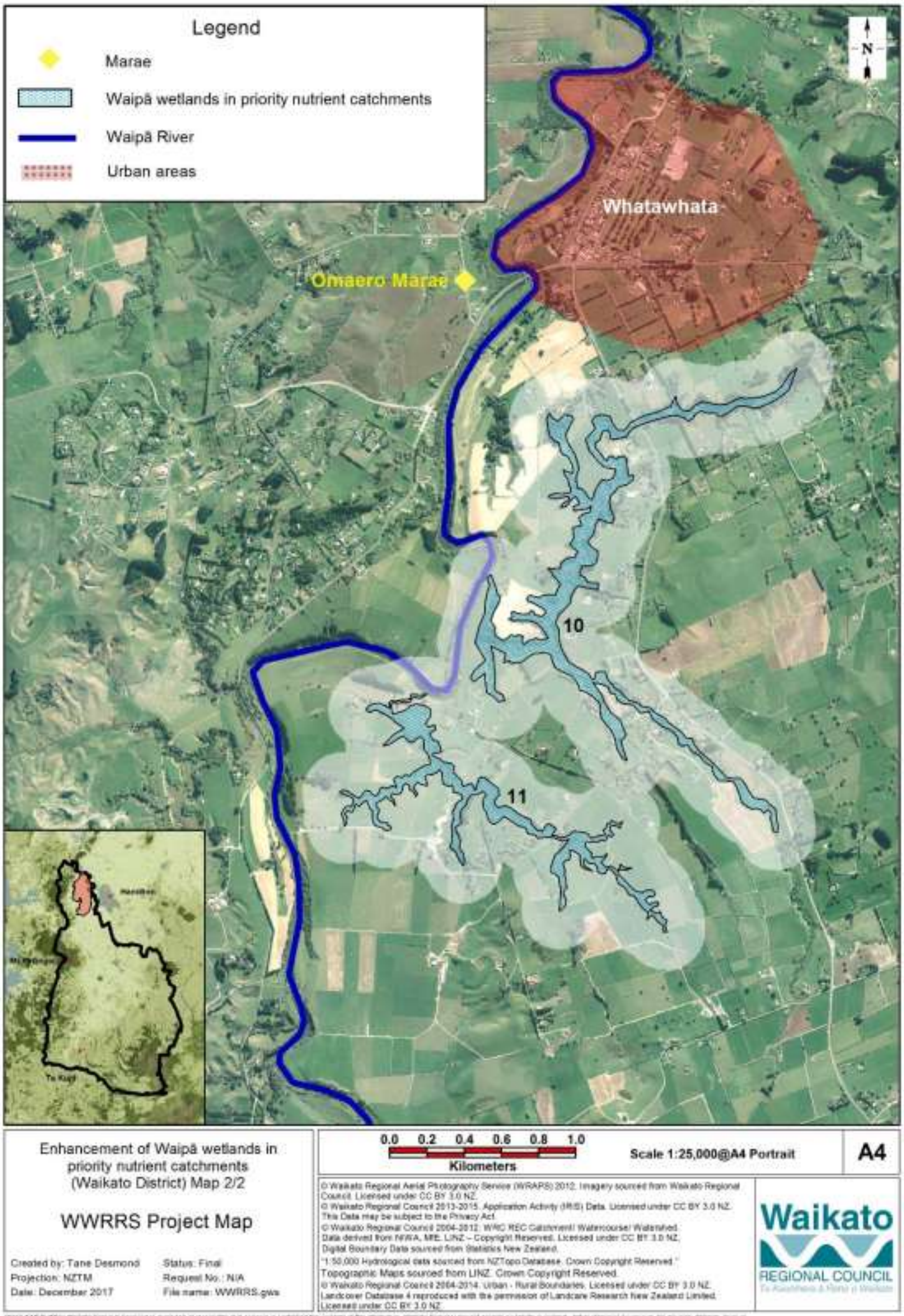
Legend
Marae
Waipā wetlands in priority nutrient catchments
Waipā River
Urban areas
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Kilometers
Scale 1:25,000@A4 Portrait
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Enhancement of Waipā wetlands in priority nutrient catchments (Waikato District) Map 2/2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Typical images of all 11 gully wetlands.

Gully wetland 11: Houghton Road Swamp (21ha, 11km perimeter).

Part of gully wetland 4 and 5: Crawford Road Wetland and Saulbrey Wetland.

Gully wetland 9: Collie Road Wetland (10ha).

WP 4 Priority: High	Kaniwhaniwha catchment erosion protection and remediation	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land.	
Name of feature	Kaniwhaniwha subcatchment	
Brief description of feature	The Kaniwhaniwha is an 11,434ha catchment extending from the bush clad slopes of Mt Pirongia to the Waipā River. Approximately 2665ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use within the catchment is predominantly pastoral farming. 41% of the catchment is in indigenous vegetation. This area was home to many historic pā sites including Purakau and Koromatua. A renowned area for the collection of birds and fisheries for the Ngāti Mahanga, Ngāti Hikairo and Ngāti Apakura hapū. According to water quality monitoring data from Waikato Regional Council, E. coli concentrations of the Kaniwhaniwha Stream at Wright Road are unsatisfactory for swimming 100% of the time.	
Desired state to achieve the Vision & Strategy	- A subcatchment where land use matches capability - The stream network has a well vegetated riparian margin (dominated by native species) along its entire length (at least 5m wide) to assist in providing shade, shelter, food and habitat for native fish species. - Stock is excluded from all waterways within the catchment. - Native fish are abundant and there is a wide diversity of species present including piharau, kōkopu and kāeo (freshwater mussels). - There are no manmade barriers to native migratory fish. - The stream is swimmable, fishable and has access for recreation. - Native bush remnants are densely vegetated, connected to riparian corridors wherever practicable and protected from stock grazing. - Native plant regeneration is occurring naturally within native bush remnants. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Kaniwhaniwha subcatchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 200

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 8000 tonnes of sediment per year to subcatchment streams and the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Kaniwhaniwha Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

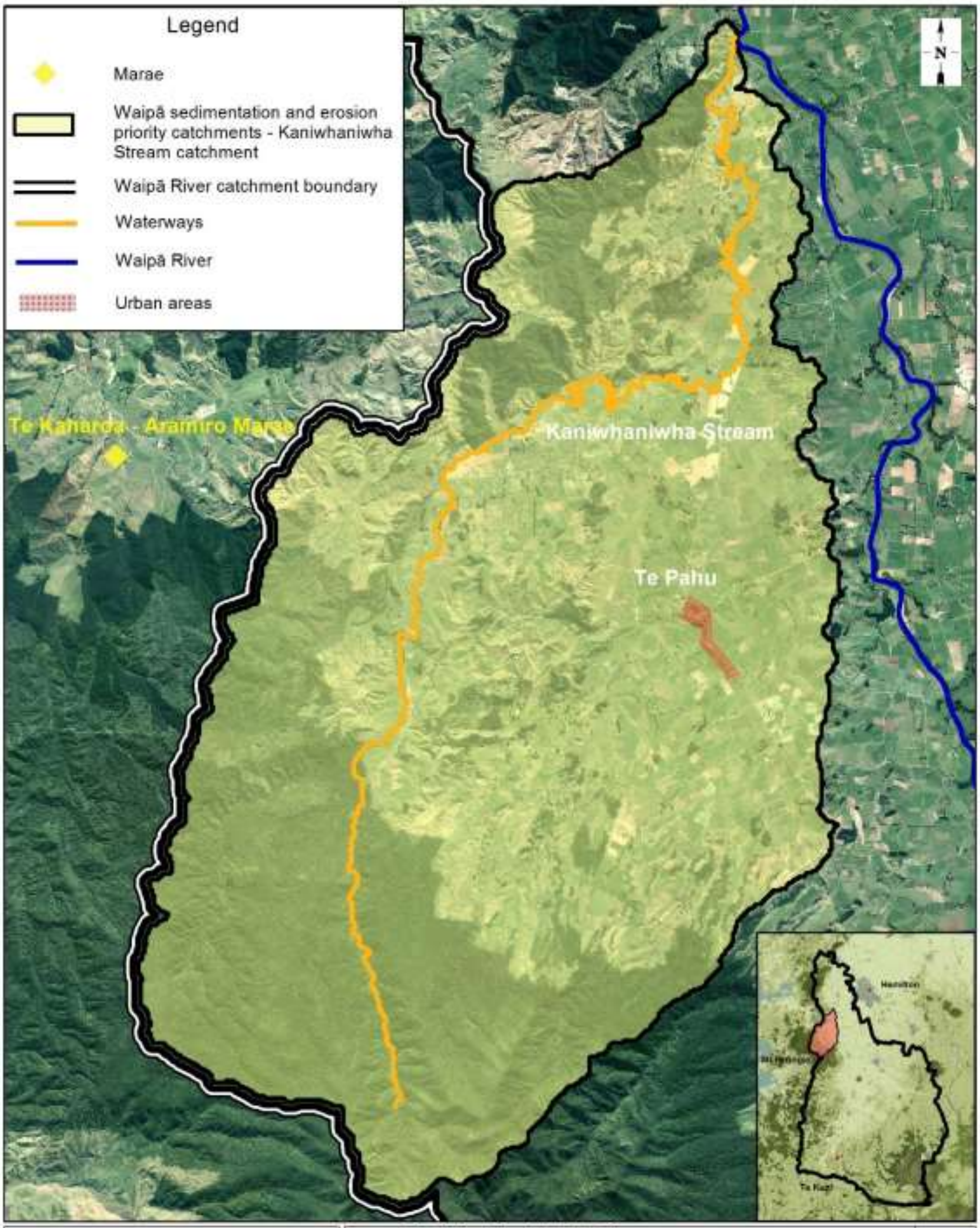
Hill country soil conservation
- 325ha LUC 6e managed with open space pole planting at $3000 per hectare ($975,000).
- 325ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($975,000).
- 65.5km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($1,310,000).
- 63ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($189,000).
- 8km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($160,000).
- 85.5ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages, etc) ($427,500).
- 28km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($700,000).

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project completion.</td><td>L = 13.5</td></tr>
<tr><td>Effectiveness of works</td><td>The Kaniwhaniwha subcatchment varies in condition with the upper catchment being fully vegetated and largely meeting the objectives of the Vision & Strategy. Other parts of the catchment are in moderate condition with some of the Vision & Strategy desired state aspects being met, although the stream is not considered swimmable due to high levels of E. coli. It is expected that over the next 20 years there could be a slow deterioration in condition of the catchment in the absence of this project. Works</td><td>W = 0.2</td></tr>
</table>

	included here address several threats to the feature and it is anticipated that if the project is fully completed the catchment will be close to the Vision & Strategy state being achieved for aspects related to land use matching capability and reduction of sediment to waterways. There would also be secondary benefits to biodiversity. There would be advantages in this project being carried out in alignment with Project WP 5 which addresses different values within the same subcatchment.	
Risk of technical failure	Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. However, proposed priority actions are widely used and accepted for managing hill country erosion. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low, however there is some momentum that has been created in the catchment in recent years that may provide encouragement for others. Flexibility in approach to managing erosion on farm is also encouraged and this should be addressed in the development of the project plan(s).	A = 0.225
Information quality	Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 5.9

Task	Cost ($)
Pole planting erosion prone LUC class 6e land (325ha)	975,000
Plantation species on erosion prone LUC class 6e land (325ha)	975,000
Fencing managed LUC class 6e land (65.5ha)	1,310,000
Plantation species on LUC class 7 land (63ha)	189,000
Fencing managed LUC class 7 land (8km)	160,000
Treating erosion outside LUC class 6e, 7 and 8 land (85.5ha)	427,500
Fencing existing indigenous vegetation (28km)	700,000
Project management/staffing/incidentals (25%)	1,184,125
Total	**$5,920,625**



Kaniwhaniwha catchment erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:78,000@A4 Portrait

A4

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Topography of the Kaniwhaniwha catchment, including high erosion class land.


Open-space pole planting on high erosion class land in the Kaniwhaniwha catchment.

A retired wetland sidling in the Kaniwhaniwha catchment, reducing sedimentation outside LUC class 6e, 7 and 8 land.

WP 5		BCR value

Priority: Very high	Kaniwhaniwha catchment streams fish habitat rehabilitation and restoration of forest remnants	
Relevant unit goal(s)	The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna. Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.	
Name of feature	Kaniwhaniwha subcatchment	
Brief description of feature	A 50km long stream network within the Kaniwhaniwha catchment has been identified by fish experts as being important habitat for native fish and a priority for fish habitat rehabilitation (where fish habitat is lacking). Waterways include: - Kaniwhaniwha Stream – a 20km long stream flowing from the forested slopes of Mt Pirongia (near the village of Te Pahu) to join the Waipā River near Whatawhata. - Rangitukia Stream – a 13km long stream flowing from Mt Pirongia in the vicinity of Corcoran Road, Te Pahu. Te Pahu Stream – a 10.6km long stream flowing from Mt Pirongia in the vicinity of Rolley Road, Te Pahu, to join the Rangitukia Stream near the end of Simmond Road, Te Pahu. - Te Kauri Stream – a 3.5km long stream flowing from Mt Pirongia in the vicinity of Limeworks Loop Road, Te Pahu, to join the Kaniwhaniwha Stream near Fillery Road. - Tawhitiwhiti Stream – a short stream with a steep gradient flowing from the bush line on Mt Pirongia for approximately 3.7km downstream to the Te Pahu Stream. There are also numerous forest remnants within the Kaniwhaniwha catchment. Five of these have been identified as being within the top 30% of biodiversity priorities within the Waikato and Waipā River catchments. These sites range in size from 0.7ha to 32ha. This area was home to many historic pā sites including Purakau and Koromatua. A renowned area for the collection of birds and fisheries for the Ngāti Mahanga, Ngāti Hikairo and Ngāti Apakura hapū. According to water quality monitoring results on the Waikato Regional Council website, the Kaniwhaniwha Stream is unsatisfactory for swimming 100% of the time due to high levels of E.coli.	
Desired state to achieve the Vision & Strategy	- The stream network has a well vegetated riparian margin (dominated by native species) along its entire length (at least 5m wide) to assist in providing shade, shelter, food and habitat for native fish species.	

<table>
<tr><td></td><td>- Stock is excluded from all waterways within the catchment.
- Native fish are abundant and there is a wide diversity of species present including piharau, kōkopu and kāeo (freshwater mussels).
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Native bush remnants are densely vegetated, connected to riparian corridors wherever practicable and protected from stock grazing. Native plant regeneration is occurring naturally within native bush remnants.
- Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Kaniwhaniwha catchment Streams and adjoining forest fragments would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Lack of riparian vegetation, streambank erosion and sedimentation.</td><td>Degraded fish habitat</td></tr>
<tr><td>Lack of in-stream woody debris</td><td>Reduction in cover and habitat for native fish</td></tr>
<tr><td>Incorrectly installed waterway crossings are a barrier to native fish</td><td>Large areas of fish habit are unused. Fish unable to complete their life cycle.</td></tr>
<tr><td>Streambank erosion</td><td>Estimated to yield 932 tonnes of sediment per year</td></tr>
<tr><td>Fragmentation of forest remnants</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest remnants</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years:
- Catchment streams are fully fenced to exclude stock with a minimum 5m fence setback.
- Riparian margins are vegetated on both sides with a mixture of exotic trees for erosion protection and native tree species that provide stream shade and enhance habitat for adult native fish (while allowing designated areas for recreational access).
- Woody structures provide in-stream habitat for native fish at approximately 64 locations along the Kaniwhaniwha Stream.
- There are healthy populations of native fish species including tuna (eel), kōura, banded kōkopu and piharau.</td><td></td></tr>
</table>

	- All identified forest remnants are fenced to exclude stock and connected to other forest remnants and riparian areas where possible. - Native planting fills in any open areas within forest fragments and provides a buffer around the outside from 'edge effects'.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing waterways** Carry out fencing (at least 5 wire with 2 electric wires unless flooding is a common issue) along the waterways identified. This shall have a minimum 5m setback from the top of the streambank. Fencing costs are estimated at $8 per metre. Cost estimates assume that 50% of the waterways are unfenced or require fences to be moved back to allow for planting. Cost estimates are as follows: - Kaniwhaniwha Stream Fencing (20km fence length) – $160,000 - Rangitukia Stream Fencing (13km fence length) – $104,000 - Te Pahu Stream Fencing (10.6km fence length) – $84,800 - Te Kauri Stream Fencing (3.5km fence length) – $28,000 - Tawhitiwhiti Stream Fencing (3.7km fence length) – $29,600 **Planting waterways** Undertake native and exotic riparian planting within the fenced area and carry out associated weed control and maintenance. Costs assume that 50% of each waterway requires planting at a cost of $37,552 per hectare (including site prep, plant purchase, planting labour and five releasing events). - Kaniwhaniwha Stream Planting (10ha) – $375,520 - Rangitukia Stream Planting (6.5ha) – $244,088 - Te Pahu Stream Planting (5.3ha) – $199,025 - Te Kauri Stream Planting (1.75ha) – $65,716 - Tawhitiwhiti Stream Planting (1.8ha) - $67,593 **In-stream woody debris** Construct in-stream woody debris structures on Kaniwhaniwha Stream for native fish habitat (4 structures per 500 m from the corner of Fillery Road and Limeworks Loop Road downstream to Smith Road) over an 8km stretch. It is critical that design and construction of fish habitat is undertaken by a suitably experienced practitioner to ensure that it does not exacerbate bank erosion. Consent may be required for this work. The estimated cost of woody debris structures (including site investigation, design and installation) is $236,712 plus $20,000 for resource consents. This cost estimate is generous and cost savings would be made if one resource consent application covered all woody debris structures and if multiple structures were installed at a time.	

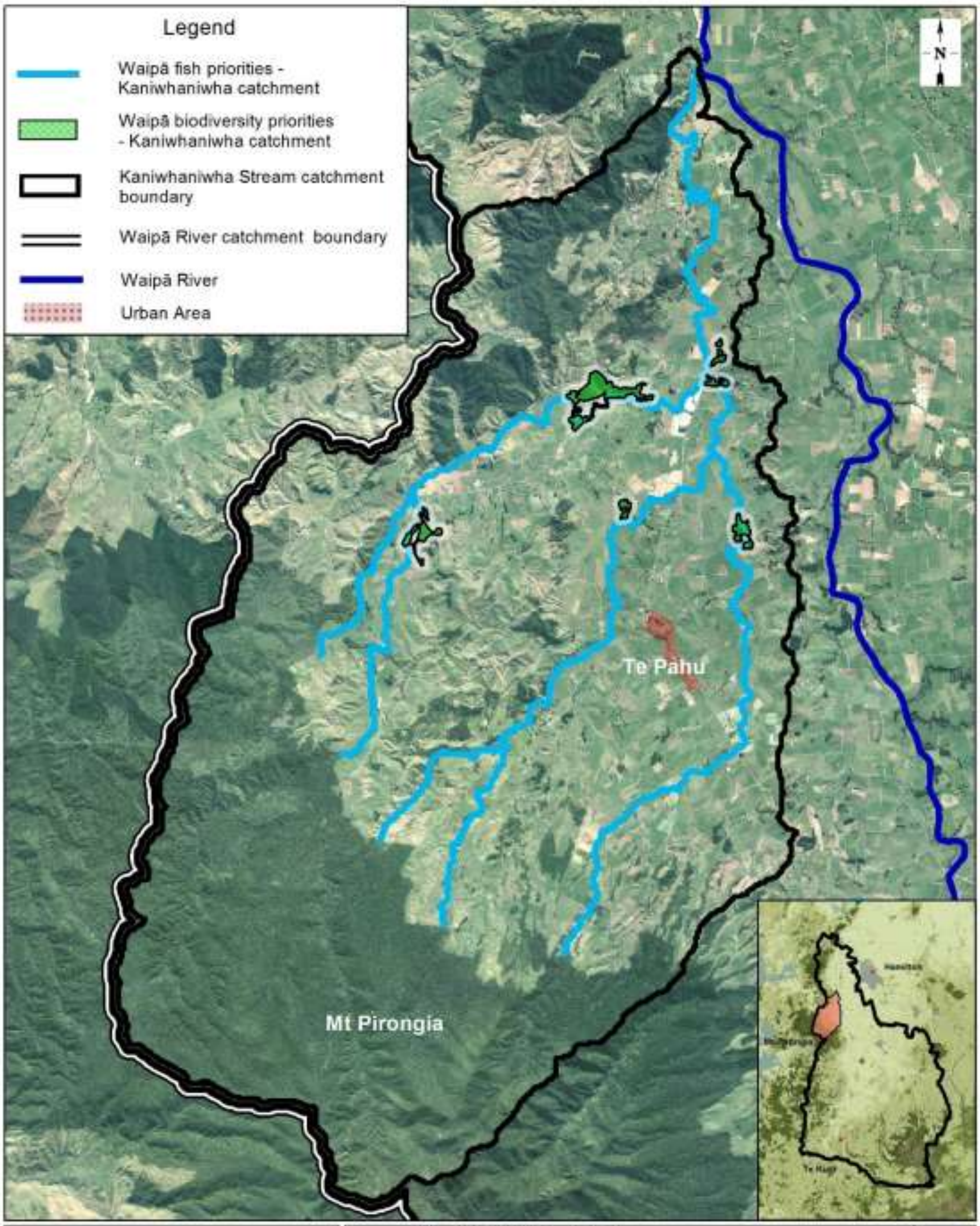
	Remediation of fish barriers Locations of barriers to fish passage are investigated and work undertaken to remedy these barriers. On the Rangitukia Stream at least three barriers are estimated to require being remedied. Remediation of fish barriers is estimated at $30,000 **Management of forest remnants** <u>Fencing forest remnants</u> Fence any unfenced forest remnants identified (see map) to exclude stock with a minimum 5 wire (2 electric) fence. - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – assume 70% (4.9km) of fencing or fence upgrade is required around the perimeter ($39,200). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – assume 500m of fencing is required ($4000). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – assume 800m of fencing or fence upgrade is required ($6400). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – assume 50% of perimeter fencing is required ($16,000). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – no fencing required. <u>Planting within and around forest remnants</u> Carry out native planting to fill gaps and protect forest remnants from edge effects if required. This is estimated to cost $37,552 per hectare including site preparation, plant purchase, planting labour and five releasing events. - Forest remnant in the vicinity of Smith Road (32 ha, 7km perimeter) – assume 10% (3ha) of the area requires planting ($112,656). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – assume 1ha requires infill planting ($37,552). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – assume 0.5ha of planting is required ($18,776). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – assume 20% (2ha) of the area requires native planting ($75,104). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – no planting required. <u>Weed control in and around forest remnants</u> Some sites might be particularly weedy and require additional plant pest control to ensure success of native plantings and	

	regeneration of native trees. A cost estimate of $2800 per hectare for weed spraying using a knapsack has been estimated per year for three years across the areas as follows: - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – weed control across 10% (3.2ha) of the site including within the 3ha planted area ($26,880). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – weed control across 20% (1.2ha) of the site including within the 1ha planted area ($10,080). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – weed control across 20% (0.5ha) of the site ($4200). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – weed control across 20% (2ha) of the site ($16,800). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – weed control across 10% (0.8ha) of the site ($6720). <u>Animal pest control</u> Possum control may be required within forest remnants to assist with the establishment of native plantings. The cost estimates provided below provide are $600 per hectare for 3 years of possum control using bait stations. The cost includes purchase and establishment of bait stations at one station per hectare and labour and bait to check and refilling of bait stations. - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – $19,200. - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – $3840. - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – $1800. - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – $6000. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project commencement.	L = 13.5
Effectiveness of works	The Kaniwhaniwha subcatchment varies in condition with the upper catchment being fully vegetated and largely meeting the objectives of the Vision & Strategy. Other parts of the catchment are in moderate condition with some of the Vision & Strategy	W = 0.17

	desired state aspects being met. It is expected that over the next 20 years there could be a slow deterioration in condition of the catchment in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed then the catchment will be close to the Vision & Strategy state being achieved for aspects related to fisheries and biodiversity in 20 years' time. The project does not address land use in the middle to lower catchment, however the proposed fencing and planting works will assist in protecting and restoring water quality at this site. There would be advantages in this project being carried out in alignment with Project WP 4 which addresses different threats and values within the same subcatchment.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding. Construction of in-stream fish habitat is a relatively recently applied tool in these environments and there is still some uncertainty around their longevity. Risk of failure can be minimised by works being designed and constructed by an appropriately experienced practitioner.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. Loss of fences to flooding may also be a deterrent for landowners who are concerned about maintenance costs. This can be mitigated by the use of 5m setbacks and a fencing standard appropriate for the location. There are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.	A = 0.45
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers, and location and design of in-stream woody debris structures would need to be determined in the early stages of the project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

Up-front cost – total for implementation phase/project duration

Task	Cost ($)
Kaniwhaniwha Stream fencing (20km)	160,000
Kaniwhaniwha Stream planting (10ha) including plant establishment	375,520
Rangitukia Stream fencing (13km of bank)	104,000
Rangitukia Stream planting (6.5ha)	244,088
Rangitukia Stream fish barrier remediation	30,000
Te Pahu Stream fencing (10.6km of streambank)	84,800
Te Pahu Stream planting (5.3ha)	199,025
Te Kauri Stream fencing (3.5km of streambank)	28,000
Te Kauri Stream planting (1.75ha)	65,716
Tawhitiwhiti Stream fencing (3.7km of streambank)	29,600
Tawhitiwhiti Stream planting (1.8ha)	67,593
In-stream woody debris	236,712
Resource consent for weedy debris structures	20,000
Remediation of fish barriers (3)	30,000
Fencing forest fragments (10.2km)	65,600
Planting in and around forest remnants	244,088
Weed control in and around forest remnants	64,680
Animal pest control	31,800
Project management and planning (30%)	624,366
Total	**2,705,588**



Kaniwhaniwha catchment streams fish habitat rehabilitation & restoration of forest remnants

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:80,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

The middle reaches of the Kaniwhaniwha Stream, with a forest remnant in the top right corner of the photo.

An unfenced section of Kaniwhaniwha Stream. The water levels are higher than usual in this photo.

An unfenced section of Rangitukia Stream.

A section of Te Pahu Stream where it is recommended that the riparian fence be moved back and the margin planted in native plants.


Te Pahu Stream in the foreground and native kahikatea forest remnants in the background.

WP 6 Priority: Medium	Enhancement of Waipā wetlands in priority nutrient catchments (Waipā district)	BCR value
Relevant unit goal(s)	The quality and flow of water is maintained and enhanced. The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Waipā district gully wetlands greater than 10ha and located within Waipā catchment priority nutrient areas.	
Brief description of feature	Eight gully ecosystems containing remnant wetlands and forest fragments. The total area covered by these sites is 215ha. These are located on the true right bank of the Waipā River and contain wetlands with remnants of native wetland vegetation, and remnant forest fragments (e.g. kahikatea). Catchment modelling undertaken by Waikato Regional Council has identified priority nutrient subcatchments in the Waipā River catchment (lower Mangapiko, Mangawhereo and northwest of Hamilton). These large gully systems have been identified within the priority nutrient subcatchments as important for water quality. In addition, many of these gully systems are home to rare and/or threatened species such as mudfish, bats, tuna and spotless crake so are also important for biodiversity reasons. In most cases pest willow trees occupy a large proportion of sites but there is a healthy understorey of native plant species. Some sites also have pockets of remnant kahikatea forest. Historically, the gullies and wetlands of the Waipā River catchments provided sustenance for iwi, hapū and marae. Tuna, and birds were the staple foods for tāngata whenua. These were active areas for gathering foods.	
Desired state to achieve the Vision & Strategy	- Gully wetland ecosystems are protected from stock grazing. - They have healthy native plant communities and healthy populations of native fish. - They are valued by the wider community for their aesthetic and cultural values. - Iwi and communities have a strong connection to the gully wetlands and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā district gully wetlands would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 25

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
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<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further clearance of native vegetation within gully wetlands</td><td>Reduced habitat for native flora and fauna and game birds, loss of nutrient attenuation areas, loss of wetland areas to slow flood flows.</td></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
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<tr>
<td>Project goal/s</td>
<td>Within 15 years of project commencement:
- All identified gully wetland systems are fenced to exclude stock and protected from extensive land drainage practices (e.g. large scale drain digging).
- Gully systems are well vegetated with native species where practicable.
- Known mudfish habitat sites within these gullies are protected from disturbance.
- Where bats are known to be present site management provides for their habitat requirements.</td>
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<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Gully wetland should be fenced at the top of the gully to exclude stock. Ideally this would be followed immediately by native planting and associated weed control. Fencing should generally be a minimum of 5 wire (2 electric) and this has been estimated to cost $8 per metre

Willow removal
This would be undertaken in circumstances where the willow trees are not providing habitat for a rare or threatened native species and where there is a dense native understorey beneath the willow canopy. Any willow removal should be undertaken in stages using ground based methods (such as treatment with x-tree basal). The estimated cost of this is $4000 per hectare.

Planting
Native planting should be carried out within open areas to create a native plant dominated ecosystem over the long term. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed within the gully ecosystem (e.g. cabbage tree, kahikatea, flax, kānuka). Native planting has been estimated to cost $39,552 per hectare</td>
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	including site preparation, plant purchase, planting labour and five releasing events. **Weed control** Most of the gully ecosystems identified have a range of weed species present so a comprehensive weed control plan (along with the native planting) will be essential to ensure success of the project. Weed control costs are generally estimated at $5000 per hectare. This is based on using a knapsack sprayer and assumes that the site is very weedy. **Animal pest control** Possum control may be required in areas where native planting is to be undertaken. The estimated cost for this work is $600 per hectare for three years using bait stations. **Management plan development** For sites where there is no current management plan a management plan should be developed. Assumptions and cost estimates for each site can be found below. Mapped area 12 – Tuhikaramea Stream tributary gully (38.7 ha, 14km perimeter). - Assume 5% (800 m) requires fencing ($5600). - Assume 35% (13.5ha) requires ground based willow control ($54,180). - Assume 25% of the area requires native planting, 13.5ha ($533,952). - Additional weed control over 30% (11.6ha) of the area over 3 years at a cost of $5000 per hectare using a knapsack ($174,150). - Animal pest control (for plant establishment) over 3 years ($23,220). - Management plan ($10,000). Mapped area 13 – Mangahia Stream gully (36ha, 13km perimeter). - Assume 10% requires fencing, 1.3km ($10,400). - Assume 40% (14.4ha) requires ground based willow control ($57,600). - Assume planting a buffer of native plants 5m wide around the perimeter, 6ha ($237,312). - Additional weed control over 40% (14.4ha) of the area over 3 years ($216,000). - Animal pest control (for plant establishment) over 3 years ($21,600). - Management plan ($10,000). Mapped area 14 – Mangaotama gully and wetland (total area 80ha).	

	- Assume the area downstream of State Highway 39 (35ha and 10km perimeter) is 10% unfenced, requires some infill planting (approx 5ha) and weed control (e.g. willow) 20% of the area. - Assume the area upstream of Hams Road (4.2ha and 1.5km perimeter) is 90% unfenced, requires 1.5ha native planting (10 m wide riparian margin) and additional weed control over 20% of the area). - The middle section between Hams Road and the state highway is already being intensively managed and only requires animal pest control for plant establishment. Total fencing cost (2350 m) is \$18,800 Total planting cost (6.5ha) is \$245,222 Total weed control over 3 years (in addition to native plant establishment) (20% of area is 7.8ha) is \$117,000 Animal pest control for native plant establishment (80ha at \$200/ha) is \$48,000 Management plan is \$10,000. Mapped area 15 - Patterson Road Wetland (17 ha, 6.7km perimeter) - Assume 30% (2km) requires fencing (\$16,081). - Assume 20% (3.4ha) requires ground based willow control (\$13,600). - Assume planting a buffer of native plants 5m wide around the perimeter, 3.4ha (\$134,476). - Additional weed control over 20% (3.4ha) of the area for 3 years (\$51,000). - Animal pest control (for plant establishment) over 3 years (\$10,200). - Management plan (\$10,000). Mapped area 16 – gully wetland, forest fragment and waterway in between (near Frontier Road, Pirongia) - Assume 50% (5.3km) requires fencing (\$42,400). - Assume planting a buffer of native plants 10m wide around 50% (5.3ha) of the perimeter (\$209,625). - Additional weed control over 10% (2.7ha) of the area for 3 years (\$40,500). - Animal pest control (for plant establishment) over 3 years (\$16,560). - Management plan (\$10,000). Mapped area 17 – Mangawhero Stream lower catchment margins (15ha, 6km perimeter) - Assume 50% (3km) requires fencing (\$24,000). - Assume 30% (4.5ha) requires ground based willow control (\$18,000). - Assume planting a buffer of native plants 10m wide around the perimeter, 6ha (\$237,312).	

	- Additional weed control over 20% (3ha) of the area for 3 years ($45,000). - Animal pest control (for plant establishment) over 3 years ($9000). - Management plan ($10,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 5 years after project completion.	L = 15
Effectiveness of works	These wetlands are currently in a moderate condition when compared to desired state. It is not expected that this will change over the next 20 years if this project is not undertaken. However, if this project is successfully completed, then it is expected that wetland condition in 20 years will be closer to the desired Vision & Strategy state than it is currently. These gully wetlands have been identified as a priority due to their importance in attenuating nutrients in these intensively farmed catchments, however they will benefit from stock exclusion and the proposed planting programmes. This project does not address wide-scale and long term pest plant control.	W = 0.15
Risk of technical failure	Risks are mostly related to weed control. There is a high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels until native plants dominate.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.45
Information quality	Poor – management requirements are based on expert knowledge but quantity of work required is based largely on aerial photography.	
Knowledge gaps and response	Costings for most sites are largely based off aerial photography combined with some local knowledge. Further work is required during project planning to determine specific amounts of fencing, planting and weed control required.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	

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<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Mapped area 12</td><td>801,102</td></tr>
<tr><td>Mapped area 13</td><td>552,912</td></tr>
<tr><td>Mapped area 14</td><td>439,022</td></tr>
<tr><td>Mapped area 15</td><td>235,356</td></tr>
<tr><td>Mapped area 16</td><td>319,085</td></tr>
<tr><td>Mapped area 17</td><td>343,312</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>807,236</td></tr>
<tr><td>Total</td><td>3,498,025</td></tr>
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<td>C = 3.50</td>
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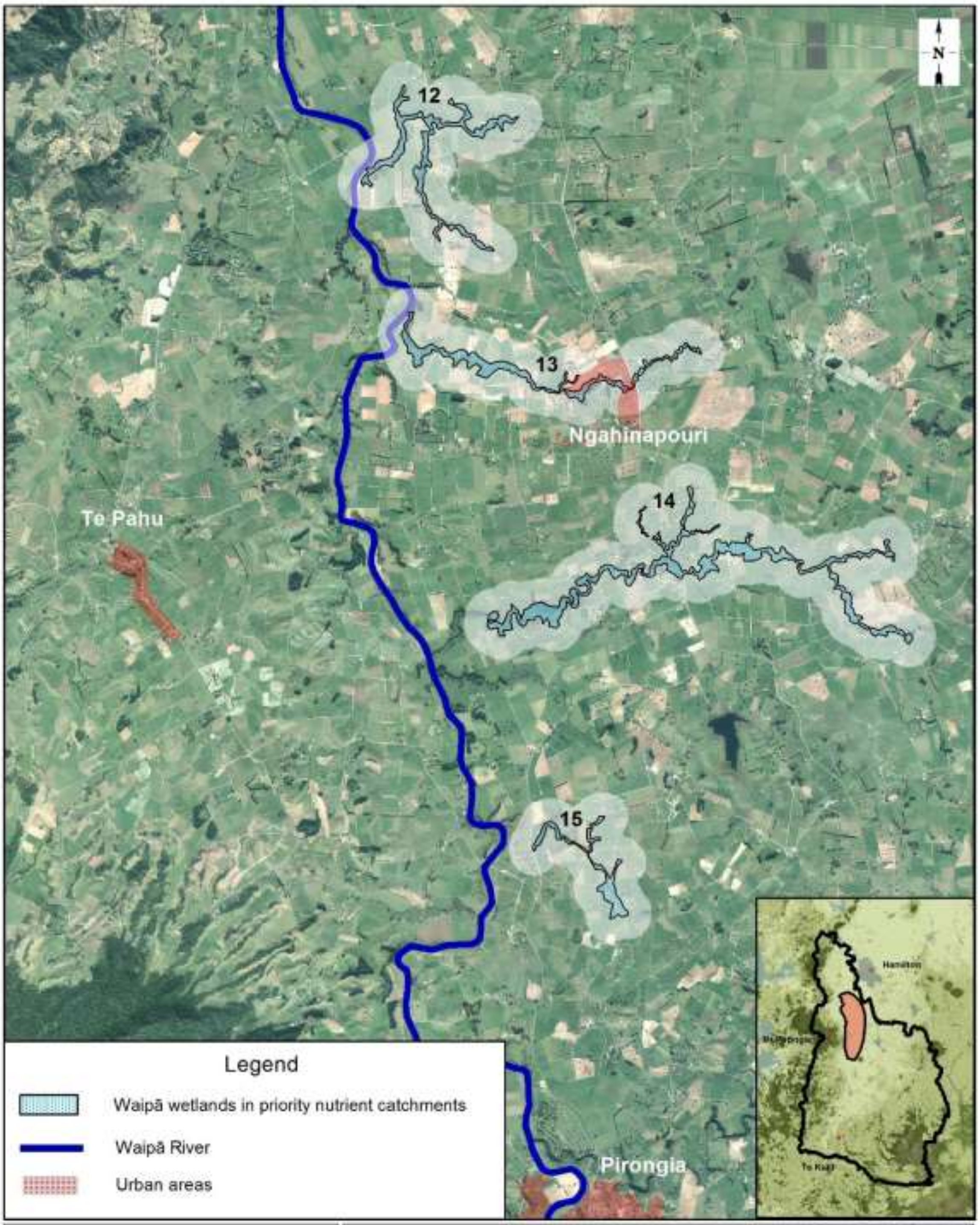

Enhancement of Waipā wetlands in priority nutrient catchments (Waipā District) Map 1/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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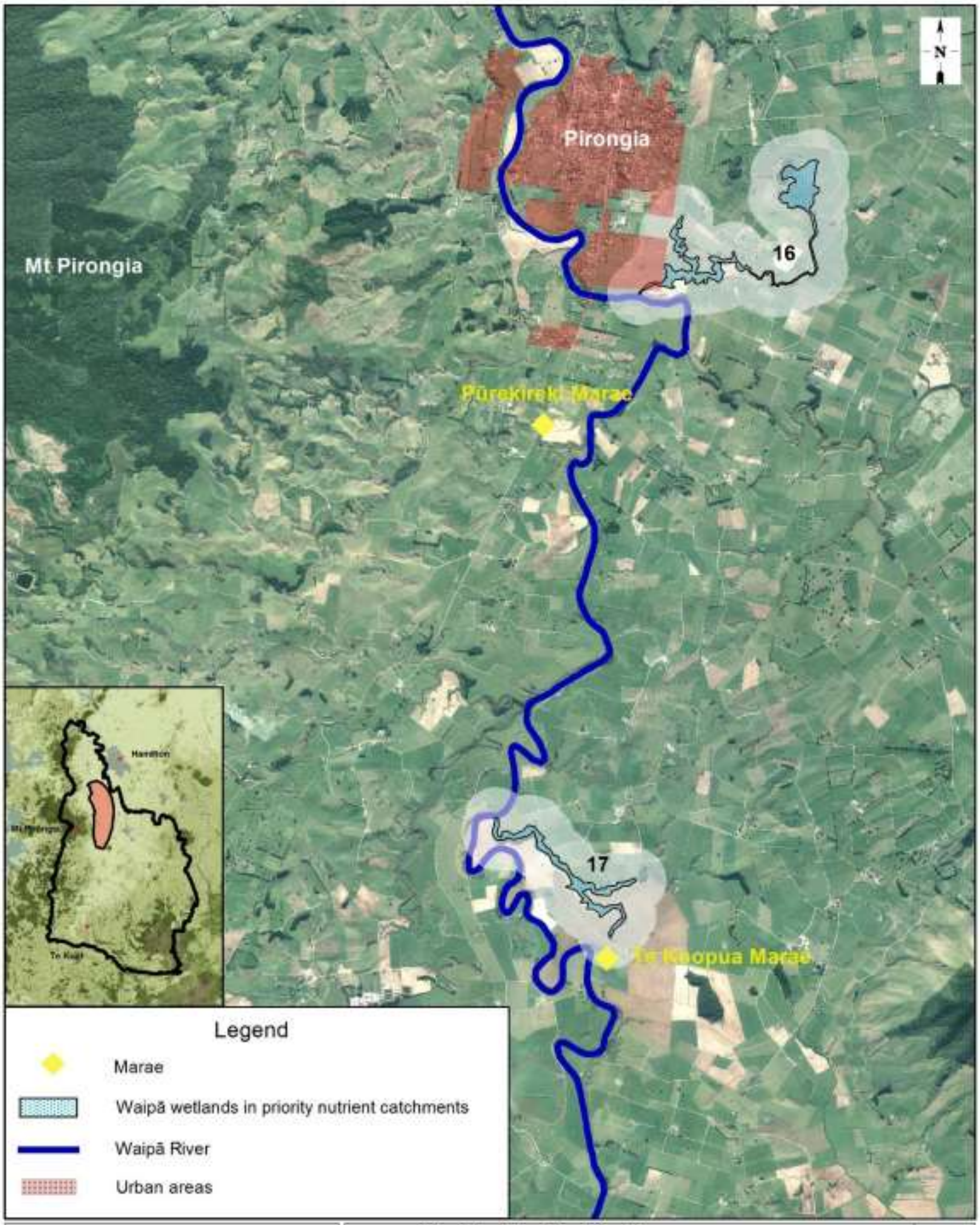
Kilometers

Scale 1:65,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL



Enhancement of Waipā wetlands in priority nutrient catchments (Waipā District) Map 2/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale 1:50,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Gully wetland 14 (downstream section): Mangaotama gully and wetland (total area 80ha).

Gully wetland 15: Patterson Road Wetland (17 ha, 6.7km perimeter).

WP 7 Priority: Medium	Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kūiti and Templeview	BCR value
Relevant unit goal(s)	The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna.	
Name of feature	Waipā River catchment kahikatea remnants and associated wetlands	
Brief description of feature	Within the Waipā catchment only 2.07% of the conifer-dominated forests (kahikatea) remain (approximately 170ha). Most have been cleared for pastoral farming and most of what remains has been degraded by grazing, land drainage weed infestation and animal pests. Most remaining kahikatea forest remnants are small (less than 10ha) and fragmented and require further management to ensure their existence long term. The remnants selected for this project include 10 small kahikatea remnants (and associated wetlands) totalling an area of 62.5ha, located within the Waipā River catchment between Te Kūiti and Whatawhata. These remnants have been identified as being within the top 30% of biodiversity sites in the Waikato catchment and/or important habitat for the 'at risk' black mudfish. Five of the remnants are located near McGregor Road near Hamilton, four are located near Te Kūiti (one of which has an associated wetland where there is a healthy population of mudfish) and one other is located near Kakepuku Mountain south of Te Awamutu. Kahikatea provide an important food resource in the kōroi berry which was skilfully harvested by Māori and also enticed birdlife to the tree, for capture.	
Desired state to achieve the Vision & Strategy	- Kahikatea remnants and their associated wetlands are densely vegetated with native vegetation, connected to riparian corridors wherever practicable and protected from stock grazing. - Native plant regeneration occurs naturally within the native forest remnants and associated wetlands. - Where wetlands retain healthy populations of black mudfish these are protected. - Iwi and communities have a strong connection to these areas and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River catchment kahikatea remnants and associated wetlands would have a high impact on giving effect to the Vision & Strategy at a local level.	VS = 1.5

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
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<tr>
<td>Project goal/s</td>
<td>Within five years of this project commencing:
- All forest remnants identified and their associated wetlands are 100% fenced to exclude stock.
- Edge effects have been reduced through native planting within canopy gaps and around the perimeter of kahikatea remnants.</td>
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<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the amount of fencing, planting and weed control required. However, based on aerial photographs and local knowledge the following estimates and assumptions have been made:

Fencing
Fencing should generally be a minimum of 5 wire (2 electric) and has been estimated at a cost of $8 per metre.

McGregor Road sites – 50% of the perimeter still remains to be fenced. This equates to 2.8km of fencing ($22,400).

Kahikatea remnants/wetlands near Te Kūiti – fencing is required around the 7.1km perimeter of these areas ($56,800).

Planting
McGregor Road Sites – some infill planting will be required around the perimeter of these sites. This is estimated to total 1.5ha of planting. The cost of this is estimated at $37,552 per hectare ($56,328) including site preparation, native plant purchase, planting labour and five releasing events.

Weed control
McGregor Road Sites – general weed control is estimated to be required over 10% of the sites (2.2ha) using a backpack sprayer at approximately $2800 per hectare ($6160) for three years ($18,480).

Kahikatea remnant near Kakepuku – weed control is</td>
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</table>

	estimated to be required over 10% (1ha) of the site to promote regeneration of native species. Using a backpack sprayer this is estimated to cost $8400 over three years. Kahikatea remnants/wetlands near Te Kūiti – some weed control is likely to be required within the site once it is fenced to promote the regeneration of native species around the perimeter. Using a vehicle with spray unit to treat a 5m wide area around the perimeter (3.5ha) is estimated to cost $1400 per hectare ($4900) per year for three years ($14,700). **Animal pest control** McGregor Road sites – possum control may be required at these sites to assist with native plant establishment. The cost of this using bait stations is estimated at $200 per hectare per year for three years (2.2ha x $200 per ha x 3 years is $1320). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These fragments are currently in a poor condition when compared to desired state. They also remain at risk of further fragmentation and loss of important hydrological conditions to sustain them, and as a result it is expected that they will deteriorate slowly over the next 20 years if this project is not undertaken. If this project is successfully completed, then it is expected that these kahikatea fragments will be in an improved condition in 20 years' time due to increased regeneration of native species and reduction in weeds. However, this project does not address the concerns around retention of wetland hydrology at these sites.	W = 0.1
Risk of technical failure	Risks are mostly related to failure to control weeds. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised. Some landowners may be concerned about the perceived loss of shelter areas for stock, or the practicalities of smaller fenced areas on farm. However generally there is good support for this type of work and for the retention of these rare features.	A = 0.63
Information quality	Average information – based on judgement of an expert with some local knowledge. Fencing and planting requirements are based on aerial photographs.	

<table>
<tr><td>Knowledge gaps and response</td><td>Specific quantities of fencing, planting and pest control required would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (9.9km)</td><td>79,200</td></tr>
<tr><td>Possum control (2.2ha)</td><td>1320</td></tr>
<tr><td>Weed control for 3 years</td><td>41,580</td></tr>
<tr><td>Native planting (1.5ha)</td><td>56,328</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>35,686</td></tr>
<tr><td>Total</td><td>214,114</td></tr>
</table>
</td><td>C = 0.21</td></tr>
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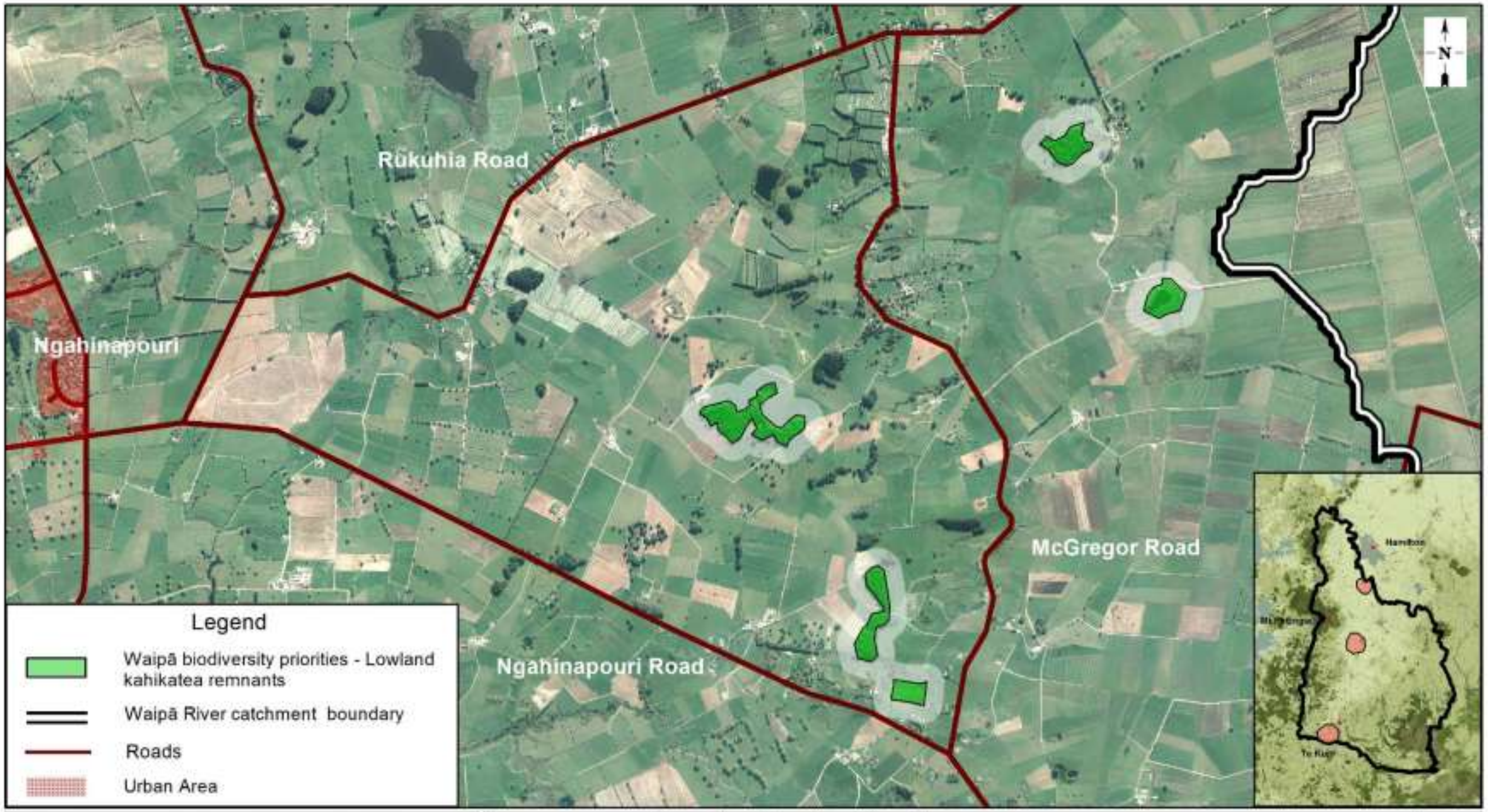

Scale 1:30,000@A4 Landscape

A4

Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 1/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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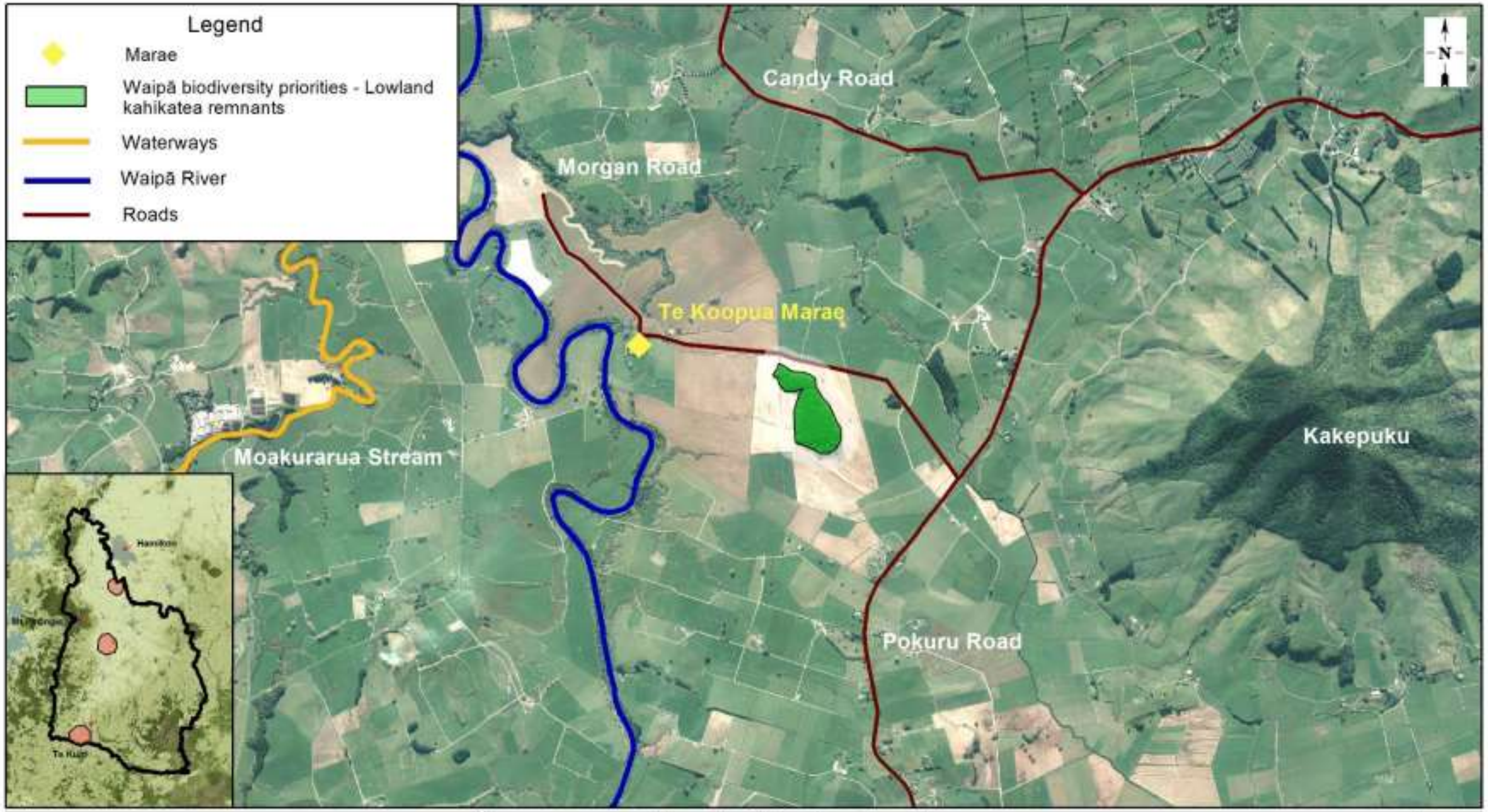

Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 2/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

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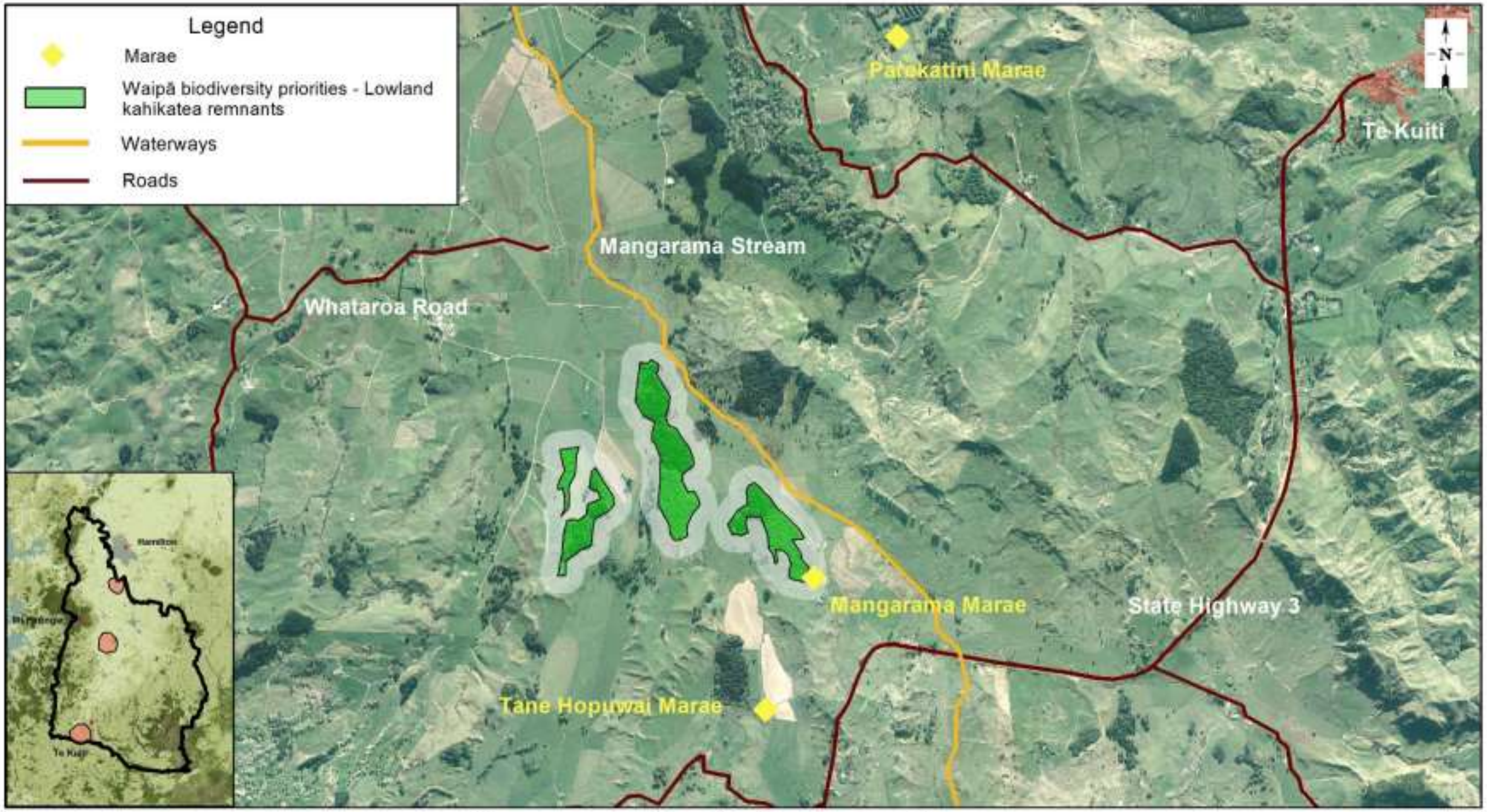

Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 3/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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<table>
<tr><td>WP 8
Priority: High</td><td>Enhancement of water levels in the Moanatuatua Wetland</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna.

Wetlands are created or protected and actively managed to enhance multiple functions.

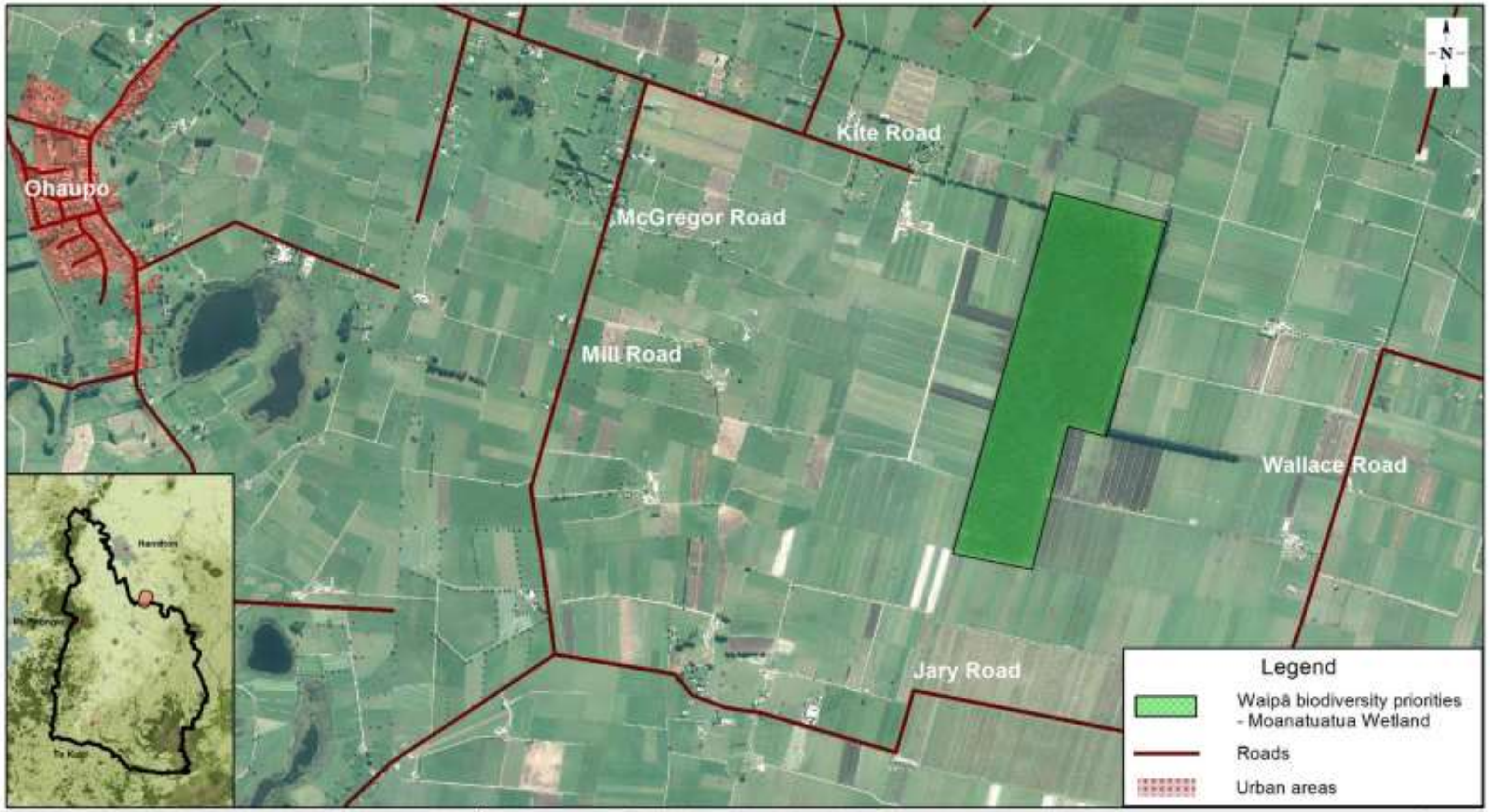
Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Moanatuatua Wetland</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Moanatuatua is an approximately 140ha peat bog – the only remaining of its type that once covered 50,000ha in the Hamilton ecological district. The rare peat-forming Sporodanthus is still found there. Ownership is split between Department of Conservation (114ha) and Waikato-Tainui (23ha).

Both remnants are ring-drained and lack buffer zones. Due to their small size and ongoing lowering of the water table they are extremely susceptible to fire.

Historically, the wetland provided sustenance and rongoā (medicines) to tāngata whenua with its unique species of plants. The soils were also used for cultural activities including the creation of dyes and strengthening of taonga (treasures).</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Peat bog is being maintained with adequate water levels to sustain peat formation and retain rare plant communities.
- Iwi and community have a strong connection to the wetland and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on the Vision & Strategy</td><td>In a restored condition the Moanatuatua Wetland would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Land drainage</td><td>Lowers water levels in the bog causing peat oxidation and changes to vegetation.</td></tr><tr><td>Fire</td><td>Could destroy existing native vegetation. Currently no nearby seed sources to revegetate.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 2 years of project commencement there are structures in place to maintain water levels throughout the wetland.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>In order for this project to proceed private landowners would be required to give consent for a weir to be installed in the drain between their property and the reserve. This project is recommended to be undertaken as one complete piece of work.</td><td></td></tr>
</table>

	Weir design and construction - Site surveys to determine land and drain invert heights and depth of peat ($15,000). - Weir design by engineer ($10,000) - Resource consent for the weir may be required (damming and diverting water ($5000)). - Construction of up to two wooden weirs in the outlet drains of the wetland ($15,000 per weir). **Project management/Staffing/Incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs due to the expected degree of consultation and negotiation required.	
Time lag for benefits to be realised	If works were implemented over a 2-year period, it is estimated that the majority of the project benefits would be seen soon after project completion.	L = 2
Effectiveness of works	The Moanatuatua Wetland is in a degraded state with land drainage having resulted in significant drying of the margins and changes in plant communities. Without this project it is expected that there will be continued and potentially rapid deterioration over the next 20 years, with the wetland at risk of losing important values. If this project is successfully completed then some significant improvement can be expected in wetland condition over the next 20 years. However, this will likely need to be supported by improvement and enforcement of rules around wetland drainage.	W = 0.3
Risk of technical failure	Moderate risk of project failure due to technical feasibility. Risks are mostly related to failure of the weirs to maintain water levels due to losses through other sources such as groundwater flows. This is especially so at this site due to the substantial peat shrinkage on adjacent farmland. However, similar weirs on the outflows of nearby peat lakes have been successful in improving minimum water levels at these sites.	F = 0.82
Adoptability	There may be significant challenges in getting key landowners to agree to this work being undertaken. This would need to be resolved during the early stages of project planning.	A = 0.04
Information quality	Average – based on site knowledge of local experts who are experienced in constructing weirs in peat drainage systems.	
Knowledge gaps and response	On site investigations would be required to get a more accurate estimate of costs and to inform a weir design and height.	
Socio-political risks	There is a high risk that the project will fail to meet its goals over the long term due to socio-political risks. It would require co-ordination of agencies, enforcement of existing rules and approval of consent that may be challenging to obtain.	P = 0.37

<table>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Site surveys to inform weir height and design</td><td>15,000</td></tr>
<tr><td>Weir design plans</td><td>10,000</td></tr>
<tr><td>Weir construction (wood and machinery) x 2</td><td>30,000</td></tr>
<tr><td>Resource consent</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>18,000</td></tr>
<tr><td>Total</td><td>78,000</td></tr>
</table>
</td><td>C = 0.08</td></tr>
</table>



Enhancement of water levels in the Moanatuatua wetland

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

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A deep drain between a bog and adjoining farm.

<table>
<tr><th>WP 9
Priority: High</th><th>Mangakara Stream fish habitat rehabilitation</th><th>BCR value</th></tr>
<tr><td>Relevant unit goal(s)</td><td>Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangakara Stream, Te Pahu</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 3.7km long stream flowing from the bush line on Mt Pirongia (near Grey Road, Te Pahu) to the Waipā River. The land use is predominantly pastoral farming.

This waterway was identified by fish experts as important habitat for native freshwater species such as tuna, kōura and bullies, and it has been identified by Maniapoto iwi as a historic fishing area for piharau. There are opportunities to increase native fish abundance and diversity by remediating barriers and providing increased and high quality fish habitat.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a well vegetated riparian margin along its entire length that provides erosion protection, shade and shelter.
- Native fish are abundant and the full range of species expected to be found in the waterway can be found there.
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Value of the feature</td><td>In a restored condition the Mangakara Stream, Te Pahu, would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 1.5</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr><tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The full 3.7km length of Mangakara Stream is fenced to exclude stock and has a riparian margin (at least 5m wide) vegetated with predominantly native plant species.
- All manmade barriers to fish migration are remedied.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This</td><td></td></tr>
</table>

	project could be undertaken as a whole, or in multiple smaller components. **Riparian management** - Undertake up to 6km of riparian fencing to a standard of at least 5 wires (2 electric) and set back at least 5m from the top of the streambank ($48,000). Include adjoining wetland areas within the riparian fencing. - Undertake native riparian planting at 1.5m spacing. Based on the assumption that 80% of the riparian margin requires planting, approximately 2.4ha of native planting is required at a cost of $37,551 per hectare ($90,124). **Fish barriers** Determine the location and type of barriers to fish passage. It is estimated that there are two barriers to fish passage (Grey Road culvert and potentially a farm crossing) on this watercourse. Undertake works to remedy fish barriers ($10,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 8.5
Effectiveness of works	The Mangakara Stream has its headwaters in native bush and is currently in good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable and fishable. Condition is not expected to signficantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Mangakara Stream is expected to be in excellent condition and very close to desired state in 20 years' time, with aspects related to fish habitat and passage and stock exclusion all being addressed.	W = 0.3
Risk of technical failure	Risks are mostly related to establishment of plantings. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.	A = 0.5

<table>
<tr><td>Information quality</td><td>Poor – riparian management requirements based predominantly on review of aerial photography. Limited knowledge regarding the location of fish migration barriers.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning and costings confirmed accordingly. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (6km)</td><td>48,000</td></tr>
<tr><td>Native planting (2.4ha)</td><td>90,124</td></tr>
<tr><td>Remedy of fish barriers</td><td>10,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>29,624</td></tr>
<tr><td>Total</td><td>177,748</td></tr>
</table>
</td><td>C = 0.18</td></tr>
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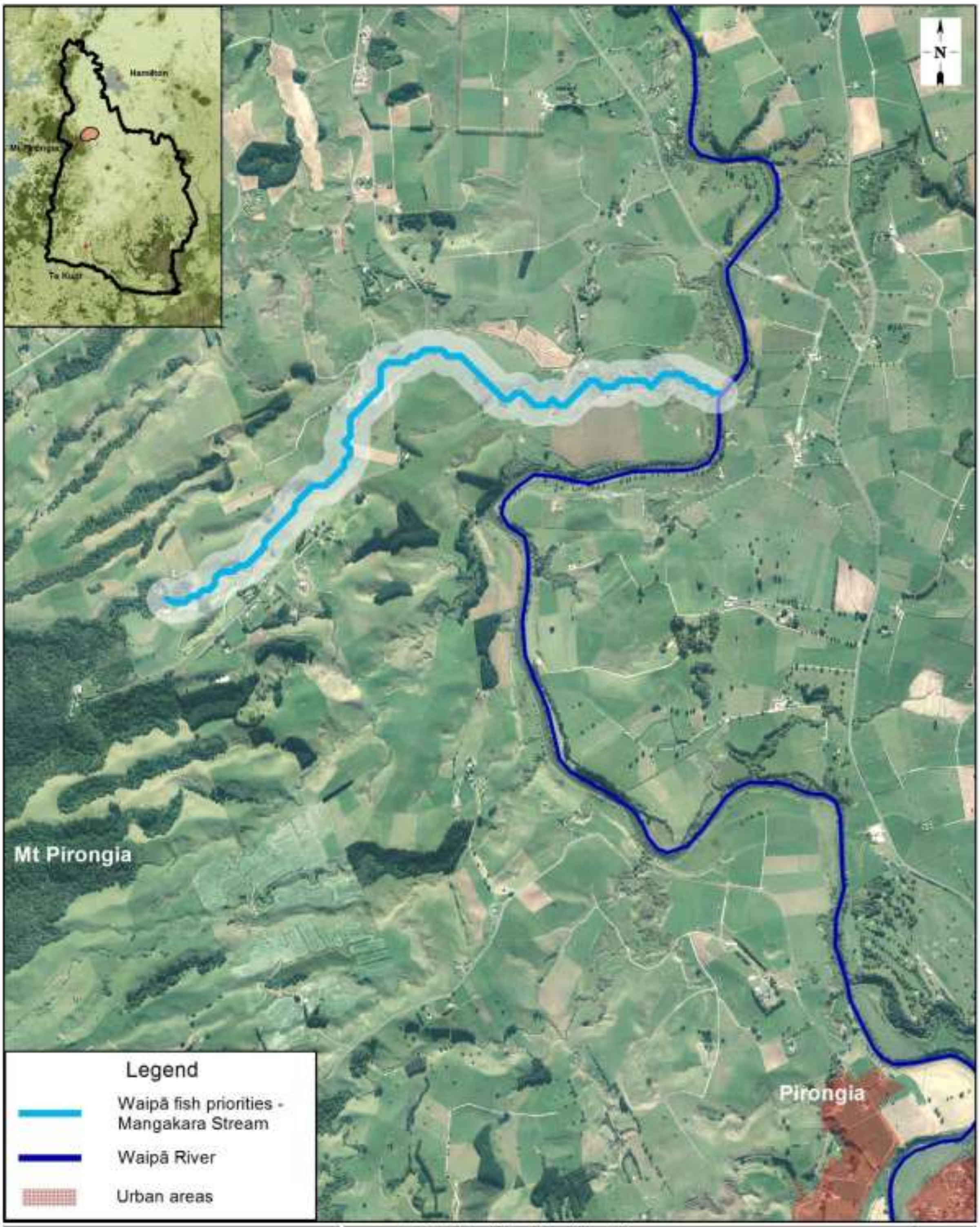

Mangakara Stream fish habitat rehabilitation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS gws

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale 1:25,000@A4 Portrait

A4

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An unfenced section of Mangakara Stream,

A section of Mangakara Stream where it is recommended fences be moved back and native riparian planting undertaken.

<table>
<tr><td>WP 10

Priority: Medium</td><td>Mangauika Stream fish habitat rehabilitation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangauika Stream, Pirongia</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 9km long stream flowing from Mt Pirongia in the vicinity of Te Tahi Road (and the water reservoir) to join the Waipā River at Pirongia village. The land use either side of the stream is predominantly pastoral farming with some remnants of native vegetation.

This waterway was identified by fish experts as important habitat for native freshwater species such as tuna, kōura and bullies and it has been identified by Maniapoto iwi as a historic fishing area for piharau and freshwater mussels. There are opportunities to increase native fish abundance and diversity by remediating barriers and providing increased and high quality fish habitat.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a well vegetated riparian margin along its entire length that provides erosion protection, shade and shelter.
- Native fish are abundant and the full range of species expected to be found in the waterway can be found there.
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangauika Stream, Pirongia, would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 1.5</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on the asset</th></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
</table></td><td></td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The full 9km length of Manguika stream is fenced to exclude stock and has a riparian margin (at least 5m wide) dominated by native plant species to assist in providing, food, shade, shelter and habitat for native fish.
- All manmade barriers to fish migration are remedied.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Riparian management for fish habitat purposes
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires). Include adjoining wetland areas within the riparian fencing.

Undertake native riparian planting within the fenced area and associated weed control and maintenance.

Further investigation is required to determine the length of stream requiring treatment. However, based on aerial photographs and known information about the catchment it is estimated that 75% of the stream (6.75km stream length or 13.5km of streambank) remains to be fenced and planted.

Fencing – 13.5km at $8/m ($108,000).

Planting of a 13.5km riparian margin that is at least 5m wide equates to 6.75ha of planting at $37,552 per hectare ($253,476). This cost includes site preparation, plant purchase, planting labour and five releasing events.

Remedy fish barriers
Investigate the locations of barriers to fish passage and undertake the required work to remedy these barriers. This is estimated to cost up to $10,000 (based on remediation of two barriers). Actual costs will depend on the number and type of fish passage barriers that require remediation.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.</td><td></td></tr>
</table>

	This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 8.5
Effectiveness of works	The Mangauika Stream is currently in moderate condition with some of the Vision & Strategy desired state aspects being met, including being swimmable at times and fishable. Condition is not expected to either decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Mangauika Stream is expected to be in very good condition and closer to desired state in 20 years' time, with aspects related to fish habitat and passage and stock exclusion all being addressed. The stream travels through pastoral land over its entire extent and so this project will not fully address the potential impacts of this on water quality.	W = 0.3
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings. The risk of losing works due to flooding are mitigated somewhat by the proposed 5m setbacks for fencing and planting.	F = 0.92
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. This would need to be determined during the project planning phase and costs adjusted accordingly for moving of fences.	A = 0.5
Information quality	Poor – riparian management requirements based predominantly on aerial photography. Limited knowledge regarding the location of fish migration barriers.	
Knowledge gaps and response	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project. The water reservoir is one known barrier but there may be another on the water reservoir access track.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Description</th><th>Cost ($)</th></tr>
<tr><td>Remedy fish barriers</td><td>10,000</td></tr>
<tr><td>Fencing (13.5km)</td><td>108,000</td></tr>
<tr><td>Native planting (6.75ha)</td><td>253,476</td></tr>
<tr><td>Project Management/staffing/incidentals (25%)</td><td>92,869</td></tr>
<tr><td>Total</td><td>464,345</td></tr>
</table>
</td>
<td>C = 0.46</td>
</tr>
</table>

Mangauika Stream fish habitat rehabilitation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:25,000@A4 Landscape

A4

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Te Kaunihera ā Rohe o Waikato

Sections of Mangauika Stream where further riparian fencing and planting is recommended.

<table>
<tr><td>WP 11
Priority: High</td><td>Waipā River bank erosion protection and remediation – Ōtorohanga to Pirongia</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems.

Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.</td><td></td></tr>
<tr><td>Name of feature</td><td>Waipā River – Ōtorohanga to Pirongia</td><td></td></tr>
<tr><td>Brief description of feature</td><td>This is a 37km stretch of the Waipā main stem lined with mostly exotic nuisance vegetation with many specimens at maturity and frequent collapse into the bed. This instigates bank instability and sedimentation of the main channel. The river is deeply incised through this stretch.

This area is historically significant to iwi with multiple historic pā sites in the vicinity and of pakanga (battles) during the “Waikato Wars”. Ōtorohanga was previously a well inhabited papakāinga for many centuries. There are currently 7 marae with significant interests in this stretch of the Waipā.

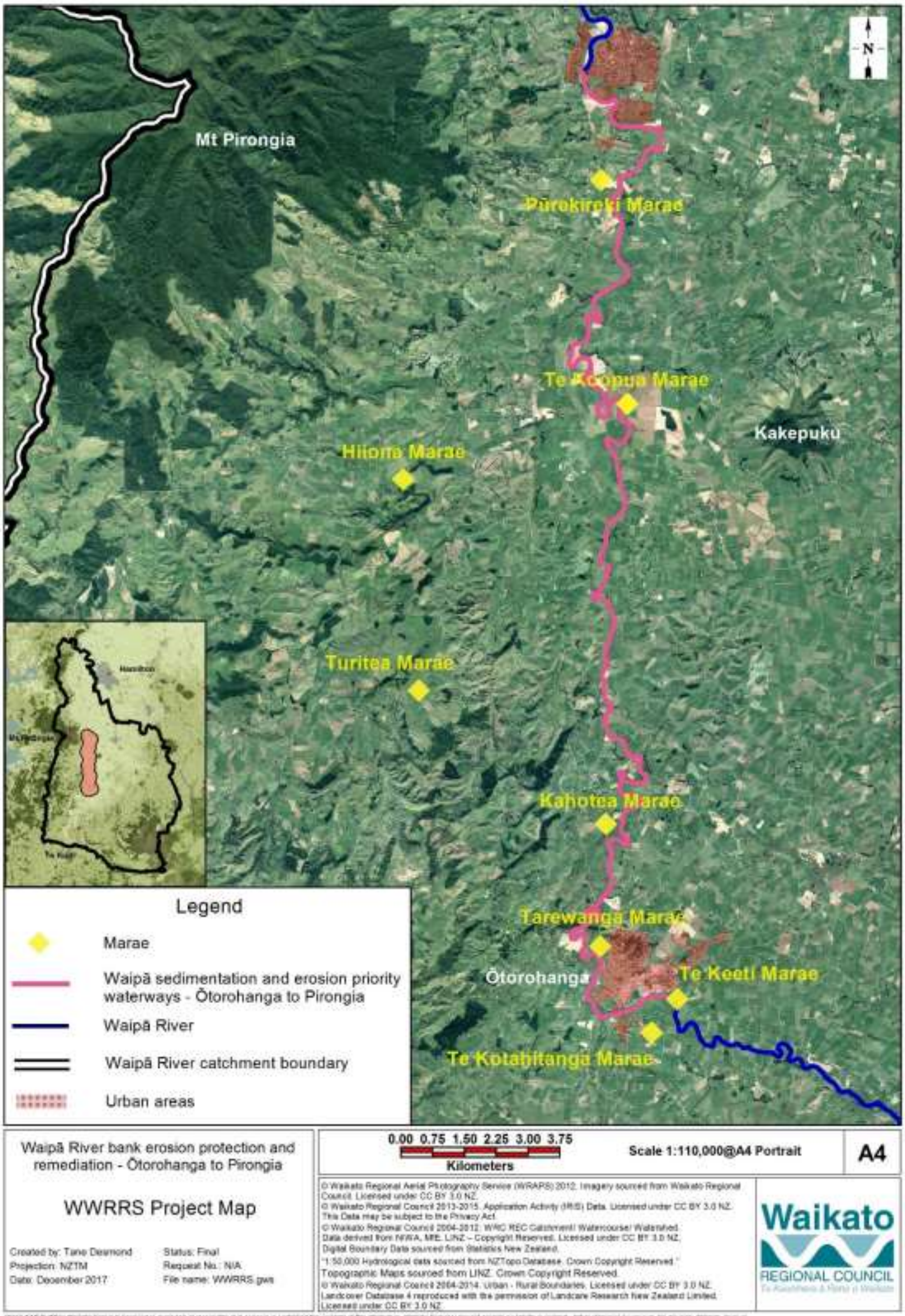
Water quality information for the Waipā River at Ōtorohanga indicates that the river here is safe for fishing and sometimes, but not always, safe for swimming. By the time it reaches Pirongia it is safe for fishing but not safe for swimming due to unsatisfactory levels of E. coli.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A 37km stretch of river with stable, vegetated banks and where major erosion events are limited.
- A riparian margin at least 10m wide that is well vegetated with native plants and exotic plants where required to prevent erosion.
- The river is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the river and are active in its use protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waipā River – Ōtorohanga to Pirongia reach – would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 125</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 9500 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr></table></td><td></td></tr>
</table>

Project goal/s	Within 15 years of project commencement: - The river has stable banks and a continuous vegetated (native and exotic for erosion control) 37km margin along the reach from Ōtorohanga to Pirongia. - Stock is excluded from 100% of the river. - Sediment to the Waipā River over this stretch is reduced by 15%.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **River erosion protection and remediation** - It is estimated that about a third of this reach will require vegetation management for erosion purposes. This equates to 12km of river at $40 per channel metre ($480,000). Note: this should not be undertaken all at once, but rather staged so that areas can revegetate before others are cleared. - Disposal is estimated at 20% of removal costs ($96,000). - Re-fencing will be required where vegetation has been removed. Assume a 3-wire electric for 24km of riverbank ($134,000). - Willow/poplar poles should be planted for initial stability, at 10m intervals along this length (2400 poles is $33,600). - For long term stability of the riverbank, native vegetation should also be planted in these areas with a 10m setback. This would require 24ha of planting ($901,248). - 30 woody debris structures (using vegetation on site) should be installed as habitat for fish. At a cost of $1600 per structure this equates to $48,000. - This stretch of the Waipā main stem is estimated to require 10 erosion protection structures along its length at a cost of $30,000 per structure ($300,000). Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management.	

	Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	The Waipā River (Ōtorohanga to Pirongia) varies in condition over this reach, being moderate at Ōtorohanga and poor by the time it reaches Pirongia. As this river travels through this reach it is joined by some rivers and streams with very high sediment loads including the Moakurarua and Puniū. The river is not swimmable towards Pirongia, the banks are unstable in many places and stock have access to the river at a number of locations. The riverbanks are not well vegetated with native plants. Some deterioration in the river is expected over the next 20 years in the absence of this project, with impacts of the upper catchment, and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. This decline is expected to be offset by the outcomes of this project which will improve aspects related to bank stability, stock exclusion and extent of native vegetation along the margins. Overall, however, the upper catchment impacts will still be the biggest factor in water quality through this reach and therefore this stretch of river will benefit from works being undertaken both locally and in the upper catchments that it receives water from. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 10m, and by planting sterile willow poles to stabilise banks while native plantings establish. Erosion control structures and fish habitats should be designed and constructed by experienced practitioners to avoid exacerbating erosion and/or other negative impacts and to minimise risk of failure.	F = 0.87
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks is likely to be a challenge in terms of uptake. In addition there are large sections of the river that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be reluctant to erect fences in these locations due to the potential maintenance costs. This	A = 0.45

	risk can be reduced by the larger setbacks and use of plantings. There are also some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.	
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	
Up-front cost – total for implementation phase/project duration	(see cost table below)	C = 2.59

Description	**Cost ($)**
Erosion protection structures (10)	300,000
Fish habitats (30)	48,000
Native planting (24ha)	901,248
Vegetation management (12km)	480,000
Vegetation disposal	96,000
Poplar/willow poles (2400)	33,600
Fencing (24km)	134,000
Project management/staffing/incidentals (30%)	597,854
Total	**$2,590,702**


N
Mt Pirongia
Purokireki Marae
Te Koopua Marae
Kakepuku
Hiiona Marae
Turitea Marae
Kahotea Marae
Tarewanga Marae
Ōtorohanga
Te Keeti Marae
Te Kotahitanga Marae
Legend
Marae
Waipā sedimentation and erosion priority waterways - Ōtorohanga to Pirongia
Waipā River
Waipā River catchment boundary
Urban areas
Waipā River bank erosion protection and remediation - Ōtorohanga to Pirongia
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.00 0.75 1.50 2.25 3.00 3.75
Kilometers
Scale 1:110,000@A4 Portrait
A4
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Waipā River – Ōtorohanga to Pirongia – showing managed areas of vegetation management and large setbacks (far side of river).

Waipā River – Ōtorohanga to Pirongia – showing areas susceptible to erosion.

Waipā River just upstream of Pirongia village. Areas of bank erosion and instability can be seen, and the impacts of high sediment loads from the upper catchment are evident.

<table>
<tr><td>WP 12
Priority: High</td><td>Tuna habitat rehabilitation within 7 Pūniu River oxbows</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species.

Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Puniū River oxbows</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A collection of old oxbows along the Puniū River. Some of these are well connected to the river while others are not. They are in various vegetated states – some with dense willow canopy and others with small remnants of native vegetation. All of the oxbows flood when the Puniū River floods and many retain water throughout most of the year.

This area is of tribal significance to Maniapoto and Waikato, known as Mangatoatoa, the same name held by the marae situated directly at the confluence of the Puniū and Waipā rivers. The restoration of these oxbows to improve tuna (eel) habitat would greatly enhance the ability of the marae to sustain its people and manuwhiri (visitors).</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Oxbows provide valuable habitat for tuna and tuna are found there in abundance.
- All oxbows are well connected to the river and have maximum opportunity to inundate when Waipā River levels are high.
- Open water areas are excluded from stock and shaded with appropriate vegetation to assist in the prevention of dense aquatic weed growth.
- Stands of willow remain in place to provide habitat for tuna.
- Iwi and communities have a strong connection to the oxbows and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Puniū River oxbows would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 2</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><td>Key threat</td><td>Impact on the feature</td></tr><tr><td>Drainage, disconnection from the river, infilling with overburden and conversion to pasture</td><td>Loss of tuna (eel) habitat and loss of a unique feature in the landscape.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of this project commencing:
- Oxbows are fenced to exclude stock
- Increase by 25% the overall area that inundates at least three times per year and retains water for at least three weeks following flood events.</td><td></td></tr>
</table>

	- A 5m buffer of native and exotic (poplars) plants is created around open water areas to provide shade to assist in reducing water weeds and providing a food source for tuna.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Project plan development** Each oxbow will need to have a more detailed works plan developed which provides a detailed design showing where work will be undertaken, ground levels for excavation (if applicable), expected inundation areas, planting and fencing areas. The cost of this will vary for each site but a cost of up to $5000 has been estimated per site. **Increase habitat for tuna** Where possible, undertake earthworks work in oxbows 1a, 1b, 1c, 1d, 1f and 1g to increase the area of land that has standing water during and after flood events, and remove weeds choking existing ponding areas. If required, improve connectivity to the river in all oxbows by installation of culverts and channels. Undertake steps to improve flow within oxbow 1e – this may involve improving connectivity to the river. Avoid removing willows unless necessary to achieve desired area of open water. **Aquatic weed management** Undertake a mix of native and exotic planting (poplars) around open water areas. The purpose of planting will be to assist in shading out water weeds and provide a food source for invertebrates. **Earthworks and planting** The following estimates have been made around the work required: Oxbow 1a – 3 days long reach excavator and a 6m long culvert ($6310), 1 day crosscutter for selective pest tree removal ($700), 620m long section of fencing ($4960) and native planting (on average 5m wide), a row of exotic trees (e.g. poplar) planted every 15m to provide shade ($12,757). Oxbow 1b – 4 days earthworks with 12 tonne excavator and a 6m long culvert ($6360), 1 day crosscutter for selective pest tree removal ($700), 260m long section of fencing ($2080) and planting (on average 5m wide), a row of exotic trees planted every 15m to provide shade ($5349). Oxbow 1c – 5 days long reach excavator for a 6m long culvert ($9550), 400m long section of fencing ($3200), native planting	

	(average 5m wide), a row of exotic trees every 15m to provide fast growing shade ($8222). Oxbow 1d – up to 20 days long reach excavator and a 6m long culvert ($33850), 700m long section of fencing ($5600), native planting (on average 5m wide), a row of exotic trees planted every 15m to provide fast growing shade ($14,403). Oxbow 1e – culvert installation if required ($1050 for a 6m long culvert). Oxbow 1f – 200m willow removal ($6000), 4 days long reach excavator to excavate inundation area and install a 6m long culvert if required ($7930), 400m fencing ($1600) and native planting. A row of exotic trees planted 15m apart to provide fast growing shade ($4115). Oxbow 1g – 1 day long reach excavator and installation of culvert if required ($3070), 700m long section of fencing ($5600), natives tree planting (5m wide margin on average) and a row of exotic trees for shade planted at 15m spacing ($14,403). It is assumed that a 12 tonne excavator will move 200m^3 of soil per hour and that a long reach excavator will remove 150m^3 per hour. **Resource consent** Resource consent costs may be required for some projects. A budget of $5000 per site has been allowed for this. This assumes that consent applications may be lodged at different times for different oxbows. A budget of $5000 per project has been provided for investigation and design. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These oxbows are currently in a poor condition when compared to desired state. It is not expected that they will deteriorate significantly over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that oxbow condition in 20 years will be significantly closer to the desired Vision & Strategy state than it is currently.	W = 0.4

	This project addresses the majority of aspirations for these features.	
Risk of technical failure	There is a high risk of project failure due to technical feasibility. Techniques are not well established or tested. Risks relate to providing adequate flow and supply of water to the oxbows year round, and preventing pest fish dominating the fish biomass at these sites. Expert engineering advice should be sought in the early stages of the project.	F = 0.65
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. There may be concerns about reconnection of sites with the river and increased flooding. However, site design should ensure that this is avoided. There could also be reluctance to give up summer grazing areas to create more open water habitat. Some sites have been contoured and re-grassed to provide additional grazing. Early landowner engagement will be important as part of project planning.	A = 0.45
Information quality	Average – recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps and response	Further investigation is required to determine what is feasible and practical at each oxbow site. More information is required about each oxbow including current connectivity to the river, and whether there is opportunity to improve connectivity and increase the area and duration of inundation. This should be undertaken at the early stages of project planning. A detailed design needs to be carried out for each site and this should be undertaken early in project implementation.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Total ($)</th></tr>
<tr><td>Project plan development (up to $5,000 per site)</td><td>35,000</td></tr>
<tr><td>Oxbow 1a physical works</td><td>24,727</td></tr>
<tr><td>Oxbow 1b physical works</td><td>14,489</td></tr>
<tr><td>Oxbow 1c physical works</td><td>20,972</td></tr>
<tr><td>Oxbow 1d physical works</td><td>53,853</td></tr>
<tr><td>Oxbow 1e physical works</td><td>1,050</td></tr>
<tr><td>Oxbow 1f physical works</td><td>19,645</td></tr>
<tr><td>Oxbow 1g physical works</td><td>23,073</td></tr>
<tr><td>Resource Consent</td><td>35,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>68,342</td></tr>
<tr><td>Total</td><td>296,151</td></tr>
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</td>
<td>C = 0.30</td>
</tr>
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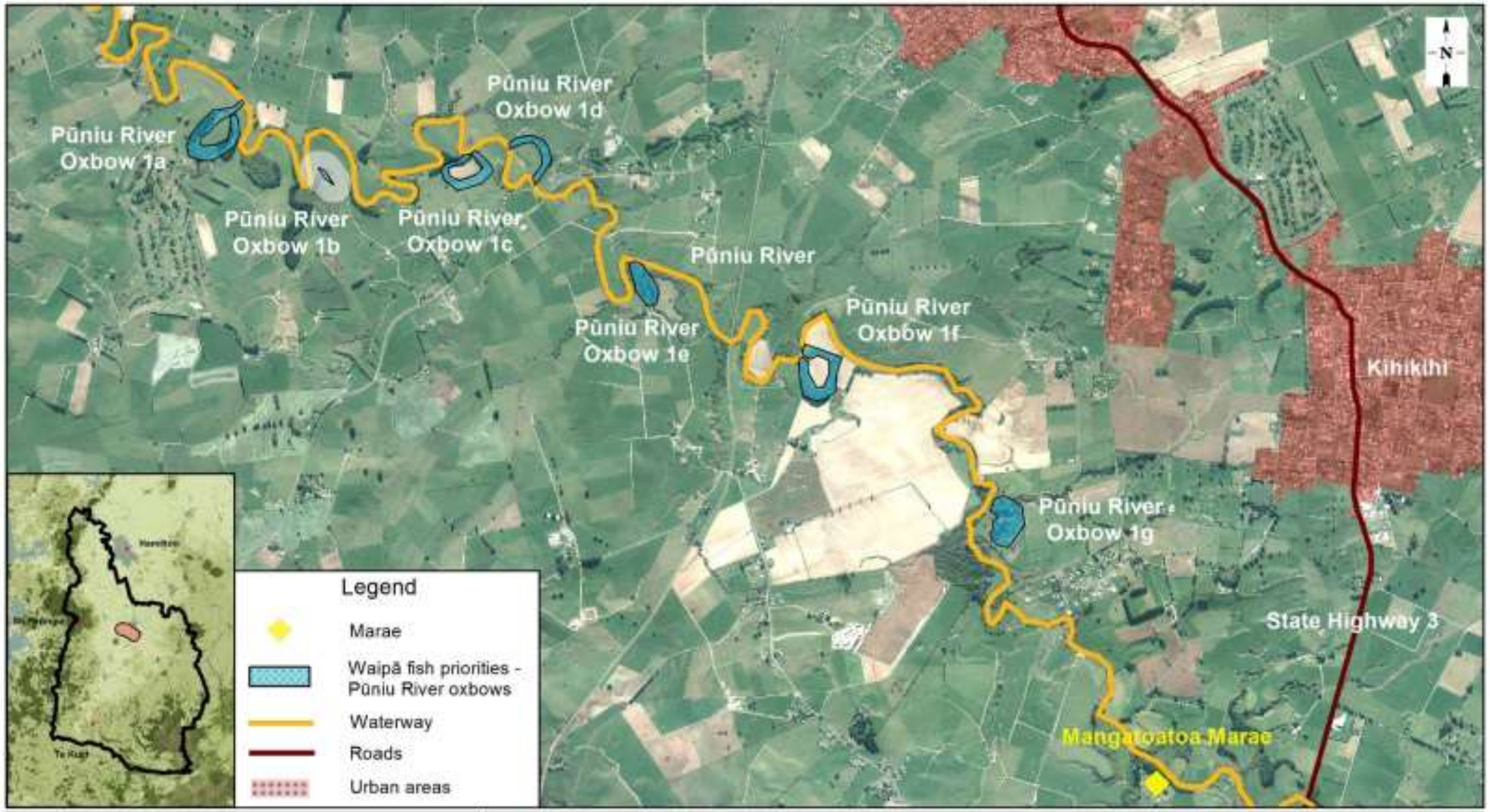

Tuna habitat rehabilitation within
7 Pūniu River oxbows

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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WP 13 Priority: Medium	Ngakoaohia Stream (and selected tributaries) fish habitat rehabilitation	BCR value
Relevant unit goal(s)	Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.	
Name of feature	Ngakoaohia Stream and selected tributaries (flowing from Pirongia mountain near Ngutunui)	
Brief description of feature	A 26km long stream network flowing from Mt Pirongia in the vicinity of Ngutunui to join the Waipā River approximately 7km kilometres upstream of Pirongia village. Streams within the network include Mangati Stream, Whakarautawa Stream, Mangakiekie Stream and Pekanui Stream. The land use either side of the stream is predominantly pastoral farming or native bush remnants. The Pirongia area has long been an important place for tāngata whenua. Its vast forests and waters were a significant food bowl for its people. Pirongia was named by Kuahupeka not long after the arrival of the Tainui waka in Kāwhia. Its full name is “Pirongia-te-aroaro-o-Kahu”. Kahupeka left the Kāwhia area to traverse inland. These waterways have been identified as priorities as they are known to have populations of native fish species and these are expected to respond well to further habitat enhancement work.	
Desired state to achieve the Vision & Strategy	Within 15 years of the project commencing: - Stock is excluded from all waterways within the catchment. - The stream network has a well vegetated native riparian margin along its entire length (at least 5m wide) - Potential manmade barriers to fish passage have been remedied. - Native fish are abundant and there is a wide diversity of species present including non-climbing species. There are no manmade barriers to native migratory fish. - Waterways are swimmable, fishable and have access for recreation. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Ngakoaohia Stream and selected tributaries flowing from Pirongia mountain would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 8

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the asset</th></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>- The full 26km stream network is fenced to exclude stock and has a riparian margin of at least 5m wide on both sides which is vegetated with plant species to provide stream shade and enhance habitat for adult native fish.
- Manmade barriers to native fish migration are identified and remedied.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas and forest remnants within the riparian fencing.

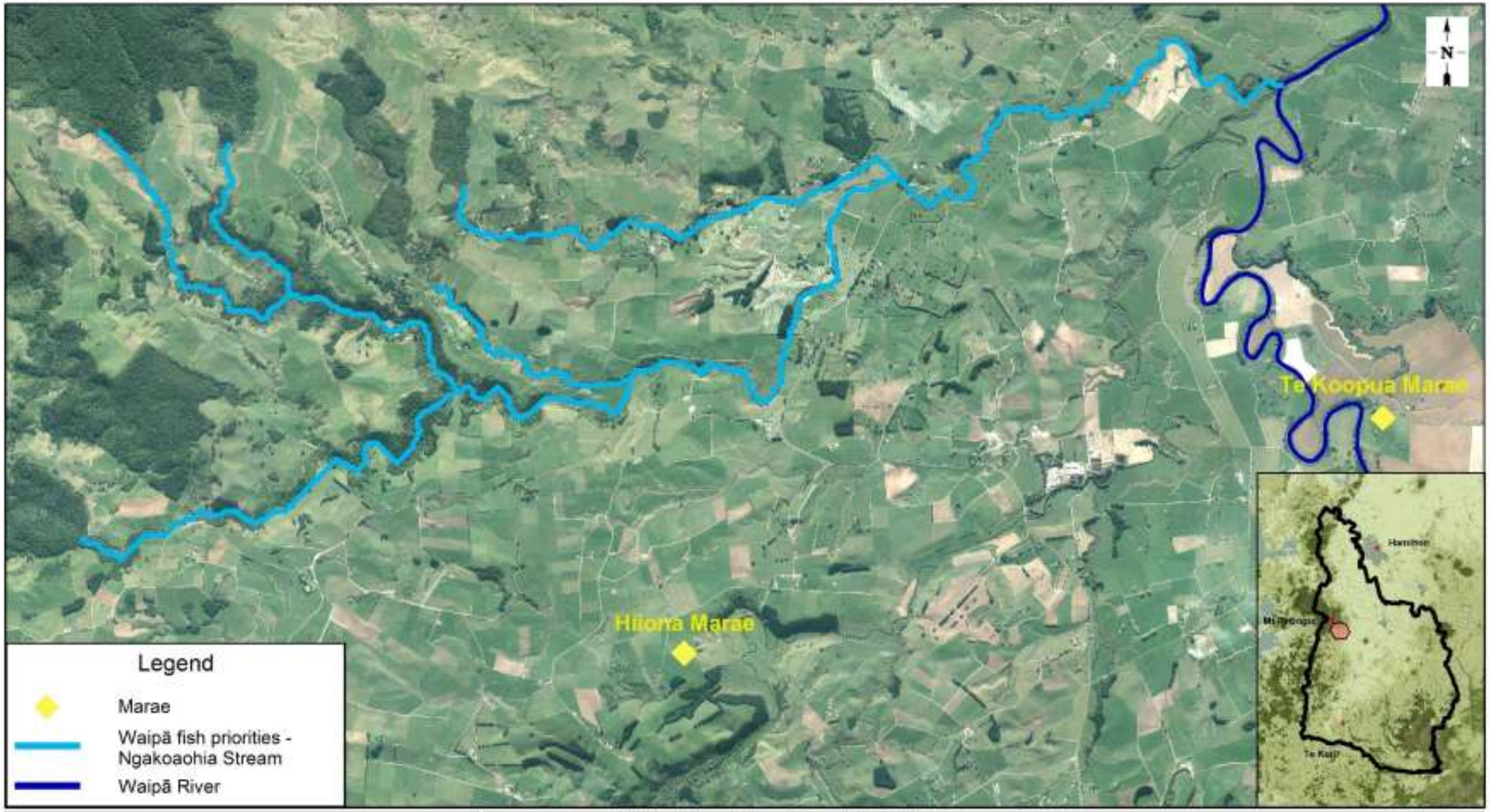
Further investigation is required to determine the length of stream requiring treatment. However, based on aerial photographs and known information about the catchment it is estimated that 50% (13km) of the stream remains to be fenced (or fence upgraded). This equates to a total fence length of 26km (both sides) at an estimated $8 per metre ($208,000).

Native planting
Undertake native riparian planting along the waterway and carry out associated weed control and maintenance for native plant establishment.
- Assume 50% (26km) of streambanks require native planting. This equates to a planting area of 13ha at an estimated cost of $37,552/ha ($488,176). Includes site preparation, plant purchase, planting labour and five releasing events.

Remediation of fish barriers</td>
<td></td>
</tr>
</table>

	Investigate the locations of barriers to fish passage and undertake the required work to remedy these barriers. Remediation options should follow the recommendations of a freshwater fish ecologist. The following culverts/crossings are thought to provide a barrier or partial barrier to fish passage: - Culvert where Pekanui Road crosses Pekanui Stream. - Culvert where Mangiti Road crosses Mangakiekie Stream. - Two culverts (in two locations) where Mangati Road crosses Mangati Stream. - Culvert where Kiwi Road crosses Ngakoaohia Stream. It is also estimated that there are a large number of fish barriers on private land, particularly along raceways and farm tracks (possibly as many as 12). The estimated cost for remediation of fish barriers is up to $5000 per barrier. Resource consent may be required for remediation of fish barriers and the cost of this should be covered by the cost estimate provided for remediation of fish barriers. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year following project completion.	L = 11
Effectiveness of works	The Ngakoaohia Stream and selected tributaries are currently in moderate to good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable and fishable. Condition is expected to decline over the next 20 years in the absence of this project. However, if this project is successfully completed then these sites are expected to improve and be closer to desired state with aspects related to fish habitat and passage and stock exclusion all being addressed.	W = 0.15
Risk of technical failure	Low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.87
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e.	A = 0.45

<table>
<tr><td></td><td>with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.</td><td></td></tr>
<tr><td>Information quality</td><td>Poor – riparian management requirements are based predominantly on review of aerial photography. Fish passage management requirements are based on some limited local knowledge but predominantly on aerial photography and GIS layers for fish barriers and fish species predictability.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown how much fencing already exists and how close it is to the stream edge. Detailed fencing requirements would need to be determined in the early stages of the project.
It is also unknown exactly how many barriers to fish passage there are along the stream and whether landowners would be willing to remedy such barriers. This will need to be determined during the project planning phase.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (26km)</td><td>208,000</td></tr>
<tr><td>Native planting (13ha)</td><td>488,176</td></tr>
<tr><td>Remediation of fish barriers</td><td>85,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>234,352</td></tr>
<tr><td>Total</td><td>1,015,528</td></tr>
</table>
</td><td>C = 1.02</td></tr>
</table>



Ngakoaohia Stream (and selected tributaries) fish habitat rehabilitation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:40,000@A4 Landscape

A4

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WP 14 Priority: Very high	Moakurarua integrated catchment programme	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land. The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna. Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.	
Name of feature	Moakurarua subcatchment	
Brief description of feature	A 14,974ha catchment in the upper Waipā with a total stream network of 277km. 34% of the catchment is in indigenous forest. Moakurarua Stream starts in the hill country south of Honikiwi and flows north to join the Waipā River approximately 7km upstream of Pirongia. The predominant land use within the catchment is pastoral farming (58% of the total area). Approximately 6000ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan and through the Healthy Rivers Plan Change. A 62km long stream network consisting of Moakurarua Stream and selected tributaries flowing from hill country to the west has been identified as a priority for native fish. Within this, a 27km stretch of the main stem of the Moakurarua Stream upstream of the Waratah piggery and an 8km stretch of the Oamaru Stream have been identified as priorities for river management through bank stabilisation. The top 6km of the Moakurarua stretch is a	

<table>
<tr><td></td><td>small gravel bottomed stream with very low banks. It is not fully fenced and lacks continuous vegetation. Erosion here is caused by stock access, lack of vegetation and flood events. The next 21km of stream has a silt/gravel bottom and highly erodible banks ranging from shallow to 4m high. Lateral bank erosion is extensive in places along this stretch of the stream.

The Oamaru Stream has extensive erosion in places. It is estimated that there is 5km of extensive bank stability works required along this stream.

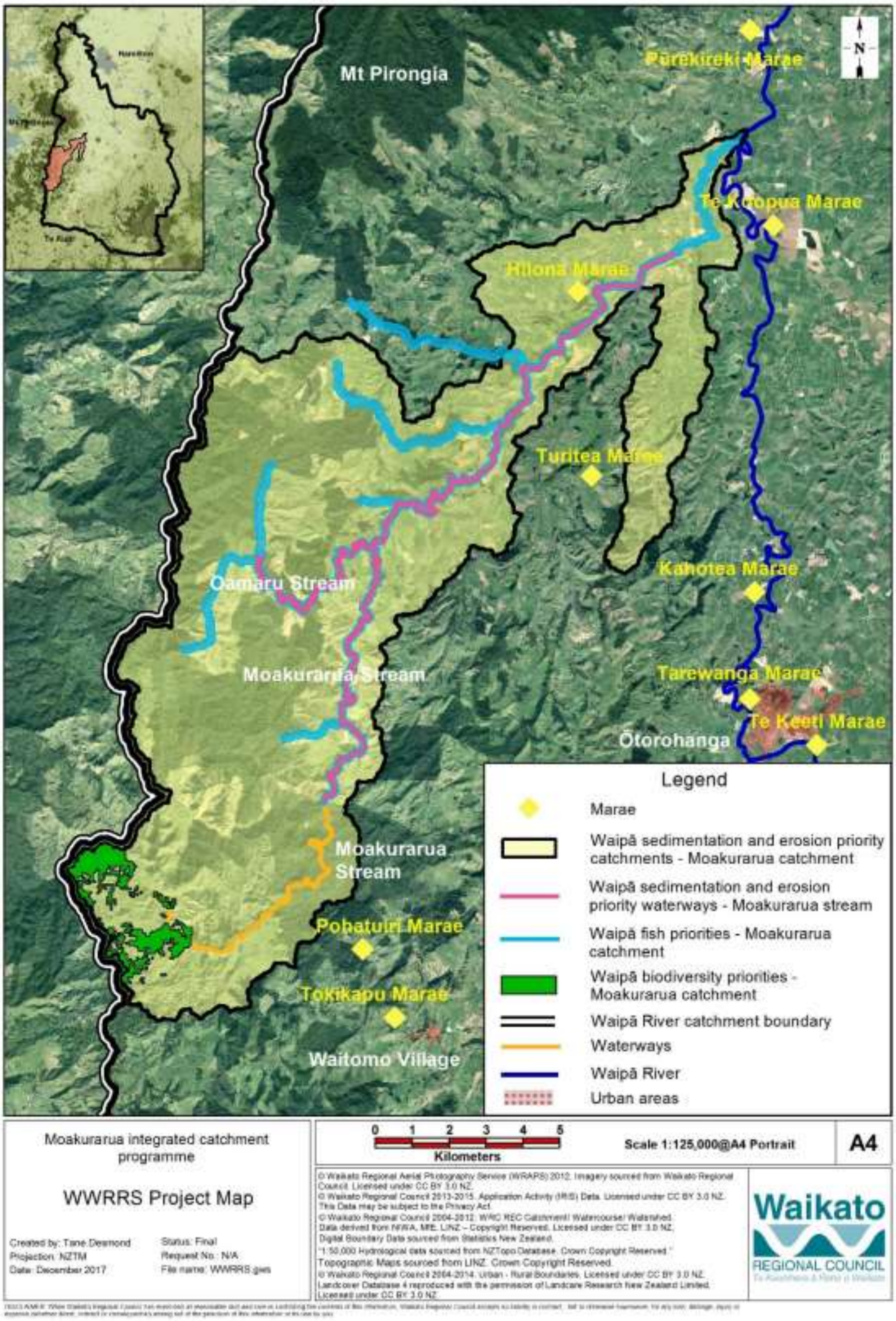
Upper Moakurarua forest fragments have been identified within the top 30% of biodiversity priorities in the Waikato River catchment (based on representativeness). There are 9 marae with significant cultural and historical interests in this area.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>A subcatchment where land use matches capability and with a stable stream network that has a well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Native and taonga species are abundant and there is a wide diversity of species present
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Moakurarua subcatchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Estimated to yield more than 10,000 tonnes of sediment per year to the Waipā River</td></tr>
<tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2300 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years of project commencement:
- The main channel of the Moakurarua Stream is stable, fenced to exclude stock and vegetated along its entire length.</td><td></td></tr>
</table>

	- There is a 25% reduction in suspended sediment in the Moakurarua Stream - A 62km stream network is established that is stable, excluded to stock and has a vegetated riparian margin of predominantly native plant species (at least 5m wide) to enhance habitat for native fish species, especially tuna, piharau, kōura and kōkopu. - Native forest remnants and wetlands identified are fully fenced to exclude stock and native regeneration occurs naturally within these areas.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 665ha LUC 6e managed with open space pole planting at $3000 per hectare ($1,995,000). - 665ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $3000 per hectare ($1,995,000). - 131km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($2,620,000). - 647ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $3000 per hectare ($1,941,000). - 91km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($1,820,000). - 22ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per ha (e.g. dewatering, retiring seepages, etc) ($110,000). - 60 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 6000ha area. - 38km fencing existing indigenous forest cover at $25m (8-wire and batten) ($950,000). **Riparian Management of rivers/streams for fish habitat and soil conservation purposes** - Carry out riparian fencing along 72km of streambank (31km of stream length) with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires) at an estimated cost of $8 per metre ($576,000). Include adjoining wetland areas within the riparian fencing. - Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 36ha of planting, and associated weed control and maintenance ($1,351,872) **River management for large scale erosion** 21km stretch in the mid-section of the Moakurarua and 5km of the Oamaru Stream requires hard and soft engineering	

	structures to protect banks from mass erosion. Estimated at $20,000 per km. This cost includes fencing and planting post completion of works ($420,000). Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13 years after project commencement.	L = 12.5
Effectiveness of works	The Moakurarua subcatchment is in very poor to poor condition compared with the desired state with few of the Vision & Strategy aspirations currently being met. It is expected that over the next 20 years there will be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address many of the threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make significant progress with respect to achieving the Vision & Strategy state in 20 years' time.	W = 0.4
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. It is important that appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project such as river erosion control structures. There are risks related to establishment of plantings or loss of works due to flooding, however techniques are well established and have been used previously on this and other local streams. River erosion structures should be designed by an appropriately qualified practitioner.	F = 0.82

Adoptability	It is estimated that about a third of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. There are large sections of stream that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these location due to the high maintenance costs. Fencing is also difficult in places due to the steepness of the land. Uptake of management of LUC class 6e and 7 land may be low however there are some existing projects along this reach that provide a good example of what can be achieved through farm planning. Early community engagement and identifying key farmers will be very important for the success of this project.	A = 0.36
Information quality	Good – estimates are based on modelled information and input from catchment officers who have experience working in the subcatchment, know the river well and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	It is unknown exactly how much fencing already exists and estimates are based on Waipā catchment riparian surveys. It is also unknown how close existing fences are to the stream edge. Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks. Opportunities to have this work incentivised should be greeted positively.	P = 0.85
Project duration (years)	15 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>26km river erosion control</td><td>520,000</td></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (665ha)</td><td>1,995,591</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (665ha)</td><td>1,995,591</td></tr>
<tr><td>Fencing managed LUC class 6e land (131km)</td><td>2,645,023</td></tr>
<tr><td>Plantation species on LUC class 7 land (647ha)</td><td>1,939,516</td></tr>
<tr><td>Fencing managed LUC class 7 land (91km)</td><td>1,813,778</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 land (22ha)</td><td>110,000</td></tr>
<tr><td>Streambank fencing (72km)</td><td>576,000</td></tr>
<tr><td>Riparian planting river/streams (36ha)</td><td>1,351,872</td></tr>
<tr><td>Fencing existing indigenous vegetation (38km)</td><td>950,000</td></tr>
<tr><td>Goat control on 6e and 7</td><td>73,440</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>4,191,243</td></tr>
<tr><td>Total</td><td>$18,162,054</td></tr>
</table>
</td>
<td>C = 18.16</td>
</tr>
</table>



N
Mt Pirongia
Pūrekireki Marae
Hiiona Marae
Turitea Marae
Kahotea Marae
Tarewanga Marae
Te Keeti Marae
Ōtorohanga
Oamaru Stream
Moakurarua Stream
Moakurarua Stream
Pohatuiri Marae
Tokikapu Marae
Waitomo Village
Legend
Marae
Waipā sedimentation and erosion priority catchments - Moakurarua catchment
Waipā sedimentation and erosion priority waterways - Moakurarua stream
Waipā fish priorities - Moakurarua catchment
Waipā biodiversity priorities - Moakurarua catchment
Waipā River catchment boundary
Waterways
Waipā River
Urban areas
Moakurarua integrated catchment programme
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 1 2 3 4 5
Kilometers
Scale 1:125,000@A4 Portrait
A4
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Examples of mass earth movement in the Moakurarua catchment.

A mixture of high erosion class land and some remnant vegetation in the Moakurarua catchment.

Large scale riverbank erosion on the Moakurarua Stream.

Resulting downstream sedimentation following a large weather event in the Moakurarua catchment.

<table>
<tr><td>WP 15
Priority: High</td><td>Tuna habitat rehabilitation within 10 Waipā River oxbows</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species.

Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Waipā River oxbows</td><td></td></tr>
<tr><td>Brief description of feature</td><td>This project focuses on a collection of historic oxbows along the Waipā River between Pirongia and Ōtorohanga. Some of these are well connected to the river while some are not. They are in various vegetated states – some with dense willow canopy and others with small remnants of native vegetation. All of the oxbows flood when the Waipā River floods and many retain water throughout most of the year.

These have been identified by fish experts as important habitat for tuna and there are opportunities to further enhance these areas for tuna habitat. The enhancement of this habitat would also support the historical relationship between the tāngata whenua and its natural resources.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Oxbows provide valuable habitat for tuna and tuna are found there in abundance.
- All oxbows are well connected to the river and have maximum opportunity to inundate when Waipā River levels are high.
- Open water areas are excluded from stock and shaded with appropriate vegetation to assist in the prevention of dense aquatic weed growth.
- Stands of willow remain in place to provide habitat for tuna.
- Iwi and communities have a strong connection to the oxbows and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waipā River oxbows would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 3</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><td>Key threat</td><td>Impact on the feature</td></tr><tr><td>Drainage, vegetation clearance and the filling of old oxbows with overburden and conversion to pasture.</td><td>Loss of tuna habitat and loss of a unique feature in the landscape.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of this project commencing:
- Oxbows are fenced to exclude stock.</td><td></td></tr>
</table>

	- Increase by 25% the overall area that inundates at least three times per year and retains water for at least three weeks following flood events. - A 5m buffer of native and exotic (poplars) plants is created around open water areas to provide shade to assist in reducing water weeds and providing a food source for tuna.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Project plan development** Each oxbow will need to have a more detailed works plan developed which provides a detailed design showing where work will be undertaken, ground levels for excavation (if applicable), expected inundation areas, planting and fencing areas. The cost of this will vary for each site but a cost of up to $5000 has been estimated per site. **Increase habitat for tuna** Ensure there is good connectivity between the Waipā River and the oxbows. If required improve connectivity to the river through installation of culverts and channels. Where possible, undertake earthworks in oxbows 2a to 2h to increase the area of land that has standing water during and after flood events, remove any dense areas of aquatic vegetation encroaching on existing ponding areas. Undertake steps to improve flow within oxbows 2i and 2j (see map) – this may involve improving connectivity to the river. Limit willow removal as this provides habitat for tuna. Any willow removal should only be undertaken above water to enable machinery access to increase the size of inundation areas. **Aquatic weed management** Undertake a mix of native and exotic planting (poplars) at oxbows 2a and 2h to provide shade over the pond area. **Earthworks and planting** The following estimates have been made around the amount of earthworks and planting required but further investigation and planning is required. Oxbow 2a – costings include earthworks and installation of up to four 450mm diameter, 6m long culverts or similar to improve connectivity (and some additional excavator time) ($5130), 1ha of selective willow herbicide control to increase the area of open water ($3800), and 1130m fencing to exclude stock ($9040).	

	Oxbow 2b - Costings allow for earthworks to increase area and/or depth of standing water and improve connectivity (2 culverts and 2 digger days $5440). Selective herbicide control of willow to increase the area of open water ($1900). 850m fencing ($6800), 200m of native planting with a 5m wide riparian margin ($3995). Oxbow 2c – costings allow for earthworks to increase area and/or depth of standing water and improve connectivity. Up to four culverts and 2 digger days ($7,240). Selective herbicide control of willow to increase the area of open water ($1900), 441m fencing ($3528), and 200m of native planting with a 5m wide riparian margin ($3995). Oxbow 2d – create permanent ponding area approximately 130m x 30m (4 days digger time using a long reach digger $6880), 320m fencing ($2560), 320m native planting around perimeter, a row of exotic trees on northern side every 15m to provide fast growing shade ($6448), and culverts to connect to the river ($1800). Oxbow 2e – create permanent ponding area approximately 6000m^2 x 2m deep (200m long x 30m wide)(10 days with long reach digger $16,600) and connect to river (with culverts if required, $1800), 750m fencing ($6000) and native/exotic planting with an average riparian margin of 5m wide ($10,008). Oxbow 2f – increase the size of the permanent ponding area by 30m x 50m (3 days with a 12 tonne excavator $4050) and connect to river with culverts if required ($1800). Undertake 500m fencing ($4000) and native planting ($3200) and additional willow/weed control if required ($2600). Oxbow 2g – improve connectivity to river with two culverts (1 day earthworks $3330). Selective willow control (x-tree basal) to increase the area of open water ($3800). Oxbow fencing 1.6km ($13,000). Some native planting along inlet/outlet (two rows 320m at $3796). Oxbow 2h – improve connectivity to the Waipā River (two culverts $1800), increase area of open water (4 long reach digger days $6880). Selective ground based willow removal ($2600), 880m of fencing ($7040) and a small amount of native planting in open areas ($3796). Oxbow 2i – investigate connecting this old oxbow to the river at the upstream end. Allow earthworks two days and two 6m long culverts ($5440). Assume mostly fenced ($1600 allocated for fencing), and selected ground based willow control if required ($2790).	

	Oxbow 2j – investigate connecting to river at upstream end. Allow earthworks two days and two 6m long culverts ($5440). Assume mostly fenced ($1600 allocated for fencing), and selected ground based willow control if required ($2790). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These oxbows are currently in a poor-moderate condition when compared to desired state. It is expected that they will deteriorate slowly over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that oxbow condition in 20 years will be significantly closer to the desired Vision & Strategy state than it is currently. This project addresses the majority of aspirations for these features.	W = 0.25
Risk of technical failure	There is a high risk of project failure due to technical feasibility. Techniques are not well established or tested. Risks relate to providing adequate flow and supply of water to the oxbows year round, and preventing pest fish dominating the fish biomass at these sites. Expert engineering advice should be sought in the early stages of the project.	F =0.7
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. There may be concerns about reconnection of sites with the river and increased flooding. However, site design should ensure that this is avoided.	A = 0.54
Information quality	Average – recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps and response	Further investigation is required to determine what is feasible and practical at each oxbow site. More information is required about each oxbow including current connectivity to the river, and whether there is opportunity to improve connectivity and increase the area and duration of inundation. This should be undertaken at the early stages of project planning. A detailed design needs to be carried out for each site and this should be undertaken early in project implementation.	

<table>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Total ($)</th></tr>
<tr><td>Design plan development (up to $5,000 per site)</td><td>50,000</td></tr>
<tr><td>Resource consent ($5,000 per site)</td><td>50,000</td></tr>
<tr><td>Oxbow 2a physical works</td><td>17,970</td></tr>
<tr><td>Oxbow 2b physical works</td><td>18,135</td></tr>
<tr><td>Oxbow 2c physical works</td><td>16,663</td></tr>
<tr><td>Oxbow 2d physical works</td><td>17,688</td></tr>
<tr><td>Oxbow 2e physical works</td><td>34,488</td></tr>
<tr><td>Oxbow 2f physical works</td><td>15,650</td></tr>
<tr><td>Oxbow 2g physical works</td><td>23,926</td></tr>
<tr><td>Oxbow 2h physical works</td><td>22,116</td></tr>
<tr><td>Oxbow 2i physical works</td><td>9,830</td></tr>
<tr><td>Oxbow 2j physical works</td><td>9,830</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>85,888</td></tr>
<tr><td>Total</td><td>372,184</td></tr>
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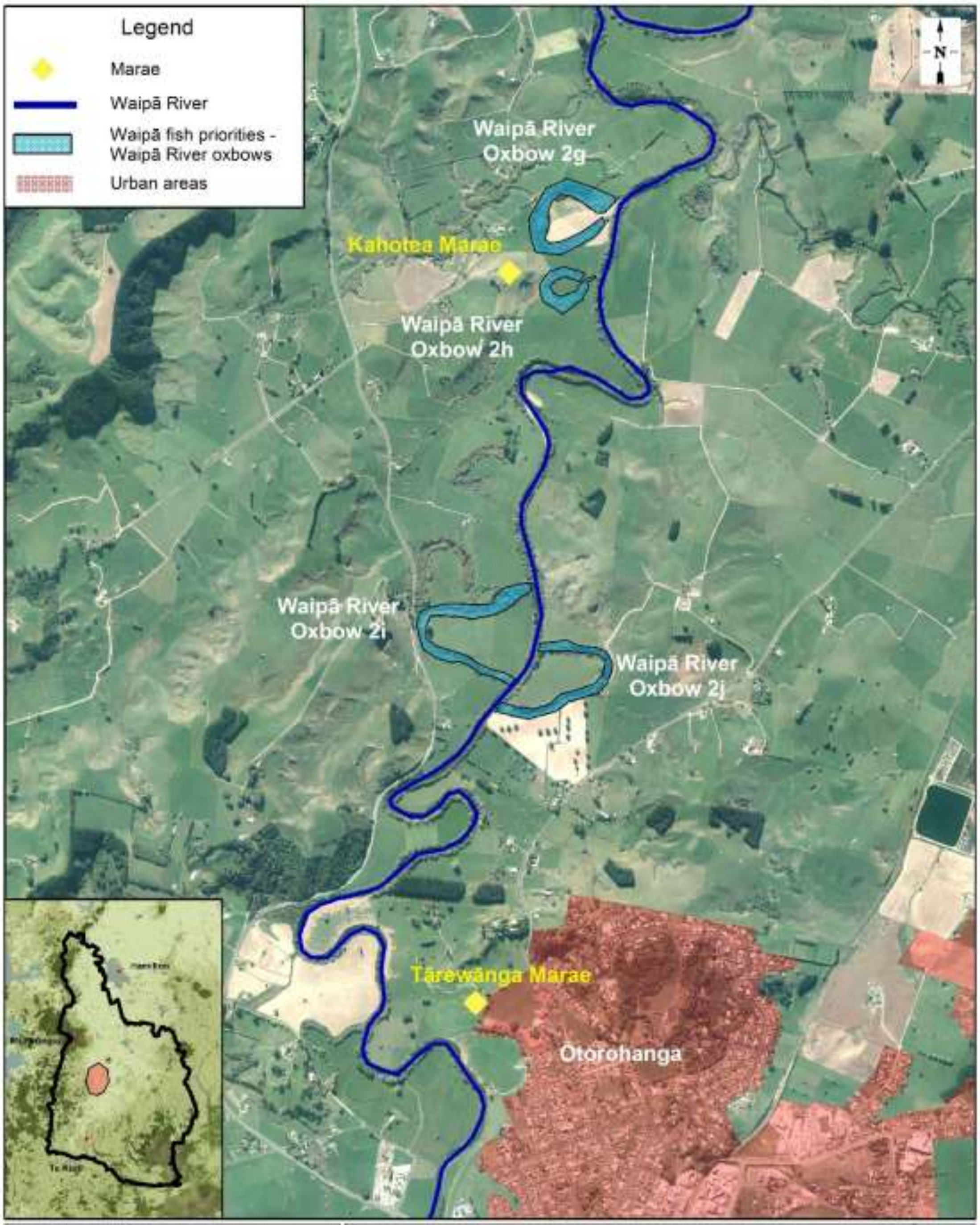


Tuna habitat rehabilitation within 10 Waipā River oxbows Map 1/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

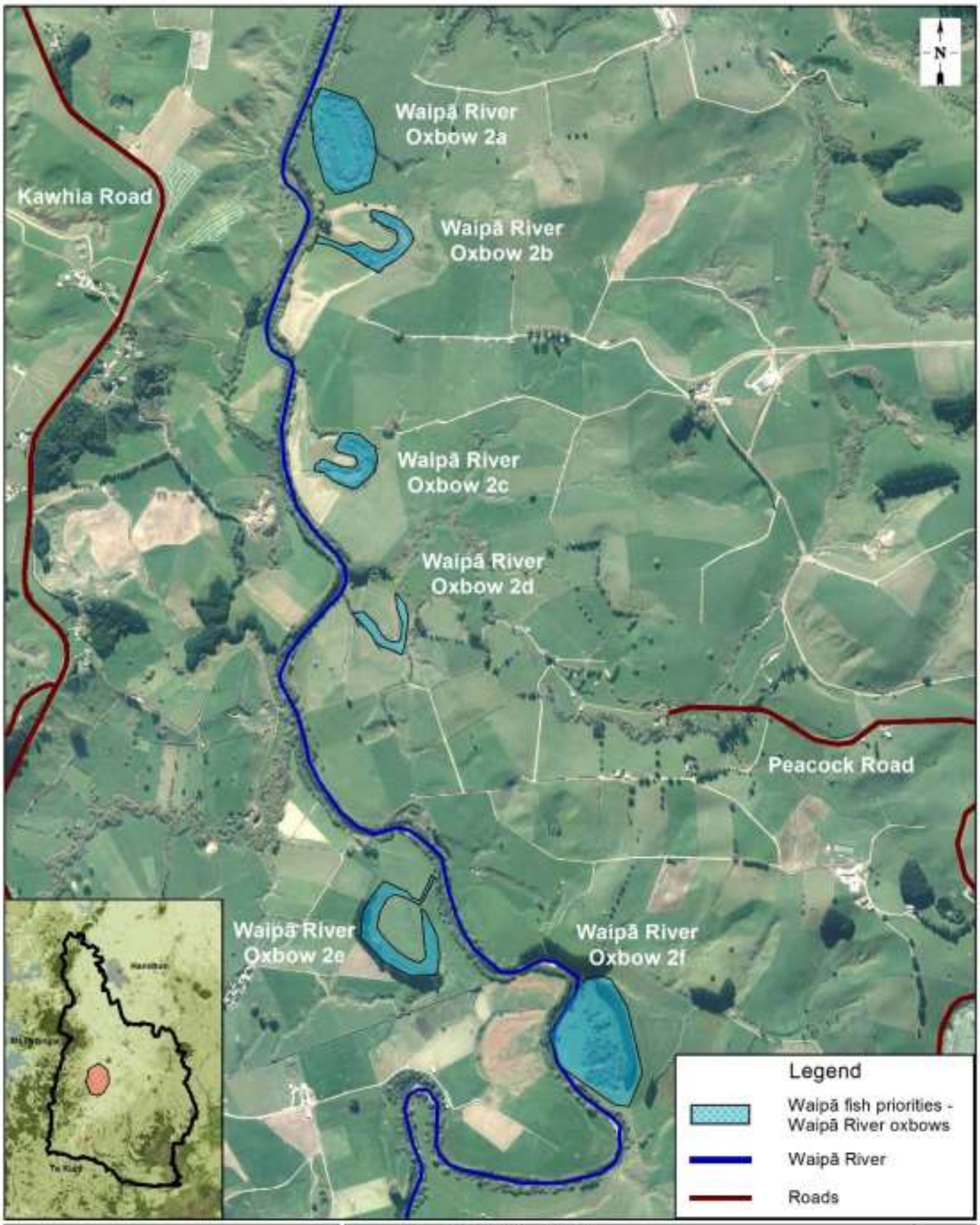
Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.15 0.30 0.45 0.60 0.75
Kilometers

Scale 1:20,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL



Tuna habitat rehabilitation within 10 Waipā River oxbows Map 2/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Scale 1:15,000@A4 Portrait

A4

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Photo of Waipā River oxbows 2a and 2b.

Photo of oxbows 2g and 2h.

Oxbows 2i and 2j.

WP 16 Priority: Very high	Mangatutu River erosion protection, remediation and management and fish habitat rehabilitation	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.	
Name of feature	Mangatutu River	
Brief description of feature	A 20km reach of the Mangatutu River from Puniū to Wharepuhanga Road. About 25% of this reach has had some work undertaken involving erosion control and native and exotic plantings. The river has a moderate gradient with a gravel and stony bed. Banks range from 1m to 3m high across the reach. Riverbank erosion along this reach generally occurs during high flow events and is prevalent where there is no stabilising vegetation – occurring mainly on outside bends. There is lateral bank erosion in the upper reach and bank slumping in the lower reach. According to Waikato Regional Council monitoring results the Mangatutu River at Walker Road bridge is safe for swimming some but not all of the time.	
Desired state to achieve the Vision & Strategy	- A 20km reach of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is well vegetated with native plants (at least 5m wide) and exotic plants where required to prevent erosion. - There is increased in-stream structure (at least 10 woody structures per kilometre) to provide habitat for fish, particularly tuna and piharau. - The river is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Mangatutu River would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

<table>
<tr><td>Key threats to the feature that this project addresses</td><td>

Key threat	Impact on feature
Riverbank erosion	Estimated to yield approximately 1300 tonnes per year of sediment to the Waipā River, excluding major flood events.
Stock access to the stream	Reduced water quality and destruction of riparian vegetation.
Lack of riparian cover and associated fish habitat	Reduced habitat for adult fish.
Lack of woody debris and structures within the stream channel	Reduced habitat for adult native fish and trout.

</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement:
- A 20km reach of the Mangatutu River is stable, fenced and vegetated (at least 5m setback) along its entire length providing increased shade, shelter and food for native fish.
- There are 10-15 structures per kilometre that provide protection against erosion and enhance habitat for native fish, particularly tuna.
- Stock is 100% excluded from the Mangatutu River</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- It is estimated from aerial photographs and on-the-ground knowledge that one third of this reach would require willow control. This equates to 7km of willow control at $20 per metre ($140,000).
- As 4km of the river is already being managed for erosion/habitat enhancement as part of a WRA/WRC funded project, there is 16km of river remaining that requires erosion management. This is likely to require hard (rock) and soft (vegetation) structures throughout at a cost of $20,000 per km (16km = $320,000). This would also provide approximately 10-15 fish habitat structures per km of stream.

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management</td><td></td></tr>
</table>

	works should discuss this with council staff during project planning. **Riparian fencing and planting** Carry out riparian management along approximately 16km of the unmanaged section of stream (32km of streambank) with a minimum 5m setback from the top of the streambank. - It is estimated that 46% of the unmanaged bank requires fencing. This equates to 14.7km of new fencing (5 wire, 2 electric) ($117,760). - It is estimated that approximately two thirds of the unmanaged stretch of 16km would require willow pole planting at 15m intervals. This would require 1422 poles ($19,908). Native planting – 5m planted margin on both sides of the stream for 16km would require 16ha of native planting ($600,832). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 7-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 7.5
Effectiveness of works	The Mangatutu Stream is in relatively good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable at times and fishable. It is expected that over the next 20 years there may be a slow deterioration in the stream in the absence of this project. Works included here address most of the threats to the feature and it is anticipated that if the project is fully completed then the stream will be in excellent condition and close to the Vision & Strategy state being achieved. The project does not address catchment land use, however the proposed fencing and planting works will assist in protecting and restoring water quality at this site.	W = 0.2
Risk of technical failure	There is a low to moderate risk of project failure due to technical feasibility if appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project. Risks are mostly related to establishment of plantings or loss of works due to flooding. Techniques are well established and have been used	F = 0.9

<table>
<tr><td></td><td>previously on the Mangatutu Stream. River erosion structures should be designed by an appropriately experienced practitioner.</td><td></td></tr>
<tr><td>Adoptability</td><td>It is estimated that currently about a third of landowners would adopt the works if they were fully incentivised. There are large sections of stream that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. The extent of the fencing setbacks may be a challenge in terms of uptake, however there are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.</td><td>A = 0.32</td></tr>
<tr><td>Information quality</td><td>Good – advice of local expert/s with a history of association to the stream and experience in undertaking similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists and estimates are based on Waipā catchment riparian surveys. This information would need to be collected in the early stages of the project. Specific locations for erosion control structures would need to be determined during preliminary site visits.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>7 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>River erosion protection/remediation (16km)</td><td>320,000</td></tr>
<tr><td>Willow management (7km)</td><td>140,000</td></tr>
<tr><td>Streambank fencing (14.7km)</td><td>117,760</td></tr>
<tr><td>Willow/poplar pole planting (1422 poles)</td><td>19,908</td></tr>
<tr><td>Native planting (16ha)</td><td>600,832</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>359,550</td></tr>
<tr><td>Total</td><td>$1,558,050</td></tr>
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</td><td>C = 1.56</td></tr>
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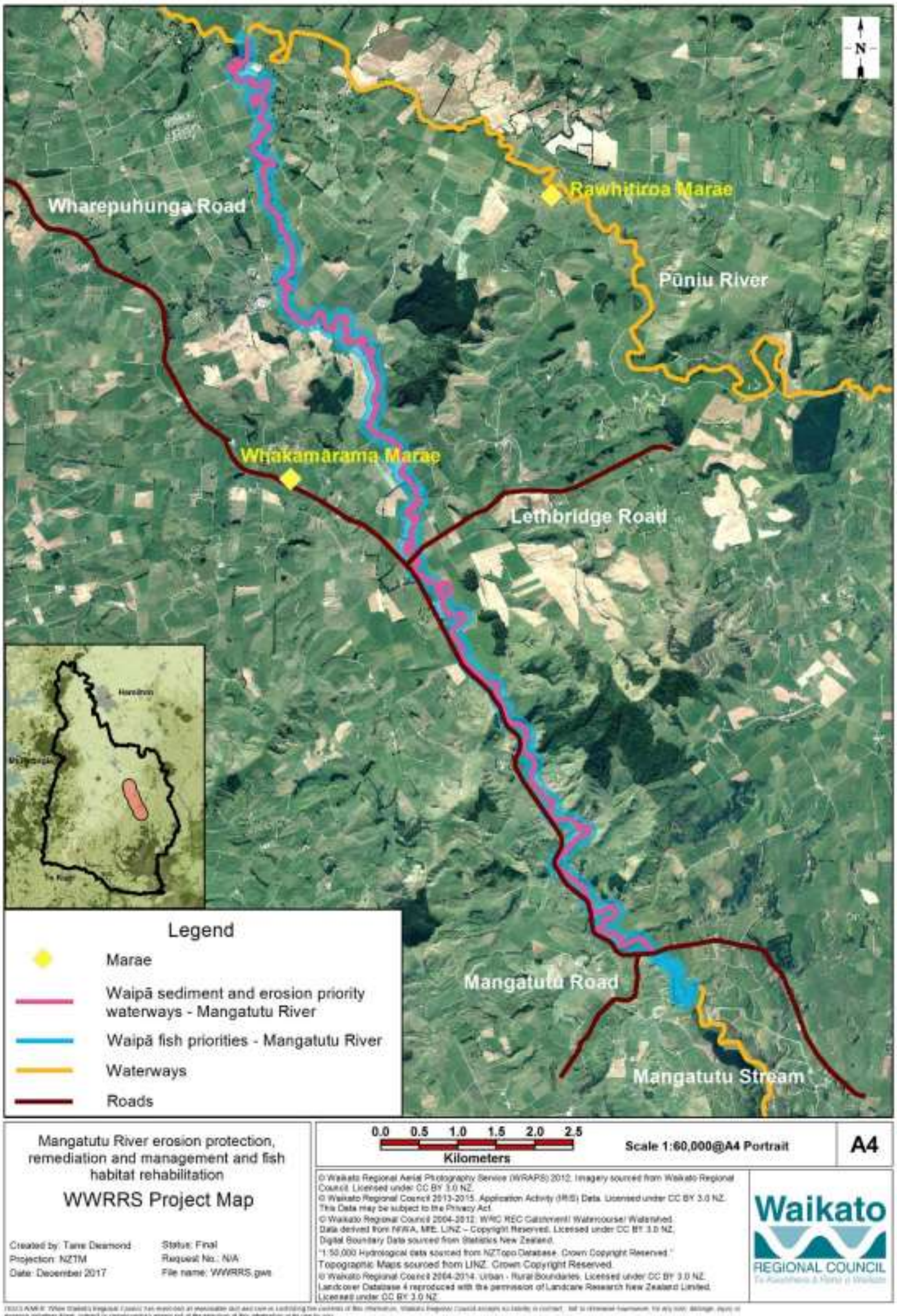
N
Wharepuhunga Road
Rawhitiroa Marae
Pūniu River
Whakamarama Marae
Lethbridge Road
Mangatutu Road
Mangatutu Stream
Legend
Marae
Waipā sediment and erosion priority waterways - Mangatutu River
Waipā fish priorities - Mangatutu River
Waterways
Roads
Mangatutu River erosion protection, remediation and management and fish habitat rehabilitation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.5 1.0 1.5 2.0 2.5
Kilometers
Scale 1:60,000@A4 Portrait
A4
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"1:50,000 Hydrological data sourced from NZTopo Database. Crown Copyright Reserved."
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Examples of large scale bank erosion along the Mangatutu River.

Examples of fish habitat enhancement.

WP 17 Priority: Very high	Waitomo River – headwaters to caves catchment erosion protection and remediation	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land.	
Name of feature	Waitomo subcatchment and caves	
Brief description of feature	This 4434ha catchment is situated southwest of Ōtorohanga, upstream of Waitomo village, and contains the Waitomo Glowworm Caves. Approximately 1394ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The pastoral land use is predominantly dairy support and dry stock with 10% of the catchment in plantation species, primarily pine. 36% of the catchment is in indigenous cover. The main waterway in this catchment is the Waitomo River. This catchment has been the site of historic catchment management works, with the focus on protecting the Waitomo Glowworm Caves which were under significant threat from sedimentation. Issues, concerns and criticism peaked during the 1970s when sedimentation was at its worst and the future of the caves, ecologically and economically, was seriously threatened. Eventually through the work of the Waitomo Catchment Trust Board (who raised 65% of the cost of works) and Waikato Regional Council (who funded 35% of the cost of works) in the 1990s and 2000s, 118km of fencing was completed and 1223ha of erosion prone land retired in this catchment. Sediment monitoring in the river indicated that this led to a 40% reduction in sediment loads by the early 2000s. Recent monitoring indicates that loads may be starting to increase again. Further work is required in the catchment to prevent this. Waikato Regional Council monitoring of water quality in the Waitomo Stream near the caves (Tumutumu Road) indicates that the stream is not safe for swimming due to high E. coli levels.	
Desired state to achieve the Vision & Strategy	- A subcatchment where land use matches capability. - A stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least	

<table>
<tr><td></td><td>5m wide) to assist in providing erosion protection and shade, shelter, food and habitat for native fish species.
- River is swimmable, fishable, safe for gathering kai, and has access for recreation purposes.
- The Waitomo Glowworm Caves are protected from further sedimentation.
- Native fish are abundant and there is a wide diversity of species present
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waitomo subcatchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Hill country erosion</td><td>Estimated to yield more than 2600 tonnes per year of sediment to the Waipā River.</td></tr>
<tr><td>E. coli to waterways</td><td>Impacts the swimmability of the site.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 20% reduction in suspended sediment in the upper Waitomo Stream within 10 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 60ha LUC 6e managed with open space pole planting at $3000 per hectare.
- 60ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare.
- 10km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten).

(Note: Estimates of management for LUC Class 6e are based on 10% of the land area requiring management to reduce erosion risk. This differs from other Waipā subcatchments due to the significant works already undertaken in the upper Waitomo as part of the Waitomo Catchment Scheme. A flexible approach should be taken to addressing remaining erosion risk and resources may be more usefully targeted to sediment traps, wetland/seep retirement etc.)

- 92ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare.
- 19km of fencing managed LUC 7 land at $20 per metre (8-wire and batten).</td><td></td></tr>
</table>

	- 3.6ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Waitomo headwaters to caves subcatchment is generally in very good condition with many of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there will be a slight deterioration in the condition of the catchment in the absence of this project. Works included here address some of the threats to the feature and it is anticipated that if the project is fully completed it would offset declines and make some progress towards achieving the Vision & Strategy state for water quality in 20 years' time. E. coli levels affecting swimmability of the stream should have some improvement as a result of this project, however will also need to be addressed through other mechanisms. The project does not directly address fish habitat and biodiversity threats however the proposed fencing and planting works provide secondary benefits to these values.	W = 0.10
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.	F = 0.87
Adoptability	It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 7 land may be more challenging however there is a well-established and successful catchment scheme already in place. This has provided an outstanding example of what can be achieved through this type of work.	A = 0.63
Information quality	Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment and are working with landowners to help them undertake similar works.	

<table>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e and 7 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (60ha)</td><td>180,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (60ha)</td><td>180,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (10km)</td><td>200,000</td></tr>
<tr><td>Plantation species on LUC class 7 land (92ha)</td><td>276,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (19km))</td><td>380,000</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 land (3.6ha)</td><td>18,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>308,500</td></tr>
<tr><td>Total</td><td>1,542,500</td></tr>
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</td><td>C = 1.54</td></tr>
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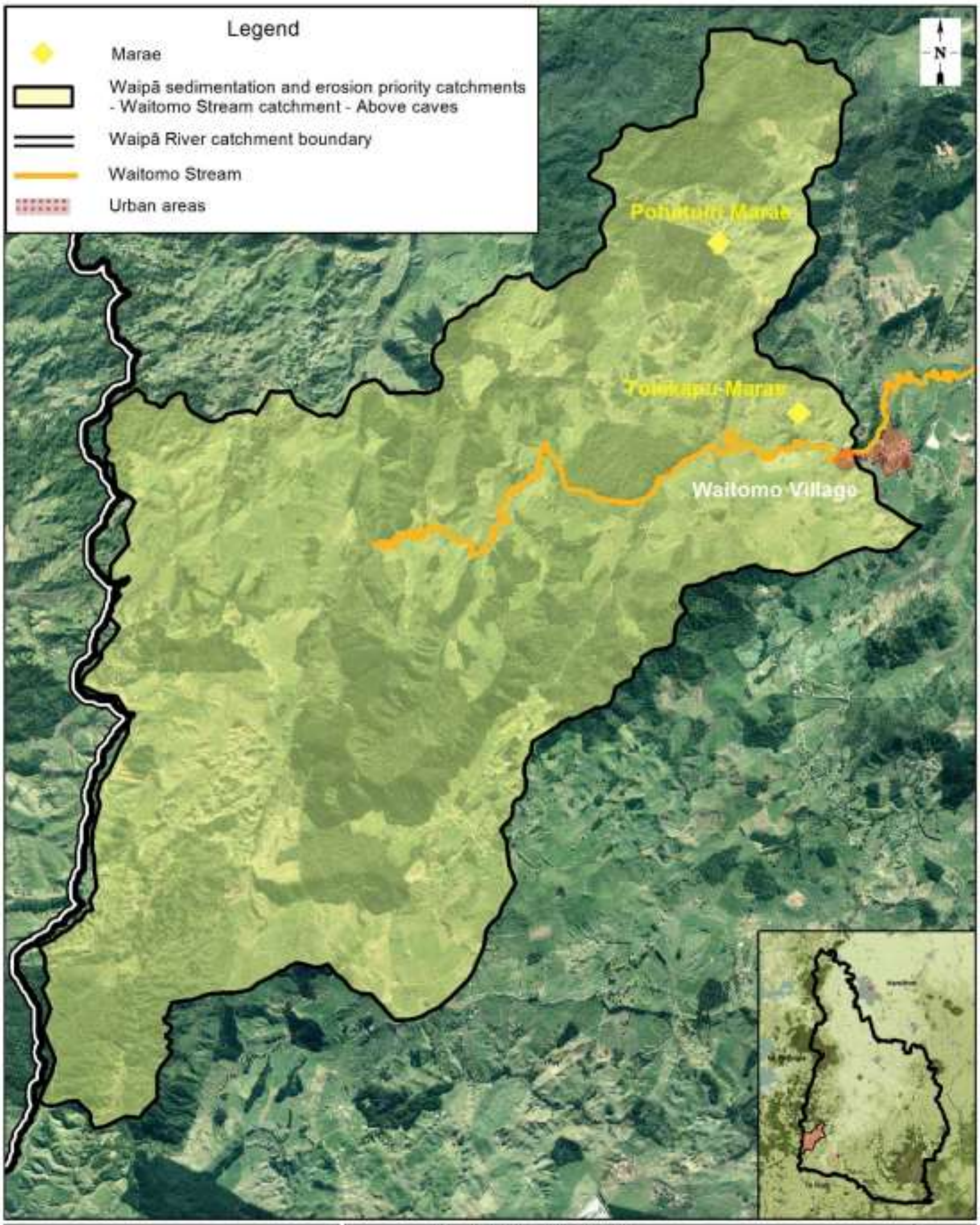

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Kilometers

Scale 1:55,000@A4 Portrait

A4

Waitomo River- Headwaters to caves catchment erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Waikato REGIONAL COUNCIL

A land slip above a Waitomo stream with soil conservation afforestation in the background.

Examples of landslips in the upper Waitomo catchment.

Sedimentation in the upper Waitomo catchment following heavy rain events

Example of fencing and retirement of erosion prone land in the upper Waitomo catchment.

Example of gully retirement and planting in the upper Waitomo catchment.

WP 18 Priority: High	Rehabilitation of fish habitat at Ōtorohanga (Waipā River)	BCR value
Relevant unit goal(s)	There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species. Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.	
Name of feature	The 1.3km section of Waipā River between Ōtorohanga rail bridge and the weir	
Brief description of feature	This section of Waipā River between Ōtorohanga rail bridge and the weir is approximately 1.3km long. It is part of the Ōtorohanga flood protection scheme and has flood levees on either side. The river channel has been cleared as part of the flood protection scheme and matsudana willow trees established along the banks for stabilisation purposes. This area is historically significant to iwi with multiple historic pā and pakanga (battle) sites in the area. Ōtorohanga was previously a well inhabited papakāinga for many centuries. This section of river has been identified by fish experts as having very little in-stream structure for fish habitat but with potential to provide a large area of habitat (particularly for tuna) if habitat rehabilitation work was undertaken.	
Desired state to achieve the Vision & Strategy	- The identified section of Waipā River has a healthy tuna population that utilise a network of in-stream structures for habitat. - The identified section of river is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition this section of the Waipā River at Ōtorohanga would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 3
Key threats to the feature that this project addresses	**Key threat**: Lack of in-stream woody debris and below water structures — **Impact on the asset**: Reduction in cover and habitat for fish.	
Project goal/s	Within two years of the project commencing the identified section of Waipā River has adequate in-stream structure (at least 5 additional structures installed per 500m) to provide habitat for tuna.	
Priority works for funding	It is not envisaged that this project be undertaken by private citizens but should be instead be undertaken by an organisation with expertise in river engineering and hydrology.	

	This work would need to be undertaken in consultation with Waikato Regional Council and Ōtorohanga District Council who manage the flood control scheme. Works must also consider risks to navigation safety as this stretch of the river is widely used for recreational boating and swimming. **Fish habitat structures** This project involves the investigation, design and installation of 5 rock or wood structures per 500m (at least 13 structures in total) for the purpose of fish habitat rehabilitation. Design would need to account for the channel being a core component of the Ōtorohanga Flood Control Scheme. A cost estimate of $3700 per rock/woody habitat structure has been made. This includes investigation, design and installation of structures. **Resource consent** Resource consent would be required and a cost estimate of $7000 has been made. It is assumed that one consent would be applied for to authorise all of the structures. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen upon project completion.	L = 2
Effectiveness of works	The Waipā River at Ōtorohanga is currently in moderate condition with some of the Vision & Strategy desired state aspects already being met, including being fishable and, at times, swimmable. There is not expected to be significant deterioration in the river over the next 20 years in the absence of this project. Works included here address only the threats to the feature's tuna fishery and it is anticipated that if the project is fully completed, the tuna habitat in this reach of the river will be in an improved condition. However, the project does not address catchment land use, water quality, biodiversity or other threats to the river.	W = 0.025
Technical feasibility	Risks are mostly related to loss of works due to flooding. There is a moderate risk of project failure due to technical feasibility. This can be minimised by works being undertaken in consultation with experiences practitioners.	F = 0.87

<table>
<tr><td>Adoptability</td><td>The land is owned by Ōtorohanga District Council and the channel is managed by Waikato Regional Council. There should be high support for adoptability so long as these organisations agree that there will be no impact on the stability of the channel and the integrity of the flood control scheme. This needs to be established in the early stages of project planning.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Good information – judgement of fish and river management experts with relevant local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>The specific location and design of structures to be installed needs to be determined during the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Installation of structures for fish habitat (13)</td><td>48,100</td></tr>
<tr><td>Resource consent</td><td>7000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>11,020</td></tr>
<tr><td>Total</td><td>66,120</td></tr>
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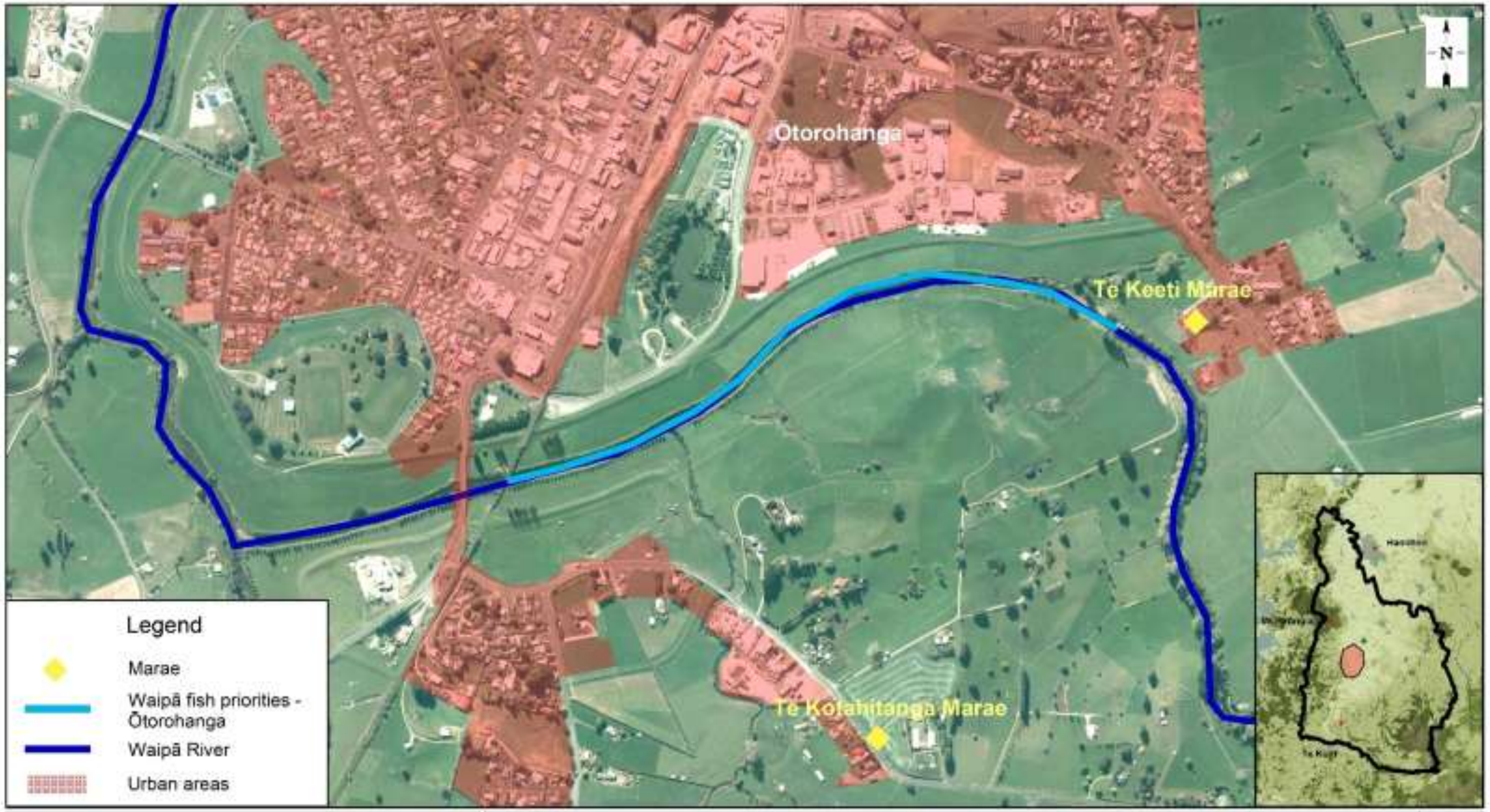


0.0 0.1 0.2 0.3 0.4 0.5
Kilometers

Scale 1:10,000@A4 Landscape

A4

Rehabilitation of fish habitat at Ōtorohanga (Waipā River)

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

The reach of the Waipā River where work is proposed.

WP 19 Priority: High	Waipā River bank erosion protection and remediation – Toa Bridge to Ōtorohanga	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Waipā River – Toa bridge to Ōtorohanga	
Brief description of feature	This reach consists of 21km of Waipā main stem from Toa bridge to Ōtorohanga. The river is steep through this stretch with a fall of 53m over 20km. This gradient is a contributing factor to the high risk of riverbank erosion through the reach. There is also a high incidence of flood driven erosion causing bank scouring. The river has a gravel bed and banks 3-4m high. Some erosion features in this stretch have been several hundred metres in length and 50m back into the bank. The river is fringed with crack willow and hybrid willow in places (the latter for erosion control). The river bed has been subject to extensive gravel extraction for commercial purposes. The river margin is fenced for a majority of the length but fences are periodically lost due to flooding. This area is historically significant to iwi with multiple historic pā and pakanga (battle) sites in the area. Ōtorohanga was previously a well inhabited papakāinga for many centuries. There are three marae with significant interests in this stretch of the Waipā. Waikato Regional Council water quality monitoring indicates that the Waipā River at Ōtorohanga is sometimes safe for swimming, however E. coli levels make it regularly unsuitable.	
Desired state to achieve the Vision & Strategy	- A 21km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is well vegetated with native plants and exotic plants where required to prevent erosion. - The river is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River – Toa bridge to Ōtorohanga – would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

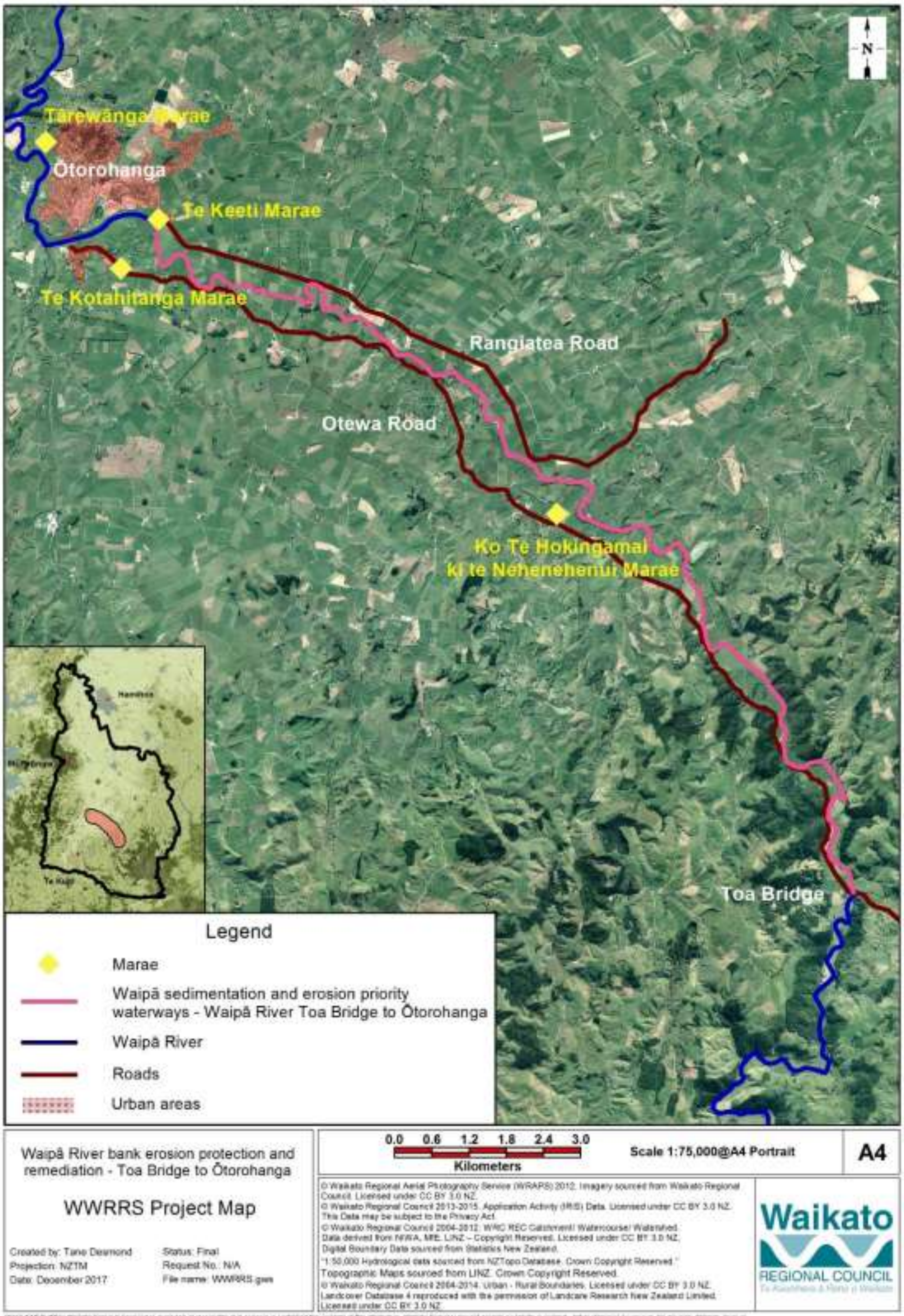
<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 2293 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement:
- The river has stable banks and a continuous vegetated (native and exotic for erosion control) 21km margin from Toa’s bridge to Ōtorohanga.
- There is 100% stock exclusion with at least 10m riparian setbacks.
- Sediment to the Waipā River over this stretch is reduced by 15%.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- It is estimated that 20 sites along this stretch would need erosion control structures/treatment. On average these structures would be 150m long and with an estimated cost of $22,500 each. Structures should be a mix of rock and vegetation and costs include materials (rock, vegetation, poles) and contracted services (including for willow removal where required). Total cost $450,000. Note: Waikato Regional Council holds resource consent for this type of work along this stretch of the river and should be consulted prior to any works being planned.
- It is estimated that 4km of native planting would be required in total behind these structures with 10m setbacks. This is equates to 4ha of native planting ($150,208).
- A further 8km of vegetation management (aged poplar and willow removal/management) for the purposes of erosion control is estimated to be required at a cost of $40 per metre of river. ($320,000). This vegetation should be replaced with hybrid willow at 10 m intervals (for 16km of bank length). This equates to 1600 poles ($22,400).

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council’s Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.</td><td></td></tr>
</table>

	Riparian Fencing & Planting - 6.5km of the 21km stretch is currently being managed as part of the WRA/WRC funded Waipā Rerenoa project. This leaves 14.5km of river (29km of bank) unmanaged. Based on surveys of Waipā catchment waterways, it is estimated that 46% of the remaining unmanaged riverbank will still require fencing. This equates to 13.3km of fencing. Fence should be set back 10m from the river and be minimum 3 wire electric ($74,480). - It is estimated that 13ha of native planting will be required along newly fenced margins ($488,176). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 7 years after project commencement.	L = 7
Effectiveness of works	The Waipā River – Toa bridge to Ōtorohanga – is currently in moderate condition with some of the Vision & Strategy desired state aspects already being met, including being fishable and on occasion swimmable. It is expected that over the next 20 years there will be some deterioration in the river along this stretch in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits on nutrient attenuation and fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and close to the Vision & Strategy state being achieved in 20 years' time. However the project does not fully address catchment land use, water quality or biodiversity threats and it is acknowledged that achieving the overall Vision & Strategy at this site will take longer than the 20-year time frame of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are related to establishment of plantings or loss of works due to flooding and/or erosion before they are established; and vegetation removal exacerbating erosion along this stretch. Exotic vegetation in and along waterways reduces flow velocities. Therefore it will be very important that willow removal is staged over the 10 years of the	F = 0.87

<table>
<tr><td></td><td>project and followed by replanting with native species to reduce the rate of channel modification resulting from increased flows. Risks would be further minimised by the fencing setbacks being at least 10m and by planting sterile willow poles to stabilise banks while native plantings establish. River erosion structures should be designed by an appropriately qualified practitioner.</td><td></td></tr>
<tr><td>Adoptability</td><td>It is estimated that about half of landowners would adopt the works if they were fully incentivised. There are large sections of river that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. Fencing setbacks of at least 10m from the riverbank should help to minimise this, however this loss of grazing land may also be a challenge with uptake, as has been the case with similar river margin projects. It would be beneficial to establish that sites that demonstrate the benefits of stable, vegetated river margins.</td><td>A = 0.54</td></tr>
<tr><td>Information quality</td><td>Good information – advice of local expert/s with a history of association with this reach of the river and experience in undertaking similar work locally.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown exactly how much fencing already exists and estimates are based on Waipā catchment riparian surveys and local knowledge. This would need to be establish during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Erosion protection structures (21km)</td><td>450,000</td></tr>
<tr><td>Native planting behind structures (4ha)</td><td>150,208</td></tr>
<tr><td>Willow management (8km)</td><td>320,000</td></tr>
<tr><td>Poplar/willow pole planting (1600)</td><td>22,400</td></tr>
<tr><td>Fencing (13.3km)</td><td>74,480</td></tr>
<tr><td>Native planting behind new fences (13ha)</td><td>488,176</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>451,579</td></tr>
<tr><td>Total</td><td>$1,956,843</td></tr>
</table>
</td><td>C = 1.96</td></tr>
</table>


N
Tārewānga Marae
Ōtorohanga
Te Keeti Marae
Te Kotahitanga Marae
Rangiatea Road
Otewa Road
Ko Te Hokingamai
ki te Nehenehenui Marae
Toa Bridge
Legend
Marae
Waipā sedimentation and erosion priority waterways - Waipā River Toa Bridge to Ōtorohanga
Waipā River
Roads
Urban areas
Waipā River bank erosion protection and remediation - Toa Bridge to Ōtorohanga
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.6 1.2 1.8 2.4 3.0
Kilometers
Scale 1:75,000@A4 Portrait
A4
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Examples of major bank erosion and instability along the Waipā River – Toa's bridge to Ōtorohanga.

A stretch of Waipā River – Toa's bridge to Ōtorohanga – where there was significant bank erosion (above) that has been remedied and stabilised (bottom photo).

Before and after river erosion remediation and stabilisation works along the Waipā River – Toa's bridge to Ōtorohanga

Examples of rock and vegetation erosion protection structures (as proposed as part of this project).

<table>
<tr><th>WP 20
Priority: Medium</th><th>Upper Pūniu catchment erosion protection and remediation</th><th>BCR value</th></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>The Upper Puniū subcatchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Upper Puniū is a 16,857ha catchment situated southeast of Te Awamutu and bordering the eastern edge of the Waipā catchment. Approximately 7357ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (2% of the catchment). 24% of the catchment is in indigenous cover.

The area is of tribal significance to Maniapoto and Waikato, known as Mangatoatoa, the same name held by the marae situated directly at the confluence of the Puniū and Waipā rivers. Better management of the upper catchment would improve the historic and cultural relationship of the marae and its people with the natural resources. It would also enhance the ability of the marae to sustain its people and manuwhiri (visitors) with local kai (food).

The main waterways in this catchment are the Puniū River, Waipāri Stream and Mangakomua Stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability and where the waterways have a riparian margin that is well vegetated with native plants and at least 5m wide.
- Waterways are swimmable, fishable and have access where appropriate for recreation.
- Iwi and community have a strong connection to the catchment and its waterways and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Upper Puniū catchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 3400 tonnes of sediment per year to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Puniū River within 15 years of project commencement.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 688ha LUC 6e managed with open space pole planting at \$3000 per hectare (\$2,064,000). - 688ha LUC 6e managed with plantation species (pine or mānuka) at \$3000 per hectare (\$2,064,000). - 116km of fencing the managed LUC 6e land at \$20 per metre (8-wire and batten) (\$2,320,000). - 1857ha LUC 7 managed with plantation species (pine or mānuka) at \$3000 per hectare (\$5,571,000). - 172km of fencing the managed LUC 7 land at \$20 per metre (\$3,440,000). - 52ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at \$5000 per ha (e.g. dewatering, retiring seepages etc.) (\$260,000). - 74 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 7400ha area. - 34km fencing existing indigenous vegetation at \$25 per metre (\$850,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 16 years after project commencement.	L = 16
Effectiveness of works	The upper Puniū subcatchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed the upper Puniū subcatchment will be significantly closer to the Vision & Strategy desired state in 20 years' time, particularly	W = 0.25

<table>
<tr><td></td><td>when it comes to land use matching capability and waterways being swimmable. The project does not directly address E. coli, fish habitat and biodiversity, however improvements are expected as secondary benefits.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. There is a high risk of project failure due to technical feasibility.</td><td>F = 0.82</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about 20% of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement, flexibility in approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.2</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (688ha)</td><td>2,064,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (688ha)</td><td>2,064,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (116km)</td><td>2,320,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (1857ha)</td><td>5,571,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (172km)</td><td>3,440,000</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 (52ha)</td><td>260,000</td></tr>
<tr><td>Fencing indigenous forest remnants (34km)</td><td>850,000</td></tr>
<tr><td>Goat control on treated 6e and 7</td><td>90,576</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>4,997,872</td></tr>
<tr><td>Total</td><td>$21,657,448</td></tr>
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</td><td>C = 21.66</td></tr>
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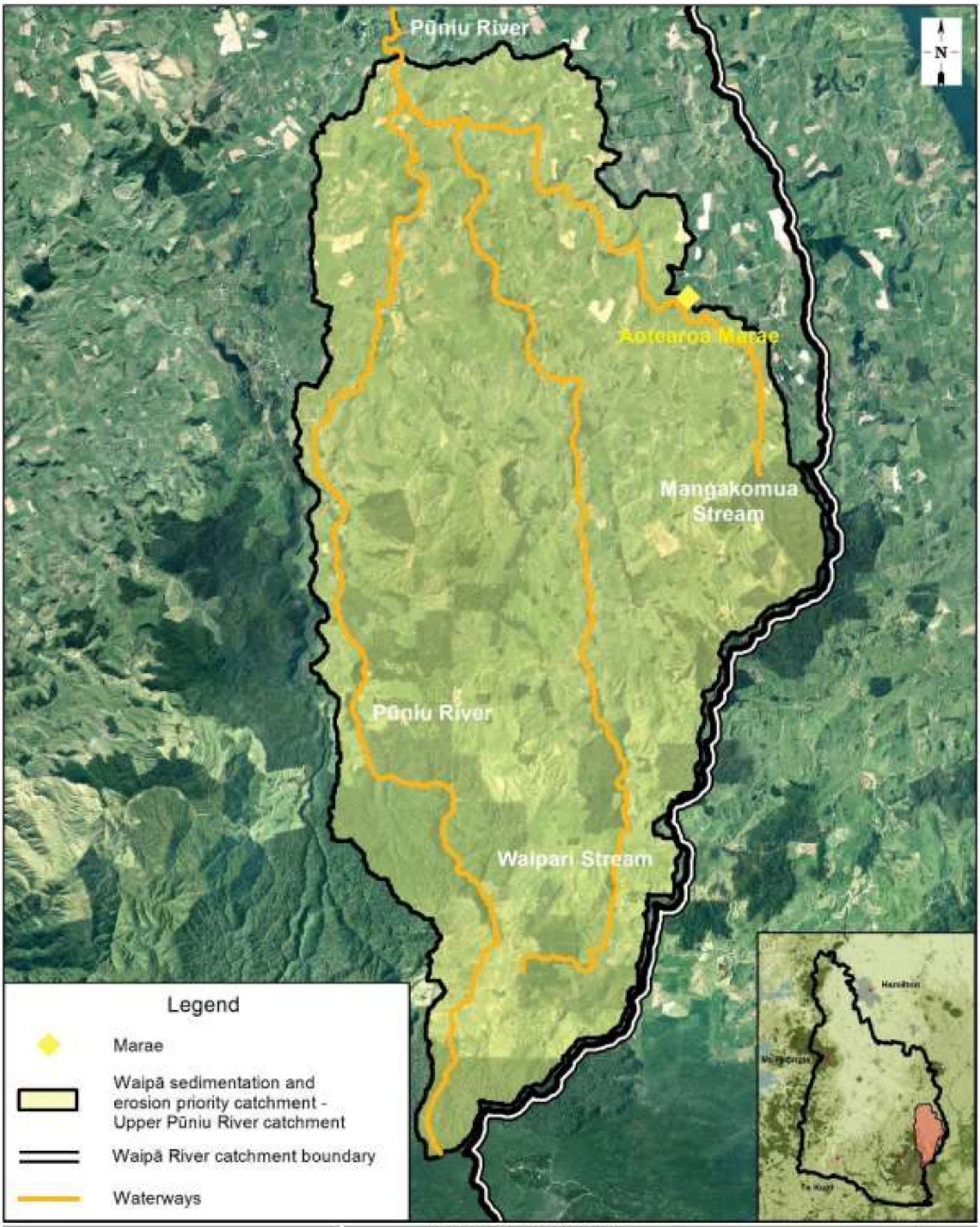


Upper Pūniu catchment erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:110,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

WP 21 Priority: High	Mangapū River erosion protection and riparian enhancement	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Mangapū River	
Brief description of feature	This is a 35km stretch of river broken up into two reaches. The top reach (Waitomo Valley Road to Trooper Road) is 21km long. Approximately 8km of this has already been managed and fenced/planted. This leaves 13km unmanaged in this reach. This reach is part of an alluvial river flat. Banks have a relatively small amount of stabilising vegetation and are subject to slumping following high flow flood events. The lower reach (downstream of Waitomo Valley Road) is 14km of stream. This portion is largely unmanaged (from a riparian perspective) and requires bank stabilisation as the river is incising through this reach. The Mangapū River is historically and culturally significant to Ngāti Maniapoto. There are historic forts along the Mangapū established during intertribal wars including Pukehōkio, Pānikau and Te Tuhi-o-te-ao-mārama. This was a commonly traversed area. There are 14 marae with interests in the Mangapū River. According the water quality monitoring undertaken regularly by Waikato Regional Council, the Mangapū River at Ōtorohanga is not safe for swimming due to unsatisfactory levels of E. coli, and the river's water clarity is unsatisfactory.	
Desired state to achieve the Vision & Strategy	- A 35km reach of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is fenced to exclude stock with a minimum 5m setback, and that is well vegetated with native plants and exotic plants where required to prevent erosion. - Native fish are abundant and there is a wide diversity of species present - The river is swimmable, fishable, safe for gathering kai, and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Mangapū River would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2600 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 8 years of project commencement:
- A 35km reach of the Mangapū River is stable, fenced and vegetated with a minimum 5m margin along its entire length providing increased shade, shelter and food for native fish.
- Stock is 100% excluded from the Mangapū River.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

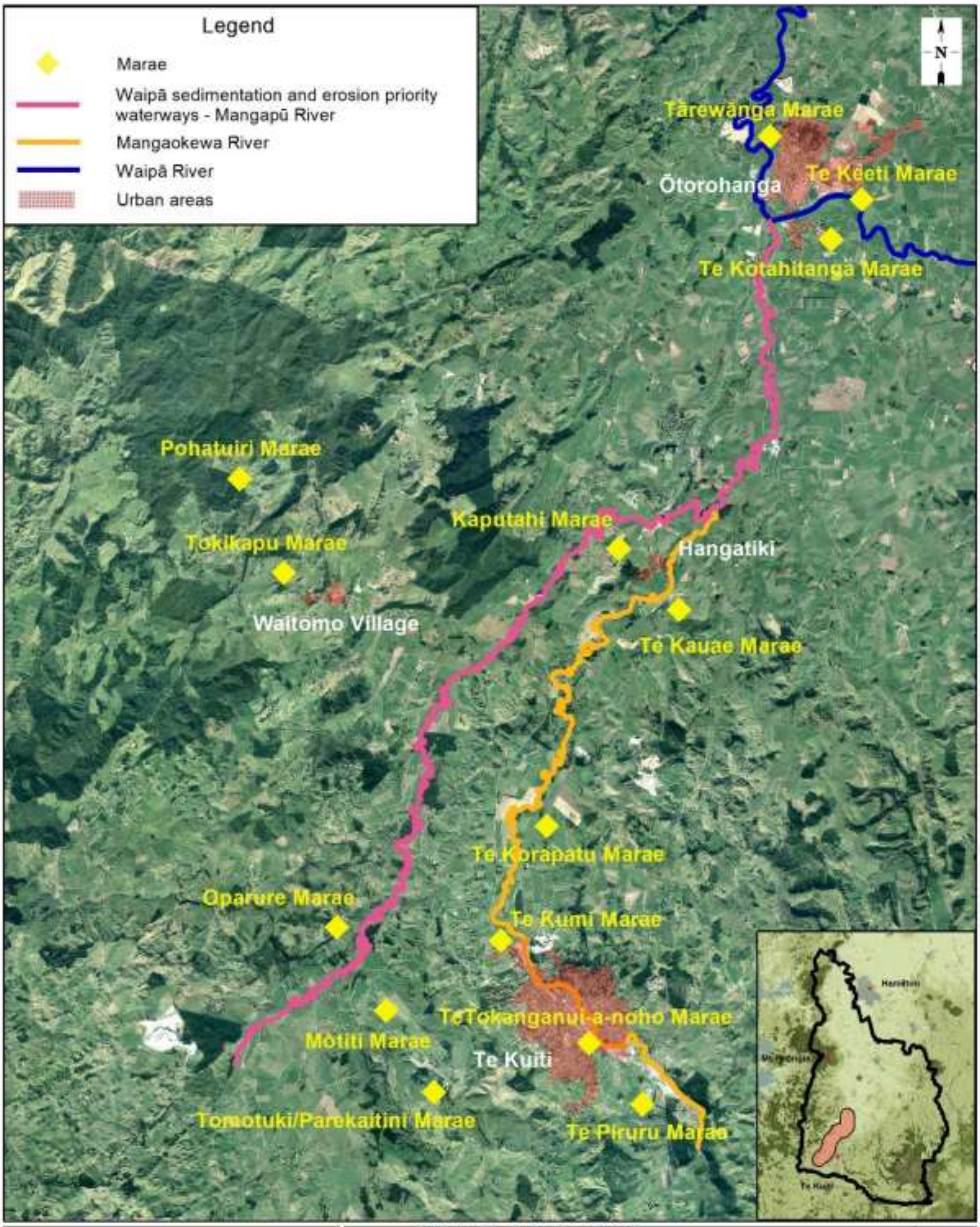
River erosion protection and remediation
- It is estimated that approximately 15% of the lower reach requires willow removal. This equates to 5.25km of willow control at $20 per metre ($105,000).
- As 8km of the top reach of the river is already being managed as part of an existing project, there is 13km of river (26km bank) remaining in the top reach that requires management. This is likely to require soft (vegetation) structures throughout at approximately 1 structure per km (a cost of $2500 per km) (13km is $32,500). The lower 14km stretch of the river would require a mix of soft and small hard engineering structures. Estimated 2 structures per km ($5000 per km) (14km is $70,000).
- The top reach is estimated to require pole planting along half of the riverbank length (13km of riverbank). Poles at 15m spacing equates to 866 poles ($12,124). The lower stretch is estimated to require pole planting along two thirds of the riverbank (14km of riverbank). Poles at 15m spacing equates to 933 poles ($13,062).

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.</td>
<td></td>
</tr>
</table>

	Riparian fencing and planting - The top 13km of the river (26km of bank) unmanaged is estimated to require 46% of riverbank to be fenced with a 5-wire, 2-electric (12km of fencing) ($96,000). - The lower 14km of the river (28km of bank) is estimated to require 46% of riverbank to be fenced (13km of fencing ($104,000). Fence should be set 5m back from the top of the bank and adjoining wetland areas included in the fencing. - A 5-metre planted margin on both sides of the river for 25km would require 27ha of native planting ($938,800) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over an eight year period, it is estimated that the majority of the project benefits would be seen approximately two years after project completion.	L = 10
Effectiveness of works	The Mangapū is currently in poor to moderate condition when compared to desired state, with few of the Vision & Strategy aspirations being met. The river is not swimmable year-round or 100% excluded from stock access. However, it still retains important values and the river is of high cultural significance for iwi. It is expected that over the next 20 years there may be some deterioration in the river in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits of nutrient attenuation, reducing E. coli to waterways and improving fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and progress will be made towards the Vision & Strategy desired state. However, the project does not fully address catchment land use, water quality or biodiversity elements, and additional work outside the scope of this project would be required for the river to be swimmable.	W = 0.05
Risk of technical failure	Low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.9
Adoptability	It is estimated that approximately half of the landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature and there are significant existing works along	A = 0.54

	the Mangapū that provide a good example of what can be achieved with larger riparian margins.	
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	It is unknown specifically how much fencing already exists and how close it is to the stream edge. Detailed fencing requirements would need to be determined in the early stages of the project.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	8 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 1.7

Task	**Cost ($)**
River erosion management and protection (27km)	102,500
Willow management (5.25ha)	105,000
Fencing (25km)	200,000
Willow/poplar pole planting (1799 poles)	25,186
Native planting (25ha)	938,800
Project management/staffing/incidentals (25%)	342,871
Total	**$1,714,357**



Mangapū River erosion protection and riparian enhancement

WWRRS Project Map

Scale 1:100,000@A4 Portrait

A4

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Mangapū River showing devegetated banks and lack of adequate setback.

WP 22 Priority: Very high	Biodiversity restoration within lowland kahikatea fragments in the Mangapū catchment	BCR value
Relevant unit goal(s)	The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna.	
Name of feature	Lowland kahikatea remnants in Waipā catchment and their associated wetlands	
Brief description of feature	Within the Waipā catchment only 2.07% of the conifer-dominated forests (kahikatea) remain (approximately 170ha). Fifty hectares of these are within the Mangapū River catchment and the rest spread throughout the remainder of the Waipā River catchment. Of the 50ha within the Mangapū catchment there is an 18.5ha area known as the Pehitawa Kahikatea Forest Reserve. This site currently has a management plan in place and has almost virgin condition forest with mature pole-stand kahikatea, some around 120 years old. Most other stands are small (less than 10ha), fragmented and impacted by stock, land drainage and plant and animal pests. They require further management to ensure their existence long term. There is also potential to extend existing stands by undertaking further planting. The Mangapū River is historically and culturally significant to Ngāti Maniapoto. There are historic forts along the Mangapū established during intertribal wars including Pukehōkio, Paanikau and Te Tuhi-o-te-ao-mārama. This was a commonly traversed area. There are 14 marae with interests in the Mangapū River.	
Desired state to achieve the Vision & Strategy	- Lowland kahikatea remnants and associated wetlands are fenced to exclude stock, densely vegetated with native vegetation and connected to riparian corridors when they are located nearby. - Native plant regeneration occurs naturally within the native bush remnants and any existing black mudfish populations within their associated wetland areas are retained.	
Impact on Vision & Strategy	In a restored condition the kahikatea forest remnants in the Mangapū catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 18

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
<tr><td>Lack of riparian vegetation and stock access to riparian areas</td><td>Reduction in in-stream biodiversity.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 5 years of the project commencing:
- Lowland kahikatea forest remnants identified within the Mangapū catchment are fenced to exclude stock and connected to the other forest remnants, associated wetlands and riparian areas as identified.
- Native planting is undertaken (along with weed control) to fill gaps within fenced areas where there is no native vegetation.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

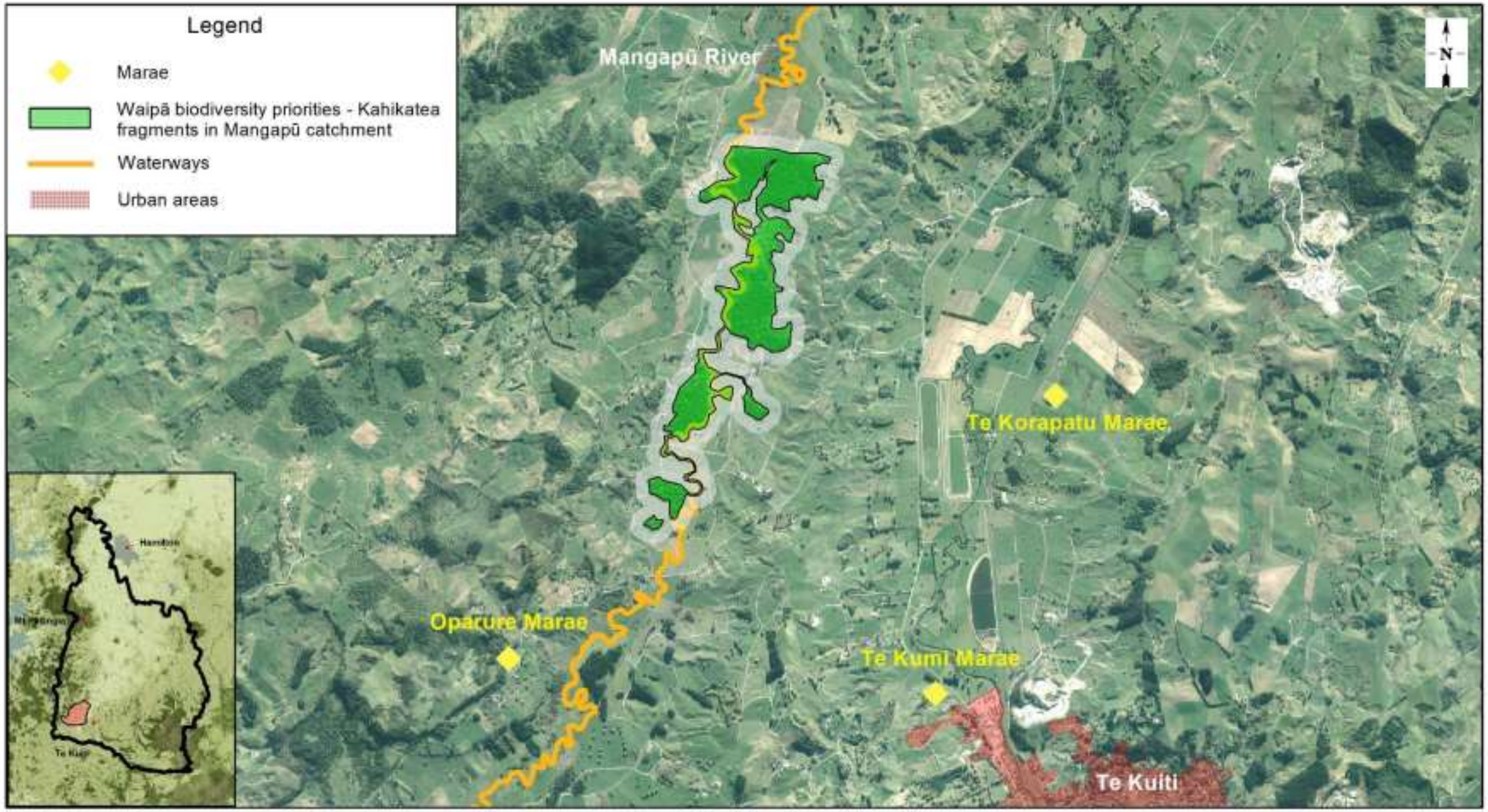
The site identified for restoration work consists of 50ha of lowland kahikatea remnants (including 18.5ha Pehitawa Forest Reserve) and 35ha of adjoining riparian margins and wetland areas. The total area of the site is 85ha. Recommended work and costings take into account management already being undertaken at Pehitawa Forest Reserve.

Management plan
A management plan should be developed for the areas outside of Pehitawa Forest Reserve. This should involve a site survey of vegetation types, detailed recommended management actions and costs. The estimated cost for a management plan is $10,000. Further investigation is required to determine the amount of fencing, planting and weed control required. However, based on aerial photographs the following estimates and assumptions have been made:

Fencing, planting, weed and possum control
- Assume that 50% of the 15.6km perimeter of the site requires fencing/fence upgrade with a 5 wire (2 electric) fence at an estimated cost of $8 per metre ($64,400)
- Four hectares of native planting required (and associated weed control) at a cost of $39,552 per hectare ($158,208).</td>
<td></td>
</tr>
</table>

	- General weed control using a knapsack sprayer required over another 10% (7ha) of the site for a period of 3 years at an estimated cost of $2800 per hectare per year ($58,800). - Possum control across the full 85ha area for a period of 3 years until native plantings are established, at $600 per hectare x 85ha ($51,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a five year period, it is estimated that the majority of the project benefit would be seen soon after project completion.	L = 5.5
Effectiveness of works	The lowland kahikatea remnants in Waipā catchment and their associated wetlands are currently in moderate to good condition with some of the Vision & Strategy desired state aspects already being partially met. Condition is expected to slightly decline over the next 20 years in the absence of this project. However, if this project is successfully completed then these features are expected to improve and be closer to desired state in 20 years' time, with aspects related to stock exclusion and native revegetation being addressed.	W = 0.1
Risk of technical failure	Low risk of project failure due to technical feasibility. Risk is mostly related to the potential for invasive weeds to overtake native planting at the site and potential for flooding to damage nearby fencing and planting.	F = 0.87
Adoptability	It is conservatively estimated that approximately 60% of landowners would adopt the works if they were fully incentivised. Land tenure is a mix of iwi owned, private and charitable trust.	A = 0.6
Information quality	Poor – management requirements based solely on aerial photography.	
Knowledge gaps and response	Detailed fencing, planting and pest control requirements would need to be determined during project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals due to socio-political risks	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Management plan</td><td>10,000</td></tr>
<tr><td>Fencing (15.6km)</td><td>64,400</td></tr>
<tr><td>Native planting (4ha)</td><td>158,208</td></tr>
<tr><td>Weed control</td><td>58,800</td></tr>
<tr><td>Possum control</td><td>51,000</td></tr>
<tr><td>Project Management/staffing/incidentals (20%)</td><td>68,482</td></tr>
<tr><td>Total</td><td>410,890</td></tr>
</table>
</td>
<td>C = 0.41</td>
</tr>
</table>



Biodiversity restoration within lowland kahikatea fragments in the Mangapū catchment
WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:40,000@A4 Landscape

A4

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Te Kaunihera ā Rohe o Waikato


Kahikatea forest fragments in the Mangapū River catchment.

WP 23 Priority: High	Mangaokewa Stream erosion protection and remediation	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Mangaokewa Stream	
Brief description of feature	A 23km reach of stream which flows from the Viaduct Reserve through the Te Kūiti township to the confluence with the Mangapū River at Hangatiki. The stream is relatively incised in places with steep banks that are susceptible to slumping. Approximately 6.6km of the stream lies within the township. Te Araroa walkway follows alongside the upper Mangaokewa from the viaduct reserve to the Te Kūiti township. There is native planting and erosion control associated with this pathway. There has been flood control works undertaken on the river through the urban area of Te Kūiti to reduce the risk of the township flooding. This included the creation of a larger floodway. Any works within this reach would need an assessment undertaken on the impact on flood levels and flood control infrastructure. There has been isolated catchment and river management works undertaken to address streambank erosion at ad hoc sites throughout the reach. There has been some privately funded fencing and native planting along this reach of stream. This extends for about 1km of bank. Waikato Regional Council monitoring of the Mangaokewa Stream at Te Kūiti indicates that the stream is not swimmable due to unsatisfactory levels of E. coli, and has unsatisfactory water clarity. The Maniapoto Maori Trust Board has recently developed a Cultural Health Index (CHI) for this river.	
Desired state to achieve the Vision & Strategy	- A 23km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is fenced to exclude stock with a minimum 5m setback, and is well vegetated with native plants and exotic plants where required to prevent erosion. - Native fish are abundant and there is a wide diversity of species present - The river is swimmable, fishable, safe for gathering kai, and has access for recreation.	

<table>
<tr><td></td><td>- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangaokewa Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 12</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2700 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr>
<tr><td>Stock access to the river</td><td>Reduced water quality and trampling of banks and destruction of riparian vegetation.</td></tr>
<tr><td>De-vegetated banks</td><td>Bank slumping and increased sediment to water.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement:
- A 23km reach of the Mangaokewa River is stable, fenced (5m setback) and vegetated along its entire length providing increased shade, shelter and food for native fish.
- Stock is 100% excluded from the Mangaokewa River.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

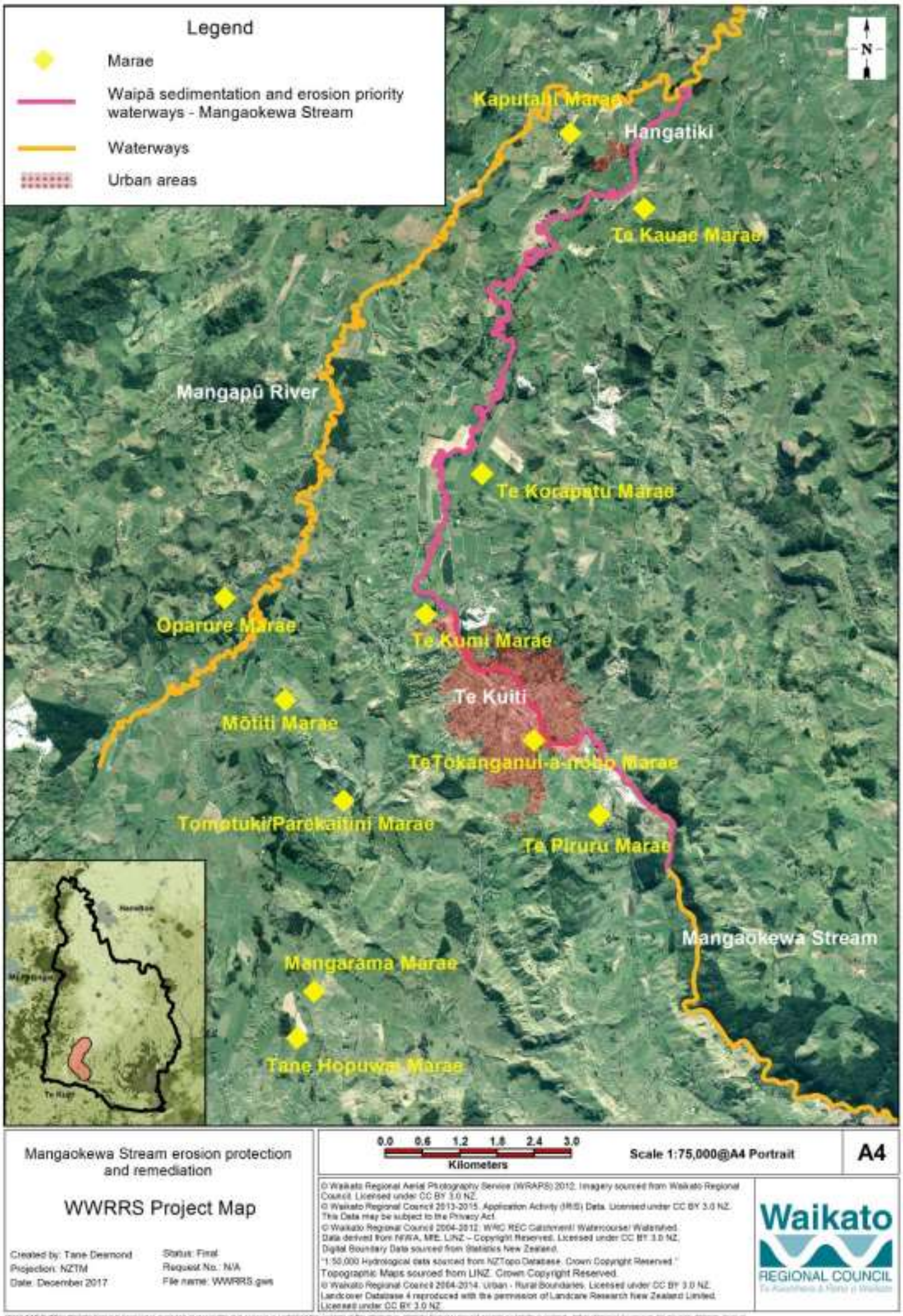
River erosion protection and remediation
- It is estimated that 23km of stream is likely to require soft (vegetation) structures throughout at a frequency of 2 per km ($5000 per km) ($115,000).
- Based on aerial photographs and on-the-ground knowledge of the reach it is estimated that approximately 15% (or 3.5km) of the lower reach would require willow/poplar management at a rate of $20 per metre ($70,000).
- Willow disposal is estimated to cost $14,000.

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.

Riparian fencing and planting
- It is assumed that 46% of the streambank will require fencing with a 5-wire (2 electric) fence. This equates to 21.2km of streambank ($169,000). This should have a minimum of a 5m</td><td></td></tr>
</table>

	setback from the top of the bank and include adjoining wetland areas. - Riparian planting should be a mix of native species with exotics where required for stability. It is estimated that willow/poplar poles would be required at 15m intervals over 23km of streambank length (1533 poles is $21,462). - Native planting should be a 5m margin on both sides of the stream for 21.2km of bank length, so 10.6ha ($398,051). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Mangaokewa Stream is currently in poor to moderate condition with few of the Vision & Strategy desired state aspects being met. The stream is not swimmable and stock still have access in places. However, the Mangaokewa still retains important values and is of high cultural significance for iwi. It is expected that over the next 20 years there may be some deterioration in the river in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits of reducing E. coli to water, nutrient attenuation and improving fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and progress will be made towards the Vision & Strategy state being achieved in 20 years' time. The project does not fully address catchment land use, water quality or biodiversity threats.	W = 0.15
Risk of technical failure	There is a low risk of project failure due to technical feasibility if appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project. Risks are mostly related to establishment of plantings or loss of works due to flooding. Techniques are well established and have been used previously on other local streams. River erosion structures should be designed by an appropriately qualified practitioner.	F = 0.9
Adoptability	It is estimated that at least half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature. There are limited examples of this type of	A = 0.54

<table>
<tr><td></td><td>work along the Mangaokewa and adoptability may be increased by working with key landowners to establish example sites.</td><td></td></tr>
<tr><td>Information quality</td><td>Good – advice of local expert/s with a history of association to the stream and experience in undertaking similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists and estimates are based on Waipā catchment riparian surveys. This information would need to be collected in the early stages of the project. Specific locations for erosion control structures would need to be determined during preliminary site visits.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>River erosion management and protection</td><td>115,000</td></tr>
<tr><td>Willow/poplar management (3.5km)</td><td>70,000</td></tr>
<tr><td>Willow/poplar disposal</td><td>14,000</td></tr>
<tr><td>Fencing (21.2km)</td><td>169,000</td></tr>
<tr><td>Willow/poplar pole planting (1533 poles)</td><td>21,462</td></tr>
<tr><td>Native planting (10.6ha)</td><td>398,051</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>196,878</td></tr>
<tr><td>Total</td><td>$984,391</td></tr>
</table></td><td>C = 0.98</td></tr>
</table>


Legend
Marae
Waipā sedimentation and erosion priority waterways - Mangaokewa Stream
Waterways
Urban areas
N
Kaputahi Marae
Hangatiki
Te Kauae Marae
Mangapū River
Te Korapatu Marae
Oparure Marae
Te Kumi Marae
Te Kuiti
Mōtiti Marae
TeTokanganui-a-noho Marae
Tomotuki/Parekaitini Marae
Te Piruru Marae
Mangaokewa Stream
Mangarama Marae
Tane Hopuwai Marae
Mangaokewa Stream erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.6 1.2 1.8 2.4 3.0
Kilometers
Scale 1:75,000@A4 Portrait
A4
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Mangaokewa Stream during a small flood showing unstable banks and limited riparian margins.

WP 24 Priority: Medium	Mangarapa catchment erosion protection and remediation	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land.	
Name of feature	Mangarapa subcatchment	
Brief description of feature	A 5306ha catchment situated to the south of Ōtorohanga and east of Te Kūiti. Approximately 2678ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry (2% of the catchment), primarily pine. Approximately 8% of the catchment is in indigenous cover. The main waterway in this catchment is the Mangarapa Stream. The catchment area provided natural resources to tāngata whenua for many purposes including rongoā (medicine), kākahu (clothing) and kai (food). An historic village, named Te Tarata, sat at the confluence of the Mangarapa and Mangaokewa.	
Desired state to achieve the Vision & Strategy	- A subcatchment where land use matches capability and where the stream has a riparian margin that is well vegetated with native plants and at least 5m wide. - The stream is swimmable, fishable and has access where appropriate for recreation. - Iwi and communities have a strong connection to the catchment and its waterways, and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Mangarapa subcatchment would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 100
Key threats to the feature that this project addresses	**Key threat** / **Impact on feature**: Hill country erosion / Estimated to yield more than 3400 tonnes of sediment per year to the Waipā River	
Project goal/s	There is a 25% reduction in suspended sediment in the Mangarapa Stream within 15 years of project commencement.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their	

	own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 325ha LUC 6e managed with open space pole planting at $3000 per hectare ($975,000). - 325ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($975,000). - 54km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($1,080,000). - 78ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($234,000). - 14km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($280,000). - 18.5ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per ha (e.g. dewatering, retiring seepages etc) ($92,500). - 14.5km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($362,500). - 27 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 2700ha area. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project commencement.	L = 18
Effectiveness of works	The Mangarapa subcatchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangarapa, however the proposed fencing and	W = 0.2

<table>
<tr><td></td><td>planting works would provide secondary benefits of reducing E. coli to waterways and improving fish habitat and biodiversity.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. However, proposed management actions are widely used and accepted for managing hill country erosion. There is a moderate risk of project failure due to technical feasibility.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about 20% of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement and identifying key farmers will be very important for the success of this project.</td><td>A = 0.2</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (54km)</td><td>1,080,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (78ha)</td><td>234,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (14km)</td><td>280,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (18.5ha)</td><td>53,600</td></tr>
<tr><td>Fencing indigenous forest bordering LUC class 6e land (14.5km)</td><td>362,500</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>33,048</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>998,287</td></tr>
<tr><td>Total</td><td>$4,991,435</td></tr>
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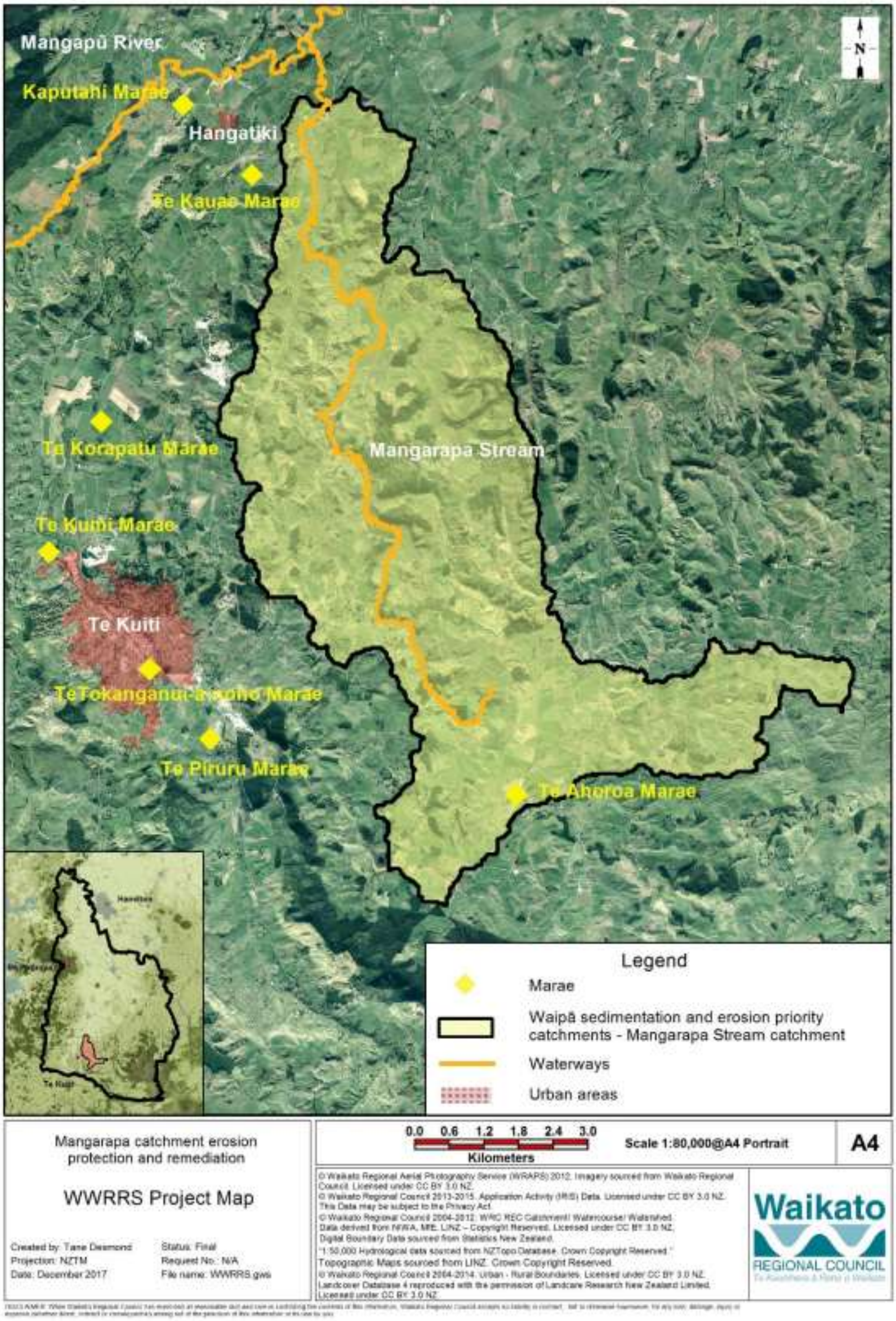
</td><td>C = 5.19</td></tr>
</table>


N
Mangapū River
Kaputahi Marae
Hangatiki
Te Kauae Marae
Te Korapatu Marae
Te Kumi Marae
Te Kuiti
TeTokanganui-a-noho Marae
Te Piruru Marae
Mangarapa Stream
Te Ahoroa Marae
Legend
Marae
Waipā sedimentation and erosion priority catchments - Mangarapa Stream catchment
Waterways
Urban areas
0.0 0.6 1.2 1.8 2.4 3.0
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Scale 1:80,000@A4 Portrait
A4
Mangarapa catchment erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
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Examples of general topography of the Mangarapa catchment.

Mass movement and slips.

Examples of erosion protection pole planting, above, and areas of plantation species, below (from the Mangapū/Mangaokewa catchments).

<table>
<tr><td>WP 25</td><td rowspan="2">Mangatea catchment erosion protection and remediation</td><td rowspan="2">BCR value</td></tr>
<tr><td>Priority: Medium</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangatea subcatchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 1326ha catchment situated in the upper Mangapū subcatchment southwest of Te Kūiti. Approximately 615ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (1% of catchment). 7% of the catchment is in indigenous cover. The main waterway in this catchment is the Mangatea Stream.

There are two marae situated alongside the Mangatea stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability.
- Waterways with a riparian margin that is fenced to exclude stock with a minimum 5m setback, and is well vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present.
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangatea Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 15</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 2600 tonnes per year of sediment to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Mangatea Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

	Hill country soil conservation - 76ha LUC 6e managed with open space pole planting at $3000 per hectare ($228,000). - 76ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($228,000). - 14km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($280,000). - 5ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($15,000). - 2km of fencing the managed LUC 7 land at $20 per metre (8-wire and batten) ($40,000). - 12.4ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($62,000). - 6 hunter days per year for 3 years of goat control while plantings on LUC 6e and 7 land establish. Control carried out over a 600ha area. - 3.4km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($85,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Mangatea subcatchment is in poor to moderate condition with some of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangatea, however the proposed fencing and planting works would provide secondary benefits to reducing E. coli to waterways and improving fish habitat and biodiversity.	W = 0.275
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.82

<table>
<tr><td>Adoptability</td><td>It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement and identifying key farmers will be very important for the success of this project.</td><td>A = 0.225</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (76ha)</td><td>228,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (76ha)</td><td>228,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (14km)</td><td>280,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (5ha)</td><td>15,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (2km)</td><td>40,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (12.4ha)</td><td>62,000</td></tr>
<tr><td>Fencing indigenous forest remnants 3.4km)</td><td>85,000</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>7344</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>236,336</td></tr>
<tr><td>Total</td><td>$1,181,680</td></tr>
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</td><td>C = 1.18</td></tr>
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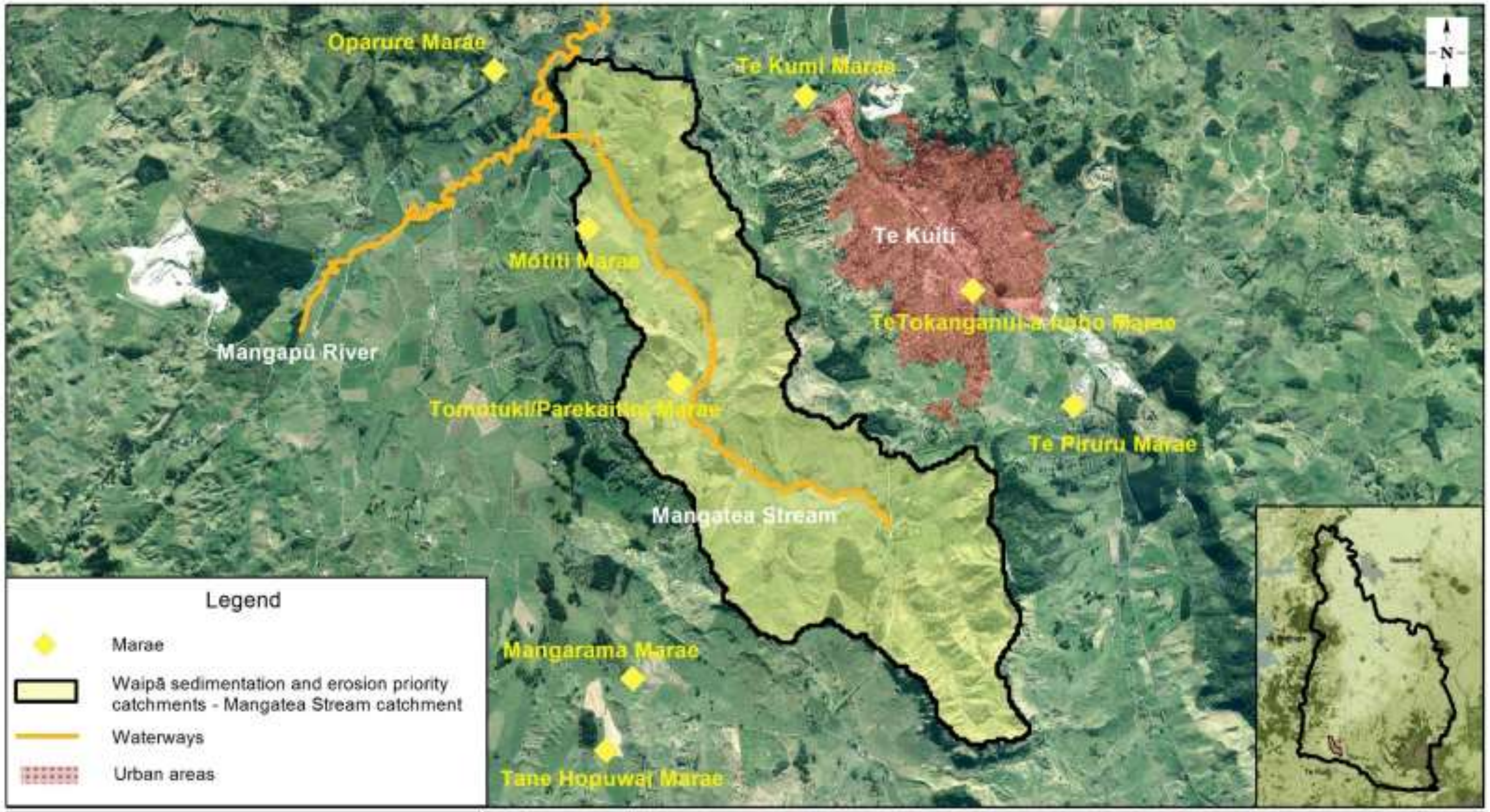

Mangatea catchment erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:55,000@A4 Landscape

A4

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Shallow soil slip (rear), mass land movement (middle) and stabilisation poplar planting (foreground),

<table>
<tr><th>WP 26
Priority: Medium</th><th>Mangarama catchment erosion protection and remediation</th><th>BCR value</th></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

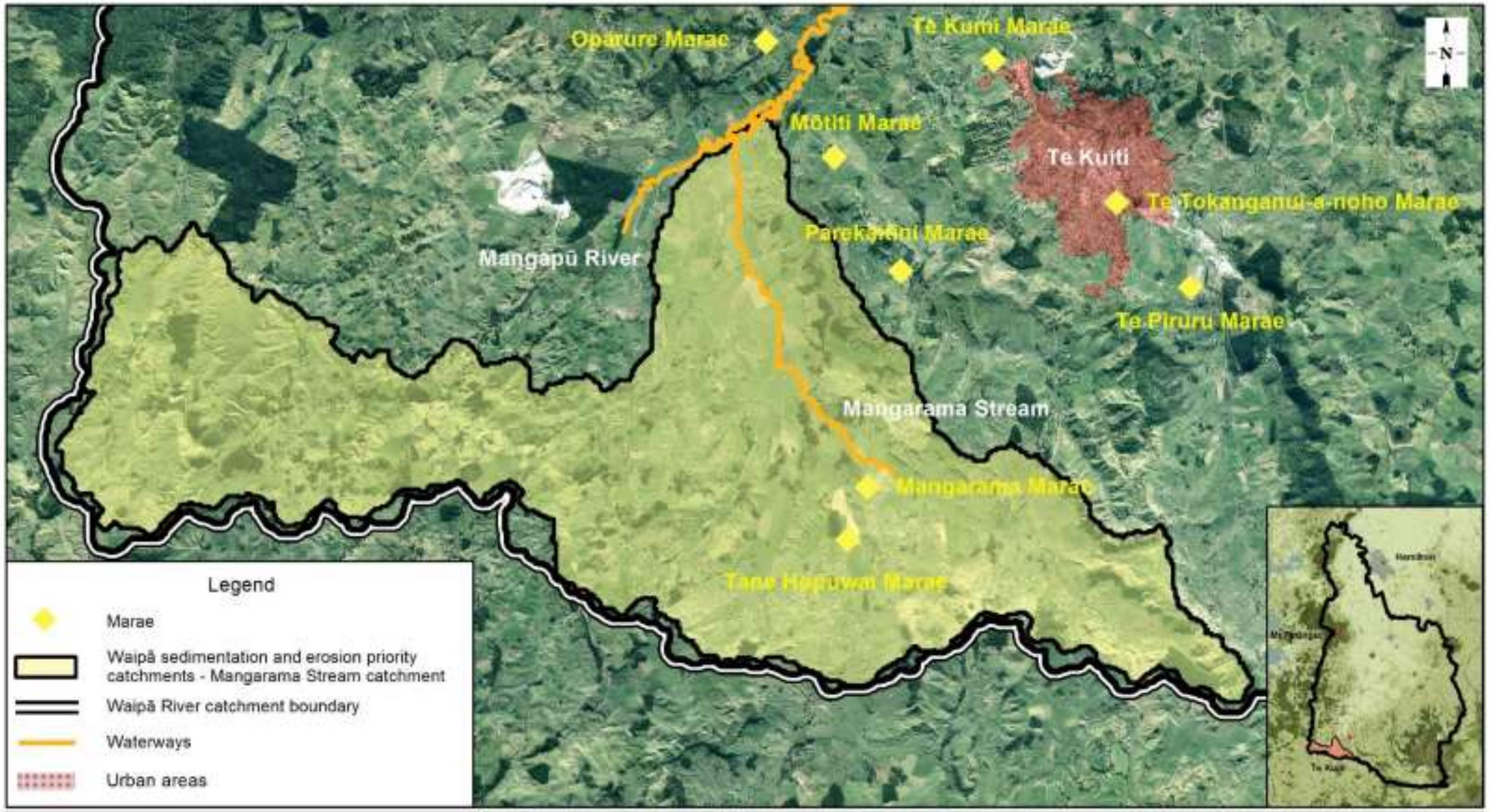
Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangarama Catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 5439ha catchment situated southwest of Te Kūiti. This is adjacent to the Mangatea catchment in the southwest corner of the Waipā catchment. Approximately 2428ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (1.5% of the catchment). Approximately 6% of the catchment is in indigenous cover.

The main waterway in this catchment is the Mangarama Stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability and waterways have a riparian margin that is fenced with a minimum 5m setback to exclude stock, and is vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangarama subcatchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield approximately 3200 tonnes of sediment per year to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Mangarama Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

	Hill country soil conservation - 264ha LUC 6e managed with open space pole planting at $3000 per hectare ($792,000) - 264ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($792,000) - 42km of fencing managed LUC 6e land at $20 per metre (8-wire and batten) ($840,000) - 315ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($945,000) - 31km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($620,000) - 3.1ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc) ($15,500) - 25 hunter days per year for 3 years of goat control while plantings on LUC class 6e and 7 land establish. Control carried out over a 2500ha area. - 6.2km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($155,000) Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 14 years after the project began.	L = 13.5
Effectiveness of works	The Mangarama subcatchment is in poor to moderate condition with some of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangarama, however the proposed fencing and planting works would provide secondary benefits of reducing E. coli to waterways and improving fish habitat and biodiversity.	W = 0.3
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding or erosion.	F = 0.82

<table>
<tr><td>Adoptability</td><td>It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken recently in this catchment. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.225</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>There is a low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (264ha)</td><td>792,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (264ha)</td><td>792,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (42km)</td><td>840,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (315ha)</td><td>945,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (31km)</td><td>620,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (3.1ha)</td><td>15,500</td></tr>
<tr><td>Fencing indigenous forest remnants (6.2km)</td><td>155,000</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>30,600</td></tr>
<tr><td>Project management, staffing/incidentals (25%)</td><td>1,047,525</td></tr>
<tr><td>Total</td><td>5,237,625</td></tr>
</table>
</td><td>C = 5.45</td></tr>
</table>



0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:75,000@A4 Landscape

A4

Mangarama catchment erosion protection and remediation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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An example of the type of erosion common in the Mangarama catchment.

An example of the type of works proposed for this project – afforestation and pole planting for soil stabilisation.

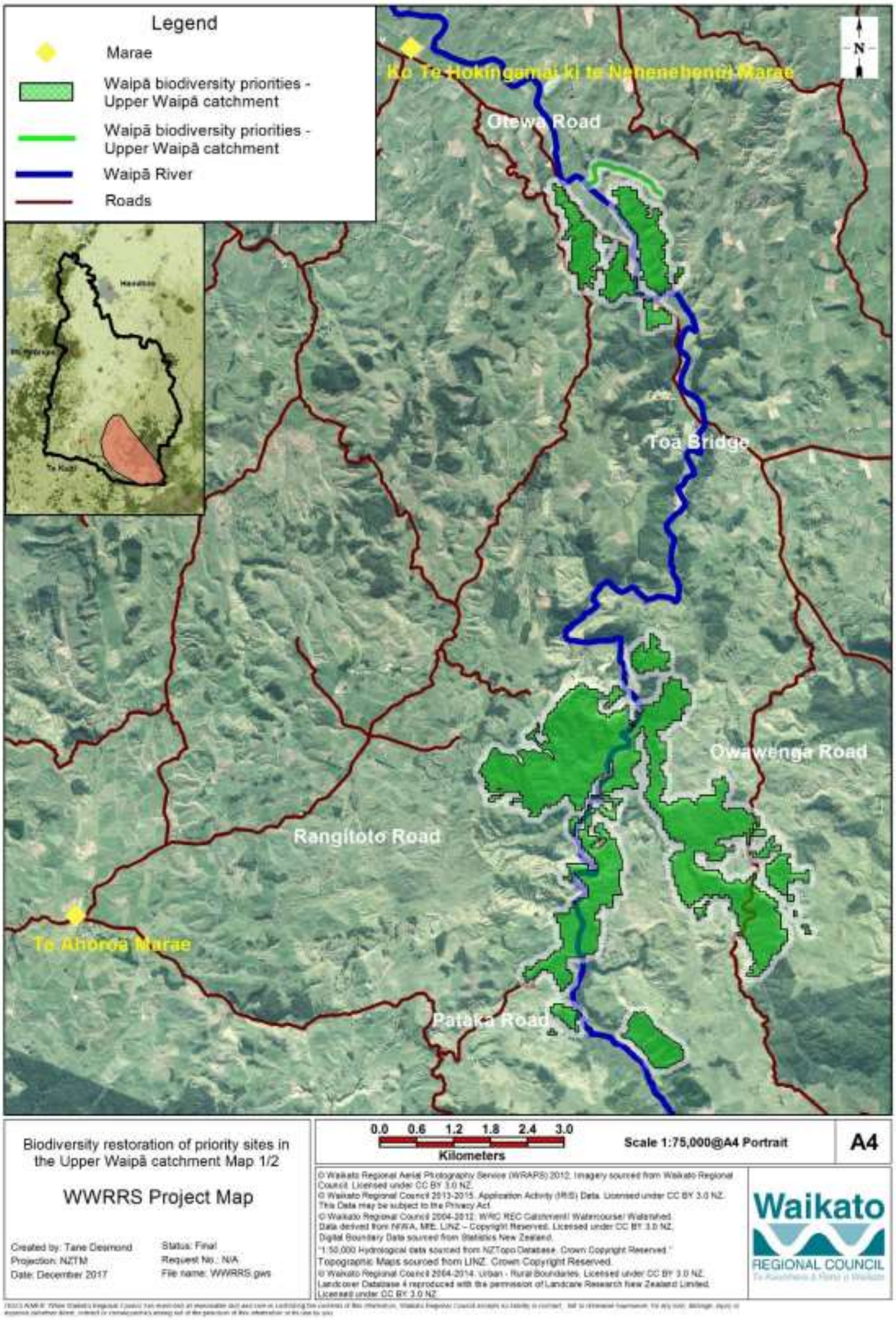
WP 27 Priority: High	Biodiversity restoration of priority sites in the upper Waipā catchment	BCR value
Relevant unit goal(s)	The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna. Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Upper Waipā River forest remnants, wetlands and associated tributary streams.	
Brief description of feature	A range of biodiversity sites in the upper Waipā River catchment in the vicinity of the Rangitoto Range. Sites include 1054ha of forest remnants, 380ha wetland/riparian site and a 1.7km long tributary waterway. Land ownership is predominantly private with the exception of the 247ha size Otoru Scenic Reserve and Pekepeke Wetland (Waipā Myers) area, both of which are owned by Department of Conservation. The upper Waipā is of high significance to iwi and its marae as it holds water of the highest quality, generally used for the most important ceremonies. The puna (springs) of the upper Waipā flow to the main stem, forming and shaping the rest of the catchment area and sustaining the many marae along its banks. Sites included here have been identified as being within the top 30% of terrestrial biodiversity sites within the Waikato catchment because of their terrestrial biodiversity values and representativeness of this ecosystem type. One exception to this is the Waipā tributary stream which has been identified as within the top 40% of waterway sites for biodiversity.	
Desired state to achieve the Vision & Strategy	- Forest remnants and wetlands adjacent to the upper Waipā River are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the forest remnants. - Iwi and communities have a strong connection to the sites and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the upper Waipā River adjacent forest remnants, wetlands and associated tributary streams would	VS = 30

<table>
<tr><td></td><td>have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td></td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
<tr><td>Lack of riparian vegetation and stock access to riparian areas</td><td>Water quality impacts and reduction in in-stream biodiversity.</td></tr>
<tr><td>Pest willow trees</td><td>Shade out native vegetation.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 6 years of the project commencing:
- Forest remnants and wetlands identified are fully fenced to exclude stock.
- The Waipā River tributary waterway identified is fenced to exclude stock with a minimum 5 wire (2 electric) fence and a riparian margin at least 5m wide. Native planting (and associated weed control) is carried out within the riparian margin at 1.5m spacing.
- The waterway flowing from Waipā Myers wetland is free from willow pests and has a naturally regenerating native riparian margin.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the exact amount of fencing and planting and weed control required. However, based on aerial photographs and local knowledge the following estimates and assumptions have been made:
- Otoru Scenic Reserve and adjoining forest fragment – 2km of post and batten fencing required at $20 per metre ($40,000).
- Other forest remnants – 18km of post and batten fencing required at $20 per metre ($360,000).
- Waipā River tributary stream (1.6km long) – 1.2km (75%) of 5 wire fencing (2 wire electric) required at a cost of $8 per metre ($9,600); 0.75ha of native riparian planting required at a cost of $37,552 per hectare including site preparation, plant purchase, planting labour and five releasing events ($28,164).
- The waterway flowing downstream from Pekepeke (Waipā Myers) Wetland requires approximately 1.5ha of ground</td><td></td></tr>
</table>

	based willow control along its margins ($4000 per hectare is $6000) plus a further two to three years of followup treatment at $2000 per hectare ($6000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	The upper Waipā River adjacent forest remnants, wetlands and associated tributary streams are currently in very good condition with some of the Vision & Strategy desired state aspects already being met, including being accessible in some circumstances and the streams and wetlands swimmable and fishable. Condition is not expected to significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then these sites are expected to be in very good condition and closer to desired state in 20 years' time, with aspects related to stock exclusion and native revegetation being addressed.	W = 0.025
Risk of technical failure	Risks are mostly related to establishment of plantings. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised.	A = 0.65
Information quality	Good information – advice of local expert/s with a history of association to selected sites.	
Knowledge gaps and response	Further investigation is required to determine the specific quantities of fencing and planting required. This should be undertaken during the early stages of project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 0.54

Task	Cost ($)
Fencing (21.2km)	409,600
Native planting (0.75ha)	28,164
Ground based willow control	12,000
Project Management/staffing/incidentals (20%)	89,953
Total	**539,717**


Legend
Marae
Waipā biodiversity priorities - Upper Waipā catchment
Waipā biodiversity priorities - Upper Waipā catchment
Waipā River
Roads
N
Ko Te Hokingamai ki te Nehenehenui Marae
Otewa Road
Toa Bridge
Owawenga Road
Rangitoto Road
Te Ahoroa Marae
Pataka Road
0.0 0.6 1.2 1.8 2.4 3.0
Kilometers
Scale 1:75,000@A4 Portrait
A4
Biodiversity restoration of priority sites in the Upper Waipā catchment Map 1/2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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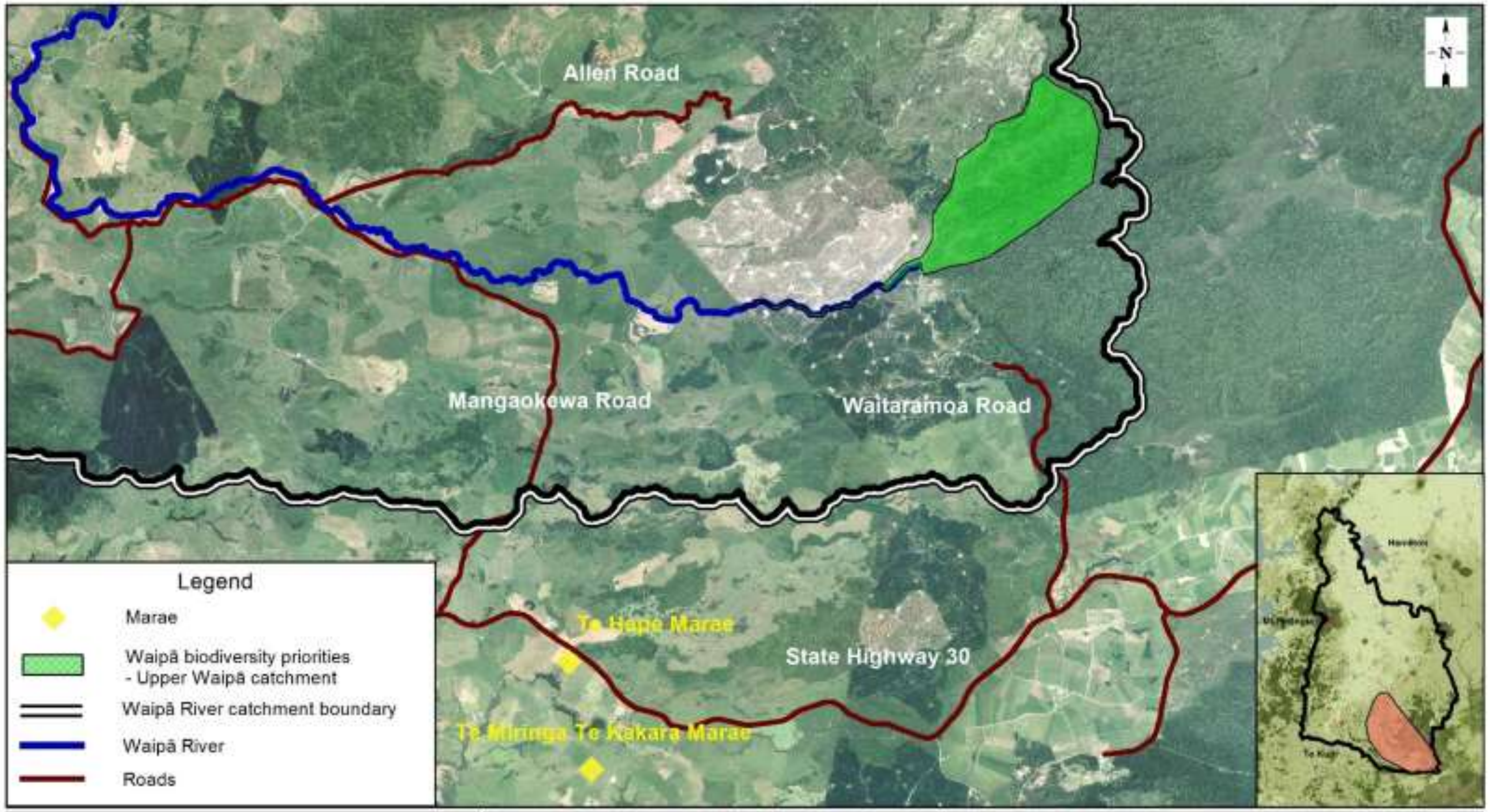

Biodiversity restoration of priority sites in the Upper Waipā Catchment Map 2/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:75,000@A4 Landscape

A4

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An example of forest remnants in the upper Waipā.

APPENDIX 8 - Shallow Lakes Project Assessments

Contents

L 1 Priority: Medium	Increase eel habitat in Lake Waikare	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Lake Waikare	
Brief description of feature	Lake Waikare is located to the southeast of Te Kauwhata township and connected to the Whangamarino wetland by the Pungarehu Canal. It is the largest lake in the lower Waikato catchment, with 3442 hectares of open water. It has an average depth of 1.5 metres and a maximum depth of 1.8 metres. Lake Waikare has very poor water quality and is hypertrophic. The lake is de-vegetated. In 1965 the lake level was lowered by 1 metre. This was in accordance with the Lower Waikato Waipā Flood Control Scheme and followed the construction of an outlet gate. Lake Waikare discharges to the Whangamarino Wetland from the artificial Pungarehu Canal. The lake is managed under a strict seasonal fluctuation regime of approximately 0.3 metres. Lake Waikare was historically regarded as the most important lake tuna fishery in the Waikato, returning up to 85 tonnes per annum. The tuna fishery declined as a result of the hydrological changes associated with the flood control scheme, but eventually stabilised at a new level that reflected reduced levels of recruitment and habitat/food availability. The fishery is mostly focused on shortfin eels, particularly migratory shortfin eels that exit the lake to sea between February and April. Lake Waikare is significant to Waikato-Tainui and its surrounding marae. The bed of the lake holds the kōiwi (bones) of people engaged in the Rangiriri Pakanga (battle) during the colonial invasion into the Waikato region. The lake bed is held in the title of the first Māori King, Pōtatau Te Wherowhero, so that the bones of the tribe's people are protected in his name. Lake Waikare was historically used to capture tuna (eels) to sustain the iwi. Its surrounding wetlands supplied rongoā (medicine), birds, trees for general use, dyes and an area for enjoyment. This project involves rehabilitation of tuna habitat within the lake. Anecdotal evidence from New Zealand shows that in lakes and rivers, eels are always found where there is cover. Trials of wood installation in streams have shown benefits for a range of	

<table>
<tr><td></td><td>species so scientists expect there to be habitat benefits for a range of biota in lakes (including tuna).

Research from overseas looking at the benefits of introducing woody structure also supports this concept.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition Lake Waikare would have a very high impact on giving effect to the Vision & Strategy at shallow lakes catchments level.</td><td>VS = 375</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Lack of in-lake vegetation</td><td>Reduced habitat for native fish, increased turbidity.</td></tr>
<tr><td>People become disconnected from Lake Waikare</td><td>The lake becomes further degraded</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- Woody structures provide habitat for tuna along a 200m stretch of the Lake Waikare northern foreshore.
- Woody structures provide habitat for tuna along a 1000m stretch of the Lake Waikare western shoreline.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

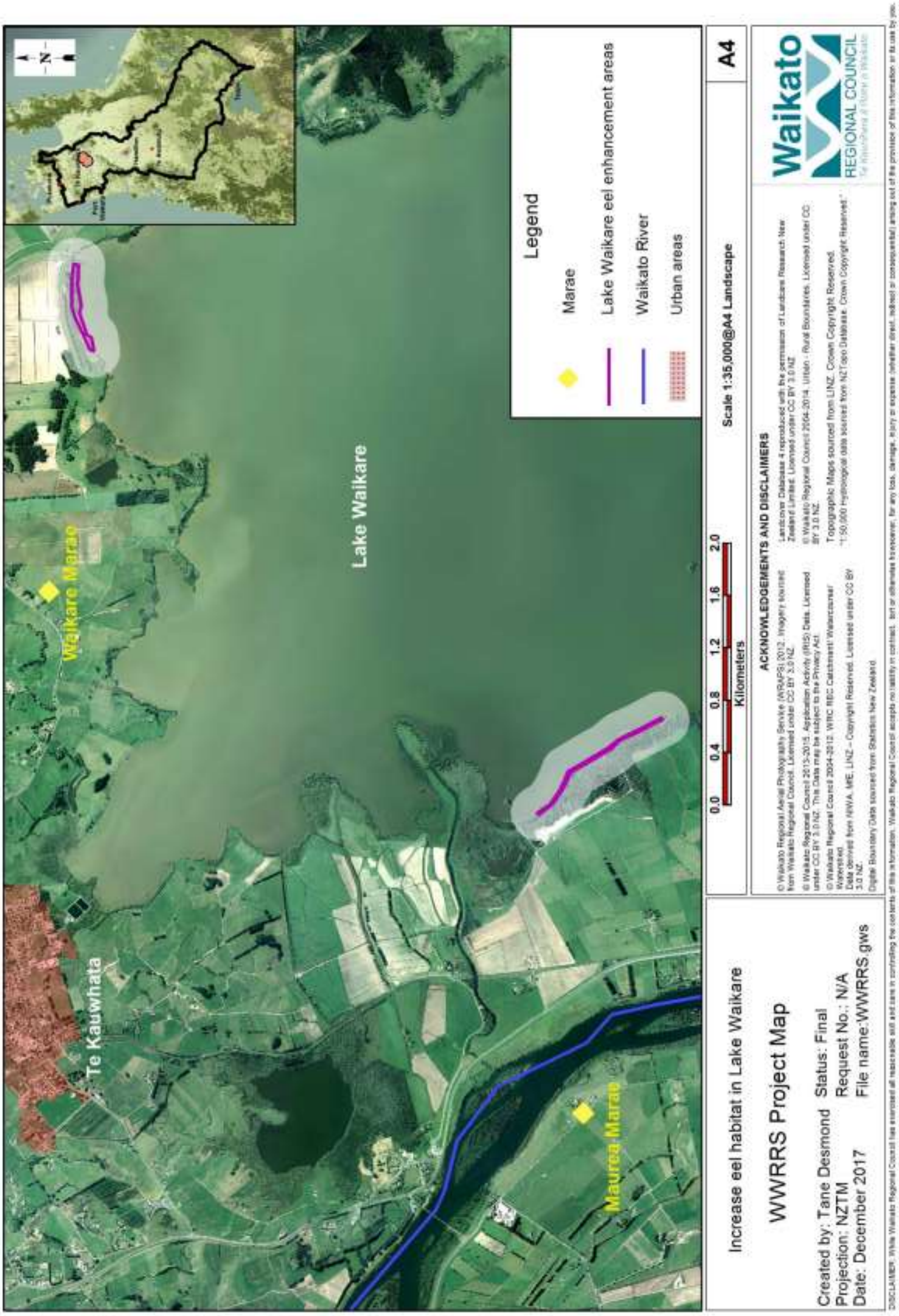
Monitoring
This project would benefit from pre and post construction monitoring to quantify the extent to which introduced structures provide habitat for tuna and other species, however this has not been costed as it is out of scope for the Restoration Strategy.

Installation of structures for fish habitat</td><td></td></tr>
</table>

	Along the northern foreshore of Lake Waikare (on Waikato Regional Council administered land) there are stands of alder trees (amongst willow and other species). This project involves topping (near the base of the tree) a 200m long section of alder trees and then using an excavator to orient the cut sections of the trees so they lie out into the lake. The network of branches and leaf material is expected to provide habitat for tuna (and other biota). Work requirements along the western shoreline are similar. Work in this location involves topping a 1000m long section of alder/poplar trees and using an excavator to orient the felled trees so they lie out into the lake. Topped trees should be secured to the lake bed and bank with rope/cable and duckbill anchors. The cut alder stumps will regrow and continue to provide an erosion control function on the lake margin. However, due to aggressive lake shore erosion some additional planting may be appropriate. Costs for northern foreshore site are based on the following estimates: - Up to 4 days of digger time (12 tonne digger) ($5400). - Two arborists for 4 days (incl 50km mileage at 0.72c per km) to top and install trees ($4870). - Materials (e.g. duckbill anchors, wire ropes and wire clamps) for placement of 10 structures 20m apart ($1350). Costs for the western shoreline site are based on the above costs multiplied by five ($58,100). <u>Planting</u> A small amount of planting along the lake shore where trees have been topped may be required to provide additional bank stability and erosion protection. It is recommended that a combination of native plant species and matsudana willow be planted for erosion control purposes. Costs are based on one willow tree every 10m (120 matsudana willow poles in total is $1440) and a row of native plants at 1.5m spacing (approximately 800 native plants at $8 each is $6400). Note that native planting costs include plant purchase, planting labour and five releasing events. **Resource consent fees**	

	Resource consent may be required from Waikato Regional Council for this work. Resource consent related costs are estimated at $5000. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately three years after project commencement.	L = 3
Effectiveness of works	When compared with desired state, Lake Waikare is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, and the presence of pest fish and plant species impacts significantly on ecological integrity. The very poor water quality is an impediment to recreational use of the lake. Despite this the lake still retains very high significance with iwi and the local community and has some important biodiversity values. Some deterioration in the lake is expected over the next 20 years in the absence of this project. This is based on trends in water quality over the past decade which show the in-lake TN has increased 4-fold over this period. This project is small in relation to the size of the lake and the scale of issues, however it can be expected to have a localised impact on tuna habitat availability. It doesn’t address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Waikare will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives.	W = 0.001
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is some uncertainty on how effective this technique will be in increasing tuna habitat in the lake.	F = 0.82
Adoptability	The bed of the lake is owned by Waikato-Tainui who are expected to be fully supportive of the project.	A = 1
Information quality	Good – advice of local and subject matter expert/s with a history of association to selected sites.	
Knowledge gaps	No known knowledge gaps other than those related to effectiveness and technical feasibility.	

<table>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Lake Waikare – northern shoreline</td><td></td></tr>
<tr><td>- Digger time</td><td>5400</td></tr>
<tr><td>- Arborists (felling and installation)</td><td>4870</td></tr>
<tr><td>- Materials</td><td>1350</td></tr>
<tr><td>Lake Waikare – western shoreline</td><td>58,100</td></tr>
<tr><td>Planting (both sites)</td><td>7840</td></tr>
<tr><td>Resource consent</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>20,640</td></tr>
<tr><td>Total</td><td>103,200</td></tr>
</table>
</td><td>C = 0.10</td></tr>
</table>


Increase eel habitat in Lake Waikare
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0.0
0.4
0.8
1.2
1.6
2.0
Kilometers
Scale 1:35,000@A4 Landscape
A4
ACKNOWLEDGEMENTS AND DISCLAIMERS
Legend
Marae
Lake Waikare eel enhancement areas
Waikato River
Urban areas
Lake Waikare
Waikare Marae
Maurea Marae
Te Kauwhata
Waikato
REGIONAL COUNCIL


Alder trees and recent native planting on Lake Waikare northern foreshore.

L 2 Priority: High	Development of Lake Waikare South Reserve for recreation	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Places that provide for safe recreational activities are identified and accessible. A platform for tourism along the river is created and connects to inland opportunities. Tribal and community histories proudly inform recreational users.	
Name of feature	Lake Waikare	
Brief description of feature	Lake Waikare is located southeast of Te Kauwhata township and connected to the Whangamarino wetland by the Pungarehu Canal. The lake is very significant to Waikato-Tainui and surrounding marae. The bed of the lake holds the kōiwi (bones) of people engaged in the Rangiriri Pakanga (battle) during the colonial invasion into the Waikato region. The lake bed is held in the title of the first Māori King, Pōtatau Te Wherowhero so that the bones of the tribe's people are protected in his name. Lake Waikare was historically used to capture tuna (eels) to sustain the iwi. Its surrounding wetlands supplied rongoā (medicine), birds, trees for general use, dyes and an area for enjoyment. It is the largest lake in the lower Waikato catchment, with 3442 hectares of open water. It has an average depth of 1.5 metres and a maximum depth of 1.8 metres. Lake Waikare has very poor water quality and is hypertrophic. In 1965 the lake level was lowered by one metre. This was in accordance with the Lower Waikato Waipā Flood Control Scheme and followed the construction of an outlet gate. The lake has a vital role in the Lower Waikato Waipā Flood Control Scheme as it acts as a water storage area during times of flood. Lake Waikare discharges to the Whangamarino Wetland from the artificial Pungarehu Canal. The lake is managed under a strict seasonal fluctuation regime of approximately 0.3 metres. The Lake Waikare South Reserve is a 2ha area of parkland on the eastern side of the lake, owned by Waikato District	

<table>
<tr><td></td><td>Council. It is currently undeveloped and under-utilised by the community.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition Lake Waikare would have a very high impact on giving effect to the Vision & Strategy at a shallow lakes and central and lower Waikato catchment level.</td><td>VS = 375</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>People become disconnected from Lake Waikare</td><td>The lake becomes further degraded.</td></tr>
<tr><td>Limited access</td><td>People see the area more as a resource than something that needs to be nurtured and cared for.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing, a local amenity park is created in accordance with the Lake Waikare reserve concept landscape plan, resulting in:
- 20,600 native plants and 18 fruit trees planted.
- Stock 100% excluded from Lake Waikare reserve area.
- An 85m length of boardwalk created (approximately 2.5m wide).
- A 415m long gravel walkway (approximately 2.5m wide) created.
- Two seating areas installed for picnics.
- A grassed verge and boat ramp created to allow boat access to the lake.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in collaboration with Waikato District Council. This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

	A Waikare reserve concept landscape plan has been developed for the site and is held by Waikato District Council. Works should be undertaken generally in accordance with the concept plan and involve: - construction of a boardwalk along the edge of the lake (approximately 85m long and 2.5m wide), $45,000 - construction of a gravel walkway (approximately 415m in length and 2.5m wide), $125,000 - fencing approximately 450m to exclude stock from the site with a minimum 5 wire fence with 2 electric wires, $3600 - planting approximately 20,600 native trees, averaged at $8.50 per plant including site preparation, plant purchase, planting labour and 5 releasing events, $175,253. - construction of two seating areas for picnicking. The estimated cost for this is $7000 per picnic table, including concrete pad and vandal proof design. Resource consent may be required for earthworks and/or boardwalk development. Cost for this are estimated to be no more than $5000. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at the planned pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3 years after project commencement.	L = 3
Effectiveness of works	When compared with desired state, Lake Waikare is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, and the presence of pest fish and plant species impacts significantly on ecological integrity. The very poor water quality is an impediment to recreational use of the lake. Despite this the lake still retains very high significance with iwi and the local community and has some important biodiversity values. Some deterioration in the lake is expected over the next 20 years in the absence of this project. This is based on trends in water	W = 0.001

<table>
<tr><td></td><td>quality over the past decade which show the in-lake TN has increased 4-fold over this period. This project is small in relation to the size of the lake and the scale of issues, however it can be expected to assist in improving access and recreation opportunities at the lake margins. It doesn’t address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Waikare will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>There is a low risk of project failure due to technical feasibility. Similar projects have been successfully completed at numerous lake sites.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>Proposed works are on publicly owned land and are expected to be adopted if fully incentivised. Waikato District Council is supportive of this project.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Good – recommendations and cost estimates were provided by Waikato District Council staff who are involved in the management of the reserve.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>A full concept plan and associated costing has not been completed and would be required prior to project commencement.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. There may be concern from the community that resources are being put into development of recreational facilities while the lake itself is in such poor condition.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Boardwalk construction (85m)</td><td>45,000</td></tr>
<tr><td>Gravel walkway construction (415m)</td><td>125,000</td></tr>
<tr><td>Fencing (450m)</td><td>3600</td></tr>
<tr><td>Planting (20,600 trees)</td><td>175,253</td></tr>
<tr><td>Picnic area development</td><td>14,000</td></tr>
<tr><td>Resource consent</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>55,178</td></tr>
<tr><td>Total</td><td>423,031</td></tr>
</table>
</td><td>C = 0.42</td></tr>
</table>

Development of Lake Waikare South Reserve for recreation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.04 0.08 0.12 0.16 0.20
Kilometers

Scale 1:4000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato
REGIONAL COUNCIL


Lake Waikare South Reserve located between Lake Waikare and Waikare Road.

L 3 Priority: High	Biodiversity enhancement of Lake Rotokawau	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Wetlands are protected, enhanced and where feasible expanded and re-established Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.	
Name of feature	Lake Rotokawau (Black Lake)	
Brief description of feature	Lake Rotokawau (22ha) lies southwest of Lake Waikare and is connected to the latter by a 500m channel. Rotokawau is a peat lake and is unique amongst the Lower Waikato lakes in that it is completely surrounded by a 145ha wetland reserve, administered by the Department of Conservation (Stewardship Land). Peat in the area is up to 14m thick. The lake and its surrounding wetlands are significant to Waikato-Tainui and surrounding marae. They supplied tuna (eels), rongoā (medicine), birds, trees for general use, dyes and an area for enjoyment. Monitoring undertaken in 1983 and 2007/08 showed the lake to be heavily nutrient enriched (hypertrophic). Submerged vegetation within the lake was once dominated by native plants but the lake became de-vegetated in the 1990s. The lake has a large wetland margin that extends 170m to 600m from its edge. A number of rare species are known or thought to exist within the wetland and around the margins of the lake including black mudfish (at risk – declining), Australasian bittern (nationally endangered), banded rail (at risk), marsh crake, spotless crake (relict) and North Island fernbird (at risk). No recent detailed botanical surveys have been conducted but nationally threatened plant species may still be present. Previously *Amphibromus fluitans* has been recorded. As a result of its hydrological connection with Lake Waikare, and the altered water level controls established through the Lower Waikato Flood Control Scheme, significant lake level fluctuation in Lake Rotokawau and the surrounding wetland have resulted in a substantial decline in biodiversity values and the lake is now hyper-eutrophic. However, the remaining peat bog is rare in type, diverse and considered the largest wetland	

	surrounding a lake in the Lower Waikato. Most bogs have been drained and converted to pasture. The site is within the top 30% of sites for biodiversity protection within the Waikato catchment because of its terrestrial biodiversity values and its representativeness of this ecosystem type. In 2009 a new drain was created to divert the Frost Road drainage area into Lake Waikare directly to reduce nutrient inputs to Lake Rotokawau. The lake continues to receive inputs from the Lake Ohinewai catchment, dairy farmland to the west and south as well as from Lake Waikare. Significant farmland adjoining the reserve boundary to the south and west is owned by Solid Energy (the Crown) and Glencoal (a subsidiary of Fonterra). Dairy farm activities from these areas (and other farms) have both direct (grazing of reserve land, peat loss) and indirect effects (drain and groundwater input into the lake of nutrients and sediment, including weed growth due to peat shrinkage on margins).	
Desired state to achieve Vision & Strategy	- The lake is swimmable, fishable and has access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species. - Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna. - Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally. - Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition Lake Rotokawau would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 20

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Nutrient and sediment inputs from inflowing drains.</td><td>Reduced water quality.</td></tr>
<tr><td>Water levels are controlled beyond that which would occur naturally. Drainage of adjoining farmed peatland.</td><td>Reduced wetland areas, reduced water quality, unnatural hydrological regime. Irrecoverable shrinkage of peat bog habitat.</td></tr>
<tr><td>Weeds – particularly the potential introduction of alligator weed which has been found in the nearby Te Onetea Stream and Whangamarino wetland.</td><td>Compete with native plant communities.</td></tr>
<tr><td>Pest fish</td><td>Reduce lake water quality</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>- Within 5 years of the project commencing surface waters from surrounding farmland no longer enter the lake.
- Yellow flag iris and alligator weed is prevented from establishing at the wetland site, and other plant pests are reduced to less than 10% coverage.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in close collaboration with DOC. This project could be undertaken as a whole, or in multiple smaller components.

Investigate isolating the lake and its reserve from farmland surface flows
The lake continues to receive inputs from the Lake Ohinewai catchment which contributes to lake sediment and nutrient loads.

An investigation is required to identify what measures are needed to isolate the lake and wetland from farm drains (and overland flow sources) whose inputs are high in sediment and nutrients. Options are likely to include sediment traps, fence realignment, bunds and drain diversion.

The estimated cost of this investigation is $25,000. Phase 1 ($10,000) would focus on immediate farmland-related management issues and identifying principal sources of flow, fence boundary issues and landowner willingness to participate in restoration.</td>
<td></td>
</tr>
</table>

	Implementation of measures to isolate Lake Rotokawau from surface water flows. Although it is unknown what the recommended measures will be from the above investigation, an estimate of $140,000 has been made for implementation of any measures. This includes design and resource consent fees. **Fencing and re-vegetation** Approximately 571m of fencing is required along the DOC reserve boundary (8-wire post and batten fence) ($9707). Riparian fencing and replanting of private land next to the reserve would be required to a minimum standard of 5-wire (2 electric) which is estimated to require 3km of fencing ($24,000) and replanting of approximately 2ha ($75,104). **Weed control** Weed control is a key management action required at this site. Terrestrial weeds such as pampas, willow and gorse have been identified at the site and a range of other weeds, including royal fern, are likely to be present. In-lake weeds that are a threat at this site include yellow flag iris and alligator weed. Department of Conservation estimate the cost for controlling weeds at this site to be $5420 per years for six years ($32,520). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately one year after project completion	L = 7.5
Effectiveness of works	Lake Rotokawau is currently in very poor to poor condition when compared to Vision & Strategy desired state. Water quality and access are poor and the community does not appear to be closely connected to the lake. The lake does	W = 0.03

	however retain significant associated wetland values which are under threat from weeds and hydrological changes. It is anticipated that further degradation in lake and wetland condition could occur over the next 20 years in the absence of this project given the threat of weeds and potential surrounding peat shrinkage. It is acknowledged that achieving the Vision & Strategy desired state at Lake Rotokawau will take longer than the 20-year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. However, if this project is successfully completed then it is expected that the Lake Rotokawau Wetland condition in 20 years will be improved, and overall this will counter some of the expected deterioration.	
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is uncertainty about the feasibility of isolation measures and whether this is technically possible. This will need to be determined by suitably qualified consultants. There are also some risks related to the success of weed control. Weed control will need to be led by experienced practitioners.	F = 0.82
Adoptability	Works on publicly owned land is expected to be adopted if fully incentivised as the Department of Conservation is supportive of this project. Some private landowners may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.75
Information quality	Good – information and recommendations have come from Department of Conservation staff with knowledge of the site and issues.	
Knowledge gaps	All known knowledge gaps have been documented in the project detail.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Consent would be required for isolation measures and this may not get support from affected landowners. Early stakeholder engagement will be very important for the successful delivery of this project.	P= 0.62
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Investigate isolating the lake from surface flows</td><td>25,000</td></tr>
<tr><td>Implementation of isolation measures</td><td>140,000</td></tr>
<tr><td>Fencing (3.5km) and re-vegetation (2ha)</td><td>108,811</td></tr>
<tr><td>Weed control</td><td>32,520</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>61,266</td></tr>
<tr><td>Total</td><td>367,597</td></tr>
</table>
</td>
<td>C = 0.37</td>
</tr>
</table>

Biodiversity enhancement of Lake Rotokawau

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:35,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

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Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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Lake Rotokawau wetland as seen from Lake Waikare.


Lake Rotokawau Reserve with intensively farmed and drained land in the foreground. The brown coloured pasture was recently flooded.

L 4 Priority: Medium	Enhancement of wetland habitat at Lake Te Kapa and Lake Waiwhata	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high natural environments.	
Name of feature	Lakes Te Kapa and Waiwhata	
Brief description of feature	Lake Te Kapa (0.7ha) and Lake Waiwhata (2.2ha) are two small peat lakes located between Lake Whangape and Lake Rotongaro-iti, about 10 minutes north of Huntly. Iwi historically accessed these lakes and surrounding wetlands to gather food, clothing and weaving materials, rongoā (medicine), birds and materials for general use. Pā tuna used to adorn the streams of this area. Lake Te Kapa is very shallow (maximum depth 1.5m) and very turbid. Water quality was recorded as hypertrophic (TLI = 6.29) in 2015. No submerged plants were found during a survey in 2015. The lake is surrounded by fringe of mostly raupō with mānuka scrub, swamp cypress and grey willow located landward. No threatened or rare plant species were recorded in a 2015 survey of the lake margin. Lake Waiwhata is also very shallow (maximum depth 1.5m) and turbid. Water quality was recorded as supertrophic (TLI=5.71) in 2015. No submerged plants were found during a survey in 2015. The lake is surrounded by mostly grey willow (70%) with some raupō (20%) and had a 20m long shoreline dominated by small amphibious plants known as 'turfs'. Two 'at risk' plants were recorded within the turfs. Both lakes contain shortfin eels, catfish and common bully but only Waiwhata contained gambusia and goldfish as well. A strongly skewed size structure and large number of harvestable tuna at Te Kapa suggest that fish passage may be inconsistent and/or the lake has been stocked. A bird survey hasn't been undertaken at these lakes, however Australasian bittern (nationally endangered) was observed at the lakes in 2015.	

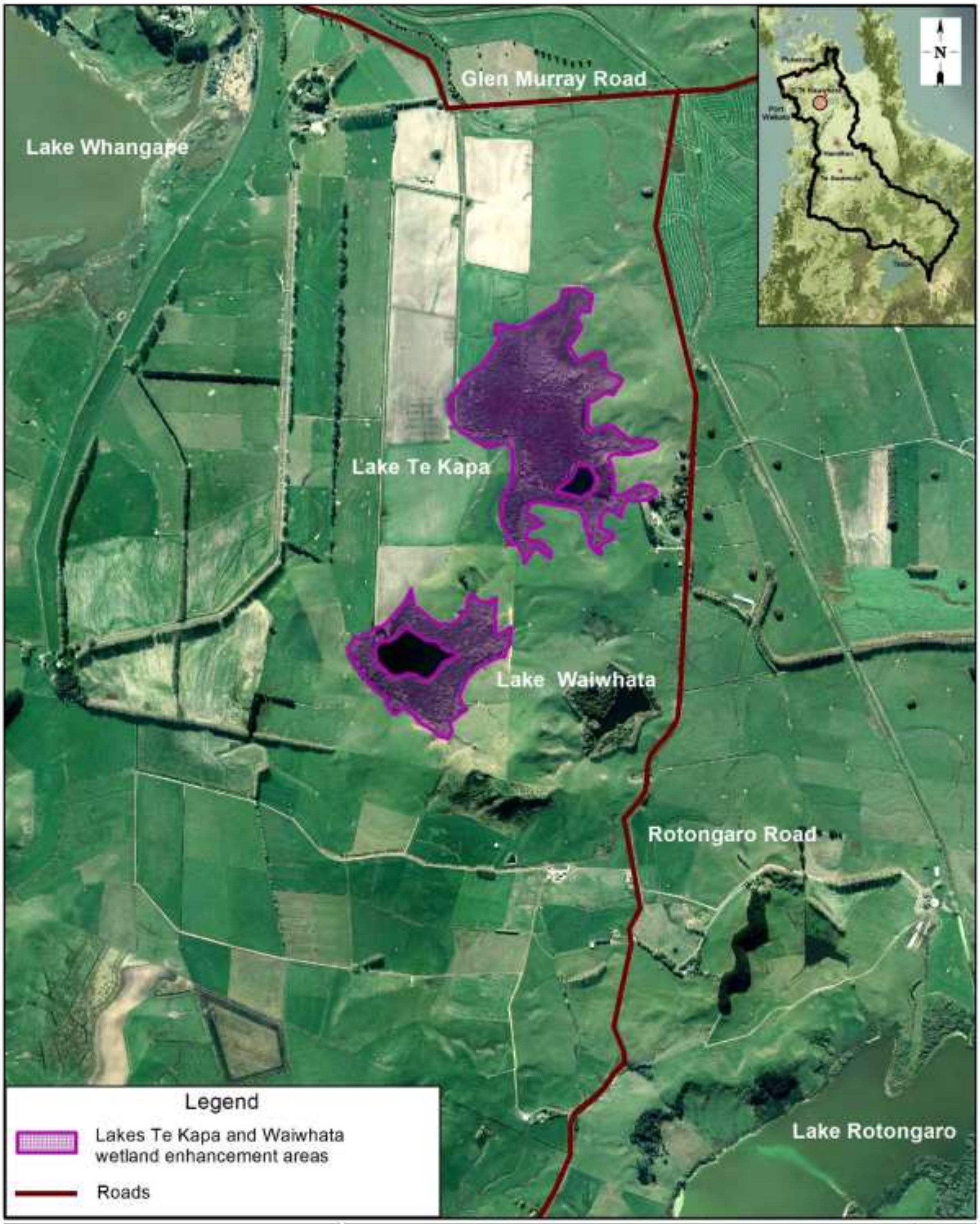
<table>
<tr><td></td><td>Both lakes are surrounded by extensive wetlands (total 27.46ha) which provide a buffer to the lakes and suitable habitat for a range of native plants and animals. The wetlands are reasonably diverse and are dominated by native plants, however grey willow and other ecosystem-changing weeds are present at low-medium abundance and pose a threat to the diversity and complexity of these wetlands. Not all of the wetland surrounding the lakes has been fenced and some of the fencing that has been done is inadequate for preventing stock access.

Both the lakes and the surrounding wetlands are privately owned and are not accessible to the public.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lakes are swimmable, fishable and have access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lakes and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition these two lakes and associated wetlands would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 3</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key Threat</th><th>Impact on Feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species. Direct inputs of nutrient and microbes into lakes.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Further drainage and clearance of native wetland vegetation.</td><td>Reduced habitat for native plants and animals and game birds. Loss of nutrient attenuation areas, and loss of wetland areas to slow flood flows.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 2 years wetlands adjoining Lakes Te Kapa and Waiwhata are 100% fenced and protected from stock and drainage.</td><td></td></tr>
</table>

	Within 5 years wetlands adjoining Lakes Te Kapa and Waiwhata are mostly (i.e. > 90% cover) comprised of native plant communities.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing:** Fencing should occur at the landward extent of wetlands. It can sometimes be difficult to accurately locate wetland margin. A wetland ecologist may be needed to determine the boundary. **Willow control:** Willow control should be undertaken using ground based methods to minimise off-target damage. This is likely to be two stage process with all willows controlled in the first year and follow-up weed control to 'mop up' any willows that were not successfully killed in the first year. **Weed control:** The wetlands contain several ecosystem changing weeds, including royal fern, gorse and blackberry. These weeds will need to be reduced to very low levels over a period of two years before any native planting occurs. **Planting:** Native planting should be carried out within existing open areas and in areas where weed removal has created open areas. Planting at 1.5m spacing is recommended, matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Meremere Ecological District. Assumptions and cost estimates for the two wetlands can be found below: Te Kapa Wetland – (20.3 ha, 3.7km perimeter) - Assume 750m requires fencing at $25 per metre ($18,750) - Assume 15% (3.05ha) of the wetland requires ground based willow control over 2 years at $4000 per hectare. In the second year it is assumed that approximately 0.5ha will need to be retreated ($14,200). - Additional weed control using a knapsack over 30% (6.1ha) of the area over 3 years at $5000 per hectare in Year 1, $2500 per hectares in Years 2 and 3 ($61,000) - Assumes 15% of the area (3.05ha) requires native planting at $37,552 per hectare ($114,533).	

	- Assumes 15% (3.05ha) of the area requires native planting in areas where 2 years of weed control has been carried out prior ($114,533) - Possum control (for plant establishment) over the 20.3ha site over 3 years ($12,180). Waiwhata Wetland – (7.16 ha, 2km perimeter) - Assume 20% (400m) requires fencing ($10,000) - Assume 20% (1.4ha) requires ground based willow control over 2 years at $4,000 per hectare. In the second year it is assumed that approximately 0.5ha will need to be retreated ($7,600) - Additional weed control using a knapsac over 10% (0.7ha) of the area over 3 years at $5,000 per hectare in Year 1, $2,500 per hectare in Year two and 3 ($7,000) - Assume 5% (0.35ha) of the area requires native planting at $37,552 per hectare ($13,143) - Possum control (for plant establishment) over the 7.16ha site over 3 years ($4,296) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	These lakes are currently in poor condition when compared to desired state. However, both lakes have extensive marginal wetlands that are in moderate condition. Overall condition is expected to deteriorate over the next 20 years in the absence of this project – particularly as a result of increased pest plant dominance. If this project is successfully completed, biodiversity values will improve at these lakes and this is expected to offset potential decline and contribute to a small improvement in condition. It is acknowledged that achieving the overall Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term.	W = 0.05

<table>
<tr><td>Risk of technical failure</td><td>There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to the success of weed control. Weed control will need to be led by experienced practitioners to reduce the level of risk to project success.</td><td>F = 0.82</td></tr>
<tr><td>Adoptability</td><td>There are 3 landowners around these sites. It is estimated that two-thirds of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.</td><td>A = 0.65</td></tr>
<tr><td>Information quality</td><td>Average – recommendations are based on the judgement of a wetland ecologist with knowledge of the sites. Quantities of work required are predominantly based on estimates made from aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Extent of weeds and fencing has been estimated from aerial photographs. Specific requirements would need to be determined during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Te Kapa Wetland</td><td></td></tr>
<tr><td>Fencing (750m)</td><td>18,750</td></tr>
<tr><td>Planting (6.1ha)</td><td>114,533</td></tr>
<tr><td>Weed control</td><td>75,200</td></tr>
<tr><td>Possum control</td><td>12,180</td></tr>
<tr><td>Te Kapa Wetland Total</td><td>220,663</td></tr>
<tr><td>Waiwhata Wetland</td><td></td></tr>
<tr><td>Fencing (400m)</td><td>10,000</td></tr>
<tr><td>Planting (0.35ha)</td><td>13,143</td></tr>
<tr><td>Weed control</td><td>14,600</td></tr>
<tr><td>Possum control</td><td>4296</td></tr>
<tr><td>Waiwhata Wetland Total</td><td>40,039</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>65,175</td></tr>
<tr><td>Total</td><td>325,877</td></tr>
</table>
</td><td>C = 0.33</td></tr>
</table>



Enhancement of wetland habitat at Lake Te Kapa and Lake Waiwhata

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.1 0.2 0.3 0.4 0.5
Kilometers

Scale 1:15,000@A4 Portrait

A4

Waikato
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In the centre of the foreground surrounded by a large wetland is Lake Te Kapa. To the left of this is Lake Waiwhata, also surrounded by wetland. Lake Whangape is shown in the background.

Lake Te Kapa and the western area of surrounding wetland. It is proposed to control willows (grey trees) at this lake along with other weeds.


Lake Waiwhata and the surrounding wetland. It is proposed to control willows (grey trees) at this lake to protect and enhance the mānuka shrubland and sedges surrounding this lake.

L 5 Priority: High	Increase eel habitat in Lake Ohinewai	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Lake Ohinewai	
Brief description of feature	Lake Ohinewai is a shallow (4.5m deep) 16ha peat lake located within a pastoral catchment (347ha in size) near the township of Ohinewai. The lake is fed by a single major drain entering the lake from the southwest and drains from its northeastern end into Lake Rotokawau, which is subsequently connected to Lake Waikare. The lake is administered by DOC and has been fully fenced to exclude stock. The fenced margin has also recently been extensively planted with native species. Next to the lake is a 52ha Waikato District Council reserve which is currently grazed. A paper road also extends from Tahuna Road to Lake Ohinewai. Native fish species recorded in the lake include common bully and longfin eel although their habitat has been dramatically reduced through land drainage and the lowering of the lake level. The lake bed has been de-vegetated since 1991 and pest fish are an issue within the lake. The University of Waikato has recently undertaken an intensive research programme to test methods for mass removal of koi carp as a lake restoration tool. Lake water quality is poor and the lake is considered hypertrophic (having high nutrient concentrations). This project involves creation of tuna habitat within the lake. Anecdotal evidence from New Zealand shows that in lakes and rivers, eels are always found where there is cover. Trials of wood installation in streams have shown benefits for a range of species so scientists expect there to be habitat benefits for a range of biota in lakes (including tuna). Research from overseas looking at the benefits of introducing woody structure also supports this concept.	

<table>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition Lake Ohinewai would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 5</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Lack of in-lake vegetation</td><td>Reduced habitat for native fish, increased resuspension of sediments and reduced water quality.</td></tr><tr><td>People become disconnected from the lake</td><td>The lake becomes further degraded. People stop using the lake for recreation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing at least 6 woody structures provide habitat for tuna in Lake Ohinewai</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in close collaboration with DOC. This project could be undertaken as a whole, or in multiple smaller components.

Investigation and design
Installation of woody structures for tuna habitat is recommended at Lake Ohinewai. The exact location and design for these structures needs to be determined as part of the project. These should be designed in a manner that will also maximize opportunities for reducing wave action and bank erosion.

One location that has been suggested by tuna experts but requires further investigation is at the west end of the lake (see photo below). The cost estimated for investigation and design is $10,000.</td><td></td></tr>
</table>


Suggested locations for woody structures.

Installation of structures for fish habitat

Details around the number and location of structures to be installed will be determined by the investigation and design phase of this project. However, for the purpose of providing a cost estimate the project assumes installation of between 6 and 9 woody debris structures. Costs are based on the cost estimates for installing woody debris structures in streams ($30,000).

Resource Consent fees

Resource consent may be required from Waikato Regional Council for this work. Resource consent related costs are estimated at $15,000. This would include cultural assessment (if required), consent application preparation and consent fees. Costs associated with consultation are incorporated into the project management costs below.

Monitoring

This project would benefit from pre and post construction monitoring to quantify the extent to which introduced structures provide habitat for tuna and other species, however this has not been costed as it is out of scope for the Restoration Strategy.

Project management/staffing/incidentals

Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.

<table>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen at project commencement.</td><td>L = 2</td></tr>
<tr><td>Effectiveness of works</td><td>When compared with desired state Lake Ohinewai is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, access is difficult and the presence of pest fish impacts significantly on ecological integrity. The poor water quality is an impediment to recreational use of the lake. Condition is not expected to change significantly over the next 20 years in the absence of this project. Proposed works are minor but can be expected to have a localised impact on tuna habitat availability. The project doesn’t address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Ohinewai will take longer than the 20 year horizon used for the purposes of the Restoration Strategy and a fuller range of initiatives.</td><td>W = 0.01</td></tr>
<tr><td>Risk of technical failure</td><td>There is a moderate risk of project failure due to technical feasibility. There is some uncertainty on how effective this technique will be in increasing tuna numbers in the lake.</td><td>F = 0.82</td></tr>
<tr><td>Adoptability</td><td>The lake is publicly owned and therefore it is anticipated that works would be adopted if they were fully incentivised.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Average – advice of subject matter expert/s based on experience in New Zealand and internationally.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>No known knowledge gaps other than those related to effectiveness and technical feasibility.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><td>Task</td><td>Cost ($)</td></tr>
<tr><td>Lake Ohinewai</td><td></td></tr>
<tr><td>- Investigation and design</td><td>10,000</td></tr>
<tr><td>- Installation of structures</td><td>30,000</td></tr>
<tr><td>- Resource consent</td><td>15,000</td></tr>
<tr><td>Project Management/staffing/incidentals (25%)</td><td>13,750</td></tr>
<tr><td>Total</td><td>55,000</td></tr>
</table>
</td><td>C = 0.06</td></tr>
</table>

Scale: 0.0 0.1 0.2 0.3 0.4 Kilometers

Scale 1:7,500@A4 Landscape

A4

Increase Eel habitat in Lake Ohinewai

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL Te Kaunihera ā Rohe o Waikato


Lake Ohinewai.

L 6 Priority: Medium	Development of Lake Ohinewai Reserve for recreation	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Places that provide for safe recreational activities are identified and accessible.	
Name of feature	Lake Ohinewai	
Brief description of feature	Lake Ohinewai is a shallow (4.5m deep) 16ha peat lake located within a pastoral catchment (347ha in size) near the township of Ohinewai on the outskirts of the Ohinewai Peat Bog. It is of cultural significance to Ngāti Hine and Ngāti Naho, who accessed these lakes and historic wetlands to gather food, clothing and weaving materials, rongoā (medicine), birds and materials for general use. The lake is fed by a single major drain entering the lake from the southwest and drains from its northeastern end into Lake Rotokawau, which is subsequently connected to Lake Waikare. The lake is owned by DOC and has been fully fenced to exclude stock. The fenced margin has also recently been extensively planted with native species. Next to the lake is a 52ha Waikato District Council reserve which is currently grazed. A paper road also extends from Tahuna Road to Lake Ohinewai. Native fish species recorded in the lake include common bully and longfin eel although their habitat has been dramatically reduced through land drainage and the lowering of the lake level. The lake bed has been de-vegetated since 1991 and pest fish are an issue within the lake. The University of Waikato has recently undertaken an intensive research programme to test methods for mass removal of koi carp as a lake restoration tool. Lake water quality is poor and the lake is considered hypertrophic (having high nutrient concentrations).	
Desired state to achieve the Vision & Strategy	The lake has a riparian margin well vegetated with native plant species and is a minimum of 50m wide. Residents and visitors are able to access and recreate in the reserve and in the waters of the lake. The lake is swimmable, fishable and has a healthy population of native fish.	
Impact on Vision & Strategy	In a restored condition Lake Ohinewai would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 5

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Opportunities for public recreation next to waterway not realised</td><td>People are disconnected from Lake Ohinewai and the lake becomes further degraded.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 10 years:
- A local amenity park is created providing public access to Lake Ohinewai via a sealed access road and car park.
- Approximately 25ha of district council reserve land is retired from grazing and revegetated with native plant species.
- The park contains a picnic area with picnic tables and lake access points for recreation such as fishing.
- There is a gravel path created around the perimeter of Lake Ohinewai for public recreation.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (in close consultation with Waikato District Council). This project could be undertaken as a whole, or in multiple smaller components.

Concept plan development
Prior to any work taking place a full concept plan and costings should be developed for the reserve area. The costs provided below are estimates only. The estimated cost for development of a concept plan is $10,000.

Works required
On the ground works and actions required include:

<u>Stage 1</u>
- Construction of a 250m long sealed access road along current paper road and parking area at the end ($120,000).

<u>Stage 2</u>
- Removal of stock from the district council reserve.
- Re-vegetation of a 25ha area with native plants ($938,800).

<u>Stage 3</u>
- Install approximately 3km of gravel walking track around the perimeter of Lake Ohinewai ($600,000) including construction of bridges over inflowing drains.
- Installation of 6 picnic tables and viewing areas (42,000).
- Installation of 3 interpretive signs ($5000).</td>
<td></td>
</tr>
</table>

	<u>Stage 4</u> - Additional planting and installation of amenity structures. Amenity structures include a jetty for lake access and potentially other lake access points. The estimated cost of this is $30,000 including resource consent. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at the planned pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 6 years after project commencement.	L = 6
Effectiveness of works	When compared with desired state, Lake Ohinewai is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, access is difficult and the presence of pest fish impacts significantly on ecological integrity. The poor water quality is an impediment to recreational use of the lake. Condition is not expected to change significantly over the next 20 years in the absence of this project. Proposed works focus on access and user experience at the lake, and will also have benefits to biodiversity. The project doesn't address other key threats and it is acknowledged that achieving the Vision & Strategy desired state for Lake Ohinewai will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives. However, if the project is completed Lake Ohinewai would have good access and a large reserve for visitors to enjoy. It is expected that this would move the lake closer to the Vision & Strategy desired state in 20 years' time.	W = 0.125
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Similar projects have been successfully completed at numerous lake sites.	F = 0.87
Works by private citizens – likelihood of adoption and adoption circumstances	Landowner is supportive.	A = 1

<table>
<tr><td>Information quality</td><td>Good – recommendations and cost estimates were provided by Waikato District Council staff who are involved in the management of the reserve.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>A full concept plan and associated costing has not been completed and would be required prior to project commencement.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks. This project delivers on the community’s aspirations for greater recreational opportunities around waterways.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Development of concept plan</td><td>10,000</td></tr>
<tr><td>Stage1 – Access road construction</td><td>120,000</td></tr>
<tr><td>Stage 2 – Re-vegetation (25ha)</td><td>938,800</td></tr>
<tr><td>Stage 3 - Installation of walkways, picnic and viewing areas</td><td>647,000</td></tr>
<tr><td>Stage 4 - Additional planting and installation of amenity structures</td><td>30,000</td></tr>
<tr><td>Project Management/staffing/incidentals (20%)</td><td>349,160</td></tr>
<tr><td>TOTAL</td><td>2,094,960</td></tr>
</table></td><td>C = 2.09</td></tr>
</table>

Legend
Lake Ohinewai recreation project area
Roads
Tahuna Road
State Highway 1
Lake Ohinewai
N
Development of Lake Ohinewai Reserve for recreation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name:WWRRS.gws
0.000 0.075 0.150 0.225 0.300 0.375
Kilometers
Scale 1:7,500@A4 Landscape
A4
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Western end of Lake Ohinewai showing approximate location of district council reserve land

L 7 Priority: High	Restoring minimum water level at Lake Kimihia	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Natural hydrology at key lakes is restored including through enhancing the size and extent of wetlands and margins and increasing water levels.	
Name of feature	Lake Kimihia	
Brief description of feature	Lake Kimihia is a medium sized (44ha) riverine lake on the northeastern outskirts of Huntly. It discharges to the Waikato River just north of Fisher Rd under SH1. The lake was originally 318ha but has been greatly modified as result of open cast mining. It is currently extremely shallow (< 0.8m) and very turbid. Water quality sampling in 2006/07 indicated that the lake is hypertrophic with an estimated TLI of 7.4. It does not support submerged plants. The lake is very significant to the iwi, in particular Ngāti Naho, Ngāti Mahuta and Ngāti Whāwhākia. The name “kimihia” means to seek or search. It refers to a “right of passage” activity used by the iwi to determine the fittest and strongest of the young men, and ensure the mana of the iwi is maintained. There are historic pā sites near the lake which also provided sustenance and resources to iwi. Lake Kimihia has a large catchment (1485ha). The main land uses are native forest (41%) and dry stock farming. The Waikato Expressway is currently being constructed along the southern margin of the lake and cuts through the southern part of the catchment. The lake is surrounded by 31ha of wetland which has only recently been fully fenced. It contains a reasonable diversity of native plant species which are threatened by the increasing abundance of weeds such as grey willow, primrose willow and blackberry. Several restoration projects are being carried out around the lake to improve the condition of the wetlands. An unconsented weir was built at Lake Kimihia in the 1980s after agreement was reached on setting a minimum lake level (8.0m Moturiki Datum). It is positioned at the western end of the lake and is flanked by a bund along the lake margin that was possibly formed when an artificial watercourse was excavated along this edge. The weir and	

<table>
<tr><td></td><td>bund have not been maintained and are no longer functioning. As a result, water levels in the lake sometimes drop considerably below the 8.0m minimum lake level that is listed in the Waikato Regional Plan. This is likely to further degrade water quality in the lake and affect wetland habitat.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Kimihia would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 24</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Further drainage of the lake.</td><td>Reduced habitat for native plants and animals and game birds. Degradation of water quality, particularly turbidity.</td></tr>
<tr><td>Pest fish</td><td>Contribute to re-suspension of sediment in the lake resulting in degradation of water quality, particularly turbidity.</td></tr>
<tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Raise the minimum lake level at Kimihia to 8.0m (Moturiki Datum).</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works should be undertaken by or in collaboration with an organisation with experience in bund design and construction.

This project will require an investigation to determine the most feasible method to repair/install a bund and weir along the western margin of the lake. This is likely to</td><td></td></tr>
</table>

	require some initial site investigation to determine ground levels. Results of the site investigation will be used to undertake hydrological modelling to determine the height of the bund and the design of the weir. The length of the bund is likely to be the same length as the western lake margin (about 600m). It is anticipated that the bund could be built from sediment located close to the site. As the site is bounded by water on both sides (lake to the east, artificial watercourse to the west) and would be occurring within a wetland, it is likely that additional costs will be incurred to provide access to the site for heavy machinery. It is proposed to build a wooden weir at the site. Consent will be required to undertake the earthworks associated with building the bund and to construct a new weir. Consultation with tāngata whenua and adjoining landowner is likely to be required as part of the consent process. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen at project completion.	L = 2
Effectiveness of works	When compared with desired state, Lake Kimihia is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, has been heavily modified and the presence of pest fish and pest plant species impacts significantly on ecological integrity. The very poor water quality is an impediment to safe recreational use of the lake. However, the lake still retains very high significance with iwi and has good populations of tuna. The lake is not expected to change in	W = 0.01

	overall condition over the next 20 years in the absence of this project given its already highly degraded state and some existing riparian restoration efforts. This project focuses solely on re-establishing a minimum water level for the lake. It doesn't address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Kimihia will take longer than the 20 year horizon used for the purposes of the Restoration Strategy and a fuller range of initiatives. However, if completed the works are expected to facilitate a very small improvement in condition over the next 20 years.	
Risk of technical failure	There is a very low risk of project failure due to technical feasibility if works are designed and constructed by experienced and qualified contractors. Weirs have been constructed successfully at many Waikato shallow lake outlets.	F = 0.92
Adoptability	Works are expected to be adopted if fully incentivised. The land is publicly owned and the minimum lake level is set in the Waikato Regional Plan.	A = 1
Information quality	Very good – the site has been investigated by regional council lake management advisor and DOC senior ranger. Regional council engineers have provided advice on the costs of the different components of the project.	
Knowledge gaps	Site constraints that could hinder the construction of a weir and bund. The work needs to be carried out in lake and may be logistically difficult. This will need to be assessed by appropriately qualified people.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. There could be concerns from surrounding landowners about flooding and this will need to be addressed through a consultation process.	P = 0.62
Project duration (years)	2 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Site investigation, survey of ground levels</td><td>10,000</td></tr>
<tr><td>Design specification and plans for bund and weir</td><td>20,000</td></tr>
<tr><td>Consent preparation, consent fees stakeholder consultation</td><td>35,000</td></tr>
<tr><td>Bund construction</td><td>20,000</td></tr>
<tr><td>Weir construction</td><td>20,000</td></tr>
<tr><td>Annual maintenance of bund and weir (for 10 years)</td><td>10,000</td></tr>
<tr><td>Project management/staffing/incidentals</td><td>25,000</td></tr>
<tr><td>Total</td><td>150,000</td></tr>
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<td>C = 0.15</td>
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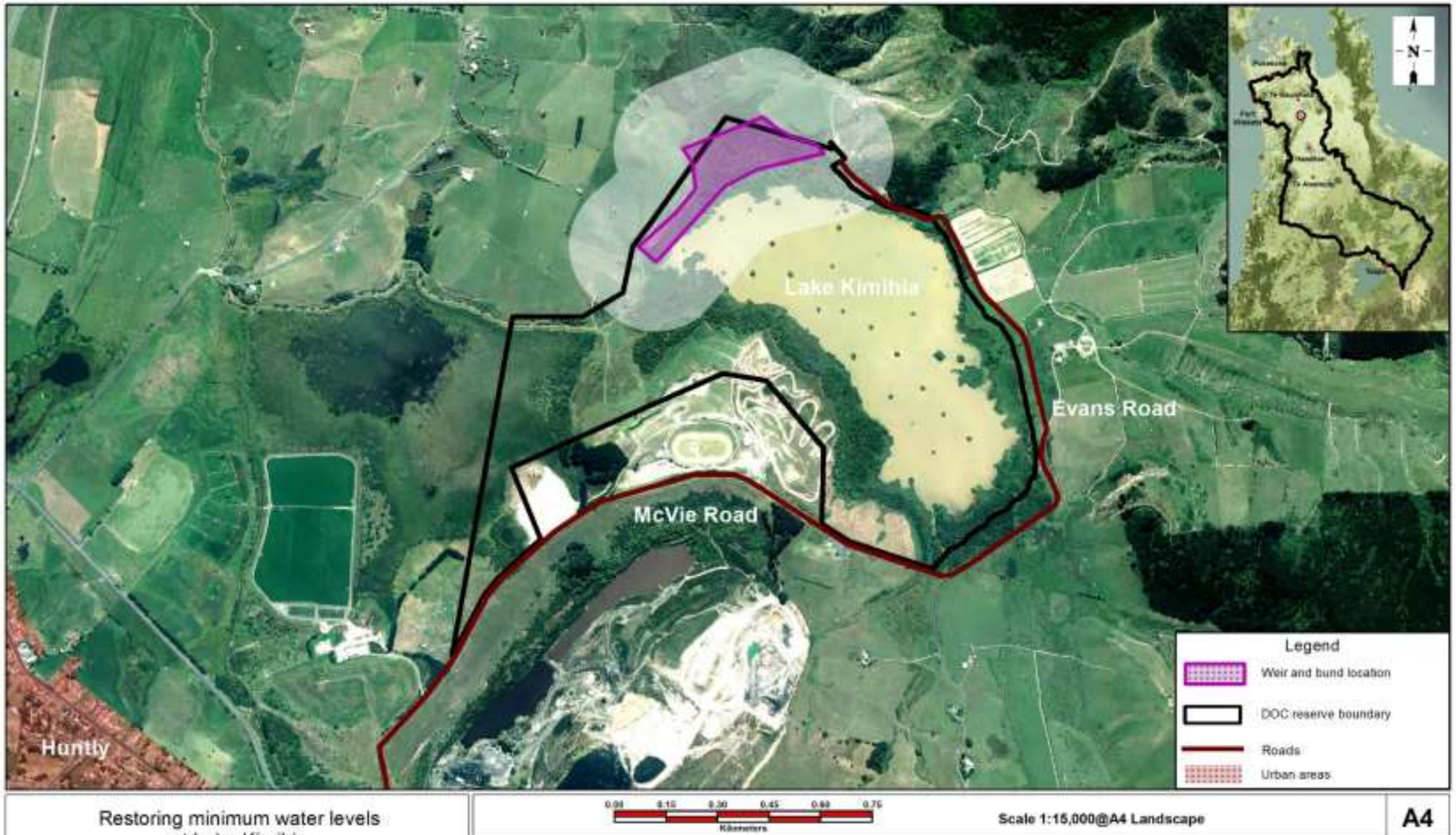

Scale 1:15,000@A4 Landscape

A4

Restoring minimum water levels at Lake Kimihia

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL


The western margin of Lake Kimihia is shown in the foreground. It discharges to the channel shown at the foot of the hill to flow underneath the Waikato Expressway which is under construction (on the right).


The wooden weir structure at Lake Kimihia that is no longer functional.

Waikato Expressway under construction along the southern margin of Lake Kimihia. The hills in the background are part of the Lake Kimihia catchment.

L 8 Priority: High	Water quality and habitat enhancement at Lake Okowhao	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high natural environments. Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species.	
Name of feature	Lake Okowhao	
Brief description of feature	Lake Okowhao is a small (8ha) riverine lake north of Huntly. It discharges under Te Ohaaki Road through an old oxbow (that has been enhanced to provide tuna habitat), before entering Waikato River. The lake was historically used as a food bowl for surrounding marae, in particular Hukanui-a-muri, Te Ohaaki and Waahi pā. Its resources clothed, sustained and healed the iwi. The lake is relatively close to the Waikato River and Taipōuri Island, where Kōkako used the waters of the Waikato to whakarite (bless) his grandson, Wairere, who became the tūpuna of Ngāti Wairere. Lake Okowhao has poor water quality (hypertrophic) although it was one of the last of the Lower Waikato riverine lakes to lose its submerged plants. The catchment (about 390ha) is mainly dairy farming with some coal mining activity at the top of the catchment. The lake fishery is depauperate and dominated by pest fish. Fish passage between the lake and the river is poor and limited to flood events. The lake and its adjoining wetlands have been assessed as having moderate-high value for birds with two threatened species recorded (i.e. Australasian bittern, New Zealand dabchick). It is popular for game bird hunting. Lake Okowhao is surrounded by a 14.6ha fenced wetland on public reserve land. It has an extensive native dominated emergent vegetation zone. The remaining wetland area is dominated by grey willow with a native understorey although there are some large areas of blackberry on the eastern margin.	

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<td>A large area (12.4ha) of private wetland occurs on the southern boundary of the lake reserve which contains a mix of native and introduced plant communities. The main inflow to the lake (draining the majority of the catchment) flows through this wetland and has slowly filled it with sediment over this time. The low value areas of this wetland could be modified to improve water quality and provide additional open water habitat.

An unformed road could be developed to provide public access to the lake. The main recreational use of the lake is for gamebird hunting.</td>
<td></td>
</tr>
<tr>
<td>Desired state to achieve Vision & Strategy</td>
<td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its protection and restoration.</td>
<td></td>
</tr>
<tr>
<td>Impact on Vision & Strategy</td>
<td>In a restored condition, Lake Okowhao would have a very high impact on giving effect to the Vision & Strategy at a local level.</td>
<td>VS = 6</td>
</tr>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key Threat</th><th>Impact on Feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species. Direct inputs of nutrient and microbes into lakes.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Further drainage and clearance of native wetland vegetation</td><td>Reduced habitat for native plants and animals and game birds. Loss of nutrient attenuation areas, and loss of wetland areas to slow flood flows.</td></tr>
<tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr>
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Project goal/s	Within 5 years, wetlands surrounding Lake Okowhao are mostly (i.e. > 90% cover) comprised of native plant communities. Within 5 years, water quality has measurably improved in Lake Okowhao.	
Works required (by whom)	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in collaboration with DOC. This project could be undertaken as a whole, or in multiple smaller components. **Wetland Habitat Enhancement** **Willow control:** Willow control should be undertaken using ground based methods to minimise off-target damage. This would be undertaken in both the wetland surrounding Lake Okowhao and on the adjoining private wetland to the south. **Weed control:** The wetlands contain several ecosystem changing weeds, including pampas, gorse and blackberry. These weeds will need to be reduced to very low levels over a period of two years before any native planting occurs or constructed wetlands are created. **Planting:** Native planting should be carried out within existing open areas and in areas where weed removal has created open areas. Planting at 1.5m spacing is recommended matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Hamilton Ecological District. **Constructed wetland** This project involves modifying the wetland on private land south of Lake Okowhao to improve its effectiveness for removing sediment and nutrients. The main inflow to the lake currently comes through this wetland, which collects about 70% of the run off from the catchment. **Design and specifications for constructed wetland:** These will need to be prepared by an appropriately qualified person using guidelines that target the reduction of nitrogen, phosphorus, *E.coli* and sediment arising from agricultural run off. The size of the constructed wetland would be 2.5% of the catchment size (i.e. 6.65ha). McKergow *et al.* (2007) estimate that the performance of a constructed wetland of this type and size (in relation to catchment area) is likely to result in the following reductions: about 80% of annual sediment load, 60% of nitrogen, 60-80% of particulate phosphorus and >90% of *E. coli*.	

	Consent for constructed wetland: Consents would need to be obtained for earthworks associated with the silt traps/constructed wetlands from both Waikato Regional Council and the Waikato District Council. This would include undertaking consultation with tāngata whenua and possibly commissioning a cultural impact assessment (although there are no known archaeological sites at this location). Based on costs for similar projects undertaken at other peat lakes the consent costs which include application preparation, consent fees and consultation is likely to cost about $25,000. **Construction of treatment wetland:** This will involve carrying out earthworks to deepen areas and re-contour to best capture sediments and nutrients. **Planting wetland:** Constructed wetlands require planting densities between 0.5m and 0.7m spacing depending on species. Infill planting (10% of original planting) in second year is recommended to replace plants that die in the first year. Assumptions and cost estimates for habitat enhancement at the two wetlands and the constructed wetland at South Okowhao are as follows: Lake Okowhao wetland enhancement – 14.6ha - Ground based willow control over 5ha at $4000 per hectare ($20,000). - Weed control over 50% of the area (7.3ha) over 2 years at $2800 per hectare ($40,880). - Assumes 2ha of the area requires native planting in areas that are currently dominated by weeds and with allowance for 10% infill planting ($42,881 per hectare) ($85,762). - Possum control (for plant establishment) over 3 years ($8,760). South Okowhao wetland enhancement – 12.4ha, 1.58km perimeter - Ground based willow control over 3.4ha at $4000 per hectare ($13,600). - Weed control over 50% of the area (6.2ha) over 2 years at $2800 per hectare ($34,720).	

	- Assumes 3ha of the area requires native planting in areas that are currently dominated by weeds and with allowance for 10% infill planting ($42,881 per hectare) ($128,643). - Fencing 1580m at $25 per metre ($39,500) - Possum control (for plant establishment) over 3 years ($7440). South Okowhao constructed wetland – 6.65ha - Construction of wetland including earthworks and planting at $100,000 per hectare ($665,000). - Planting maintenance for 2 years at $600 per hectare ($7980). - Annual maintenance of sediment basins for 10 years at $1880 per annum ($18,800). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen upon project completion.	L = 10
Effectiveness of works	When compared with desired state, Lake Okowhao is in poor to moderate condition with few of the Vision & Strategy desired state aspects being met or partly met. Although lake water quality is not as poor as many of the other Lower Waikato riverine lakes, it is not at a swimmable standard. Access to the lake is difficult which means many members of the community are not well connected to the site. Overall state is not expected to change over the next 20 years in the absence of this project. Works included here are expected to help in addressing some of the key threats to the lake including external nutrient – they will treat approximately 70% of lake inflows – and improve biodiversity values at the site. However, the lake water quality would still be expected to remain in a NOF D band even with this project being undertaken. It is acknowledged that achieving the Vision & Strategy desired state at Lake Okowhao will take longer than	W = 0.15

<table>
<tr><td></td><td>the 20-year horizon used for the purposes of the Restoration Strategy and a fuller range of initiatives over the long term. However, if this project is successfully completed it is expected that there will be a significant improvement in overall condition in 20 years and the lake will be closer to the desired Vision & Strategy state than it is currently. There would be benefits in this project being carried out in alignment with project L 9.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>There is a moderate risk of project failure due to technical feasibility. Effectiveness of constructed wetland treatment systems has not yet been fully established.</td><td>F = 0.82</td></tr>
<tr><td>Works by private citizens – likelihood of adoption and adoption circumstances</td><td>Works proposed on publicly owned land are expected to be adopted if fully incentivised. The constructed wetland is proposed for land that is owned by Solid Energy and there is come uncertainty about whether the company would agree to this going ahead. Early engagement with landowners, iwi and stakeholders will be critical to project success.</td><td>A = 0.75</td></tr>
<tr><td>Information quality</td><td>Average – recommendations are based on advice of local expert/s and examination of aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>The condition and extent of fencing of the wetland on private land has been estimated from aerial photographs. Specific requirements will need to be determined during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Wetland habitat enhancement at Lake Okowhao</td><td>155,402</td></tr>
<tr><td>Wetland habitat enhancement at South Okowhao</td><td>223,903</td></tr>
<tr><td>South Okowhao constructed wetland</td><td>691,780</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>214,217</td></tr>
<tr><td>Total</td><td>1,285,302</td></tr>
</table></td><td>C = 1.29</td></tr>
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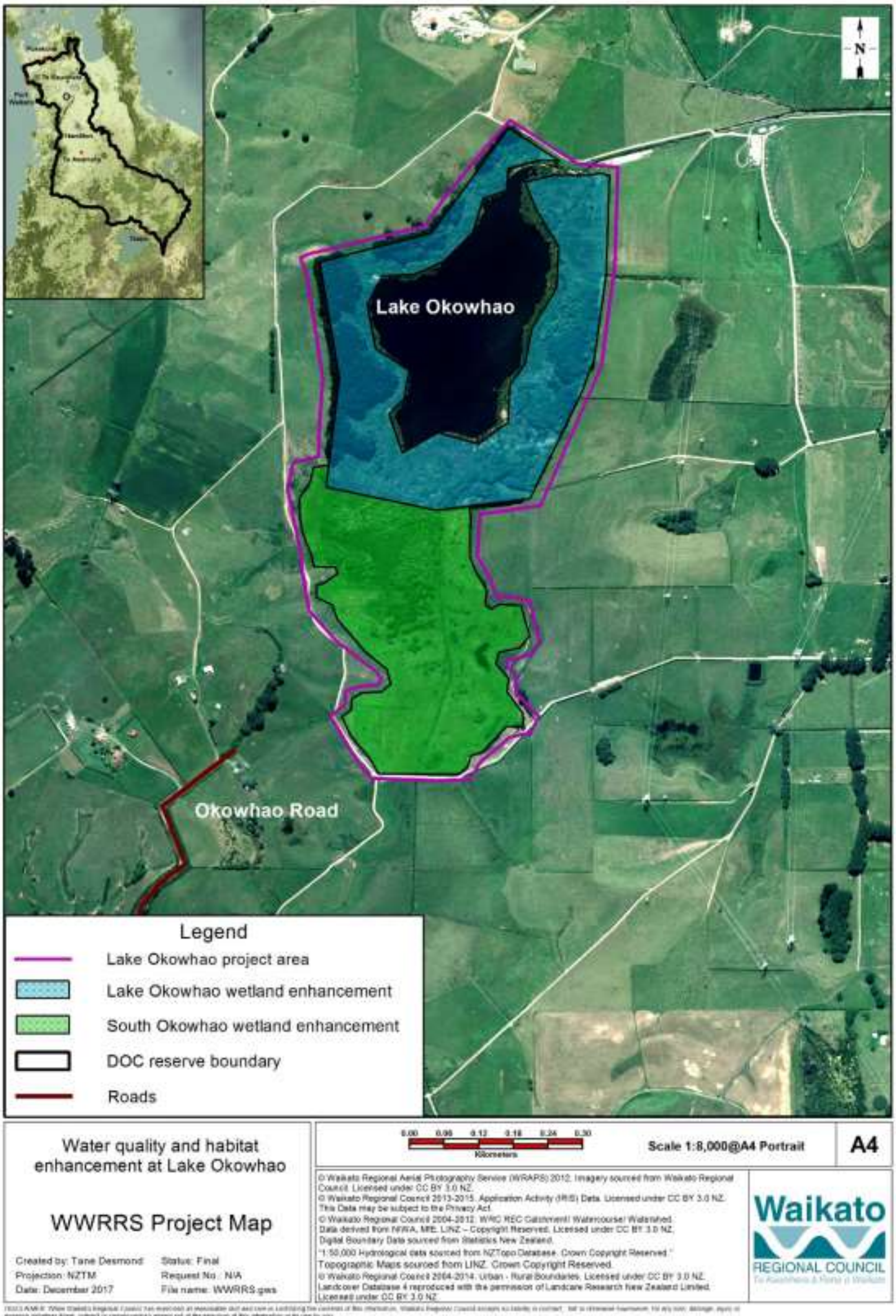

N
Lake Okowhao
Okowhao Road
Legend
Lake Okowhao project area
Lake Okowhao wetland enhancement
South Okowhao wetland enhancement
DOC reserve boundary
Roads
Water quality and habitat enhancement at Lake Okowhao
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
Kilometers
Scale 1:8,000@A4 Portrait
A4
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The extensive wetland margin in the south of Lake Okowhao. The grey vegetation is grey willow, which is invading some of the native wetland plant communities around the lake.

The partially drained wetland area south of Lake Okowhao reserve where a constructed wetland is proposed.

L 9 Priority: High	Provide fish passage past Lake Okowhao outlet stream pump station and floodgate	BCR value
Relevant unit goal(s)	Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish. The abundance of native fish, including taonga species, in the catchment is restored and protected.	
Name of feature	Lake Okowhao	
Brief description of feature	Lake Okowhao is an 8ha riverine lake located north of Huntly and lying within of the Okowhao drainage area. The lake has a maximum depth of 2.2m and is part of a Wildlife Management Reserve administered by DOC. The lake is de-vegetated and water quality hypertrophic meaning it has very high nutrient concentrations and poor clarity. Lake Okowhao was historically used as a food bowl for surrounding marae, in particular Hukanui-a-muri, Te Ohaaki and Waahi pā. The lake is relatively close to the Waikato River and Taipōuri Island, where Kōkako used the waters of the Waikato to whakarite (bless) his grandson, Wairere, who became the tūpuna of Ngāti Wairere. The lake receives water from drains that run through farmland to the south and east of the lake. The lake outlet discharges to the Waikato River via an incised drain that runs east to west. The lake either discharges through a gravity fed culvert passing under Te Ohaaki Road or water is pumped through another set of culverts during high flow events. Both of these culverts have flap gates installed at the downstream end to prevent ingress of water from the Waikato River during high flows (see Figure 1).	

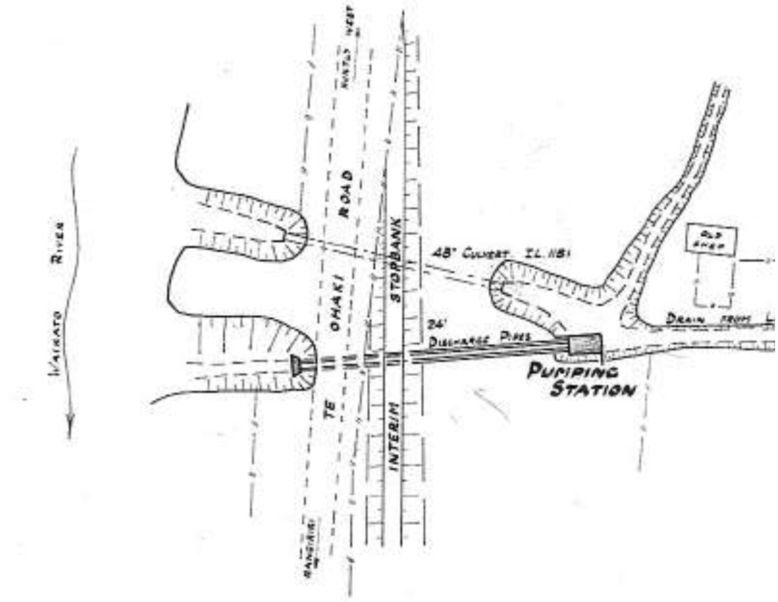


Figure 1: Site Plan Okowhao Pump Station.

Fish passage issues past the flap gated culvert
The drain and gravity fed culvert (Figure 2) allows water to flow naturally whenever downstream levels (i.e. the Waikato River) are lower than up levels. Under such conditions, downstream fish passage is possible, except that at very low flow there is usually not enough water pressure from upstream to keep the flap gate at the end of the pipe open (Figure 3). While the flap gate is closed, upstream fish passage is also not possible. To remedy this situation a fish-friendly flood gate needs to be installed (Figure 4).

This fish-friendly flap gate remains open at low flow, and has the added advantage of allowing good quality water to enter the upstream catchment until a pre-set trigger level allows the gate to close and prevent flooding.

Figure 2: Inlet of gravity flow outlet pipe at Okowhao Pump Station, February 2017. Photo: Taroi Rawiri, Waahi Whaanui

Figure 3: Outlet of gravity flow outlet pipe Okowhao Pump Station. Photo: Taroi Rawiri, Waahi Whaanui

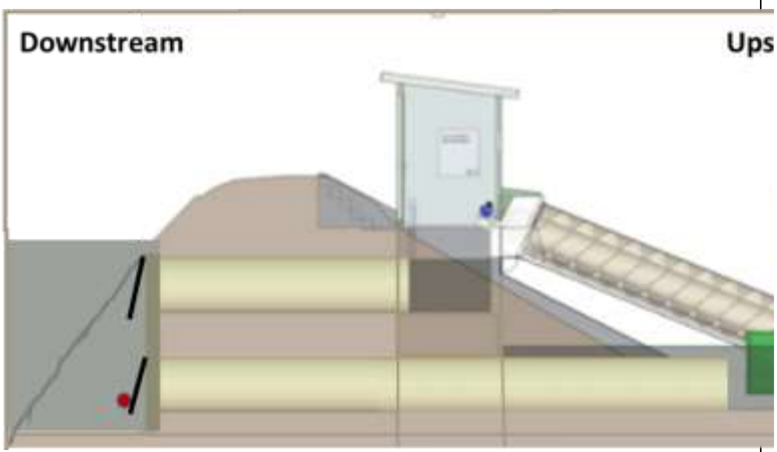
Figure 4: Example of a fish friendly floodgate. In this example, the float and lever arrangement allow a portion of the gate to remain open at levels below a pre-set maximum thus allowing unhindered upstream (and downstream) fish passage during periods of low flows.

Fish passage issues past the pump

When downstream levels are higher than upstream levels the only way of preventing flooding upstream is to pump the water over the stopbank. Currently, this is done by the existing axial flow (impeller/propeller) Flygt pumps. These pumps, unfortunately, have now been shown to kill or maim fish, especially larger tuna, attempting to pass through the pumps. Given that tuna migrate on floods to reach spawning sites at sea, at this site, while the gravity culvert outlet is closed, there is no free downstream passage.

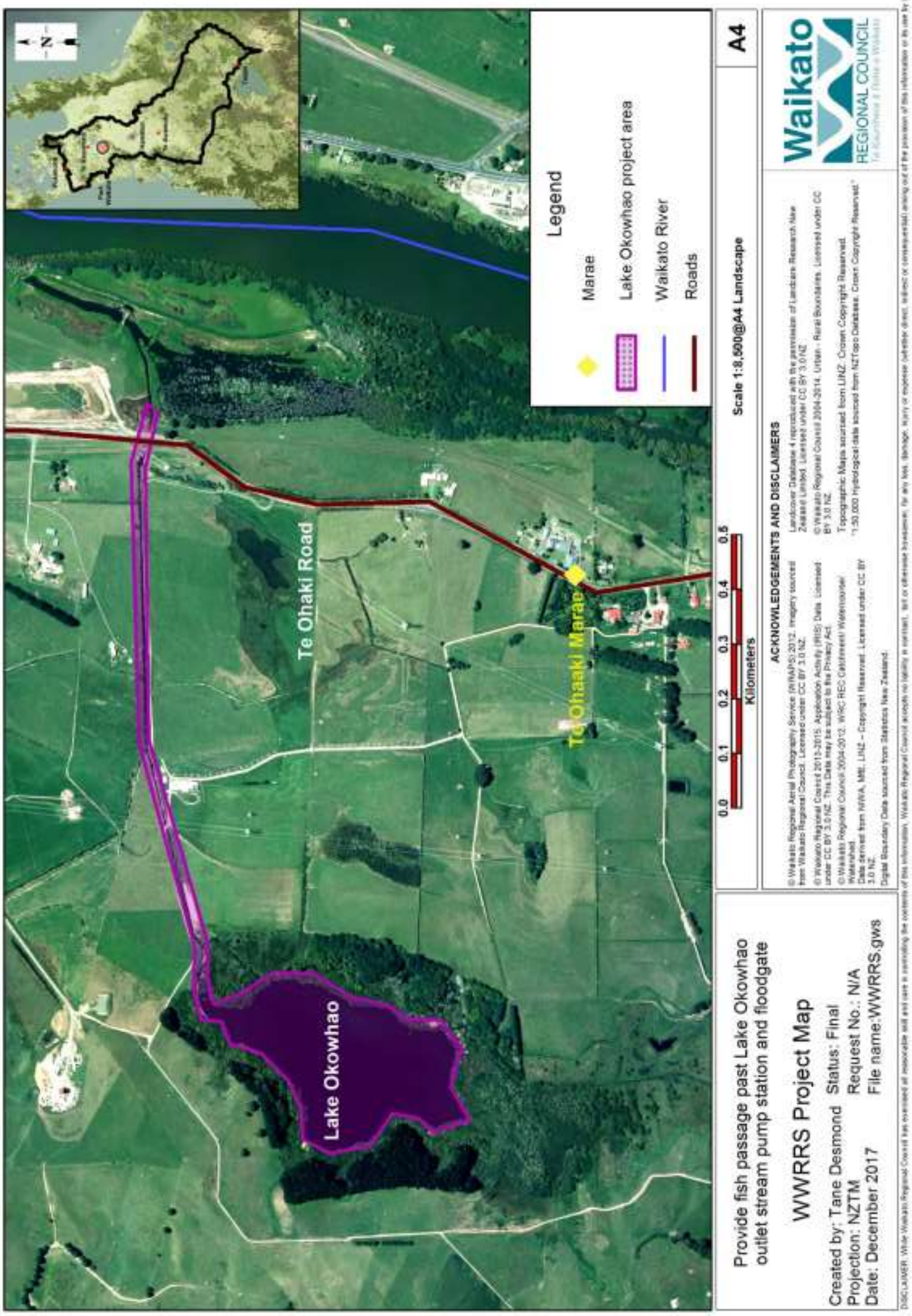
<table>
<tr><td></td><td>An alternative type of pump is therefore recommended.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- There are no manmade barriers to native migratory fish and there is an abundance of tuna in the lake.
- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition Lake Okowhao would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 6</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>The flood pump and floodgate are barriers to native fish migration</td><td>- Native fish are impeded from migrating between Lake Okowhao and the Waikato River.
- Reduced habitat available for tuna and other native migratory fish.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- Fish passage is provided past the floodgate and pump station between Lake Okowhao and the Waikato River.
- Lake Okowhao has an abundance of healthy tuna.</td><td></td></tr>
<tr><td>Works required</td><td>Suggested works should be implemented by an organisation that has engineering experience and experience in installing floodgates and pumps. It is envisaged that a project manager would be required to co-ordinate and manage aspects of the project, and work closely with Waikato Regional Council who are responsible for the flood control assets.

Installation of fish friendly floodgate
There are a number of fish-friendly flood gates on the market, and some investigation will be required to determine which one is best suited to this site. The estimated cost of purchasing and installing a fish friendly floodgate has been generously estimated at $64,000. This cost is based on importing a gate from the United States. A cheaper gate may</td><td></td></tr>
</table>

	be able to be sourced locally but further investigation is required. **Installation of fish friendly flood pump** Overseas work has shown that Hydrostal and Archimedes screw pumps can pass fish with minimal damage, but there are still some uncertainties regarding the ability of Hydrostat pump to pass large eels. The alternative Archimedes screw pumps, especially those with a shroud around the screw and installed on a float, are reputed to be not only fish-friendly but also less noisy, so less prone to trigger avoidance reaction in fish. This type of pump is recommended as replacement for the existing pumps at the Okowhao pump station (Figure 5). The Archimedes screw pump available from FishFlow technology in the Netherlands costs between €88,000 and €108,000 (NZ$135,000 to $165,000). This cost is excluding shipping, but includes mechanical installation (electrical installation and connection to the grid are additional). This cost assumes that the new pump can be connected to the existing pipework under Te Ohaaki Road. For the purpose of the Restoration Strategy, installation of a fish friendly flood pump (Archimedes screw pump) has been estimated to cost $180,000.  **Figure 5:** Concept diagram of a screw pump with variable level floating inlet and gravity flow culvert. **Monitoring** As this will be the first such pump station installed in New Zealand, the site will likely serve as a model for future pump replacement, not only in the Waikato but for the whole of the country. It is therefore important that detailed monitoring be undertaken to fully document installation and maintenance issues, as well as determine effectiveness. For this it is	

	recommended that fish surveys be undertaken prior to and after installation and that nets be installed on the outlet of the pump to document survival rate for at least one season. This work has not been costed as it is out of scope for the Restoration Strategy. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 3-year period, it is estimated that the majority of the project benefits would be seen approximately one year before project completion.	L = 2
Effectiveness of works	Lake Okowhao is currently in poor condition with very few of the Vision & Strategy desired state aspects being even partially met. There is not expected to be significant deterioration or improvement in the lake over the next 20 years in the absence of this project. Works included here address only the threats to the fishery in the lake, however it is anticipated that if the project is fully completed there will be improvements in both the fish ability and biodiversity of the lake and that these aspects will move closer to the Vision & Strategy desired state. This project does not address catchment land use, water quality, or other threats to the lake, but would benefit from being undertaken in conjunction with project L 8 for broader outcomes to be achieved.	W = 0.075
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. This technology has not yet been tested in the New Zealand environment. This project will need to be undertaken using qualified engineering expertise and in close consultation with Waikato Regional Council.	F = 0.82
Adoptability	This site is on publicly managed lands and therefore it is anticipated that works would be adopted if fully incentivised.	A = 1
Information quality	Very good – summary of work required is based on detailed advice of a fish ecologist and local experts.	
Knowledge gaps	Some additional investigation is required to confirm costs. This would need to be done in the early stages of project planning.	

Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early consultation on the potential impacts on drainage and flood control will be critical for the local community acceptance of this project.	P = 0.62
Project duration (years)	3 years	
Up-front cost – total for implementation phase/project duration	<table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Installation of fish friendly floodgate</td><td>64,000</td></tr><tr><td>Installation of fish friendly flood pump</td><td>180,000</td></tr><tr><td>Project management/staffing/incidentals (15%)</td><td>36,600</td></tr><tr><td>Total</td><td>280,600</td></tr></table>	C = 0.28



L 10		BCR value

Priority: Very high	Biodiversity enhancement of selected wetlands around shallow lakes	
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Wetlands are protected, enhanced and where feasible expanded and re-established Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.	
Name of feature	Wetlands around Lakes Hakanoa, Rotongaro and Rotongaroiti, Waahi and Waikare	
Brief description of feature	Lake Rotongaro and Lake Rotongaroiti are located within a predominantly pastoral catchment northwest of Huntly township. Lake Rotongaro is 292ha in size and Rotongaroiti is 53ha in size. The lakes are connected via a small channel and both lakes are within the Lake Rotongaro Wildlife Management Reserve managed by Department of Conservation. Wetland vegetation is present around the margins of the lakes and in seasonally damp hollows within the catchment. There are large areas that are dominated by grey willow, however, indigenous species are common beneath. A regionally significant area of mānuka scrub is located at the southwestern corner of Lake Rotongaro. There are historic pā tuna along the streams from these lakes. Lake Waahi is a 522ha riverine lake located west of Huntly. It features two significant wetland areas, the Waikokowai Wetland on the western arm of the lake (55ha), and the southern wetland alongside Rotowaro Road (137ha). Both wetlands are dominated by a canopy of willow, but feature a native understorey of sedges and shrubs. Mānuka shrubland and raupō are also present in some parts. Lake Waahi historically provided many tuna (eels) for the iwi and marae. It was known as a great provider of kai (food) for the marae and was a regular stopover during journeys between the west coast and the Waikato River. Lake Waikare is the second largest lake in the Waikato catchment (after Lake Taupō) and is 3442ha in size. It is located southeast of Te Kauwhata township and is connected to the Whangamarino Wetland by the Pungarehu Canal. Lake Waikare historically sustained many marae and holds the kōiwi (bones) of Waikato ancestors killed in the Waikato invasion at Rangiriri. The lakebed is held in the title of the first Māori King, Pōtatau	

	Te Wherowhero, so that the bones of the tribe's people are protected in his name. Lowering of the lake level by the Lower Waikato Waipā Flood Control Scheme and drainage of land for pastoral farming has resulted in the loss of vast areas of wetland habitat around the lake. Significant wetland areas remain on the southwest margins of the lake and many wetland restoration projects have been completed or are underway in areas around the lake. The southeastern margin of the lake has been identified as a location where wetland enhancement and further creation could be undertaken. The approximate size of this area is 10ha. Lake Hakanoa is a riverine lake located east of the Waikato River in Huntly. It is 52ha in size and part of a 73ha wildlife refuge reserve administered by the Department of Conservation. There is also a small area of Local Purpose Reserve land administered by Waikato District Council. Lake Hakanoa was named after the lifting of the rahui (prohibition) that allowed the regeneration of tuna (eels) within the lake. This was undertaken through a ceremony of noa, which makes the lake available for normal or common activities. A haka was performed to lift the tapu, therefore returning the lake to a noa (common) state, hence the name Haka-noa. The lake has extensive areas of riparian wetlands mainly located to the south and east of the lake. One of these is an 11ha wetland in the southwest corner of the lake. The wetland is currently dominated by willows but has the potential for restoration into a native dominated ecosystem. These wetlands have been identified as a priority as despite being significantly degraded sites they still retain high wetland ecosystem values. They have high potential for restoration and fit with the goals of the Restoration Strategy. All of these lakes are culturally significant to iwi, hapū and marae as they provided food, recreation and in some instances hold the kōiwi (bones) of the people involved in the wars triggered by the invasion of the Waikato.	
Desired state to achieve Vision & Strategy	- The selected wetlands are fenced to exclude stock and have a natural functioning hydrology. - Native fish are abundant and open water areas are fishable and have access for recreation and collection of kai. - Iwi and communities have a strong connection to the wetlands and are active in their use, protection and restoration.	

<table>
<tr><td></td><td>- Wetlands are dominated by native plant communities and native plant regeneration occurs naturally.
- Where wetlands provide habitat for native fauna these values are preserved e.g. native mudfish habitat</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the wetlands around these selected shallow lakes would have a high impact on giving effect to the Vision & Strategy at a shallow lakes catchment level.</td><td>VS = 35</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access</td><td>Reduced water quality and destruction of wetland vegetation through trampling, grazing and introduction of weeds.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities.</td></tr>
<tr><td>Land drainage</td><td>Lowers water levels and degrade the ecosystem.</td></tr>
<tr><td>Vegetation clearance</td><td>Destroys wetland ecosystems</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 2 years of the project commencing, wetlands are 100% fenced to exclude stock.
- Within 10 years, wetlands identified at Lake Hakanoa, Lake Waikare, Lake Rotongaro and Rotongaroiti are dominated by native plant communities, and native plant regeneration occurs naturally.
- Within 20 years, weed species (with the exception of willow) present at Lake Waahi make up less than 10% of the vegetation cover and there is a more natural hydrological regime within the surrounding wetlands.</td><td></td></tr>
<tr><td>Works required (by whom)</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Management plan development
Management plans should be developed for the sites at Lake Waikare, Lake Hakanoa and Lake Waahi. The estimated cost of this is up to $10,000 per lake ($30,000).

<u>Lake Rotongaro and Rotongaroiti</u>
A vegetation assessment and management plan has been undertaken for these lakes by Wildland Consultants (2013) in the document titled “Vegetation Assessment of Lake Rotongaro Wildlife Management Reserve”. Anyone interested in this document should contact the Department of Conservation.</td><td></td></tr>
</table>

	Restoration work should be undertaken in accordance with Wildland's recommendations and the estimated costs provided below are based on these (excluding work that has already been undertaken on the Kerr property). Some of the estimated costs provided below are more generous than those provided in the Wildland report but are consistent with standard costs used throughout the Restoration Strategy. **Fencing** <u>Lake Rotongaro and Rotongaroiti</u> Fencing should be undertaken in locations recommended in the Wildland report. Fences should be a minimum of 20m back from the lakes and a minimum of 5 wire (2 electric) for cattle and 7 wire post and batten for sheep. - It is estimated that 8.4km of fencing and/or fence upgrade is required at $8 per metre ($67,200). <u>Lake Hakanoa wetland</u> The boundary of the wetland should be fully fenced to a stock proof standard (a 5 wire fence with 2 electric wires at a minimum). - It is assumed that approximately 1.2km of new fencing or fence upgrade is required at $8 per metre ($9600). <u>Lake Waahi wetlands</u> Fencing should be undertaken to exclude stock from the two main wetland areas. - Waikokowai wetland – 1km fencing with 5 wire required at $8 per metre ($8000) - Southern wetland – 1km fencing with 5 wire required at $8 per metre ($8000) <u>Lake Waikare wetland</u> Up to 5km of fencing at $8 per metre is expected to be required to exclude stock from this site ($40,000) **Willow removal** <u>Lake Rotongaro and Rotongaroiti</u> Willow removal should be carried out in accordance with the recommendations made by Wildland. - Approximately 9.3ha of willow control is required using ground based methods at $4000 per hectare ($39,320). <u>Lake Waahi</u>	

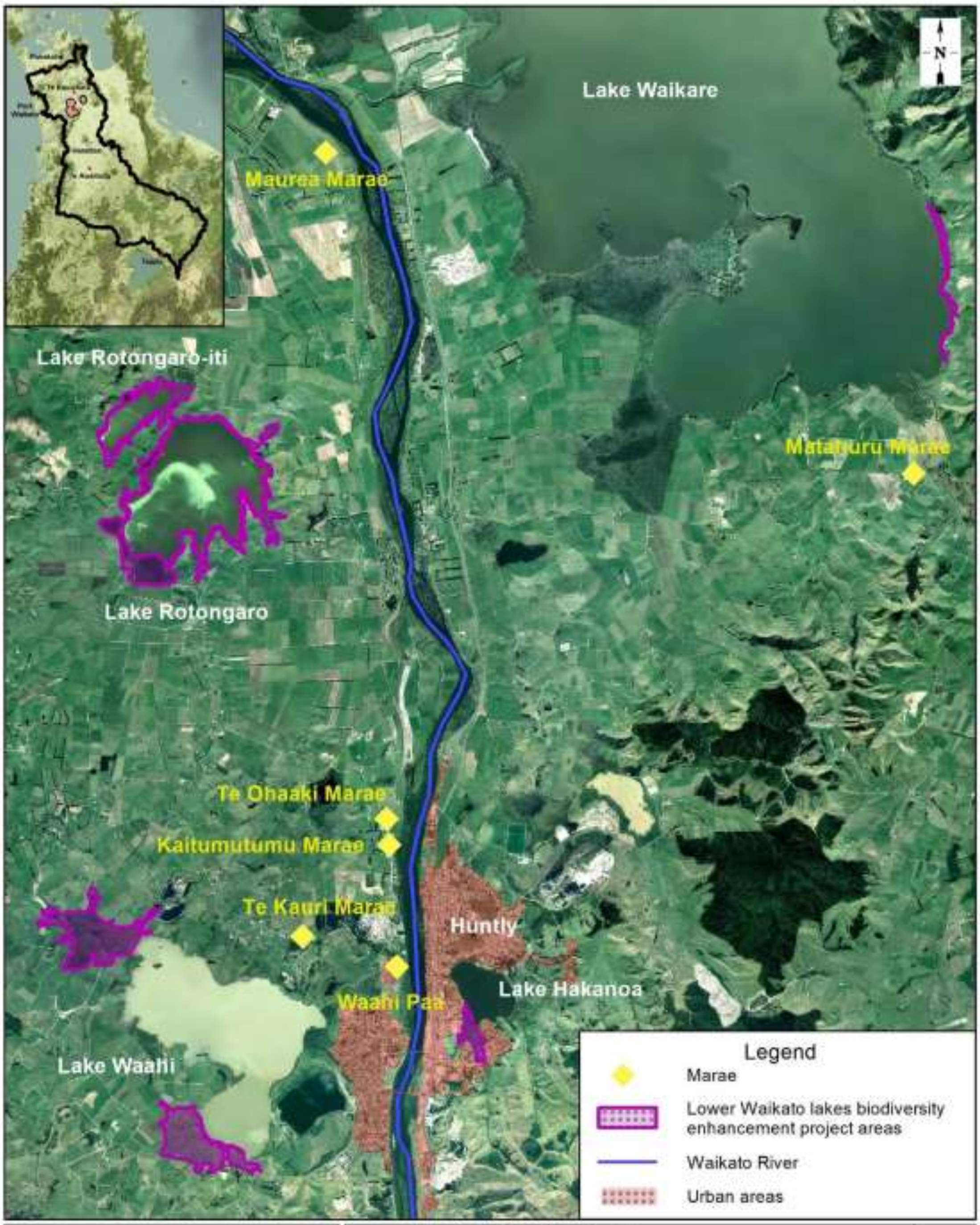
	Large scale willow removal is not recommended for this site but willow should be contained within the current areas (see weed control section below). Lake Hakanoa wetland A staged approach to willow control should be undertaken at this site and willows gradually poisoned over time as native plants establish beneath them. Ground based control of willow is estimated to be approximately $4000 per hectare over an 11 hectare area plus $2000 per hectare for follow-up maintenance ($66,000). **Planting** Lake Rotongaro and Rotongaroiti Native planting should be carried out in accordance with the recommendations made by Wildland. - It is estimated that 41ha of re-vegetation is required at a cost of $37,552 per hectare (including site preparation, plant purchase, planting labour and five releasing events) ($1,540,758) Lake Hakanoa wetland It is recommended that weed control and planting be undertaken in stages at this site by leaving willow trees in place, undertaking targeted weed control and planting, allowing native plants to grow up through the willows and then selectively poisoning willows over a 20-year period. It is assumed that native planting is required over approximately 25% of the 11ha site (2.75ha) at $37,552 per hectare ($103,268). This includes site preparation, plant purchase, planting labour and five releasing events. Lake Waahi Native planting should be undertaken within the fenced area where there is currently no native vegetation and where native regeneration is not expected to occur naturally following fencing: - Waikokowai wetland – 10ha of native planting within open and weed control areas (assuming 20% of wetland requires planting at $37,552) is $375,520. - Southern wetland – 15ha of native planting within open and weed control areas (assuming 10% of wetlands requires planting) is $536,280. Lake Waikare wetland	

	The exact quantity of native planting required at this site is unknown as it will depend of what native regeneration occurs naturally. For the purpose of the Restoration Strategy a cost estimate is provided based on planting 80% (7.8ha) of the site at $37,552 per hectare ($292,905). **Weed Control** Lake Rotongaro and Rotongaroiti Weed control should be carried out in accordance with the recommendations made by Wildland. - Royal fern control across 8.4ha at $502 per hectare ($4216). - Wattle/pine control across 0.7ha at $3000 per hectare ($2,100). Lake Hakanoa wetland A comprehensive weed control plan will be essential to ensure success of this project and should be undertaken as part of the management plan for the site. Exact costs associated with undertaking weed control are unknown but for the purpose of the Restoration Strategy the following estimates have been made: - $2800 per hectare three times per year over two years in order to establish weed-free areas in preparation for native planting ($92,400). - Additional weed control following native plant establishment is estimated at $700 per hectare (11ha) every year for 13 years ($100,100). Lake Waahi Weed control is required to promote regeneration of native species and enhance biodiversity around the wetland margins. It is accepted that willow will always be a dominant component of these ecosystems, and thus widespread willow control is not considered. However some willow control has been allowed for within the weed control costings below. - Waikokowai wetland – 10ha of weed control (assuming 20% of wetland requires control) at an estimated cost of $2800 per hectare per year (using knapsack spray methods) over three years ($84,000). - Southern wetland – 15ha of weed control (assuming 10% of wetlands requires control) at an estimated cost of $2800 per hectare per year (using knapsack spray methods) over three years ($126,000). Lake Waikare wetland	

	Exact costs associated with undertaking weed control are unknown but for the purpose of the Restoration Strategy the following estimates have been made: - The 7.8ha that is planted will require weed control for a period of three years following native plant establishment. This could be undertaken using a combination of knapsack spraying and use of a spray unit on a vehicle (estimated to cost $2100 per hectare per year). Spraying would be required over a three year period ($49,140). **Hydrological reinstatement** Hydrology could be reinstated to sections of some wetlands by blocking off historic drainage routes and constructing low earth bunds in key locations. Longer water retention times in the wetland will reduce the occurrence of pest plants including willow, improve overall wetland habitat, and act to retain some sediment from the catchment. Lake Waahi - Waikokowai wetland – 500m of earth bunding ($5000). - Southern wetland – 500m of earth bunding ($5000). Lake Waikare Some earthworks may be required to infill drains and reinstate a more natural hydrological regime and restore the wetland margin. The exact extent and cost of this is unknown but for the purpose of the Restoration Strategy a cost of $6500 has been estimated which allows for one week of digger time. Resource consent fees Resource consent may be required for hydrological reinstatement work. This is estimated to be no more than $5000 per lake site ($10,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 13 years after project commencement.	L = 13

Effectiveness of works	These wetlands are currently in poor to moderate condition when compared to desired state. This is not expected to change significantly over the next 20 years in the absence of this project given existing measures that are in place such as the Dairy Water Accord, and the fact that some of the sites are already very degraded. However, if this project is successfully completed then it is expected that wetland condition in 20 years will be significantly closer to the desired Vision & Strategy state than it is currently. This project addresses the many of the aspirations for these features and wetland condition can be expected to move to moderate to good as a result of this project.	W = 0.3
Risk of technical failure	There is a moderate to high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and undertaken by experienced operators. This project would benefit from Project CLW 9 (control of yellow flag iris and alligator weed) being undertaken concurrently.	F = 0.8
Adoptability	It is estimated that about three-quarters of landowners would adopt the works if they were fully incentivised. Works on publicly owned land are expected to be fully adopted. Some private landowners may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands, and the value of wetlands in general, are becoming better recognised. There are also currently landowners around these lakes that are undertaking similar projects and these farmers can be good advocates to others in their catchments.	A = 0.75
Information quality	Average – recommendations are based on the judgement of a wetland ecologist with local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs and information taken from a recent survey of Rotongaro and Rotongaroiti Reserve.	
Knowledge gaps	Further work is required to determine the specific amounts of fencing, planting and weed control required. This should be undertaken in the early stages of project planning.	
Socio-political risks	There is low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	20 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Development of management plans</td><td>30,000</td></tr>
<tr><td>Fencing</td><td></td></tr>
<tr><td>- Lake Rotongaro and Lake Rotongaroiti (8.4km)</td><td>67,200</td></tr>
<tr><td>- Lake Hakanoa wetland (1.2km)</td><td>9,600</td></tr>
<tr><td>- Lake Waahi wetlands (2km)</td><td>16,000</td></tr>
<tr><td>- Lake Waikare wetland (5km)</td><td>40,000</td></tr>
<tr><td>Native planting</td><td></td></tr>
<tr><td>- Lake Rotongaro and Lake Rotongaroiti (41ha)</td><td>1,540,758</td></tr>
<tr><td>- Lake Hakanoa wetland (2.75ha)</td><td>103,268</td></tr>
<tr><td>- Lake Waahi wetlands (25ha)</td><td>536,280</td></tr>
<tr><td>- Lake Waikare wetland (7.8ha)</td><td>292,905</td></tr>
<tr><td>Willow control</td><td></td></tr>
<tr><td>- Lake Rotongaro and Lake Rotongaroiti (9.3ha)</td><td>39,320</td></tr>
<tr><td>- Lake Hakanoa wetland (11ha)</td><td>66,000</td></tr>
<tr><td>Weed control</td><td></td></tr>
<tr><td>- Lake Rotongaro and Lake Rotongaroiti</td><td>6,316</td></tr>
<tr><td>- Lake Hakanoa wetland</td><td>192,500</td></tr>
<tr><td>- Lake Waahi wetlands</td><td>210,000</td></tr>
<tr><td>- Lake Waikare wetland</td><td>49,140</td></tr>
<tr><td>Hydrological reinstatement</td><td></td></tr>
<tr><td>- Lake Waahi wetlands</td><td>10,000</td></tr>
<tr><td>- Lake Waikare wetland</td><td>6,500</td></tr>
<tr><td>- Resource consent fees</td><td>10,000</td></tr>
<tr><td>Project Management/staffing/incidentals (30%)</td><td>967,736</td></tr>
<tr><td>Total</td><td>4,193,523</td></tr>
</table>
</td>
<td>C = 4.19</td>
</tr>
</table>



Biodiversity enhancement of selected wetlands around shallow lakes

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:75,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL

Willow wetland at Lake Hakanoa with native plant understorey beneath willow trees.

Willow wetland at Lake Waahi.

Lake Waikare’s eastern shoreline, where wetland restoration is recommended.

L 11 Priority: Very high	**Water quality and habitat enhancement at Lake Whangape**	**BCR value**
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high natural environments.	
Name of feature	Lake Whangape	
Brief description of feature	Lake Whangape is the second largest lake (1450ha) in the lower Waikato River catchment and is associated with about 910ha of marginal wetlands, including the Awaroa Swamp and a large private wetland (Beverland Wetland). A large proportion of the lake and adjoining wetland is public conservation land (1330ha). It is located to the west of SH1, and is a short distance from Rangiriri. Lake Whangape was historically used to capture tuna (eels) to sustain the iwi. The raupō edges provided materials for clothing and baskets. Its surrounding wetlands supplied rongoā (medicine), birds, trees for general use, dyes and an area for enjoyment. The lake is shallow (mean depth of 1.5m) but varies considerably in size between about 9.5km^2 to 21km^2 depending upon water levels. The lake has a short residence time of 1.5 to 2.5 months, and connects with the Waikato River via the Whangape Stream. Lake Whangape receives water from a 35,000ha catchment to the west of the lake that includes steep hill country (upper catchment), moderately steep and strongly rolling hills (middle catchment) and flat to rolling land in the lower parts. The land is predominantly pasture with small areas of native bush and some forestry. Land use is mainly sheep and beef with dairy grazing on the rolling and flat land. Peat has formed around many parts of the lake which has been impacted by drainage and lowering of water tables in recent decades. Lake Whangape and its adjoining wetlands and lowland forests are identified within the DOC Waikato Conservation Management Strategy as being key wetland sites within the region. District and regional planning has identified the wetlands adjoining Lake Whangape as being of national or regional significance. Of note are 32ha of seasonally flooded kahikatea forest, the second largest forest of this type	

	remaining in the Waikato ecological region, and extensive and diverse amphibious turf (small stature) plant communities on the lake margin which contain several threatened plant species. Recent analyses of water quality data collected by Waikato Regional Council between 2002 and 2016 indicate that: - the lake has low water quality and supports high algal biomass that regularly exceeds recreational guideline levels - the minimum annual water clarity is 0.2m and was highest in 2004 with 0.6m - there is high inter-annual variability of chlorophyll a and nutrient (TP and TN) concentrations which are consistently higher than the national bottom line values. Despite the degradation in water quality, Lake Whangape continues to support a diverse range of flora and fauna, including nationally important threatened species. It also retains important cultural and recreational values. Public access to the reserves is available at five locations and there are three boat launching sites. It is popular for game bird hunting. Lake Whangape is identified as a priority 1 waterbody for stock exclusion in the Waikato Regional Plan. Whilst sections of the lake and wetlands are well fenced (e.g. Awaroa swamp) there are large areas that remain unfenced as large fluctuations in water levels (>2m), topography and geology of the lake shore make fencing particularly challenging. To date WRC and DOC have worked with landowners to fence about 10km of the lake along a boundary that supports the health of the lake while trying to minimise ongoing fence maintenance from flood inundation. Alligator weed is both aquatic and terrestrial in the Waikato region and is classified under Waikato's Regional Pest Management Strategy as an 'eradication pest plant'. It is of limited distribution and is a high threat to the region, environmentally and economically. Lake Whangape has been identified as a source site for dispersal of the weed into the lower Waikato catchment. Control of alligator weed has been impeded by continued stock grazing of seasonally inundated land around Lake Whangape. Any restoration of the lake margins at Lake Whangape needs to address management of alligator weed.	

<table>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition Lake Whangape would have a very high impact on giving effect to the Vision & Strategy at a shallow lakes and central and lower Waikato catchment level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species. Direct inputs of nutrient and microbes into lakes.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture. Alligator weed is a particular problem at Lake Whangape, occupying large areas of shoreline habitat and spreading into adjoining farmland.</td></tr>
<tr><td>Further drainage and clearance of native wetland vegetation.</td><td>Reduced habitat for native plants and animals and game birds. Loss of nutrient attenuation areas, and loss of wetland areas to slow flood flows.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years:
- Lake Whangape and the adjoining wetland are 100% fenced and protected from stock.
- 12 hectares of lake marginal habitat has been revegetated. Willow and other ecosystem changing weeds have been reduced to < 5% of their current abundance in high value wetlands adjoining Lake Whangape.
- Alligator weed within Lake Whangape has been reduced to an area that can be contained.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in collaboration with DOC. This project could be undertaken as a whole, or in multiple smaller components. Note: Some costings for this project differ from standard cost assumptions. This is due to more detailed knowledge of the site and management requirements at Lake Whangape. **Fencing** This project proposes to fence Lake Whangape close to the high water level where it adjoins pasture, and around wetlands and lowland forest where they adjoin the lake. This will involve 22.5km of new fencing at $25 per metre ($562,500) and upgrading a 3.6km stretch of fencing at $11 per metre ($39,600) that does not effectively exclude stock in its current state. Fully fencing the lake margin is crucial to achieving containment of alligator weed at Lake Whangape. **Alligator weed control** Land based control of yellow flag iris and alligator weed around Lake Whangape (Additional to existing WRC programme). - Years 1, 2, 3 – two contractors for 10 days per year ($1000 per day). - Years 4, 5, 6 – two contractors for 5 days per year. Total: $45,000 over 6 years. **Weed and willow control** There are a number of other weeds that are progressively impacting on the integrity of littoral and wetland plant communities adjoining Lake Whangape. These include grey willow, crack willow, yellow flag, blackberry, reed sweet grass and royal fern. This project involves controlling these weeds in areas of highest conservation values (e.g. Tikotiko Arm, Awaroa Wetland, Beverland Wetland). The objective is to reduce them to very low levels over the five years so that any ongoing control is of a scale that can be sustained by landowners, including DOC. The following works are proposed: Aerial willow control of 66ha of wetland habitat (with sparse native understorey) is required at $1200 per hectare	

	($79,200), with ground based control in following year at $400 per hectare ($26,400). Ground based willow control of 40.24ha of high value wetland habitat at $4000 per hectare (low-high willow density) ($160,960) with follow-up control in following year at $400 per hectare ($16,096). Ground based control of ecosystem changing weeds (e.g. yellow flag iris, blackberry, reed sweet grass and royal fern) over 37.91ha of high value wetland habitat at $2800 per hectare ($106,148), with follow-up control in following year at $400 per hectare ($15,164). **Planting of lake shoreline** Planting of the lake shoreline involves supplementary planting of 12.02ha of lake margin including adjoining wetlands and is estimated to require 53,500 native plants. Assumes planting at 1.5m spacing. 7.02ha of pasture to be planted at $37,552 per hectare ($263,615) and 5ha of weedy site to be planted at $39,552 per hectare ($197,760). Follow-up weed control for two years at $800 per hectare ($9616). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	When compared with desired state Lake Whangape is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, and the presence of pest fish and exotic plant species impacts significantly on ecological integrity. The very poor water quality is an impediment to safe recreational use of the lake. However, the lake still retains very high significance with iwi and the local community, and retains very important cultural and biodiversity values. In particular, it has a good contiguam of ecosystem types, which is now rare for a Lower Waikato	W = 0.1

	lake. Some decline in condition is expected over the next 20 years in the absence of this project due to the impact of alligator weed at the site. This project will address stock access and pest plant issues and is expected to improve biodiversity values at the lake. It is not expected to improve lake water quality. It is acknowledged that achieving the Vision & Strategy desired state for Lake Whangape will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives. However, this project will move the lake closer to this state by making significant improvements to surrounding wetlands and lake margins.	
Risk of technical failure	There is a moderate to high risk of project failure due to technical feasibility. Risks are mostly related to weed control. There is a particularly high risk of project failure due to technical feasibility if weed control isn't well planned and undertaken by experienced operators. This project would benefit from Project CLW 9 (control of yellow flag iris and alligator weed) being undertaken concurrently.	F = 0.7
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. Works on publicly owned land are expected to be fully adopted. Some private landowners may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming better recognised. There are also currently landowners around the lake that are undertaking similar projects and these farmers can be good advocates to others in the catchment.	A = 0.5
Information quality	Very good – recommendations are based on advice of a trusted local expert with detailed on-the-ground knowledge. Department of Conservation and Waikato Regional Council staff who have worked at this site were consulted about what further work was required to enhance surrounding wetlands.	
Knowledge gaps	Some of the weed control and planting work has been estimated from aerial photographs. Specific requirements will need to be assessed during project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (26.1km)</td><td>602,100</td></tr>
<tr><td>Alligator weed control</td><td>45,000</td></tr>
<tr><td>Willow control</td><td>282,656</td></tr>
<tr><td>Targeted weed control of other weeds</td><td>121,312</td></tr>
<tr><td>Planting of lake shoreline (12.02ha)</td><td>470,991</td></tr>
<tr><td>Project Management/staffing/incidentals (20%)</td><td>304,412</td></tr>
<tr><td>Total</td><td>1,826,471</td></tr>
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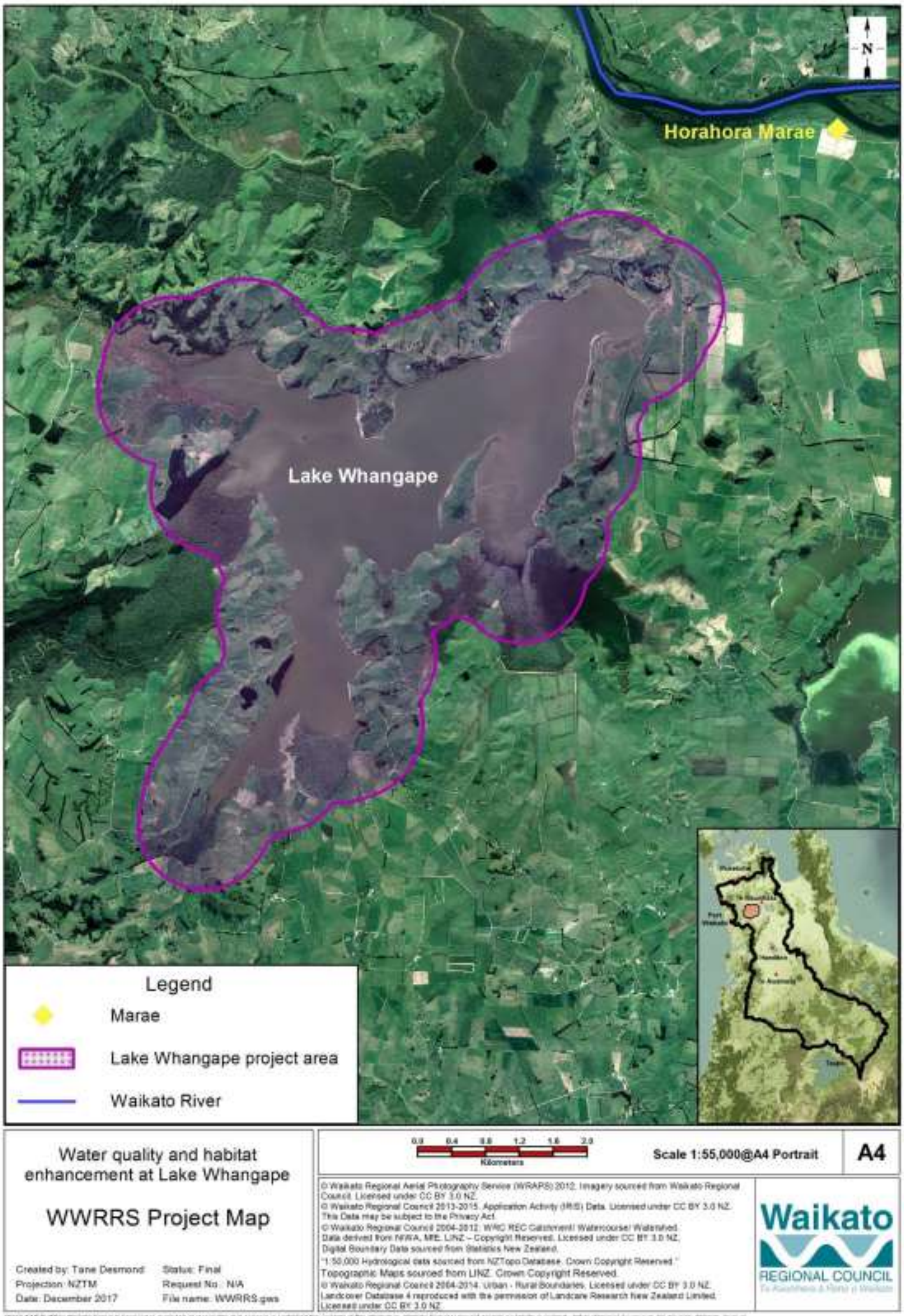
<td>C = 1.83</td>
</tr>
</table>


Horahora Marae
Lake Whangape
N
Legend
Marae
Lake Whangape project area
Waikato River
Water quality and habitat enhancement at Lake Whangape
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.4 0.8 1.2 1.6 2.0
Kilometers
Scale 1:55,000@A4 Portrait
A4
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Waikato
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Ineffective fence on the lake margin at Lake Whangape.

Alligator weed on the edge of the lake (by back the hooves of the front cow) gets trampled and spread around the lake margin at Lake Whangape.

Unfenced lake margins result in destruction of littoral vegetation, lakeshore erosion, spread of alligator weed and faecal contamination from stock.

Some of the high value wetlands and lowlands forests in the Tikotiko Arm that are contiguous with Lake Whangape.

L 12 Priority: Very high	Water quality and habitat enhancement at Lake Waahi	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Innovative interventions are developed, tested and implemented to improve lake values, including options such as flocculants, dredging and enhancing lake embayments. Communities have plentiful, safe access to lakes for a range of recreational purposes, including safe contact and immersion in water and food gathering. Projects on lakes are prioritised according to cultural significance, ability to improve and ability or appropriateness to access. Nutrient, sediment and *E. coli* inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality and so that it is safe for swimming and gathering of taonga species. Catchment management programmes protected and enhance priority shallow lakes and their catchments Flagship lakes catchments are established for educational and promotion purposes.	
Name of feature	Lake Waahi	
Brief description of feature	Lake Waahi is the third largest lake in the Lower Waikato catchment with a surface area of 522ha. It has a maximum depth of 5m and a catchment area of 9407ha. The lake is situated to the west of Huntly township, within a predominantly pastoral catchment. It receives inflows from a range of sources including Awaroa Stream and the much smaller Waikokowai Stream. A coal haulage road was constructed across the northwestern end of Lake Waahi in 1977, dissecting the northwest arm of the lake, and restricted water movement between the arm and the main body of the lake. Diffuse and direct discharges from coal mining have contributed large quantities of suspended sediments to Lake Waahi which have altered the colour, clarity and chemistry of the lake's water. Coal mining was reportedly responsible for up to 90% of the sediment entering the lake at times (Dell 1988). A significant shift in the lake water quality was observed after the lake aquatic vegetation collapsed in 1978-79,	

	causing the waters of the main body of the lake to become highly turbid. Waikato Regional Council has monitored the water quality of Lake Waahi regularly since September 1995. In addition, a lake monitoring buoy was installed in Lake Waahi in 2014 to collect real-time information about the physico-chemical conditions (and dynamics) within the lake. The most recent monitoring results indicate that Lake Waahi is currently supertrophic, with low water clarity, high nutrient levels and high phytoplankton density. Blue-green algae have also become abundant in recent years. Analysis of recent data indicates that between 2006 and 2010 there has been a probable decline in the trophic state of Lake Waahi (WRC 2012). During the most recent LakeSPI survey in 2010, the lake was mostly devegetated and supported only sparse milfoil fringes (<5% cover) at depths of <0.3m (Edwards et al. 2010). This survey recorded a further decline in the extent of offshore stands of reeds (*Eleocharis sphacelata*). Poor aquatic plant regeneration levels have been attributed to the shallow nature of the lake, poor water clarity due to sediment re-suspension, and low levels of seeds. Numerous planting and fencing initiatives have been undertaken around the lake over the last decade or more. This has involved a large number of contributors, including landowners, WRC, Solid Energy, WCEET, WRA, Waikato-Tainui, Waahi Whanui and Genesis Energy. Native species known from the lake include shortfin eel, longfin eel, giant kōkopu, kōaro and grey mullet. Exotic species include koi carp, goldfish, rudd, perch and catfish. Koi and rudd in particular limit the regeneration of aquatic macrophytes. Tuna have been commercially fished in the past, although the productivity of the fishery has declined significantly. The Lake Waahi tuna fishery is also very culturally significant, with an important traditional eeling site located on the Waahi outlet stream. Lake modelling of Lake Waahi in 2017 has identified that algal blooms in the lake are most likely driven by internal release of phosphorus that has accumulated over time in the lake. Phosphorus in the lake sediments is released into the overlying lake water whenever the lake is depleted of oxygen, which occurs frequently during the	

<table>
<tr><td></td><td>summer and autumn months. Sediment resuspension from wind and the impacts of pest fish also negatively impact on lake water quality.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Waahi would have a very high impact on giving effect to the Vision & Strategy at a shallow lakes and central and lower Waikato catchment level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr>
<tr><td>Exotic fish</td><td>Prevent the re-establishment of self-sustaining native macrophyte beds. Increase resuspension of lake bottom sediments and nutrients.</td></tr>
<tr><td>In-lake nutrient load</td><td>Phosphorus is released from lake sediments when there are anoxic events, which can lead to algal blooms that affect the use of the lake for recreation.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement water quality has measurably improved in Lake Waahi.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

Reduce external sediment load

Reducing sediment and phosphorus entering the lake is considered to be a high priority for the long term improvement of water quality in Lake Waahi. The upper catchment (Upper Awaroa) recommended works are detailed in a separate project assessment (total value $2,329,610). Recommendations for the remainder of the lake catchment are as follows:

<u>Hill country soil conservation</u>

- 41ha LUC 6e land managed with open space pole planting at $3000 per hectare ($123,000)
- 41ha LUC 6e land managed with plantation species (pine or mānuka) at $3000 per hectare ($123,000)
- 10km of fencing the managed LUC 6e land at $25 per metre (8-wire and batten) ($250,000)
- 3km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($75,000).

<u>Riparian management of rivers/streams in pasture for reducing erosion</u>

Costs for fencing are based on a 5-wire (2 electric), however in flood prone streams a 3-wire electric fence would also be acceptable.

Carry out riparian fencing with a minimum 5m setback from the top of the streambank along an estimated 33km of streambank ($8 per metre is $264,000). Include adjoining wetland areas within the riparian fencing. Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 13ha of planting, and associated weed control and maintenance ($37,552 per hectare is $488,176). 2976 willow poles are estimated to be required for river and stream erosion control ($14 per pole is $41,664). These should be planted a 10m intervals in erosion prone reaches.

Addition of flocculent to lake inflow

This project involves reducing phosphorus in Lake Waahi using continuous alum dosing, a highly effective method for removing phosphorus from freshwater systems. Continuous alum dosing is currently being employed by the Bay of Plenty Regional Council to help meet water

	quality targets for lakes Rotorua, Rotoehu and Okaro. Before this is undertaken at Lake Waahi, further trials are required to determine the likely effectiveness of this technique in Waikato lakes. Continuous alum dosing involves pumping low levels of alum (the chemical, aluminium sulphate) into major lake inflows. It requires a small facility to safely store alum close to the site and some method for dispensing the alum (e.g. chemical pump). At Lake Waahi. works and costs are estimated as follows: - Pump shed and pump (\$150,000) - Resource consent and consultation (\$50,000) - Investigations for establishing appropriate dose rate (\$100,000) - Dosing at \$600,000 per year for 5 years (\$3,000,000). This includes the ongoing monitoring to determine that dose rates are appropriate. After a 5-year period the programme should be reassessed to determine the cost-effectiveness of continuing. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 15% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 7-8 years after project commencement.	L = 7.5
Effectiveness of works	When compared with desired state, Lake Waahi is currently in poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable but it is sometimes fishable and access for recreation is good. The lake retains very high significance with iwi and the local community, as well as some important wetlands and biodiversity values. The lake is not expected to change in overall condition over the next	W = 0.15

	20 years in the absence of this project. This project will help address catchment sediment load and reduce internal P loading. It will also have secondary biodiversity benefits. Modelling undertaken by the University of Waikato in 2017 indicates that this work would move chl in the lake close to the National Objectives Framework C band and improve water clarity. There would be significant benefits to this project being carried out in alignment with Lakes project L13. It is acknowledged that achieving the Vision & Strategy desired state for Lake Waahi will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives. However, this project is expected to lead to a measurable improvement in lake condition over the next 20 years.	
Risk of technical failure	There is a moderate to high risk of project failure due to technical feasibility. The highest risk component of the project relates to the alum dosing which has not yet been proven in a shallow lake in New Zealand. This work should not be attempted until smaller laboratory and field based trials have shown that it will be effective (see section on investigation priorities).	F = 0.80
Adoptability	Works on publicly owned land are expected to be adopted if fully incentivised. There is uncertainty around the willingness of private landowners to sell land for wetland and constructed treatment system development. This would need to be confirmed before the project was initiated. Uptake of management of LUC class 6e and 7 land and riparian retirement may be low, and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.	A = 0.6
Information quality	Good – the lake is well known and has recently been the subject of detailed modelling by the University of Waikato. Estimates for reducing external sediment and phosphorus come from a desk top exercise.	
Knowledge gaps	There is uncertainty around the effectiveness of continuous alum dosing where koi carp are present. Trials should first be undertaken in a smaller lake or lake embayment.	
Socio-political risks	Moderate to high risk that the project will fail to meet its goals over the long term due to socio-political risks. This relates to the proposed use of alum which may not be acceptable to iwi, stakeholders and community. Early	P = 0.62

<table>
<tr><td></td><td>engagement with tāngata whenua during project scoping will be critical.</td><td></td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Reduce external sediment load</td><td></td></tr>
<tr><td>- Hill country erosion</td><td>571,000</td></tr>
<tr><td>- Stream bank erosion</td><td>793,840</td></tr>
<tr><td>Addition of flocculant to lake inflow</td><td>3,300,000</td></tr>
<tr><td>Project management/staffing/incidentals (15%)</td><td>699,726</td></tr>
<tr><td>Total</td><td>5,364,566</td></tr>
</table></td><td>C=5.36</td></tr>
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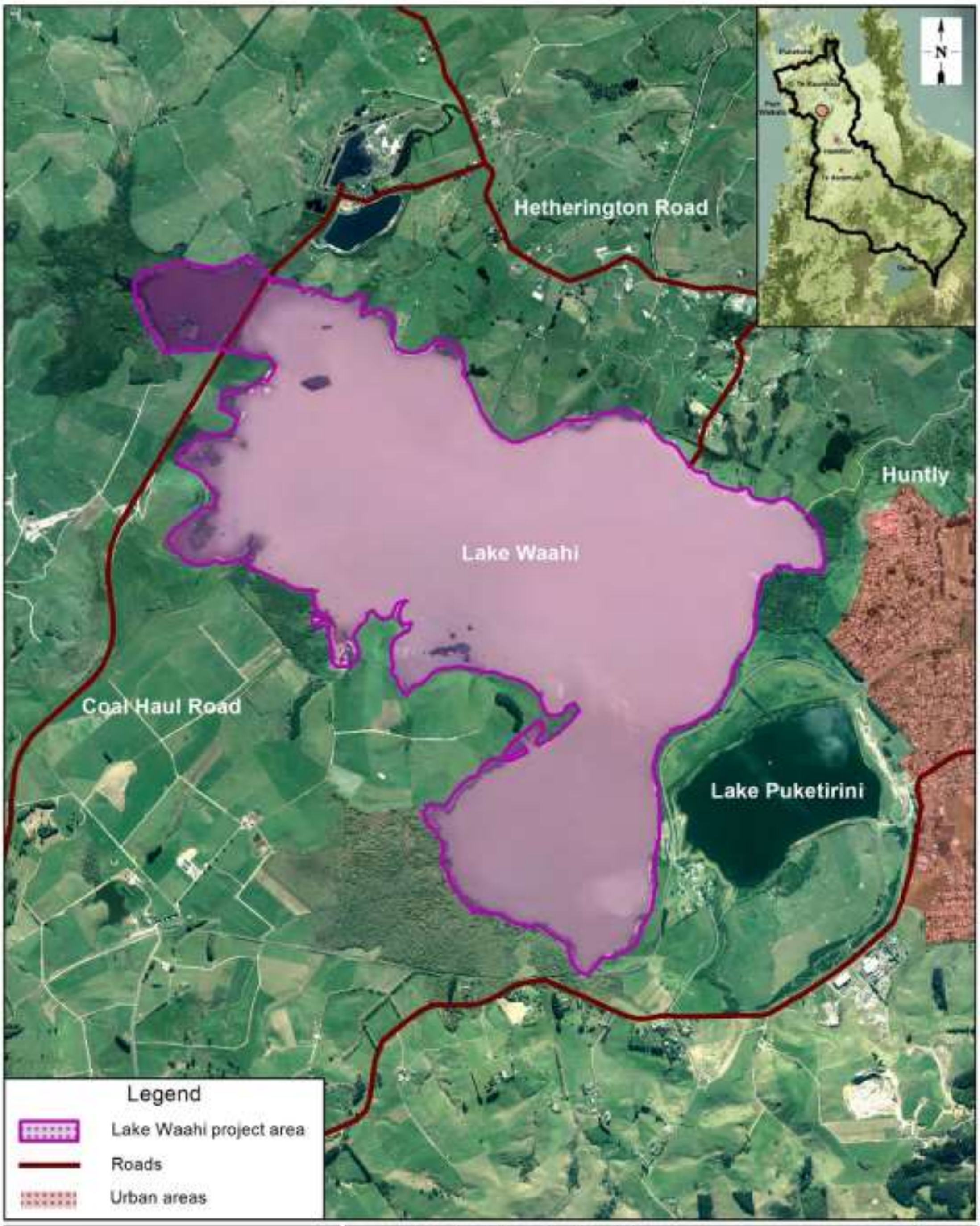

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Kilometers

Scale 1:25,000@A4 Portrait | **A4**

Water quality and habitat enhancement at Lake Waahi

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

Waikato REGIONAL COUNCIL


Lake Waahi showing a high suspended sediment load. (Photo: NIWA)

L 13 Priority: Very high	Intensive removal of pest fish at Lake Waahi	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species. Koi biomass is reduced by 80% in key lakes and maintained at this level. The impacts of other pest fish on lake water quality are managed.	
Name of feature	Lake Waahi	
Brief description of feature	Lake Waahi is the third largest lake in the Lower Waikato catchment with a surface area of 522ha. It has a maximum depth of 5m. The lake is situated west of Huntly township, within a predominantly pastoral catchment. It receives inflows from a range of sources, including Awaroa Stream and the much smaller Waikokowai Stream. A coal haulage road was constructed across the northwestern end of Lake Waahi in 1977, dissecting the northwest arm of the lake, and restricted water movement between the arm and the main body of the lake. Diffuse and direct discharges from coal mining have contributed large quantities of suspended sediments to Lake Waahi, which have altered the colour, clarity and chemistry of the lake's water. Coal mining was reportedly responsible for up to 90% of the sediment entering the lake at times (Dell 1988). A significant shift in the lake water quality was observed after the lake aquatic vegetation collapsed in 1978-79, causing the waters of the main body of the lake to become highly turbid. Waikato Regional Council has monitored the water quality of Lake Waahi regularly since September 1995. In addition, a lake monitoring buoy was installed in Lake Waahi in 2014 to collect real-time information about the physico-chemical conditions (and dynamics) within the lake. The most recent monitoring results indicate that Lake Waahi is currently supertrophic, with low water clarity, high nutrient levels and high phytoplankton density. Blue-green algae have also become abundant in recent years. Analysis of recent data indicates that between 2006 and 2010 there has been a probable decline in the trophic state of Lake Waahi (WRC 2012). During the most recent LakeSPI survey in 2010, the lake was mostly devegetated and supported only sparse milfoil fringes	

	(<5% cover) at depths of <0.3m (Edwards et al. 2010). This survey recorded a further decline in the extent of offshore stands of reeds (*Eleocharis sphacelata*). Poor aquatic plant regeneration levels have been attributed to the shallow nature of the lake, poor water clarity due to sediment re-suspension, and low levels of seeds. Numerous planting and fencing initiatives have been undertaken around the lake over the last decade or more. This has involved a large number of contributors including landowners, WRC, Solid Energy, WCEET, WRA, Waikato-Tainui, Waahi Whanui and Genesis Energy. Native species known from the lake include shortfin eel, longfin eel, giant kōkopu, kōaro and grey mullet. Exotic species include koi carp, goldfish, rudd, perch and catfish. Koi and rudd in particular limit the regeneration of aquatic macrophytes. Tuna have been commercially fished in the past, although the productivity of the fishery has declined significantly. The Lake Waahi tuna fishery is also very culturally signficant, with an important traditional eeling site located on the Waahi outlet stream. Lake modelling of Lake Waahi in 2017, has identified that algal blooms in the lake are most likely driven by internal release of phosphorus that has accumulated over time in the lake. Phosphorus in the lake sediments is released into the overlying lake water whenever the lake is depleted of oxygen, which occurs frequently during the summer and autumn months. Sediment resuspension from wind and the impacts of pest fish also negatively impact on lake water quality.	
Desired state to achieve Vision & Strategy	- The lake is swimmable, fishable and has access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species. - Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna. - Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally. - Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, Lake Waahi would have a very high impact on giving effect to the Vision & Strategy at a Central and Lower Waikato catchment level.	VS = 275

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key Threat</th><th>Impact on Feature</th></tr><tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr><tr><td>Exotic fish</td><td>Prevent the re-establishment of self-sustaining native macrophyte beds. Increase resuspension of lake bottom sediments and nutrients reducing lake water quality</td></tr><tr><td>In-lake nutrient load</td><td>Phosphorus is released from lake sediments when there are anoxic events, which can lead to algal blooms that affect the use of the lake for recreation.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement, water quality has measurably improved in Lake Waahi.

Knowledge and tools have been developed that can be applied at other large lakes, such as Whangape, Waikare, and Ngāroto, that are also koi carp spawning and recruitment hotspots.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>This is an adaptive management project and works could be implemented by a single organisation but preferably as a collaboration. This project is an opportunity for wide community involvement, with the potential for iwi, landowners, agencies and other groups to partner and run the fish removal work and ongoing monitoring.

Barrier design and construction
- Engineering assessments to develop an effective adult koi carp barrier. The design may incorporate a cage to enable pest fish to be uplifted for processing into useful materials (refer to the Carp Neutral project at Lake Waikare).
- Undertake consultation with iwi and stakeholders.
- Prepare and submit documentation to gain necessary consents/permits, including any other assessments and consultation.
- Barrier construction and installation.

Intensive removal of pest fish
- Trial intensive and targeted trapping/netting work over a 10 year period. This will include using various techniques to</td><td></td></tr>
</table>

	account for species and size selectivity, and analysing the best places and times to do this, e.g. targeting work in weedy areas during spawning times. **Monitoring and adapting approach** - Undertake monitoring of water quality, changes in koi carp and other pest fish populations, barrier effectiveness, water quality, koi carp larval hotspots and the effects of the works on indigenous fish (also invertebrates, and plants, if possible). Various techniques could be trialled for this monitoring, such as drones to identify koi aggregation locations and larval hotspots, and/or remote sensing for water quality. - Assessment of trialled methods to see how they can be improved and whether they will be applicable for other large waterbodies. This task should include not only possible modifications to existing methodologies, but also investigation of new techniques, e.g. slow-release baits, liquid rotenone, moveable barriers to isolate spawning areas, ways to identify and target important larval rearing sites. - Ongoing barrier maintenance. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs in Year 1 and 20% in Years 2-10.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 7 years after project commencement.	L = 7
Effectiveness of works	When compared with desired state, Lake Waahi is currently in poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, but it is sometimes fishable and access for recreation is good. The lake retains very high significance with iwi and the local community, as well as some important wetlands and biodiversity values. The lake is not expected to change in overall condition over the	W = 0.15

	next 20 years in the absence of this project. This project will help address internal sediment resuspension in the lake. It will also have secondary biodiversity benefits through reducing pest fish biomass. There would be significant benefits to this project being carried out in alignment with Lakes project L 12. It is acknowledged that achieving the Vision & Strategy desired state for Lake Waahi will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives. However, this project is expected to lead to a measurable improvement in lake condition over the next 20 years.	
Risk of technical failure	There is a high risk of project failure due to technical feasibility. There is uncertainty around how effective intensive fishing will be in reducing koi numbers significantly in a lake of this size. Magnitude of reduction required to improve water clarity is also not well known. This project should be viewed as an adaptive management project and therefore be flexible in response to monitoring results.	F = 0.7
Adoptability	Works are on publicly owned land and are expected to be adopted if fully incentivised.	A = 1
Information quality	Average – there is much known about the lake and species, but this would be the first attempt at an intensive removal of koi carp in a Lower Waikato lake. Recommendations have been made by subject matter experts and those with local knowledge of the site.	
Knowledge gaps	There is currently no known effective control and/or eradication methodology for koi carp in large waterbodies in New Zealand. This project would therefore be adaptive in nature. There is also limited options for barriers that prevent pest fish incursion whilst still enabling indigenous species access to and from the lakes (see section on investigation priorities).	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	10 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><td>Task</td><td>Cost</td></tr>
<tr><td>Detailed project plan</td><td>20,000</td></tr>
<tr><td>Engineering assessments and design of barrier</td><td>40,000</td></tr>
<tr><td>Consultation and cultural assessment</td><td>30,000</td></tr>
<tr><td>Consents/permits</td><td>15,000</td></tr>
<tr><td>Construction and installation of barrier</td><td>70,000</td></tr>
<tr><td>Fish removal using traps/nets (3 people for 40 days, $70 per hour; plus $35,000 for purchase of equipment and use of boats)</td><td>102,200</td></tr>
<tr><td>Monitoring for koi carp population changes and overall ecosystem effects of this work (3 people for 40 days, $70 per hour)</td><td>67,200</td></tr>
<tr><td>Landowner reparation (e.g. easements, fencing, flood mitigation)</td><td>5000</td></tr>
<tr><td>Project management Year 1 (30%)</td><td>104,820</td></tr>
<tr><td>Sub-total (up-front cost)</td><td>454,220</td></tr>
<tr><td>Project management per year (Years 2-10) (20%)</td><td>40,258</td></tr>
<tr><td>Fish removal using traps/nets (3 people for 40 days, $70 per hour; plus $25,000 for purchase of equipment and use of boats)</td><td>92,200</td></tr>
<tr><td>Monitoring for koi carp population changes and overall ecosystem effects of this work (3 people for 40 days, $70 per hour)</td><td>67,200</td></tr>
<tr><td>Technical reports analysing the monitoring data</td><td>40,000</td></tr>
<tr><td>Barrier maintenance (annual; 2 people for 2 days, $70 per hour plus $500 materials)</td><td>2740</td></tr>
<tr><td>Consent fees (annual)</td><td>500</td></tr>
<tr><td>Annual cost</td><td>243,168</td></tr>
<tr><td>Sub-total (annual costs × 9 years)</td><td>2,188,512</td></tr>
<tr><td>TOTAL for 10 year period</td><td>$2,642,732</td></tr>
</table>
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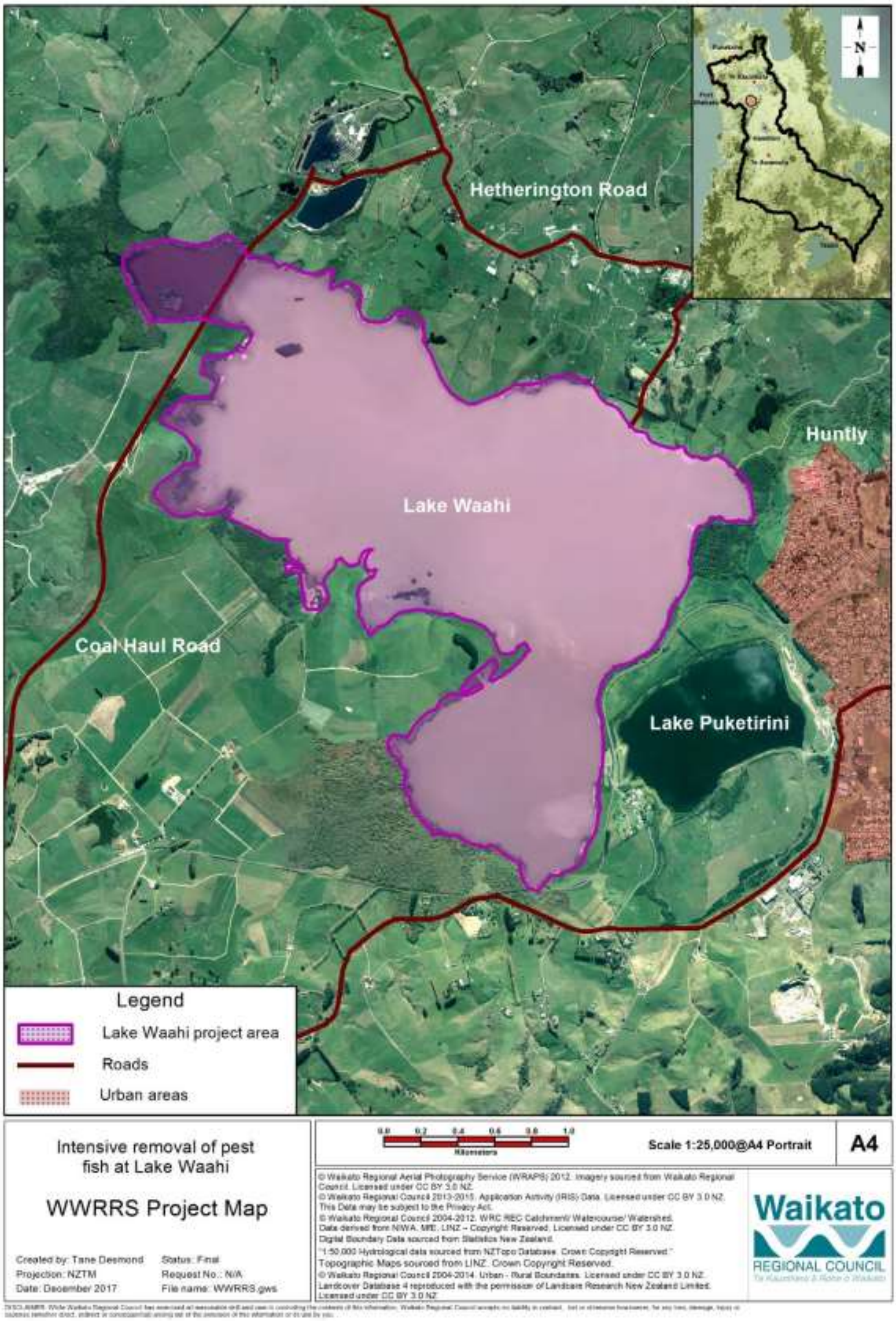
<td>C = 2.64</td>
</tr>
</table>



L 14	**Water quality and habitat enhancement at Lake Areare**	**BCR value**

Priority: High		
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species.	
Name of feature	Lake Areare	
Brief description of feature	Lake Areare is a 33ha peat lake in the Horsham Downs area. Lake water quality is poor (hypertrophic) with frequent algal blooms. The lake has an average depth of 3m and maximum depth of 4.5m. The lake is well mixed (i.e. oxygenated) all year round. It contains no submerged plants. The lake is public reserve land managed by DOC with an accessway and car park off Driver Rd. An informal circuit track at the lake can be traversed by foot. The Lake Areare catchment is 263ha with the main land use being pastoral farming, primarily dairy with a few dry stock farms. The Waikato Expressway bisects the catchment with stormwater from the four lane motorway discharging into the lake via a constructed wetland designed to mitigate effects of stormwater (not agricultural run off). The size of the constructed wetland is not sufficient to treat all of the inflow volumes which includes drainage water from about 140ha of dairy farming. All but one of the other inflows have silt traps with constructed wetlands built on them to attenuate nutrient and sediment inputs to the lake. The lake is fully fenced and is surrounded by wetland which varies from 5m to 200m in distance from the lake edge. The wetland is dominated by native plants, many of which have been planted over the last 15 years. The extent of problematic weed species has been reduced to manageable levels in recent years. The lake provides habitat for a range of indigenous plants and animals, including eight threatened bird and fish species and good-sized populations of game-bird species. Lake Areare and the Horsham Downs lakes are culturally and historically significant to iwi. There are many historic pā sites within the area between Gordonton and Taupiri. Iwi would have accessed these lakes and wetlands to gather food, clothing and weaving materials, rongoā (medicine), birds and materials for general use.	

<table>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Areare would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 6</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement water quality has measurably improved in Lake Areare.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Extend the size of the constructed wetland on the main inflow to reduce nutrients, sediment and harmful microbes entering Lake Areare from agricultural run off.

Department of Conservation is currently negotiating with NZTA to add land that was obtained but not used for the Waikato Expressway to the Lake Areare Wildlife Management Reserve. This would enable the wetland to be increased from 1.8ha to 3.5ha. The size of the wetland would be 2.5% of the catchment size. McKergow et al. (2007) estimate that the performance of a constructed wetland of this type and size (in relation to catchment area) is likely to result in the following reductions: about 80% of annual sediment load, 60% of nitrogen, 60-80% of particulate phosphorus and >90% of E. coli.

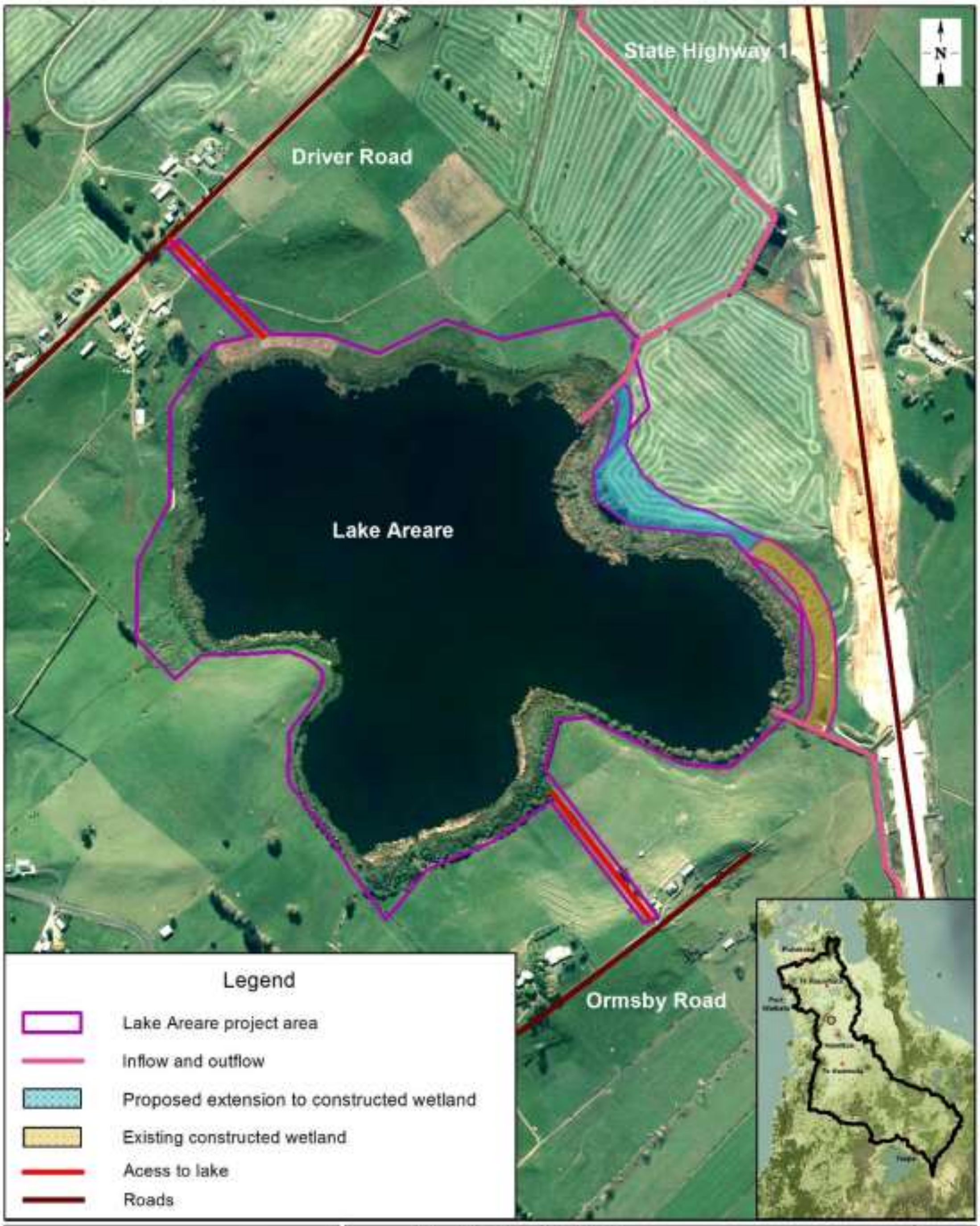
Work should be implemented by an organisation (using contractors) and is likely to need a project manager to co-ordinate the works and to work closely with the land managers (i.e. Department of Conservation).

The work would involve the following:</td><td></td></tr>
</table>

	Design and specifications for constructed wetland: These will need to be prepared by an appropriately qualified person using guidelines that specifically target the reduction of nitrogen, phosphorus, *E.coli* and sediment arising from agricultural run off. Based on costs for similar projects undertaken at other peat lakes, it is estimated that this will cost approximately $10,000. **Consent:** Consents would need to be obtained for earthworks associated with the constructed wetland, from both Waikato Regional Council and the Waikato District Council. This would include undertaking consultation with tāngata whenua and possibly commissioning a cultural impact assessment. Based on costs for similar projects undertaken at other peat lakes, the consent costs, which include application preparation, consent fees and consultation, is likely to cost approximately $25,000. **Construction of wetland:** This will involve carrying out earthworks to create a large wetland or series of wetlands. It will also involve creating a connection to the existing stormwater wetland and filling the current outlet from this wetland to the lake. Estimated volume of earthworks is 17,000m^3 (based on area of 1.7ha and average depth of 1m). Cost – $21,000. Additional $4000 to cover costs to connect wetlands and close current outlet. **Planting wetland:** Constructed wetlands require high planting densities. The area to be planted is 1.7ha at $100,000 per hectare ($170,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 3-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 4.5

<table>
<tr><td>Effectiveness of works</td><td>When compared with desired state, Lake Areare is in moderate condition with some of the Vision & Strategy desired state aspects already being met or partly met. This includes having access for recreation and some large and well planted margins. It is expected that over the next 20 years there may be a slight improvement in overall lake condition as a result of recent restoration works. Works included here are expected to help in addressing some of the key threats to the lake, including external nutrient and sediment inputs, as well as improve surrounding wetland biodiversity values. However, the lake water quality would still be expected to remain in a NOF D band even with this project being undertaken. It is acknowledged that achieving the Vision & Strategy desired state at Lake Areare will take longer than the 20-year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. However, if this project is successfully completed it is expected that there will be a small additional improvement in condition in 20 years and the lake will be closer to the desired Vision & Strategy state than it is currently.</td><td>W = 0.025</td></tr>
<tr><td>Risk of technical failure</td><td>There is a moderate risk of project failure due to technical feasibility. Effectiveness of constructed wetland treatment systems has not yet been fully established.</td><td>F = 0.82</td></tr>
<tr><td>Adoptability</td><td>Works proposed are on publicly owned land are expected to be adopted if fully incentivised.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Average – recommendations are based on advice of local expert/s with a history of association to the site.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Only generic information on the likely expected reductions in contaminants is currently available.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks. There have already been significant enhancement works successfully completed at the lake.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>3 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Design and specifications</td><td>10,000</td></tr>
<tr><td>Consents, iwi consultation</td><td>25,000</td></tr>
<tr><td>Construction</td><td>25,000</td></tr>
<tr><td>Planting (1.7ha)</td><td>171,020</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>46,200</td></tr>
</table></td><td>C = 0.28</td></tr>
</table>

	Total	**277,220**	



Water quality and habitat enhancement at Lake Areare

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.05 0.10 0.15 0.20 0.25
Kilometers

Scale 1:7,000@A4 Portrait

A4

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Lake Areare in the foreground. Lake Pikopiko and Lake Hotoanaga can also be seen (top right).

The existing constructed wetland (small sequence of ponds) is shown between Lake Areare and the Waikato Expressway. It is proposed to extend this to the northwest, across the area of bare land.

L 15 Priority: High	Wetland enhancement at Horsham Downs lakes	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high value natural environments.	
Name of feature	Lakes Pikopiko, Hotoananga, Kaituna, Tunawhakaheke, Whakatangi, Komakorau	
Brief description of feature	These small peat lakes are located in the Horsham Downs area. All of the lakes are surrounded by wetland habitat. The collective area of these lakes and their wetlands is 71.7ha. All of the lakes discharge to the Waikato River near Taupiri. The Horsham Downs lakes are culturally and historically significant to iwi. There are many historic pā sites within the area between Gordonton and Taupiri. Iwi would have accessed these lakes and wetlands to gather food, clothing and weaving materials, rongoā (medicine), birds and materials for general use. The names of these lakes provide clues as to their historic use. E.g. kai (food) tuna (eels) or kōmako (bellbird) rau (hundred, numerous). The lakes vary in size from 14ha (Lake Hotoananga) to less than 3ha(Lake Whakatangi). All of the lakes are situated within the historic Kainui peatland, which has been drained and converted to pasture. Collectively they are nationally significant and support a moderate waterfowl population and several threatened species. Water quality sampling has been infrequent or not been undertaken at these lakes. From sampling that has been done it is most likely that lakes Kaituna, Komakorau and Tunawhakaheke are hypertrophic (i.e. TLI 6-7), Whakatangi supertrophic (i.e. TLI 5-6) and Hotoananga and Pikopiko are at least eutrophic (i.e. TLI 4-5). Note: the higher the TLI the more enriched the lake and the less suitable it is for swimming or kai gathering. Submerged plants have disappeared from all of these lakes except Hotoananga, where a low cover of native submerged plants (charophytes and pondweeds) persists. Where willow control has been undertaken in the past (i.e. Komakorau, Kaituna, Hotoananga, Tunawhakaheke), wetlands	

<table>
<tr><td></td><td>are dominated by native plant communities. These wetlands still contain some weeds, including grey willow, crack willow, blackberry and gorse. Wetlands at Lakes Pikopiko and Whakatangi are dominated by grey willow and contain other weed species, including Japanese honeysuckle, privet and blackberry. The understorey contains some native wetland plants that would have typically comprised the sedge shrubland that would have originally occurred around these lakes.

With the exception of Lake Whakatangi, these lakes contain public reserve land managed by DOC and Waikato District Council. Public access is limited to these lakes at present but opportunities exist through the subdivision process to gain access and by utilising unformed roads.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lakes are swimmable, fishable and have access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lakes and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition these lakes would have a very high impact on giving effect to the Vision & Strategy at a local level</td><td>VS = 10</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species. Direct inputs of nutrient and microbes into lakes.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Further drainage and clearance of native wetland vegetation.</td><td>Reduced habitat for native plants and animals and game birds. Loss of nutrient attenuation areas, and loss of wetland areas to slow flood flows.</td></tr>
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</td><td></td></tr>
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Project goal/s	Within 2 years of project commencement, wetlands adjoining lakes Whakatangi and Pikopiko are 100% fenced and protected from stock. Within 5 years, wetlands adjoining lakes Pikopiko, Hotoananga, Kaituna, Tunawhakaheke, Whakatangi, Komakorau are mostly (i.e. > 90% cover) comprised of native plant communities.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing, weed control and native planting** Fencing, weed control or native planting (or a combination) is proposed at the six peat lakes in Horsham Downs to provide a wider buffer for the lake and to increase and improve the quality of wetland habitat surrounding the lake. Fencing is required at Lake Pikopiko and Whakatangi. The fence needs to be moved to the landward boundary of the esplanade reserve at Pikopiko which will substantially increase the land buffer at this lake. Part of the fence at Lake Whakatangi needs to be upgraded to prevent stock access to the lake. Willow control using ground based methods to minimise off-target damage is proposed at all the lakes. This is likely to be a two stage process at lakes where willows have not been controlled before, with all willows controlled in the first year and follow-up weed control to 'mop-up' any willows that were not successfully killed in the first year. Where willows have been controlled in the past, 'mop-up' ground based spraying is recommended. All of the wetlands contain several ecosystem changing weeds including royal fern, gorse and blackberry. Control of these weeds to very low levels that can be easily managed by landowners or DOC is proposed at all lakes. Native planting is proposed at some lakes to extend wetland habitat surrounding the lake. Planting at 1.5m spacing is recommended, matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Meremere Ecological District.	

	Assumptions and cost estimates for implementing fencing, weed control and planting at the six lakes follows: <u>Pikopiko Wetland</u> – (4.3ha, 1.2km perimeter) - Assume 90% (1100m) requires fencing at $25 per metre ($27,500). - Assume 1.24ha requires ground based willow control in Year 1 at $4000 per hectare with 15% of the area being retreated in Year 2 ($5704). - Additional weed control at $1400 per hectare over 30% of the area over 3 years ($5418). - Assume 3.5ha requires native planting where not much site prep is required and with provision for 10% infill planting ($42,880 per hectare) ($150,083). - Possum control (for plant establishment) over 3 years ($2580). <u>Whakatangi Wetland</u> – (1.1 ha, 0.73km perimeter) - Assume 20% (145m) requires fencing at $25 per metre ($3625). - Assume 1ha requires ground based willow control in Year 1 at $4000 per hectare with 15% of the area being retreated in Year 2 ($4600). - Additional weed control at $2800 per hectare over 50% of the area over 3 years ($4620). - Assume 0.9ha requires native planting in area not requiring much site prep and with provision for 10% infill planting ($42,880 per hectare) ($38,592). - Possum control (for plant establishment) over 3 years ($660). <u>Tunawhakaheke Wetland</u> – (3.9ha) - Assume 1.56ha requires ground based willow control in Year 1 at $4000 per hectare with 15% of the area being retreated in Year 2 ($7,176). - Additional weed control at $1400 per hectare over 100% of the area over 3 years ($16,380). - Assume 1.72ha (20% of wetland) requires native planting at $37,552 per hectare and with provision for 10% infill planting ($71,048). - Possum control (for plant establishment) over 3 years ($2340). <u>Hotoananga Wetland</u> – (5.8ha) - Assume 50% of wetland requires weed control (at $1400 per hectare) over 3 years ($12,180).	

	- Assume 10% of the area (0.6ha) requires native planting in at $37,552 per hectare and with provision for 10% infill planting ($24,784). - Possum control (for plant establishment) over 3 years ($3,480). <u>Komakorau Wetland</u> – (6.3ha) - Assume 50% of wetland requires weed control (at $1400 per hectare) over 3 years ($13,230). <u>Kaituna Wetland</u> – (7.8ha) - Assume 50% of wetland requires weed control (at $1400 per hectare) over 3 years ($16,380). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	These wetlands currently range in condition from very poor to moderate when compared to desired state. Lake water quality is very poor across all lakes. There has been substantial riparian restoration work around lakes Kaituna and Komakorau in the past 15-20 years, however other lakes have very limited vegetated margins. Condition is not expected to change over the next 20 years in the absence of this project. This project focuses solely on biodiversity restoration and it is expected to make a significant improvement in this area. It is acknowledged that achieving the overall Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. However, if this project is successfully completed, then it is expected that the lakes will move closer to the desired Vision & Strategy state than they are currently. Overall condition is still likely to be poor.	W = 0.05
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Plants generally establish quickly and with high survivorship	F = 0.87

	around peat lakes. Work should be carried out by experienced practitioners to ensure weed control is effective.	
Adoptability	It is estimated that about three-quarters of landowners would adopt the works if they were fully incentivised. Works on publicly owned land are expected to be fully adopted. Some private landowners may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.75
Information quality	Average – recommendations are based on the knowledge of local land and lakes management staff and from examining aerial photographs.	
Knowledge gaps	Some of the weed control and planting work was estimated from aerial photographs. DOC and regional council staff who have worked at these lakes were consulted about what further work was required to enhance wetlands surrounding the lakes. Specific quantities of work will need to be established for each lake during project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.97
Project duration (years)	5 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 0.49

Task	**Cost ($)**
Pikopiko Wetland enhancement	191,285
Whakatangi Wetland enhancement	52,097
Tunawhakaheke Wetland enhancement	96,944
Hotoananga Wetland enhancement	40,446
Komakorau Wetland enhancement	13,230
Kaituna Wetland enhancement	16,380
Project management/staffing/incidentals (20%)	82,076
Total	**492,458**

0.00 0.10 0.20 0.30 0.40 0.50
Kilometers

Scale 1:8,000@A4 Landscape

A4

Wetland Enhancement at Horsham Downs Lakes Map 1/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

ACKNOWLEDGEMENTS AND DISCLAIMERS

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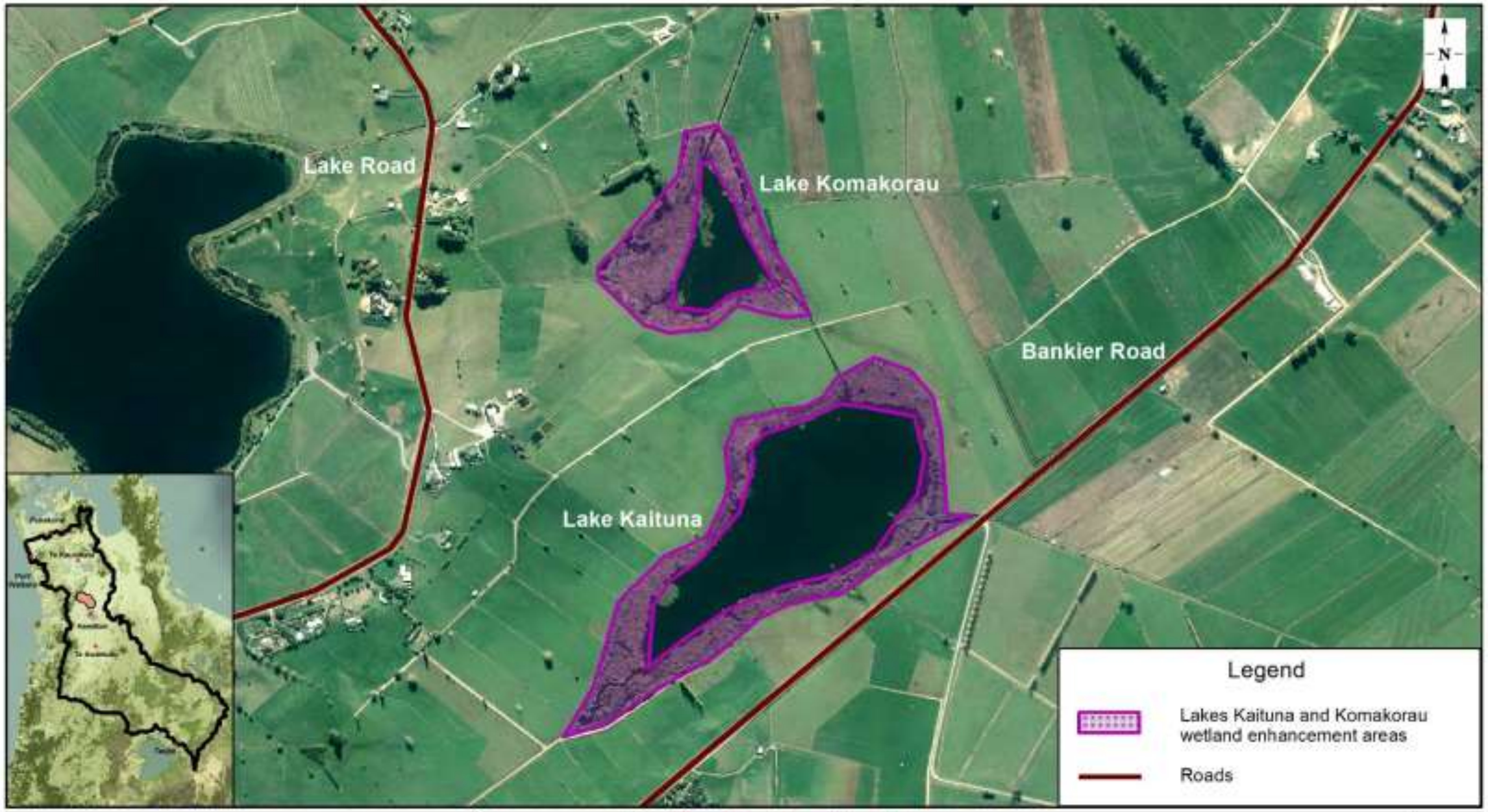

0.00 0.10 0.20 0.30 0.40 0.50
Kilometers

Scale 1:10,000@A4 Landscape

A4

Wetland Enhancement at Horsham Downs Lakes Map 2/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

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Wetland Enhancement at Horsham Downs Lakes Map 3/3

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.15 0.30 0.45 0.60 0.75
Kilometers

Scale 1:12,000@A4 Landscape

A4

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A fenced area next to Lake Tunawhakaheke where re-vegetation with native wetland plants is proposed.


Lake Hotoananga before willow control. The extensive areas of emergent reeds in the lake can be seen in this photo.

Planting a seep on an inflow to Lake Pikopiko. Willows and blackberry can be seen on the lake margin.

Lake Kaituna (foreground) flows into Lake Komakorau (behind).

A floating wetland within one of the constructed treatment systems at Lake Kaituna.

Margin of Lake Whakatangi where weed control and native planting is proposed.

L 16 Priority: High	Development of Lake Rotokauri Reserve for recreation	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Places that provide for safe recreational activities are identified and accessible.	
Name of feature	Lake Rotokauri and surrounding reserve	
Brief description of feature	Lake Rotokauri is a 41.7ha lake that receives inflows from a 933ha catchment. Catchment land use is a mix of residential, industrial and dairy farming. The catchment also includes nearby Lake Waiwhakareke (Horseshoe Lake). Lake Rotokauri discharges into the Ohote Stream which then flows into the Waipā River. Lake Rotokauri is located on the boundary between Waikato District Council and Hamilton City Council and its catchment is divided between the two councils. Approximately 37ha of reserve land surrounds the lake. A large proportion of this is owned and managed by Waikato District Council while Hamilton City Council administers a small area on the southeastern side of the lake. The lake is managed through the Lake Rotokauri Management Committee. The lake is fully fenced to exclude stock and fenced margins vary in width from 25m-100m and mostly comprise a District Council Local Purpose (Ecological Management) Reserve. Some areas of the reserve land continues to be grazed by stock. The lake water quality has deteriorated significantly since 1980 and has high concentrations of nutrients and phytoplankton and poor water clarity, which is indicative of a shift to a turbid, phytoplankton dominated state. Lake Rotokauri is considered to be hypertrophic. There is no submerged aquatic vegetation within the lake but the lake does have extensive areas of emergent plants that provide habitat for a range of wetland bird species. Beyond this is a wide margin of willow and mānuka scrub. The level of Ohote Stream has been significantly lowered by drainage activities, which has decreased the lake level by up to 5m and reduced the size of the lake to half of the size it was in 1860. A new rock-rubble weir was installed in 2000 in an effort to improve	

<table>
<tr><td></td><td>native fish passage to the lake whilst maintaining minimum water levels.

As the amount of rural subdivision in the area has increased so has the demand for recreational facilities around the lake. A gravel walkway has been partially constructed, providing walking access to the southwest side of the lake, and there is demand to provide access around the full perimeter of the lake.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy of feature</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Rotokauri and its surrounding reserve would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 24</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Lack of access to the lake reserve. Opportunities for public recreation next to waterway not realised.</td><td>People become disconnected from Lake Rotokauri and the lake becomes further degraded.</td></tr>
<tr><td>Land drainage</td><td>Alters the ecology of marginal wetlands.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement:
- Stock is excluded from reserve land around the lake and it is vegetated with a dense cover of native plant species.

- A 4km pathway is completed around Lake Rotokauri.

- A picnic area is developed and there are designated areas where people can access the lake for recreation, including a jetty.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Works could be implemented either by an organisation or private citizens (working closely with Waikato District Council). This project could be undertaken as a whole, or in multiple smaller</td><td></td></tr>
</table>

	components. Works would be undertaken in accordance with the concept plan developed for Lake Rotokauri and held at Waikato District Council. **Works required** On the ground works and actions required include: Stage 1 - Construction of a 2km long walkway, approximately 2.5m wide, to join up with the existing walkway. The walkway will comprise of wooden boardwalk sections and metal tracks ($800,000). Stage 2 - Planting of approximately 6ha of native plants within areas where weed control is undertaken ($237,321). - Possum (and possibly rabbit control) will be required over a period of 3 years for native plant establishment. Costs are generously estimated at $200 per hectare over an area of 37ha ($22,200 over 3 years). The method of possum control will need to be determined following consultation with local residents. Stage 3 - Installation of picnic and viewing areas. This will involve installation of picnic tables (including concrete pads), interpretive signage and exotic vegetation clearance (if required) ($15,000). Stage 4 - Additional planting and installation of amenity structures. Amenity structures include a jetty for lake access and potentially other lake access points ($25,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen near project completion.	L = 4.5
Effectiveness of works	When compared with desired state, Lake Rotokauri is currently in poor to moderate condition with only some of the Vision & Strategy aspirations being partly met. The lake is not swimmable, and the presence of pest fish impacts significantly on ecological	W = 0.04

	integrity. The poor water quality is an impediment to recreational use of the lake, although it is still of high value to the local community. Recent enhancement works are improving the biodiversity of the lake margins. Overall lake condition is not expected to change significantly over the next 20 years in the absence of this project, with some aspects likely to improve as a result of current initiatives, while others have potential for some deterioration. This project addresses aspirations relating to the recreational use of the lake and if completed is expected to move the lake slightly closer to the Vision & Strategy desired state. It doesn't address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Rotokauri will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives.	
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Works proposed have been successful at other lake sites, and plantings around peat lakes generally have very high rates of survival and growth.	F = 0.92
Adoptability	It is estimated that about three-quarters of landowners would adopt the works if they were fully incentivised. The works proposed on Waikato District Council managed land is expected to be fully adopted, with the council being very supportive of the project. There may be some difficulty with uptake on some privately owned lands, with the loss of marginal grazing areas likely to be the biggest challenge in terms of uptake.	A = 0.75
Information quality	Very good – recommendations and estimates of work are based on a concept plan for the reserve and costings were developed with input from Waikato District Council staff.	
Knowledge gaps	Costs provided are estimates based on the concept plan, and a more detailed project plan with costings will need to be developed as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Walkway construction (2km)</td><td>800,000</td></tr>
<tr><td>Native planting (6ha)</td><td>237,321</td></tr>
<tr><td>Possum control</td><td>22,000</td></tr>
<tr><td>Installation of picnic and viewing areas</td><td>15,000</td></tr>
<tr><td>Additional planting and installation of amenity structures</td><td>25,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>219,864</td></tr>
<tr><td>TOTAL</td><td>1,319,185</td></tr>
</table>
</td>
<td>C = 1.32</td>
</tr>
</table>

Development of Lake Rotokauri
Reserve for recreation

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name:WWRRS.gws

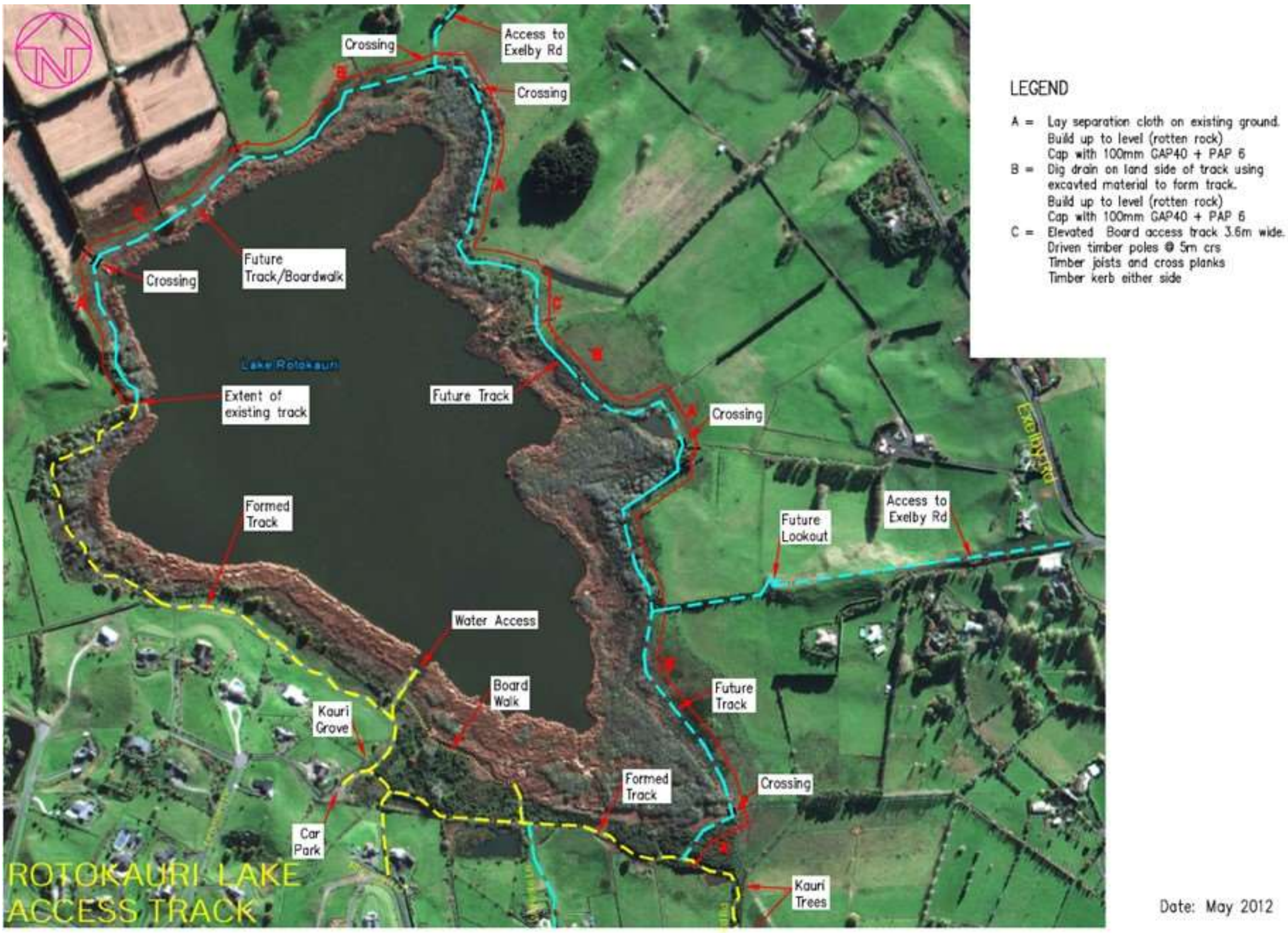
0.00 0.15 0.30 0.45 0.60 0.75
Kilometers

Scale 1:11,500@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato
REGIONAL COUNCIL


Access to Exelby Rd
Crossing
Crossing
Future Track/Boardwalk
Crossing
Lake Rotokauri
Extent of existing track
Future Track
Crossing
Exelby Rd
Access to Exelby Rd
Future Lookout
Formed Track
Water Access
Board Walk
Kauri Grove
Future Track
Formed Track
Crossing
Car Park
Kauri Trees
ROTOKAURI LAKE ACCESS TRACK
LEGEND
A = Lay separation cloth on existing ground. Build up to level (rotten rock) Cap with 100mm GAP40 + PAP 6
B = Dig drain on land side of track using excavted material to form track. Build up to level (rotten rock) Cap with 100mm GAP40 + PAP 6
C = Elevated Board access track 3.6m wide. Driven timber poles @ 5m crs Timber joists and cross planks Timber kerb either side
Date: May 2012

L 17 Priority: Very high	Water quality and habitat enhancement at Lake Rotoroa	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Communities have plentiful, safe access to lake for a range of recreational purposes, including safe contact and immersion in water and food gathering. Projects on lake are prioritised according to cultural significance, ability to improve and ability or appropriateness to access. Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species.	
Name of feature	Lake Rotoroa	
Brief description of feature	Lake Rotoroa (55ha) is situated in central Hamilton, and is the focus of land and water-based recreational activities including waka ama, sailing and running. The lake was associated with a former peat swamp that was initially drained for farming purposes and then developed for urban and residential use. Today, the lake receives water from stormwater drains, direct rainfall and overland flow. Water leaves the lake via a (constructed) piped outlet that flows into the Waitawhiriwhiri Stream and eventually to the Waikato River. The water quality of Lake Rotoroa has fluctuated significantly in the past as it has flipped between being dominated by submerged plants and algae. Recent water quality analyses from 2006-2010 data indicate that the trophic status of Lake Rotoroa has been eutrophic and stable during this period. The lake has a well-documented history of weed invasion that has seen it dominated by exotic weed species, completely devegetated, and then recolonised by native submerged plants. In 1959, sodium arsenite was aerially applied to Lake Rotoroa to control aquatic weeds. While this treatment effectively eliminated submerged aquatic plants for 5 years, elevated levels of arsenic persist in the lake sediments today. By 1991, submerged plant species had been completely removed from the lake through multiple herbicide treatments of Diquat, and the lake remained devegetated for several years. By 2005, native submerged plants had re-established, although recently Egeria has again been found in the lake. Rotoroa is one of a few shallow lakes in New Zealand that have transitioned from a devegetated, algal-dominated state to a clear water, macrophyte-dominated state, so has been of scientific interest. In recent years, *E. coli*	

	concentrations in the lake – thought to be predominantly from duck faeces – have been an impediment to contact recreational activities with warnings often in place. Considerable effort has been undertaken by Hamilton City Council to eradicate weeds in marginal plant communities. Revegetation with indigenous species within the marginal fringe now complements the large beds of indigenous emergent macrophytes. Lake Rotoroa is dominated by exotic fish species, including perch, rudd, brown bullhead catfish, tench, goldfish and *Gambusia*. Whilst the coarse fishery is valued, there are ecological concerns about the presence of some of these fish species. Tuna and common bullies also occur in the lake, and freshwater mussels were re-introduced to the lake in 2001 in an attempt to re-establish a naturally reproducing population for water quality purposes. Common smelt historically occurred at the lake but are no longer present. Lake Rotoroa was historically fished for tuna (eels), kākahi (freshwater mussels) and kōura (freshwater crayfish). The raupō edges provided materials for baskets and clothing. The historic Te Rapa pā site is situated nearby, towards the Waikato Hospital. The lake was selected for inclusion in the Restoration Strategy as it has significant values for iwi and the community, including for recreational purposes; and is considered to be a strong candidate for successful enhancement due to its current condition being only eutrophic (compared to many Waikato lakes that are hypertrophic and devegetated).	
Desired state to achieve Vision & Strategy	- The lake is swimmable, fishable and has access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species. - Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna. - Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally. - Iwi and community have a strong connection to the lake and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, Lake Rotoroa would have a high impact on giving effect to the Vision & Strategy at a Central and Lower Waikato catchment level.	VS = 50

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>E. coli from game bird faeces</td><td>Results in water that is not safe for swimming or contact recreation.</td></tr><tr><td>Exotic fish</td><td>Prevent the re-establishment of self-sustaining native submerged plants.</td></tr><tr><td>Exotic submerged plants</td><td>Outcompete native plants and are a recreational hazard creating nuisance for boats and safety risks for swimmers.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement, water quality has measurably improved in Lake Rotoroa.

Native submerged plants dominate the aquatic flora and the lake has a LakeSPI score of at least 70%.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. Work needs to be undertaken in close collaboration with Hamilton City Council. Projects identified below are consistent with the Hamilton City Council Draft Hamilton Lake Domain Management Plan.

Public information campaign
Large populations of water fowl contribute to high levels of E. coli in Lake Rotoroa. This is exacerbated by public feeding these birds, particularly bread. An information campaign should be undertaken to increase awareness of the impact of water fowl on lake water quality.

To support the proposed programmes to reduce exotic fish, eradicate exotic submerged plants and re-establish native macrophytes at the lake, new signage discouraging the release of fish and encouraging cleaning of water craft should be erected at appropriate locations around the lake.

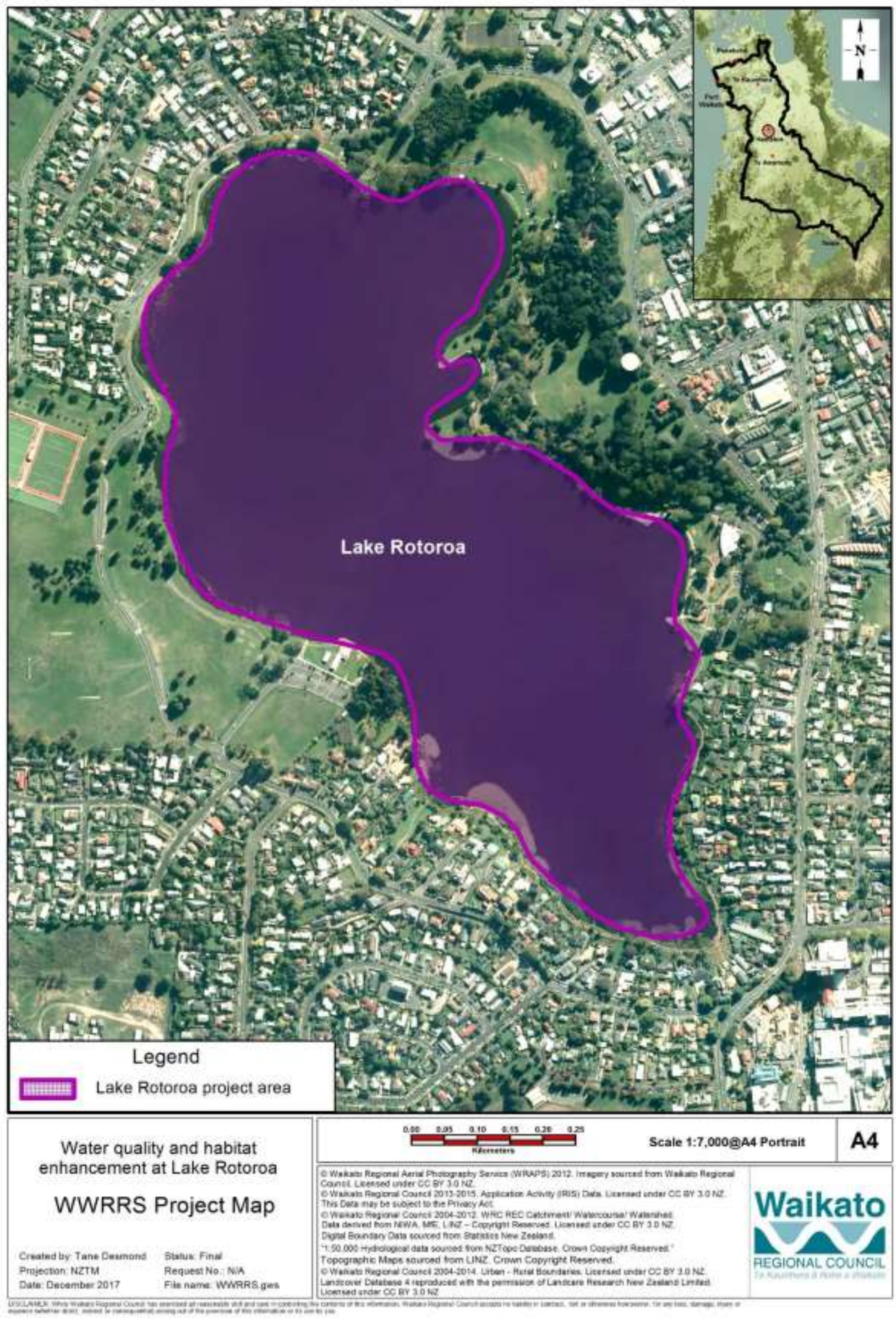
Public education programme tasks should include:

- Collation of existing public awareness material, availability and relevance to the Lake Rotoroa situation.
- Identification of needs for new material.
- Design and production of necessary new material, in consultation with other relevant parties (including signage).
- Identification of key groups within the community to work with and ways to disseminate the information to the relevant people to inform and develop behaviour changes.</td><td></td></tr>
</table>

	Estimated at $25,000 based on signage and fact sheet costs for similar projects (e.g. on pest fish). Stakeholder collaboration component is covered in Project Management. **Management of pest fish** The purpose of the pest fish removal programme is to enable re-establishment of healthy beds of native submerged plants. Prior to commencing removal work, a baseline survey should be undertaken to establish densities of exotic fish and confirm required fishing effort ($30,000). Annual fish removal should then be undertaken twice per year – in late August prior to spawning, and then in summer to coincide with periods of thermal stratification in the lake when fish are concentrated in the top 2m-3m of the water column. This is estimated to require 4 people for 20 days per year for the first 5 years, and then 2 people for 20 days per year for the following 5 years. Labour is estimated at $70 per hour (total cost $336,000). Fishing equipment (nets, clips, etc) is estimated at $150,000 over the 10 years. **Re-establishment of native aquatic plants** Aquatic plants stabilise lake bottom sediments and contribute to improved water quality through nutrient uptake. Investigations in Lake Rotoroa indicate that there is a seed bank that is sufficient to enable plants to naturally re-establish once the pressure from exotic fish and plants is reduced or removed. To address the removal of exotic plants the following tasks are recommended: - Establish current status of exotic macrophytes – diver survey delimitation (2 days for dive team) and hydro-acoustic transects ($10,000). - Treatment of lake with Diquat – Diquat application at $2000 per hectare for 55ha ($110,000), with consenting requirements, signage and follow-up water quality monitoring ($10,000). - Annual monitoring of submerged plants to assess recovery of natives and any new incursions of exotics. This will allow an adaptive response with treatment as required – LakeSPI once per year using 20 sites within the lake, including the existing 5 long term sites ($15,000 per year for 9 years – $135,000), with any exotics being removed by hand or through the use of coconut fibre matting ($10,000 per year for 9 years – $90,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works,	

	manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L=8
Effectiveness of works	When compared with desired state, Lake Rotoroa is in moderate to good condition with some of the Vision & Strategy desired state aspects already being met or partly met. This includes being fishable, highly valued by iwi and community, and having excellent access for recreation. Condition is not expected to change over the next 20 years in the absence of this project. Works included here are expected to improve in-lake biodiversity and contribute to maintaining water lake quality. They won't, however, fully address the *E. coli* issues in the lake or bring water quality back to swimmable levels. In order to do this the sources of *E. coli* need to be confirmed and further actions developed in response to this information (see section on investigation priorities). However, if the proposed project is successfully completed it is expected that the lake will progress closer to desired state and be in good condition in 20 years' time.	W=0.1
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is still some uncertainty around the relationship between pest fish densities and re-establishment of macrophytes. It is critical that aquatic pest plant control and surveillance is undertaken by experienced contractors.	F=0.82
Adoptability	All works are proposed to be undertaken on publicly owned and managed sites. It is expected that full adoption would be achieved if the works were fully incentivised.	A=1.0
Information quality	Average – recommendations are based on judgement of subject matter experts with local knowledge.	
Knowledge gaps	A LakeSPI assessment of Lake Rotoroa has not been undertaken since 2010 and therefore the current status of macrophytes in the lake needs to be established prior to management work commencing. Disposal options for pest fish removed from the lake will also need to be agreed during project planning.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. The use of Diquat to eradicate exotic aquatic plants may be met with some resistance from iwi and the community, although it has been used previously in the lake for the same purpose. Early stakeholder engagement will be very important for the successful delivery of this project.	P=0.62

<table>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Public information campaign</td><td>25,000</td></tr>
<tr><td>Management of pest fish</td><td></td></tr>
<tr><td>- Baseline survey</td><td>30,000</td></tr>
<tr><td>- Fish removal over 10 years</td><td>336,000</td></tr>
<tr><td>- Fishing equipment and consumables</td><td>150,000</td></tr>
<tr><td>Eradication of Egeria and native plant re-establishment</td><td></td></tr>
<tr><td>- Delimitation survey</td><td>10,000</td></tr>
<tr><td>- Diquat application/consents/monitoring</td><td>120,000</td></tr>
<tr><td>- Follow-up survey and adaptive management over 10 years</td><td>225,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>179,200</td></tr>
<tr><td>Total</td><td>1,075,200</td></tr>
</table>
</td><td>C=1.08</td></tr>
</table>



L 18		BCR value

Priority: Medium	Wetland enhancement at Lake Rotopotaka, Lake Pataka and Lake Posa	
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high natural environments.	
Name of feature	Lake Rotopotaka, Lake Pataka, Lake Posa	
Brief description of feature	These small peat lakes are located in the Waipā district. Lakes Posa (2ha) and Pataka (4.6ha) are located south of Templeview. Lake Pataka flows into Lake Posa and discharges to the Waipā River. They would have once abutted the historic Rukuhia Bog. Lake Rotopotaka (2.8ha) is located north of Te Awamutu and would have once abutted the now greatly diminished Moanatuatua Bog. It discharges to the Waikato River. All of the lakes have small catchments (< 100ha) that are mostly in pasture with dairy farming the dominant land use. There is no recent water quality information for these lakes. In 1997 when the last sampling was done, all of the lakes were nutrient enriched. Only Lake Pataka retains submerged plants but at low covers. All of the lakes have extensive raupō beds at the edges of the lake but there is limited wetland habitat beyond this. Willow and weed control has been undertaken at all of the lakes and some native plantings have been established. Further weed control and planting is required to establish self-sustaining native wetland plant communities around these lakes. Lakes Posa and Pataka are on private land, with Posa visible from Tuhikaramea Rd. Lake Rotopotaka is public reserve land administered by DOC and the Waipā District Council. There is an unformed road that provides foot access to Lake Rotopotaka from Thompson Rd. Given the proximity of Rotopotaka to the Moanatuatua Wetland and the Waipā River, the area would have provided rich resources for iwi. There are historic pā sites within the area. Minimum water levels have been set at all of the lakes, however the weir at Rotopotaka needs to be repaired.	
Desired state to achieve Vision & Strategy	- The lakes are swimmable, fishable and have access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.	

<table>
<tr><td></td><td>- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lakes and are active in their protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition these lakes would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 3</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species. Direct inputs of nutrient and microbes into lakes.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
<tr><td>Further drainage and clearance of native wetland vegetation.</td><td>Reduced habitat for native plants and animals and game birds. Loss of nutrient attenuation areas, and loss of wetland areas to slow flood flows.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 2 years, wetlands adjoining lakes Rotopataka and Posa are 100% fenced and protected from stock.
- Within 5 years, wetlands adjoining lakes Rotopataka, Potaka and Posa are mostly (i.e. > 90% cover) comprised of native plant communities.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing: Fencing should occur at the landward extent of wetlands or the legal boundary of the reserve, if that is the greater distance from the lake margin. Fences need to be moved out to the esplanade reserve boundary at Lake Rotopotaka. Maintenance of fences at Lake Posa is required to ensure stock aren’t accessing the wetland.

Willow control: Willow control should be undertaken using ground based methods to minimise off-target damage. All of these lakes have had previous willow control undertaken in the past 10 years but follow-up has been limited. Willow control density has been</td><td></td></tr>
</table>

considerably reduced but ground based control of young willow (and some regrown older willow) is required.

Weed control: The wetlands contain several ecosystem changing weeds, including Japanese honeysuckle, gorse and blackberry. These weeds will need to be reduced to very low levels over a period of two years before any native planting occurs.

Planting: Native planting should be carried out within existing open areas and in areas where weed removal has created open areas. Planting at 1.5m spacing is recommended, matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Hamilton ecological district.

Assumptions and cost estimates for the three wetlands follow:

Rotopotaka Wetland – 3.25 ha, 0.9km perimeter

- Assumes 395m requires fencing at $25 per metre ($9875).
- Weed control over 80% of the area over 3 years at $2800 per hectare in Year 1 and $1400 per hectare in Years 2-3 ($14,650).
- Assumes 0.5ha of the area requires native planting at $37,552 ($18,776).
- Assumes 2ha of the area requires native planting in weedy areas at $39,552 per hectare ($79,104).
- Possum control (for plant establishment) over 3 years ($1950).

Pataka Wetland – 1.28 ha, 1.1km perimeter

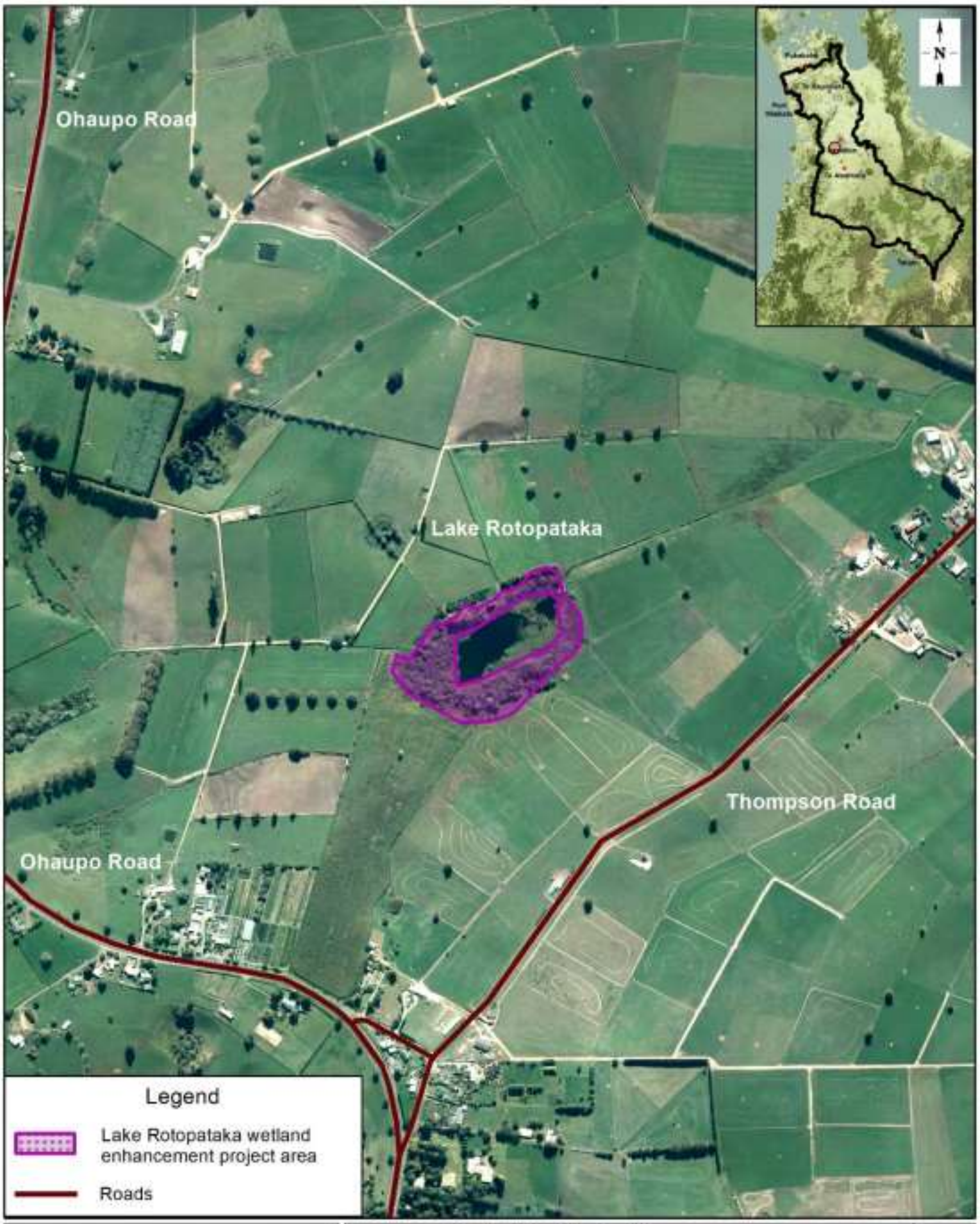
- Ground based willow control over 0.5ha at $4000 per hectare in Year 1 and $600 per hectare in Year 2 ($2300).
- Weed control over 50% of the area over 3 years at $2800 per hectare in Year 1 and $1400 per hectare in Years 2-3 ($3584).
- Assumes 1ha of the area requires native planting in weedy areas ($39,552).
- Possum control (for plant establishment) over 3 years ($770).

Posa Wetland – 3.05 ha, 1.2km perimeter

- Assumes 400m requires fencing at $25 per metre ($10,000).
- Ground based willow control over 0.5ha at $4000 per hectare in Year 1 and $600 per hectare in Year 2 ($2300).

	- Weed control over 70% of the area over 3 years at $2800 per hectare in Year 1 and $1400 per hectare in Years 2-3 ($11,956) - Assumes 2ha of the area requires native planting in weedy areas at $39,552 ($79,104). - Possum control (for plant establishment) over 3 years ($1830). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 2-3 years after project completion.	L = 7.5
Effectiveness of works	These wetlands are currently in very poor condition when compared to desired state. There has been substantial drainage and modification at these sites in recent years, intermittent stock access, and the presence of plant pests and small riparian margins limits biodiversity values. It is anticipation that further degradation in lakes and wetlands condition could occur over the next 20 years in the absence of this project given the recent dairy conversion that has occurred around lakes Posa and Pataka. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives over the long term. However, if this project is successfully completed, then it is expected that wetland condition in 20 years will be moderate, and closer to the desired Vision & Strategy state than it is currently.	W = 0.025
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Plants generally establish quickly and with high survivorship around peat lakes. Work should be carried out by experienced practitioners to ensure weed control is effective.	F = 0.87
Adoptability	It is estimated that about three-quarters of landowners would adopt the works if they were fully incentivised. Works on publicly owned land are expected to be fully adopted. Some private landowners may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised. There are also landowners around these lakes who have undertaken similar projects in the past and indicate a willingness to protect these wetland sites.	A = 0.75

<table>
<tr><td>Information quality</td><td>Average – recommendations are based on the knowledge of local land management staff and from examining aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Weed control and planting requirements have been predominantly estimated from aerial photographs. More detailed costings will be required to be done during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Rotopotaka Wetland</td><td>124,355</td></tr>
<tr><td>Pataka Wetland</td><td>46,206</td></tr>
<tr><td>Posa Wetland</td><td>105,190</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>55,150</td></tr>
<tr><td>Total</td><td>330,901</td></tr>
</table></td><td>C = 0.33</td></tr>
</table>



Wetland enhancement at Lake Rotopataka, Lake Pataka and Lake Posa Map 1/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.06 0.12 0.18 0.24 0.30
Kilometers

Scale 1:8,000@A4 Portrait

A4

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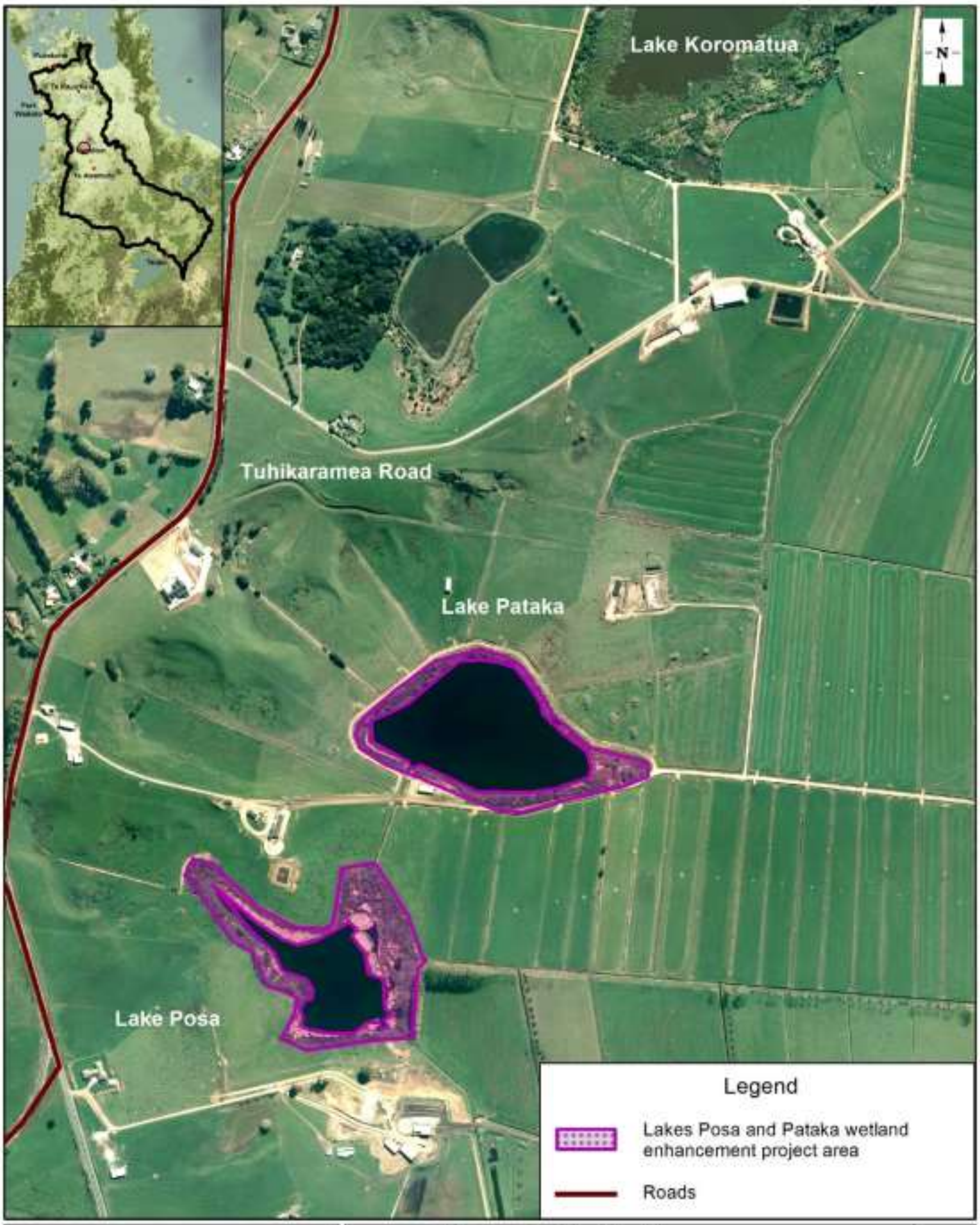


Wetland enhancement at Lake Rotopataka, Lake Pataka and Lake Posa Map 2/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.qws

0.00 0.06 0.12 0.18 0.24 0.30
Kilometers

Scale 1:7,500@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Extensive raupō beds (pale brown plants) encircle Lake Posa. Not all of the lake has been fenced.

Lake Pataka, in the foreground, discharges to Lake Posa in the background.

Lake Pataka is ringed by a farm race. There are extensive raupō beds (pale brown) around parts of the lake margin, but limited wetland habitat landward of the raupō.


Wetland surrounding Lake Rotopotaka, with blackberry (foreground) and grey willow (on the left and right).

L 19 Priority: Very high	Protecting and enhancing water quality at Lake Rotomanuka	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in water quality so that lakes are safe for swimming and gathering of taonga species. Integrated catchment management programmes protected and enhance priority shallow lakes and their catchments.	
Name of feature	Lake Rotomanuka	
Brief description of feature	Lake Rotomanuka was previously a single waterbody, but is now a complex of two separate lake basins that are hydrologically connected through a 10ha shallow seasonally flooded wetland. Lake Rotomanuka (North) has a surface area of 12.3ha and is the oldest and deepest of the Waipā peat lakes (up to 8.7m). Lake Rotomanuka South lake (Lake Gin) is considerably smaller with a surface area of 5.4ha and a depth of 4.8m. Historically, it was a significant lake and wetland which provided bountiful food and resources for iwi including tuna (eels), dyes, birdlife and materials for clothing. The name suggests that the area was populated with mānuka which was useful for rongoā (medicines) and general domestic use. The beds of the lakes and connecting wetlands are administered by the Department of Conservation as a Government Purpose (Wildlife Management) Reserve. Additional reserves have been subsequently acquired by Waipā District Council to buffer the lakes from the effects of adjoining land uses. Most recently an area of approximately 6ha was purchased on the eastern side of South Lake and added to the reserve. The Rotomanuka lakes sit within a catchment of 479 ha, which is predominantly pastoral with intensive agriculture on all sides and also includes the Rotopiko lakes complex. Approximately 79% of the catchment is privately owned, whilst Crown owned reserve land (including the 5 lake beds of the Rotomanuka and Rotopiko lakes) accounts for 19% of the catchment. Lake Rotomanuka ranks highly for its natural and biodiversity values. In the most recent assessment of biodiversity values of shallow lake SNAs within the Waikato Regional Council boundaries, Lake Rotomanuka ranked third of the 37 peat lakes, and 18th of all 96 lakes. The wetlands associated with the lakes have been assessed to be nationally significant, and the site is part of a	

	Special Landscape Character Area designation in the Waipā District Plan. The results of water quality testing show a distinct difference in water quality between South and North lakes. Water quality monitoring has been undertaken by Waikato Regional Council in Rotomanuka North since 1995 and it has relatively good water quality in comparison to other peat lakes within the catchment, with an average trophic level index (TLI) score of 4.8, which has been stable over the last 5 years. South Lake was extremely nutrient enriched (i.e. hypertrophic) when it was last surveyed in 2001. Lake modelling of the Rotomanuka lakes in 2017 has identified that Rotomanuka North is vulnerable to increases in external inputs of phosphorus and therefore restoration efforts to improve water quality should focus on reducing external nutrient loads. These studies have confirmed that a substantial portion of the water column in Rotomanuka North is anoxic for 3-4 months per year during periods of prolonged thermal stratification. The combination of low water levels and thermal stratification means that only a shallow surface layer (2-3m) of the entire water column contains oxygen. In the most recent (2007) submerged plant survey, some plants were located in Rotomanuka North but they were not present at sufficient density to generate a LakeSPI score. There is no recent fish data for the lakes, however it is notable that koi have not been recorded from this lake or the upstream Rotopiko lakes. Caged fish-exclusion experiments have established that some of the pest fish that are present in these lakes are preventing the re-establishments of submerged plants. A baseline bird survey was carried out at Rotomanuka in 2015/16 and showed that the lake supported significant populations of wetland birds, including the following threatened or at risk species: black shag, pied shag, little black shag, spotless crake, pied stilt, grey ducks and New Zealand dabchicks. It is a popular lake for game bird hunting. The five major catchment landowners (all dairy farms) have had whole farm plans carried out on their farms. A catchment plan for the lake was created by NZ Landcare Trust, and this included recommended actions to improve the quality of water entering the lake. Since then the lake was chosen to be one of the Living Water (DOC-Fonterra partnership) project areas. Living Water and NZ Landcare Trust have installed a total of four silt traps on drains	

<table>
<tr><td></td><td>entering the lakes (three on North Lake and one on South Lake) and another one has been consented for North Lake, due for construction in summer.

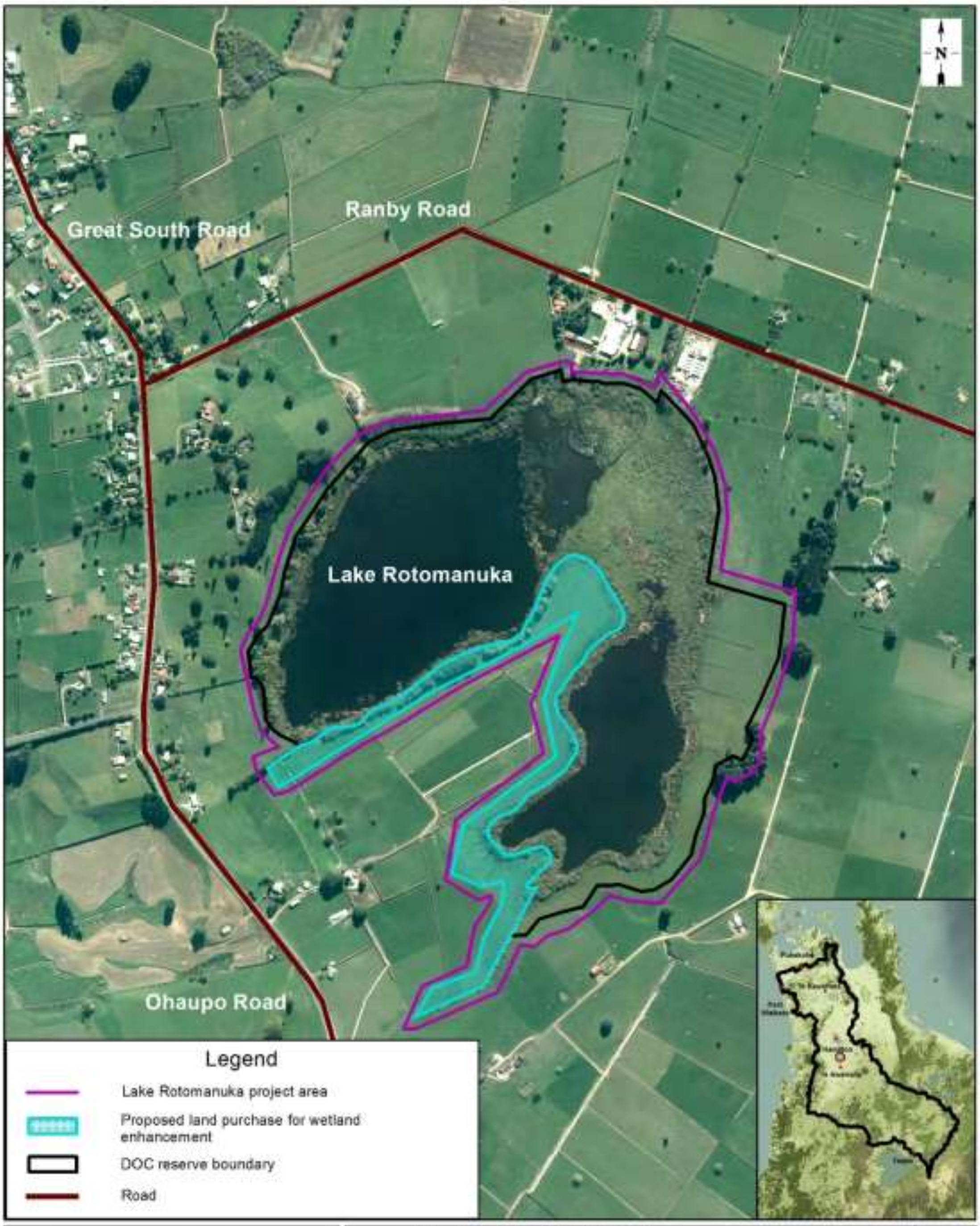
Substantial weed control has taken place removing willows as well as other large exotic trees to make room for native plantings. Approximately 20,000 native plants have been planted around the lake margin as well as into the silt traps. Animal pest control is taking place using DOC 200s, Timms traps and some Goodnature self-resetting traps. The trapping is being undertaken by local residents adjoining the lake with funding and support from Living Water.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lake is swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lake and are active in its protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Rotomanuka would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Pest fish</td><td>Prevent re-establishment of submerged plants.</td></tr>
<tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 5 years, water quality has measurably improved in Lake Rotomanuka, and native submerged aquatic plants have been re-established in the littoral zones of Rotomanuka North.
- Within 5 years, rudd densities have been reduced to levels that support submerged aquatic plants.
- Within 5 years, wetlands surrounding Lake Rotomanuka are mostly comprised of native plant communities (i.e. > 90% cover).</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour) in collaboration with DOC and Waipā District Council. This project</td><td></td></tr>
</table>

	could be undertaken as a whole, or in multiple smaller components. **Land purchase:** This project proposes purchasing 6ha of wetland soils that are estimated to be contributing to significant overland flow of nutrients and sediment into Lake Rotomanuka. Estimated costs of land purchase for land of this type is $50,000 per hectare ($300,000). Conveyancing fees are estimated to be approximately $2500 and surveying new parcel boundaries is estimated to be $5000. This land would be fenced (1500m at $25 per metre – $37,500) and planted. A 'swamp pā' occurs in the land proposed for purchase and is likely to be left as ungrazed pasture. Total cost for purchase survey and fencing is estimated to be $345,123. **Planting:** Native planting should be carried out within the existing open area of reserve land on the eastern side of the lake (3ha at $39,552 per hectare is $118,656). As well as on the proposed land for purchase (5ha at $37,552 per hectare is $187,760) Planting at 1.5m spacing is recommended, matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Hamilton Ecological District. Total cost for planting is $306,416. **Re-establishment of submerged aquatic plants in Lake Rotomanuka North:** Prior to re-establishing aquatic plants a baseline survey should be undertaken to establish densities of exotic fish ($30,000). Annual fish removal should then commence and be undertaken twice per year – in late August prior to spawning, and then in summer to coincide with periods of thermal stratification in Rotomanuka North when fish are concentrated in the top 2-3m of the water column. This is anticipated to require 4 people for 10 days per year for the first 5 year, and then 2 people for 10 days per year for the following 5 years. Labour is estimated at $70 per hour (total cost $168,000). Fishing equipment (nets, clips etc) is estimated at $75,000 over the 10 years. After undertaking 1-2 years of fishing (when rudd populations have been reduced), appropriate native submerged aquatic plants should be translocated to the littoral zones of Lake Rotomanuka. Translocation would include retrieving plants from Rotopiko lakes using divers, placing plants into biodegradable pots, growing plants for 3 months and then 'bombing' plants from the lake surface so pots wedge into the lake bottom sediments. Monitoring of plant survival and condition would be undertaken as part of the project. Some plants may be caged to provide a baseline comparison (i.e. no fish interference). Translocation of submerged plants to approximately 1ha of littoral habitat (1-2m depth around the lake	

	margin) will require 11,460 plants at a cost of $10 per plant to translocate ($114,600). Plants will need to be monitored by divers every 2 years to confirm establishment and health ($5000 per visit for 5 visits is $25,000). **Constructed treatment systems (CTS) on drains** Investigations have been undertaken at lakes Rotomanuka and Rotopiko to identify the best locations, types and sizes of constructed treatment systems (CTS) for incoming drains. Six of these have been constructed within the last 2 years. Four remaining CTS are a high priority. Costs associated with their construction are listed below: **Rotopiko 2:** This CTS consists of a sediment basin (826m^2), average depth 1.5m and an infiltration wetland (684 m^2), average depth 1.2m. This would require 1500m^3 of earthworks ($2200), 1500$m^2$ of planting ($15,100), planting maintenance for two years ($400) and annual maintenance of sediment basin to remove sediment for 10 years ($18,800). **Rotomanuka 7**: This CTS consists of a large circular silt trap (140m^2), average depth 1.8m. This would require 140m^3 of earthworks ($940), 80$m^2$ of planting ($2000), planting maintenance for two years ($100) and annual maintenance of sediment basin to remove sediment for 10 years ($6800). **Rotomanuka 11**: This CTS consists of a small circular silt trap (140m^2), average depth 1.8m. This would require 29m^3 of earthworks ($680), 20$m^2$ of planting ($500), planting maintenance for two years ($50) and annual maintenance of sediment basin to remove sediment for 10 years ($6800). **Rotomanuka 12:** This CTS consists of an infiltration wetland (330m^2), average depth 0.3m. This would require 100m^3 of earthworks ($780), 330$m^2$ of planting ($5710) and planting maintenance for two years ($100). It would also require 220m of fencing ($3740) and a planted riparian setback (330m^2, cost $840) of 1.5m either side of the wetland. Consent would be required for all of these from both Waikato Regional Council and the Waikato District Council. This would include undertaking consultation with tāngata whenua and possibly commissioning a cultural impact assessment (although there are no known archaeological sites at the CTS locations). Based on costs for similar projects undertaken at other peat lakes, consent application preparation, consent fees and consultation is likely to cost about $25,000.	

	Project management/staffing/incidentals Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs (excluding the land purchase cost).	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	When compared with desired state, Lake Rotomanuka is in a moderate to good condition with some of the Vision & Strategy aspirations already being met or partly met. This includes being fishable and having access for recreation. It is expected that over the next 20 years there may be some improvement in overall lake condition as a result of restoration works that have been carried out at the lake recently by a range of stakeholders and landowners. Works included in this project are expected to address some of the key threats to the lake, including external nutrient and sediment inputs and pest fish, as well as facilitate in-lake restoration through re-establishment of native aquatic plants. The proposed wetland area would also have significant biodiversity benefits. Modelling undertaken by the University of Waikato in 2017 indicates that works would move some water quality parameters in North lake from the D to the C band under the NOF framework. The project is focused on Lake Rotomanuka North and won't directly address pest fish and contaminant issue in South lake. However it is anticipated that if completed, the proposed work will complement and build on existing programmes and progress the lake to a good/very good condition and measurably closer to the Vision & Strategy desired state in 20 years' time.	W = 0.2
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. There is still some uncertainty around the relationship between pest fish densities and re-establishment of macrophytes. Effectiveness of constructed wetland treatment systems has not yet been fully established.	F = 0.82
Adoptability	Works on publicly owned land is expected to be adopted if fully incentivised as Waipā District Council and the Department of Conservation are both very supportive of this project. There is uncertainty around the willingness of private landowners to sell land for wetland and constructed treatment system development. This would need to be confirmed before the project was initiated.	A = 0.7

<table>
<tr><td>Information quality</td><td>Very good – analysis of area required for purchase has been done. Analysis of location, type and size of constructed treatment systems has been completed by NIWA for Rotopiko and Landcare Trust for Rotomanuka. Previous studies have confirmed the survival of native submerged aquatic plants in the littoral areas of Lake Rotomanuka North.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>No known gaps other than those identified in the technical feasibility section.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Proposed purchase of land</td><td>307,500</td></tr>
<tr><td>Fencing purchased land</td><td>37,500</td></tr>
<tr><td>Planting purchased land</td><td>187,760</td></tr>
<tr><td>Planting reserve land on eastern side of lake</td><td>118,656</td></tr>
<tr><td>CTS construction Rotopiko 2</td><td>36,500</td></tr>
<tr><td>CTS construction Rotomanuka 7</td><td>9840</td></tr>
<tr><td>CTS construction Rotomanuka 11</td><td>8030</td></tr>
<tr><td>CTS construction Rotomanuka 12</td><td>11,170</td></tr>
<tr><td>CTS consents and consultation</td><td>25,000</td></tr>
<tr><td>Baseline survey of Lake Rotomanuka North to establish fish densities.</td><td>30,000</td></tr>
<tr><td>Annual fishing of Rotomanuka North</td><td>168,000</td></tr>
<tr><td>Fishing equipment and operational costs (nets, clips, fuel)</td><td>75,000</td></tr>
<tr><td>Submerged plant translocation</td><td>114,600</td></tr>
<tr><td>Aquatic plant monitoring</td><td>25,000</td></tr>
<tr><td>Project management/staffing/incidentals (20% excluding land purchase)</td><td>169,411</td></tr>
<tr><td>Total</td><td>$1,323,967</td></tr>
</table>
</td><td>C = 1.3</td></tr>
</table>



Protecting and enhancing water quality at Lake Rotomanuka

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.000 0.075 0.150 0.225 0.300 0.375
Kilometers

Scale 1:9,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL

Lake Rotomanuka South in the foreground with Rotomanuka North in the background. The large wetland that separates them can be seen on the right.

Constructed treatment system on the main inflow into Rotomanuka South (2016). (Photo: Department of Conservation)

Grazed pasture between Rotomanuka North (left) and Rotomanuka South. This land is proposed for purchase.

L 20 Priority: Medium	Lake Rotopiko pest fish eradication	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Projects on lakes are prioritised according to cultural significance, ability to improve and ability or appropriateness to access. A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high value natural environments. Koi biomass is reduced by 80% in key lakes and maintained at this level. The impacts of other pest fish on lake water quality are managed.	
Name of feature	The Rotopiko lakes and wetlands	
Brief description of feature	This peat lake complex is situated south of Ōhaupō and is remnant of a larger peat lake that was historically lowered by artificial drainage. It is managed by DOC as a Wildlife Management Reserve. This would have originally been a closed system, but is now connected to the surrounding catchments by several inlets and one outlet (on the eastern side). There remain three permanent lakes named North (5.3 ha, 4 metres deep), East (1.6 ha, 4.4 metres deep) and South (8.3 ha, 3.6 metres deep). There is an ephemeral wetland area between North and South lakes, and this connects them during wet seasons (referred to as Winter Lake). Historically, these were part of a significant wetland area which provided bountiful food and resources for iwi, including tuna (eels), dyes, medicines, birdlife and materials for clothing and domestic use. The lakes have been monitored for water quality by Waikato Regional Council since 2002 and these results indicate that the Rotopiko lakes are eutrophic – supertrophic, although they are in better overall condition than other shallow lakes in the Waikato region overall. All three lakes still support healthy almost wholly indigenous macrophyte communities, and this is rare both in the Waikato catchment and nationally. There are five indigenous fish species recorded in these lakes; including “at risk-declining” black mudfish and longfin eel (the tuna population is unfished). The greatest direct threat to the macrophyte community at this site is rudd, but goldfish, catfish, and gambusia are also present and they contribute to direct and indirect adverse effects through feeding on the plants, altering ecosystem processes, and causing degraded water quality. DOC has been carrying out annual set-netting in these lakes, with the aim of controlling rudd to low levels (since 2001), and has also removed other pest fish species during	

<table>
<tr><td></td><td>this work. Notably, rudds have not been detected in East Lake since 2007.

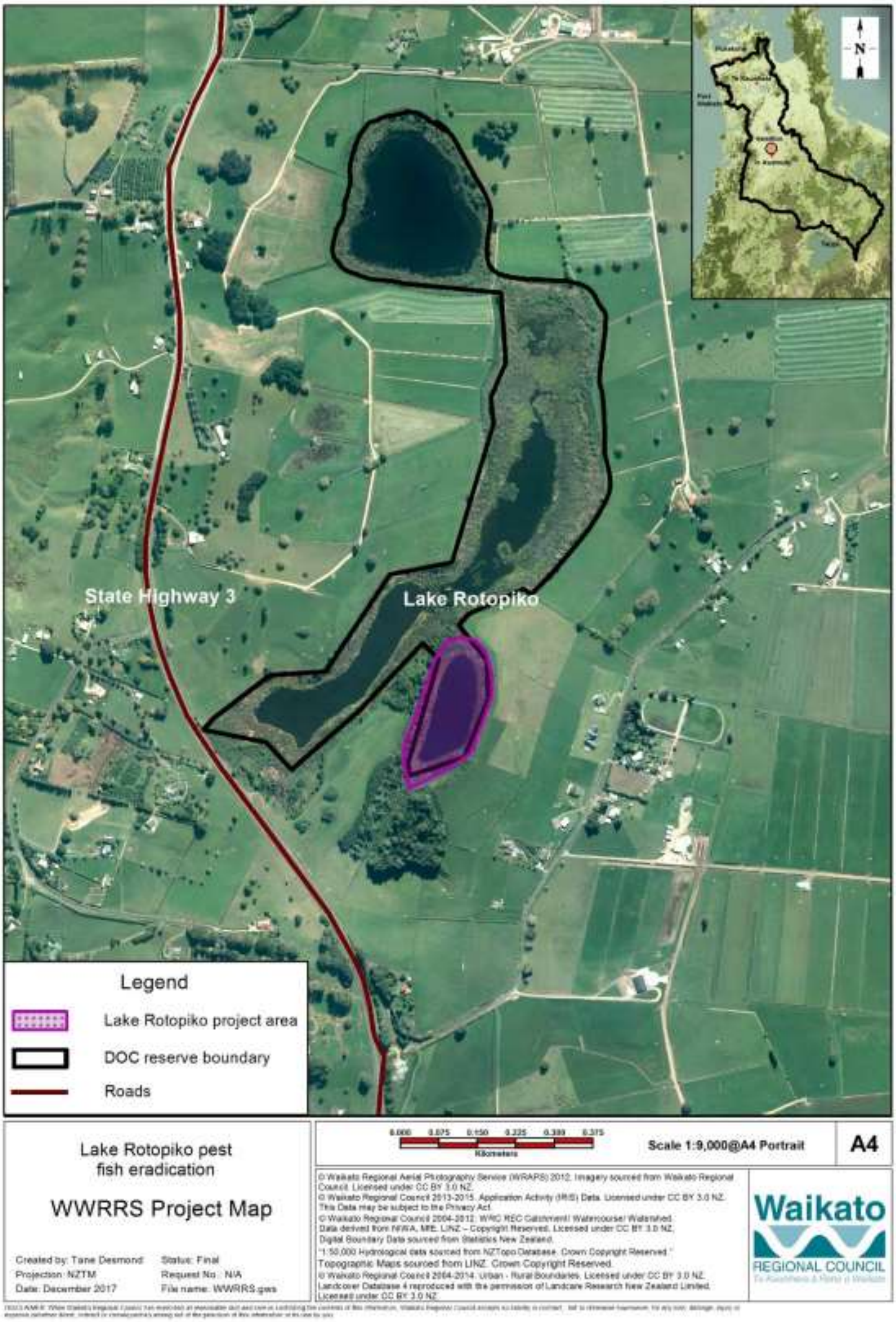
A weir was installed in 2012, approximately 2km downstream of the Rotopiko outlet. This weir was designed as a barrier to prevent pest fish moving from Lake Rotomanuka into Lake Rotopiko, whilst still allowing some native fish access (e.g. elver passage). The weir has been damaged, however work is underway to gain a revised resource consent that would enable DOC to remedy the problem and satisfy landowner concerns. There is no current evidence as to the effectiveness, or otherwise, of this weir as a pest fish barrier. In 2013 a predator-proof fence was installed around the entire margin of East Lake. This fence goes through the connecting waterways in such a way as to form a barrier to all fish passage. A manually-operated fish cage was installed in the outlet of this lake, to control passage of fish such as eels. The presence of this fence means that reincursion of pest fish into East Lake can be prevented and the success, or otherwise, of an eradication operation can be determined.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- The lakes are swimmable, fishable and has access for recreation and gathering of kai.
- Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species.
- Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna.
- Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.
- Iwi and community have a strong connection to the lakes and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, the Rotopiko lakes and wetlands would have a high impact on giving effect to the Vision & Strategy at a shallow lakes catchment level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Rudd, a largely herbivorous species.</td><td>Destruction of indigenous macrophytes; increased threat of aquatic plant collapse and decreased water quality.</td></tr><tr><td>Goldfish, catfish, and gambusia</td><td>Modification of invertebrate and fish communities; disturbance of sediments and resuspension of nutrients leading to decreased water quality.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 5 years of project commencement, LakeSPI score in East Lake is at least 80%.
- Within 5 years of project commencement rudd, goldfish and catfish will be unable to be detected in East Lake.</td><td></td></tr>
</table>

	- The eradication in East Lake provides important learnings for the methodology to be applied in the remainder of the Rotopiko complex and in other small shallow lakes in the Waikato.	
Priority works for funding	Works could be implemented by a specific organisation or preferably be a collaboration between multiple parties. Due to the nature of this site and the pest species present, more than one fish pesticide application would need to be carried out. Key tasks: - Assess the lake and prepare an implementation plan for an eradication programme using fish pesticide. This would include assessment of inflows/outflows, best time of year, quantity of pesticide, delivery method (aerial and/or ground), number of applications, tuna and other fish relocation methods and new location/holding area, post-eradication restocking of native fish. Also identify resource requirements (e.g. people and equipment), potential risks, benefits and opportunities of this work. (This is included in the project management cost.) - Undertake consultation with iwi and stakeholders. A cultural impact assessment should be undertaken by tāngata whenua. - Prepare and submit documentation to gain necessary consents/permits, including any other assessments and consultation. - Carry out eradication operation in East Lake: remove indigenous fish species, control inlets/outlets, public notification, apply pesticide, monitor water. - Monitor East Lake to ensure that pest fish species are absent. - Return indigenous fish species to East Lake. - If pest fish eradication is successful, then begin process to carry out eradications in the other Rotopiko lakes (this will require sourcing of additional funds). - Ongoing monitoring to ensure the eradication was successful and that the project goals are being achieved. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

	This is estimated to be 30% of the direct project costs in Year 1. For Years 2-5 it is assumed that this would be carried out by a staff member of an organisation at approximately 0.25 FTE.	
Time lag for benefits to be realised	If works were implemented at the planned pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately within a year of project completion.	L = 5.5
Effectiveness of works	When compared with desired state, the Rotopiko lakes are in good condition with some of the Vision & Strategy aspirations already being met or partly met. This includes being fishable, having healthy populations of native aquatic plants and tuna, and having good access for recreation. Significant restoration works have been undertaken at this site over the last 15 years and therefore overall condition is not expected to deteriorate in the next 20 years in the absence of this project. Works included in this project are focused only on East Lake and so impacts won't extend to North or South lakes. However, project learnings could be extended to these sites if the work is successful. Eradication of pest fish from East Lake would re-establish a natural food web there and thereby enhance the biodiversity and intrinsic values of the lake. If the project is successfully completed it is expected that the Rotopiko lakes complex will move closer to Vision & Strategy desired state.	W = 0.05
Risk of technical failure	There is a high to very high risk of project failure due to technical feasibility. Risks are mostly related to the efficacy of rotenone in a vegetated and peat influenced environment. This project is dependent on further work being undertaken to assess this at a laboratory and field trial scale prior to attempting at a lake scale (see section on investigation priorities).	F = 0.4
Adoptability	Works are identified to be undertaken on publicly owned land, however managing agencies would require more certainty on the efficacy of the work before agreeing for it to be undertaken.	A = 0.75
Information quality	Average – there is generally a good understanding of the pest fish populations, water quality and condition of macrophytes at this site, and the toxicity effects on pest fish using this lake water (through previous trials at the University of Waikato). Methodology of applying the fish pesticide will need fine-tuning, due to the vegetated peaty lake environment and whether that will provide difficulties in getting good toxin coverage to eliminate refugia for pest fish.	
Knowledge gaps	Feasibility of using fish pesticide in all lakes at this site – duration of toxin effectiveness in the water column and the peaty substrate, drawdown capability, presence of pest fish refugia and practicality of getting full coverage of the toxin in swampy vegetated areas,	

	effectiveness of the toxin on each pest species (including their behavioural response, particularly catfish).	
Socio-political risks	There is a high to very high risk that the project will fail to meet its goals over the long term due to socio-political risks. The use of a toxin in this lake may not be acceptable to local iwi, particularly given the good populations of longfin eel that are present. The local community and other stakeholders may also be averse to the use of a toxin for pest fish control. This project would rely on several organisations working together to progress approvals, permits and consents and this may be quite challenging. Early stakeholder engagement is critical for the successful delivery of this project.	P = 0.25
Project duration (years)	5 years	
Up-front cost – total for implementation phase/project duration	(see table below)	C = 0.5

Task	Cost ($)
Consultation and cultural assessment	30,000
Consents/permits	35,000
Eradication operation (includes native fish removal; 2 dosing attempts, initial monitor – 10 people for 8-10 days plus toxin purchase and storage, applicators/tanks/pumps/boats/helicopter)	180,000
Monitor for eradication success (2 people for 8 days, $70 per hour)	8960
Return indigenous fish species (2 people for 15 days, $70 per hour)	16,800
Landowner reparation (e.g. repairing fencing, flood mitigation)	5000
Project management Year 1 (30%)	82,728
Sub-total (up-front cost)	**358,488**
Project management/incidentals (staff member, 0.25 FTE)	25,000
Monitoring/surveillance (annual: 2 people for 8 days, $70 per hour)	8960
Consent fees (annual)	500
Sub-total per year for 4 years	34,460
Sub-total (annual costs × four out years)	**137,840**
Total	**496,328**



The Rotopiko lakes complex – with East Lake at the southeast corner.

Target species for eradication – rudd. (Photo: DOC)

L 21 Priority: Very high	Restoration of wetland and aquatic plant ecosystems at Lake Mangakaware.	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high natural environments. Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species. Important lake species such as kāeo and native aquatic plants are reproduced for retention and re-establishment.	
Name of feature	Lake Mangakaware	
Brief description of feature	Lake Mangakaware lies west of Te Awamutu and is situated within a basin of peat. The lake is managed by Waipā District Council as part of a large (about 48ha) recreational reserve, which at its widest extends 240m from the lake edge. This is a considerably larger lake buffer than any other peat lake in the Waipā District. The lake's area is 12.9ha and has a catchment area of approximately 238ha. There are five recorded archaeological sites at Lake Mangakaware that are all associated with pre-European Māori occupation. These include three swamp pā, burrow pit and cached items on the lake bed. The lake has three major inflows and 10 smaller inflows. Two of the major inflows have large constructed treatment systems on them and have been planted with submerged, emergent and wetland plants which are all well established. Water quality data indicates that the lake is nutrient enriched (hypertrophic) with a TLI of 6.41. Algal blooms frequently occur in summer and early autumn. The lake still retains a small cover of submerged plants which has recently recovered to > 10% cover in a survey in 2015. These plants included native submerged plants (pondweed and milfoils) but also the exotic weed Egeria. The lake has been fully fenced to exclude stock but the fenced area does not include about 25ha of the reserve. The unfenced areas of the reserve are currently grazed by adjoining landowners through leasing arrangements. Waipā District Council has undertaken extensive willow, blackberry and yellow flag control around the lake. Approximately 10,000	

	native plants have been planted in the reserve area and in the silt traps in recent years. Grey duck, grey teal, NZ shoveler, large black shag, little shag, pied stilt, whitefaced heron and morepork have been recorded in the area, along with other more common species of birds and waterfowl. NZ dabchick (threatened species) appears to be breeding at the lake. An extensive trapping network targeting feral cats, possum, mustelids, hedgehogs and rats is run by Hamilton Fish and Game Club. Four species of native fish are present – common bully, smelt, shortfin and longfin eels. Catfish, gambusia and goldfish are the only pest fish species known to be in the lake. There is a small waterfall approximately 500m downstream of the lake which is likely to be preventing pest fish from accessing the lake from the wider Waipā catchment. The lack of koi and rudd is likely to be beneficial for re-establishing submerged plants. An access road that terminates in a small car park next to the lake was built in 2016 providing public access to the lake. The lake is used by game bird hunters.	
Desired state to achieve Vision & Strategy	- The lake is swimmable, fishable and has access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species. - Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna. - Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally. - Iwi and community have a strong connection to the lake and are active in its protection and restoration.	
Impact on Vision & Strategy	In a restored condition, Lake Mangakaware would have a high impact on giving effect to the Vision & Strategy at shallow lakes catchment level.	VS = 28

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr><tr><td>Egeria</td><td>Smother the recovering native submerged plants. Egeria is prone to ‘collapsing’ in nutrient rich lakes leading to a flip back to an algal dominated state.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 3 years, eradicate egeria from Lake Mangakaware.
- Within 10 years, native submerged plant cover at Lake Mangakaware has reached 30%.
- Within 5 years, CTS are established on all inflowing drains to the lake leading to a 50% reduction in sediment, nitrogen and phosphorus entering the lake.
- Within 10 years revegetate all of the surrounding reserve land to establish a sequence of ecosystem types that would have naturally occurred at peat lakes in the Waipā District.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. Work would need to be undertaken in close collaboration with Waipā District Council.

Revegetation of Lake Mangakaware Reserve
<u>Fencing:</u> It is proposed to fence all of the reserve area. Total length of fencing required is 2050m at $8 per metre ($16,400).

<u>Planting:</u> Native planting is proposed in the currently unfenced areas of the reserve. Planting at 1.5m spacing is recommended, matching wetland species with flooding depth and duration. All native plants should be species that naturally occur in the Hamilton Ecological District. The area requiring revegetation is 27.3ha at $39,552 per hectare ($1,079,770).

Constructed treatment systems (CTS) on drains
Some investigations have been undertaken at Lake Mangakaware to identify the best locations, types and sizes of constructed treatment systems (CTS) on incoming drains. Many of the small drains (< 100m) originate within the reserve and won’t require CTS once the reserve is fully fenced and replanted. Four remaining inflows are considered a high priority for establishing a CTS. Costs associated with their construction are listed below:

Mangakaware 4-6: A CTS has been designed to capture inflows from 3 drains including the last major drain without a CTS. It</td><td></td></tr>
</table>

	consists of a sediment basin (400m^2), average depth 1.5m, and an infiltration wetland (800 m^2), average depth 1.2m. This would require 2200m^3 of earthworks ($3100), 1200m^2 of planting ($19,420) and planting maintenance for two years ($600). **Mangakaware 1**: The CTS designed for this inflow consists of a large sediment basin (270m^2), average depth 2.0m, and an infiltration wetland (589m^2), average depth 1.2m. This would require 1240m^3 of earthworks ($2000), 720m^2 of planting ($11,185) and planting maintenance for two years ($500). **Mangakaware East 1**: A CTS has not been designed for this inflow. It is similar sized drain/catchment to Rotomanuka 7 CTS so the same specifications are given here. A large circular silt trap (140m^2), average depth 1.8m. This would require 140m^3 of earthworks ($940), 80m^2 of planting ($2000) and planting maintenance for two years ($100). **Mangakaware East 2:** A CTS has not been designed for this inflow. It is similar sized drain/catchment to Rotomanuka 7 CTS so the same specifications are given here. A large circular silt trap (140m^2), average depth 1.8m. This would require 140m^3 of earthworks ($940), 80m^2 of planting ($2000) and planting maintenance for two years ($100). Consent would be required for CTS from both Waikato Regional Council and the Waipā District Council. This would include undertaking consultation with tāngata whenua and commissioning a cultural impact assessment. Based on costs for similar projects undertaken at other peat lakes, consent application preparation, consent fees, cultural impact assessment and consultation is likely to cost approximately $35,000. Annual maintenance of sediment basins to remove sediment for 10 years for all proposed CTS at Manakaware ($1880 per annum) would be required to keep them operational and prevent sediment being washed into the lake in an extreme flood event. **Eradication of Egeria** Egeria, a serious aquatic weed, is present at low abundances in the lake. It is proposed to eradicate this weed from the lake while it occurs at low covers and before there is an anticipated improvement in lake water clarity (resulting from a decrease in sediment from CTS on all inflows). In increase in water clarity in the lakes is highly likely to result in a rapid expansion of Egeria in the lake.	

	The proposed method is to handweed with divers and use hessian or coconut fibre matting for any large patches (total area of patches up to 5000m^2). This has been successfully used in other parts of New Zealand to eradicate Egeria and other nuisance oxygen weeds. It is a natural product that breaks down over two years. Native submerged plants such as pondweeds and charophytes will grow through the matting. The project will require a scoping survey with divers to assess the extent of Egeria, purchase of the hessian and pins, divers to lay the matting, and monitoring to assess the effectiveness. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	When compared with desired state, Lake Mangakaware is in moderate condition with some of the Vision & Strategy desired state aspects already being met or partly met. This includes being fishable and having access for recreation. It is expected that over the next 20 years there may be a slow deterioration in lake condition as a result of recent intensification of land use in the catchment. Works included here are expected to address some of the key threats to the lake, including external nutrient and sediment inputs, as well as facilitate in-lake restoration through re-establishment of native aquatic plants. Significant biodiversity gains can also be expected through the proposed planting programme. It is anticipated that this will offset predicted declines and progress the lake measurably closer to the Vision & Strategy desired state. If this project is successfully completed it is expected that the lake will be in good condition in 20 years' time.	W = 0.15
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Effectiveness of constructed wetland treatment systems has not yet been fully established. It is critical to the success of this project that works are carried out by experienced practitioners.	F = 0.82
Adoptability	Proposed works are entirely on publicly owned land and therefore full adoption is expected if the project was fully incentivised.	A = 1

<table>
<tr><td>Information quality</td><td>Very good – a recent (2015) LakeSPI survey was undertaken and the divers who did the work have assessed the methods and costs involved in the Egeria eradication component of the project. Other recommendations were developed by a subject matter expert with detailed knowledge of the site.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Data on the abundance of Egeria is 2 years old and so current status has been assumed.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>There is a low to moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. The lake is highly significant for local iwi and there are numerous interested stakeholders. Support from these partners and interested parties will be critical to project success and therefore engagement will be required early in the project development stage.</td><td>P = 0.7</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (2.05km)</td><td>16,400</td></tr>
<tr><td>Native re-vegetation of lake margin/reserve</td><td>1,079,770</td></tr>
<tr><td>CTS Mangakaware 4-6</td><td>23,120</td></tr>
<tr><td>CTS Mangakaware 1</td><td>13,685</td></tr>
<tr><td>CTS Mangakaware East 1</td><td>3040</td></tr>
<tr><td>CTS Mangakaware East 2</td><td>3040</td></tr>
<tr><td>Consent, consultation for CTS</td><td>35,000</td></tr>
<tr><td>Annual maintenance of sediment basins/silt traps for 10 years</td><td>18,800</td></tr>
<tr><td><u>Eradication of Egeria</u>

Consent costs (about $15,000)
Scoping survey and handweeding in spring and autumn ($8740)
Barrier control ($15,000)
Monitoring for 3 years ($7,500)</td><td>47,480</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>248,067</td></tr>
<tr><td>Total</td><td>1,488,402</td></tr>
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</td><td>C= 1.49</td></tr>
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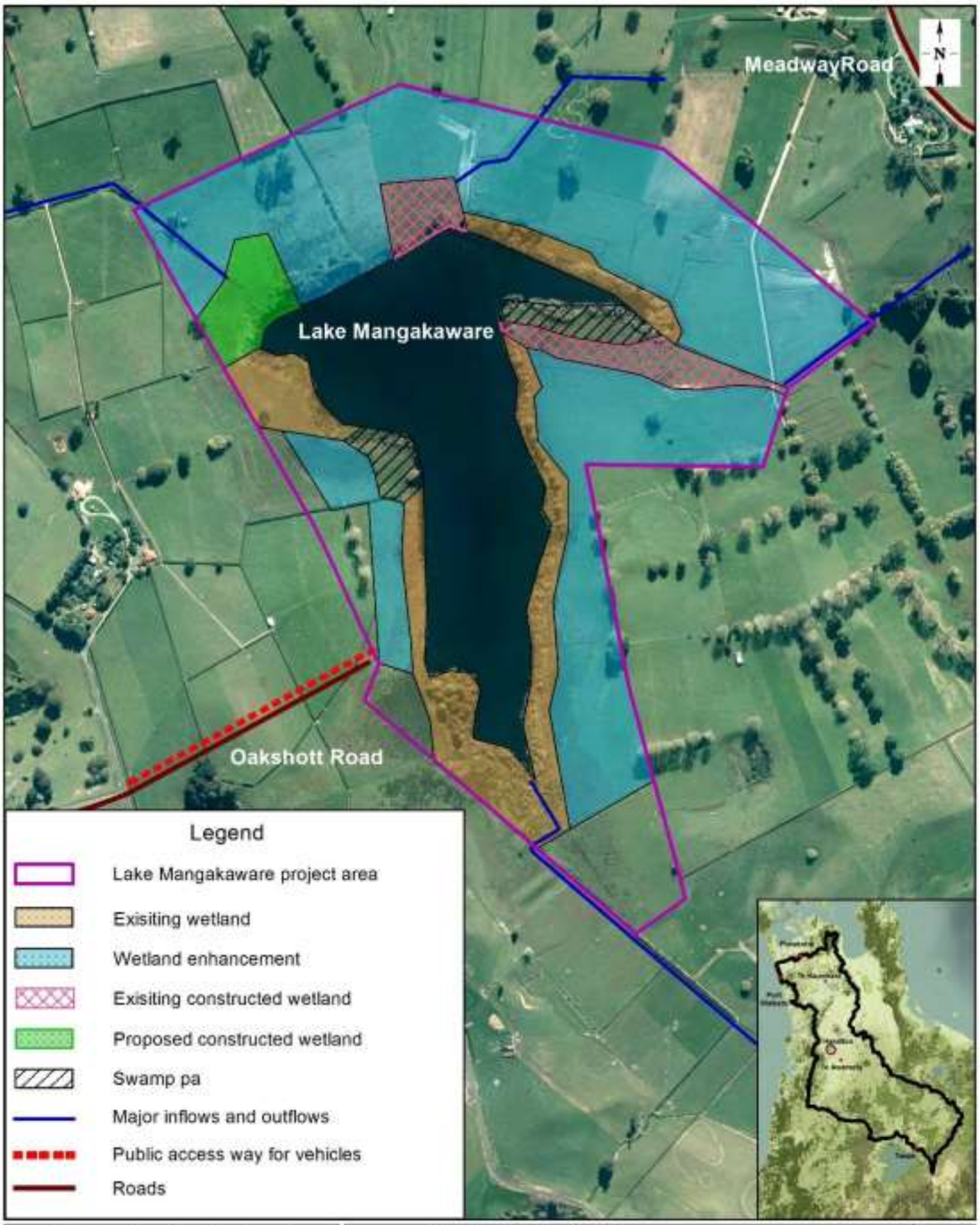


Restoration of wetland and aquatic plant ecosystems at Lake Mangakaware

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

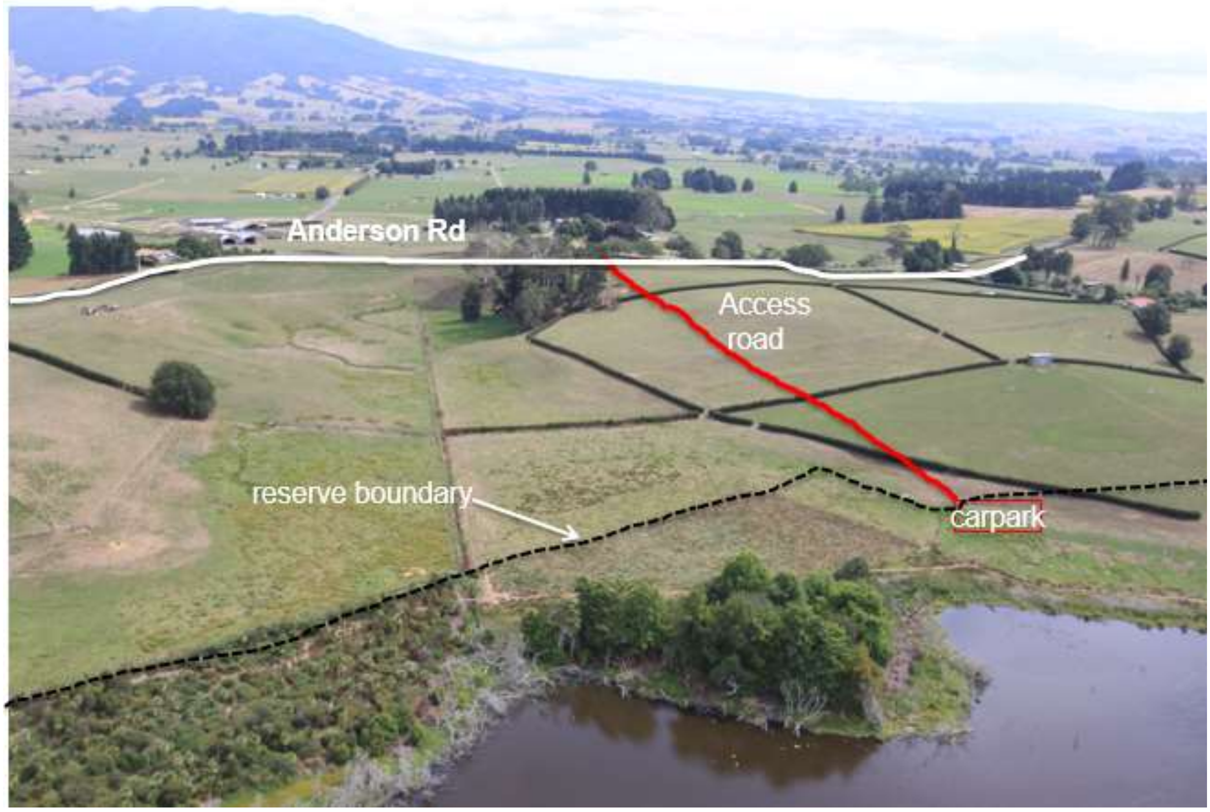
0.00 0.05 0.10 0.15 0.20 0.25
Kilometers

Scale 1:7,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Informal circuit track and one of the areas that has been revegetated at Lake Mangakaware.



Location of the access road and car park (have been completed since this photo) at Lake Mangakaware. (Photo: copyright Waipā District Council)

A constructed treatment system at Lake Mangakaware that consists of a series of silt traps and infiltration wetlands. This CTS treats the main inflow and several smaller drains. A green algal bloom can be seen in the lake. (Photo: copyright Waipā District Council)

Hessian matting being deployed in a lake in Ireland to eradicate oxygen weeds. (Photos: copyright Joe Caffery, Central Fisheries Board, Ireland)

Native plants growing through hessian matting deployed in Lake Wanaka to eradicate lagarosiphon. (Photos: copyright Mary de Winton, NIWA)

L 22 Priority: Medium	Water quality and habitat enhancement at Lake Ngāroto	BCR value
Relevant goals from Central/Lower Waikato unit and Shallow Lakes unit	Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of taonga species. Innovative interventions are developed, tested and implemented to improve lake values, including options such as flocculants, dredging and enhancing lake embayments.	
Name of feature	Lake Ngāroto	
Brief description of feature	Lake Ngāroto is the largest of the peat lakes in the Waikato region with an area of 108ha. This is part of a 149ha recreation reserve that is managed by Waipā District Council via a reserve management plan to protect and maintain its important recreational, cultural and natural values. The reserve is fully fenced. Lake Ngāroto is highly significant to Māori with six pā sites located in close proximity to the lake, including 2 swamp pā on the lake shoreline. The lake provided numerous resources to Māori, including kai, clothing, medicines and shelter. Lake Ngāroto is a central figure in the battle of Hingakaka, which is regarded as the biggest battle fought within the Tainui lands before the introduction of guns. The lake is easily accessible to the public and has toilets, boat ramps, a 6km walking track around the lake, yacht club and rowing club. The lake and its reserve is used by a large number of people on a daily basis including motorhomes, which can stay overnight. Game bird hunting remains popular. Lake Ngāroto receives water from 3 major inflows as well as about 20 smaller drains. It discharges to the Waipā River via the Mangaotama Stream. The three main subcatchments are to the south (755ha), east (620ha), and west (300ha) of the lake. The subcatchment to the east was diverted around the lake in 2015. Water quality sampling has been undertaken at Lake Ngāroto periodically since the 1970s. The lake is very nutrient enriched (hypertrophic, TLI=6.81) with high levels of turbidity. Toxic blue-green algal blooms occur frequently in the warmer months resulting in closures for contact recreation. High turbidity has resulted in the loss of submerged plants from the lake.	

	Lake modelling of Ngāroto in 2017 identified that algal blooms are most likely driven by external inputs of nutrients (coming into the lake via the surrounding drains) and phosphorus that has accumulated over time in the lake itself. Phosphorus in the lake sediments is released into the overlying lake water whenever the lake is depleted of oxygen, which occurs frequently during the summer and autumn months. The reserve surrounding the lake is mostly revegetated with native wetland and lowland forest plants but also contains several ecosystem changing weeds such as grey willow, blackberry, gorse and inkweed. A catchment action plan was created by NZ Landcare Trust in 2014 to provide recommendations to farmers as well as agencies in order to help improve the water quality of the lake and prevent it from degrading further. Eight farms in the catchment have had whole farm plans done as part of this process. Inflows to the lake were assessed to determine the best type of constructed treatment system (CTS) to install to reduce nutrients and sediment entering the lake. Two farmers have since installed CTS on some inflows and Waipā District Council has consent to install CTS on some drains on the eastern side of the lake. Shortfinned eels are the most abundant fish species found in the lake. Other native fish species present include longfinned eel and common bully. Pest fish present in the lake include bullhead catfish, rudd, goldfish, koi carp and gambusia. The extensive wetland habitat around the lake attracts a high number of bird species. Twenty-nine species of wetland birds have been recorded, including one “nationally critical” species (white heron), two “nationally endangered” species (Australasian bittern and grey duck) and one “nationally vulnerable” species (Caspian tern). Ngāroto is close to several other lakes (e.g. Ruatuna, Ngāroto-iti, Rotopiko), with birds observed flying between them.	
Desired state to achieve the Vision & Strategy	- The lake is swimmable, fishable and has access for recreation and gathering of kai. - Native aquatic plants dominate the in-lake flora and provide habitat for healthy populations of other indigenous species. - Lake margins retain natural hydrological function and are well vegetated with native plant communities that support indigenous fauna. - Wetlands adjacent to lakes are densely vegetated with native plant species, connected to riparian corridors, protected from stock grazing and native plant regeneration occurs naturally.	

<table>
<tr><td></td><td>- Iwi and community have a strong connection to the lake and are active in its protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition, Lake Ngāroto would have a high impact on giving effect to the Vision & Strategy at a shallow lakes catchment level.</td><td>VS = 60</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Diffuse pollution from catchment land use</td><td>Further degradation of water quality due to increases in nutrients, sediment and harmful microbes.</td></tr>
<tr><td>In-lake nutrient load</td><td>Phosphorus is released from lake sediments when there are anoxic events which can lead to algal blooms that effect the use of the lake for recreation.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of project commencement, water quality has measurably improved in Lake Ngāroto.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. Work would need to be undertaken in close collaboration with Waipā District Council.

Reduction of external nutrients and sediment
This project would install constructed treatment systems (CTS) on the highest priority drains entering Lake Ngāroto. These have been identified in the community catchment plan for Lake Ngāroto. Most of these would occur on private land.

Most of the CTS would occur on private land but it is proposed to purchase low-lying land at the southern end of the lake to construct a very large constructed wetland to treat all the water entering the lake from the southern catchment.

Works required on the priority drains are detailed below:

Ngāroto 1: This CTS is the proposed large constructed wetland at the southern end of the lake. It involves purchasing 19ha of low lying land. Estimated costs of land purchase for land of this type is $50,000 per hectare ($950,000). Conveyancing fees are estimated to be $2500 and surveying new parcel boundaries is estimated to be about $8000. This land would be fenced (2600m) at $20 per metre ($52,000). The size of the constructed wetland would be 2.5% of the catchment size (i.e. 18.9ha). It is estimated that the performance of a constructed wetland of this type and size (in relation to catchment area) is likely to result in the following</td><td></td></tr>
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	reductions: about 80% of annual sediment load, 60% of nitrogen, 60-80% of particulate phosphorus and >90% of *E. coli*. Cost of this type of constructed wetland is \$100,000 per hectare (\$1,890,000) and would involve significant earthworks and planting. It would also require the preparation of design specifications (\$10,000). **Ngāroto 4, 6:** The CTS recommended for these two drains is a circular sediment trap discharging to an infiltration wetland. Sediment trap (140m^2) would require 140m^3 of earthworks (\$940), 80m^2 of planting (\$2000), and planting maintenance for two years (\$100). The infiltration wetland (330m^2, average depth 0.3m) would require 100m^3 of earthworks (\$780), 330m^2 of planting (\$5710) and plant maintenance for two years (\$100). It would also require 220m of fencing at \$20 per metre (\$4400) and a planted riparian setback (330m^2, cost \$840) of 1.5m either side of the wetland. Cost per drain is \$14,870 (\$29,740). **Ngāroto 9, 13:** The CTS recommended for these two drains is a circular sediment trap discharging to an infiltration wetland and then a habitat pond (the pond located within the reserve). The sediment trap (140m^2) would require 140m^3 of earthworks (\$940), 80m^2 of planting (\$2000) and planting maintenance for two years (\$100). The infiltration wetland (330m^2, average depth 0.3m) would require 100m^3 of earthworks (\$780), 330m^2 of planting (\$5710) and plant maintenance for two years (\$100). It would also require 220m of fencing at \$20 per metre (\$4400) and a planted riparian setback (330m^2, cost \$840) of 1.5m either side of the wetland. The habitat pond would be same size as the sediment trap and involve the same quantity of earthworks and planting (\$3040). Cost per drain is \$17,910 (\$35,820). **Ngāroto 10, 11 & 12:** The CTS recommended for these drains consists of a small circular silt trap (140m^2), average depth 1.8m. This would require 29m^3 of earthworks (\$680), 20m^2 of planting (\$500), planting maintenance for two years (\$50), and 60m fencing at \$20 per metre (\$1200). Cost per drain is \$2430 (\$7290). Consent would be required for all CTS from both Waikato Regional Council and the Waipā District Council. This would include undertaking consultation with tāngata whenua and may include commissioning a cultural impact assessment. Based on costs for similar projects undertaken at other peat lakes, consent application preparation, consent fees, cultural impact assessment and consultation is likely to cost about \$35,000. Annual maintenance of sediment basins to remove sediment for 10 years for all proposed CTS at Ngāroto (\$3760 per annum) would be	

	required to keep them operational and to prevent sediment being washed into the lake in an extreme flood event. **Reduction of internal nutrients and sediment** This project involves reducing phosphorus in Lake Ngāroto using continuous alum dosing, a highly effective method for removing phosphorus from fresh water systems. Continuous alum dosing is currently being employed by the Bay of Plenty Regional Council to help meet water quality targets for lakes Rotorua, Rotoehu and Okaro. Before this is undertaken at Lake Ngāroto, further trials are required to determine the likely effectiveness of this technique in Waikato lakes. Continuous alum dosing involves pumping low levels of alum (the chemical, aluminium sulphate) into major lake inflows. It requires a small facility to safely store alum close to the site and some method for dispensing the alum (e.g. chemical pump). Costs of implementing a continuous alum dosing plant at Lake Ngāroto are still being investigated. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 8 years after project commencement.	L = 8
Effectiveness of works	When compared with desired state, Lake Ngāroto is currently in very poor condition with few of the Vision & Strategy aspirations being met. The lake is not swimmable, and the presence of pest fish and plant species impacts significantly on ecological integrity. The very poor water quality is an impediment to safe recreational use of the lake. However, the lake still retains very high significance with iwi and the local community, has a well-used walking track and retains some important wetland and biodiversity values. The lake is not expected to change in overall condition over the next 20 years in the absence of this project. There have been ongoing restoration efforts at the site which should help offset potential declines. This project will address catchment inflows and reduce internal P loading. It will also significantly increase the extent of wetland habitat around the lake. Modelling undertaken	W = 0.1

	by the University of Waikato in 2017 indicates that this work would still not move the lake into the National Objectives Framework C band, or meet swimmable targets, however it may increase clarity in the lake and move it closer towards the Vision & Strategy desired state. It doesn't address the majority of threats to the lake and it is acknowledged that achieving the Vision & Strategy desired state for Lake Ngāroto will take longer than the 20 year horizon used for the purposes of the Restoration Strategy, and a fuller range of initiatives.	
Risk of technical failure	There is a moderate to high risk of project failure due to technical feasibility. Effectiveness of constructed wetland treatment systems has not yet been fully established. However, the highest risk component of the project relates to the alum dosing which has not yet been proven in a high peat environment. This work should not be attempted until smaller laboratory and field based trials have shown that it will be effective (see section on investigation priorities).	F = 0.7
Adoptability	Works on publicly owned land is expected to be adopted if fully incentivised as Waipā District Council is very supportive of this project. There is uncertainty around the willingness of private landowners to sell land for wetland and constructed treatment system development. This would need to be confirmed before the project was initiated.	A = 0.5
Information quality	Good – recommendations for land retirement and constructed treatment systems have come from subject experts who have a history of association with the lake. Recommendations for alum are less accurate and site specific costings will need to be developed if trials indicate that it is likely to be successful in the lake.	
Knowledge gaps	Only generic information on the likely expected reductions in sediment and nutrients is currently available.	
Socio-political risks	Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. This relates to the proposed use of alum which may not be acceptable to iwi, stakeholders and the community. Early engagement with tāngata whenua during project scoping will be critical.	P = 0.62
Project duration (years)	10 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Land purchase</td><td>950,000</td></tr>
<tr><td>CTS Ngāroto 1</td><td>1,962,500</td></tr>
<tr><td>CTS Ngāroto 4 & 6</td><td>29,740</td></tr>
<tr><td>CTS Ngāroto 9 & 13</td><td>35,820</td></tr>
<tr><td>CTS Ngāroto 10, 11 & 12</td><td>7290</td></tr>
<tr><td>Consent, consultation for CTS</td><td>35,000</td></tr>
<tr><td>Annual maintenance of sediment basins/silt traps for 10 years</td><td>37,600</td></tr>
<tr><td>Continuous alum dosing</td><td></td></tr>
<tr><td>- Storage shed and pump</td><td>150,000</td></tr>
<tr><td>- Investigations on dose rates and impacts</td><td>100,000</td></tr>
<tr><td>- Consents and consultation</td><td>50,000</td></tr>
<tr><td>- Dosing with alum (5 years)</td><td>1,500,000</td></tr>
<tr><td>Project management/staffing/incidentals (20% excluding land purchase)</td><td>781,590</td></tr>
<tr><td>Total</td><td>5,639,540</td></tr>
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<td>C = 5.64</td>
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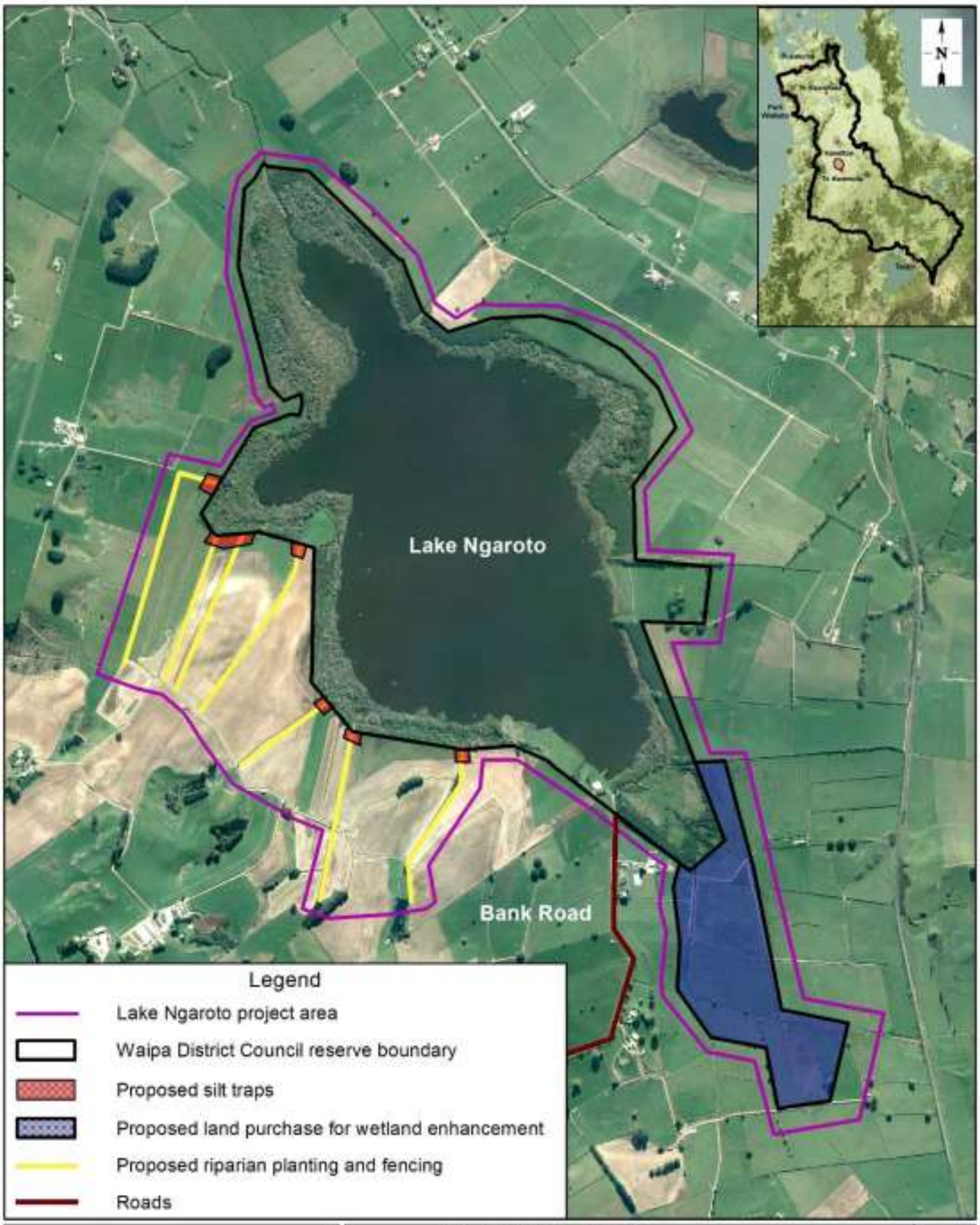

Water quality and habitat enhancement at Lake Ngaroto

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.1 0.2 0.3 0.4 0.5
Kilometers

Scale 1:15,000@A4 Portrait

A4

Waikato
REGIONAL COUNCIL

The southern end of Lake Ngāroto showing the adjacent low-lying area (which appears flooded) proposed for purchase for a large constructed wetland.

APPENDIX 9 - Waikato-Tainui Iwi Project Assessments

Contents

Waikato-Tainui 1 Priority: Very high	Enabling manawhenua to engage in river restoration – Waikato-Tainui
Project summary	This project was identified as a very high priority by iwi present at the four iwi priorities waananga throughout Waikato-Tainui. The project will see the development of a comprehensive hands-on training package that will provide iwi with the necessary skills to engage in river restoration.
Vision for the project	Waikato-Tainui are knowledgeable, participating and leading aspects of river restoration, thus enabling mana whenua to be reconnected with the tuupuna awa, which is an integral part of our identity.
Location	This project is located within the Waikato River catchment and tributaries within the Waikato-Tainui rohe
Brief description of site	The Waikato-Tainui area of the Waikato River is from Karapiro to Te Puuaha and the Waipaa River from the Puuniu junction down to Ngaaruawaahia.
Key threats/impacts	Loss of maatauranga. Loss of connection and identity. Iwi become disconnected from the awa. Iwi become bystanders to the restoration of our tuupuna awa.
Project goal/s (SMART)	Within 10 years of the project commencing, the iwi are more engaged, knowledgeable, connected and active in regards to protecting and restoring our tuupuna awa and our associated traditional practices. 40 training courses (4 per year) have been completed over 10 years.
Works required	Works could be implemented by iwi, hapuu, marae, or whaanau level. Co-funding contributions from other interested partners to complete this project would be welcomed. Prior to any works taking place, a full concept plan and costings should be developed for the project. The costs provided below are estimates only. **Develop a training package to enable manawhenua to engage in river restoration ($150,000)** Iwi (Waikato-Tainui Education Team, Waikato Raupatu River Trust and/or the Waikato-Tainui College for Research and Development) work with Wintec or other industry training providers to develop a NZQA recognised restoration training package that could include but is not limited to the following components: • Grow Safe certification • Health and safety • Fencing skills • Plant identification • Planting skills • Site preparation

	• Plant release • Plant propagation • Chainsaw • 4 wheel drive • Quad bike/ATV etc **Delivery of river training package ($3,000,000)** The delivery of the hands-on enabling of mana whenua to engage in restoration programmes should occur (in partnership with the training provider) annually across four locations within the tribe, i.e. Whatawhata, Te Puuaha, Huntly/Ngaaruawaahia and Hamilton/Karapiro. This will build critical mass of skilled tribal members to work in the river restoration space. Assume 4 sites, 10 years at $75,000 per site (includes but not limited to marae costs, waananga costs, assessors, course fees). **Resources to support the programme ($480,000)** Creation of restoration kits for whaanau that complete the programme, i.e. planting spade, health and safety gear (wet weather gear, safety boots), etc. Assume 4 sites, 10 years at $12,000 per site per year. **Project management/staffing/incidentals (30%)** Project manager/management over 10 years would be required to manage the project, including organising the development of the training package and extensive coordination to arrange delivery of the package across the different areas of the tribe and the different levels (33 hapuu, 68 marae, 65,000+ tribal members). This would be a comprehensive task.
Risks to project success	Lack of funding.
Land tenure – likelihood of adoption and adoption circumstances	N/A
Knowledge gaps and response	No known knowledge gaps.
Project duration (years)	10
Costs	

Work description	Cost ($)
Develop education package	150,000
Delivery of education programme at various locations within the tribe	3,000,000
Resources	480,000
Project management/staffing/incidentals (30%)	1,095,000
Total	**4,725,000**

Waikato-Tainui 2 Priority: Very high	Waikato-Tainui river education programme
Project summary	This project was identified as a very high priority by iwi present at the four iwi priorities waananga throughout Waikato-Tainui. The project will see the development of a comprehensive Waikato River education package based on Waikato-Tainui maatauranga, tikanga and kawa to be delivered throughout Waikato-Tainui.
Vision for the project	Waikato-Tainui are knowledgeable and reconnected with the tuupuna awa, which is an integral part of our identity.
Location	This project is located within the Waikato River catchment and tributaries within the Waikato-Tainui rohe
Brief description of site	The Waikato-Tainui area of the Waikato River is from Karapiro to Te Puuaha and the Waipaa River from the Puuniu junction down to Ngaaruawaahia.
Key threats/impacts	Loss of maatauranga. Loss of connection and identity.
Project goal/s (SMART)	Within 10 years of the project commencing, iwi are more engaged, knowledgeable, connected and active in regards to protecting and restoring our tuupuna awa and our associated traditional practices.
Works required	Works could be implemented by iwi, hapuu, marae and whaanau. Co-funding contributions from other interested partners to complete this project would be welcomed. Prior to any works taking place, a full concept plan and costings should be developed for the project. The costs provided below are estimates only. **Develop river education curriculum ($200,000)** Iwi (Waikato-Tainui Iwi Authority or the Waikato-Tainui College for Research and Development) work with marae and hapuu to develop a comprehensive river education package based on Waikato-Tainui maatauranga, tikanga and kawa. The education package should be tiered so that it can be delivered at different levels and in different locations within the tribe. Example: • Kohanga based river programme • Rangatahi based river programme • Pakeke river education package • Kaumatua/kuia river waananga series The river education package could include but is not limited to the following components: • environmental (e.g. environmental management plan, restoration education/case studies, co-management framework, taonga species restoration)

	• cultural (e.g. reo, waiata, karakia waananga, maatauranga based – traditional intergenerational knowledge transfer methods) • historical (e.g. learn the koorero associated with the sites along the river) • spiritual (e.g. learn and reconnect and practice our spiritual traditions such as whakarite, whakanoa and traditional healing practices associated with the awa). **Delivery of river education ($4,000,000)** The delivery of the education programmes could take various forms, e.g. waananga, tira hoe, integration into the curriculum, school holiday programmes. $100,000 per tier (x4) per year x 10 years ($4,000,000). **Development of resources to support the programme ($500,000)** Creation of resources to suit kohanga, rangatahi, pakeke and kaumatua/kuia learning. Could include bilingual rangatahi computer aps, books/comics, CDs, videos, history books, maatauranga/science books, etc. **Project management/staffing/incidentals (25%)** Project manager/management over 10 years would be required to manage the project, including organising the development of the curriculum and massive coordination to arrange delivery of the package across the different areas of the tribe and the different levels (33 hapuu, 68 marae, 65,000 tribal members). This would be a comprehensive task.
Knowledge gaps and response	No known knowledge gaps.
Project duration (years)	10
Costs	

Work description	Cost ($)
Develop education package	200,000
Delivery of education programme across 4 tiers and at various locations within the tribe	4,000,000
Resources	500,000
Project management/staffing/incidentals (25%)	1,100,000
Total	**5,800,000**

Waikato-Tainui 3 Priority: Very high	Waikato-Tainui river champions
Project summary	This project was identified as a very high priority by iwi at waananga. It was considered that by celebrating and acknowledging river champions (iwi members who have achieved great things on the ground, e.g with planting projects, protecting taonga species, creating enhancement opportunities or education of whanau, etc.), awareness would grow about the inspirational work that is happening for the good of the awa and inspire future river iwi champions. This project will fund an annual Iwi River Champions Awards dinner to be held at a suitable venue and award carved paddles/tohu to four successful river champions. The four tohu could be spread out over the geographical areas of Waikato-Tainui (i.e. Mercer to Te Puuaha; Ngaaruawaahia to Mercer; Puuniu to Ngaaruawaahia; and Ngaaruawaahia to Cambridge) or could be over categories, e.g. rangatahi award, mana o te awa award, mana whakahaere award, etc.
Vision for the project	Greater awareness of inspiring successful river iwi champions and their mahi on, in and around the river. The next generation of river champions are inspired to achieve even greater things.
Location	This project is located within the Waikato River catchment and tributaries within the Waikato-Tainui rohe
Brief description of site	The Waikato-Tainui area of the Waikato River is from Karapiro to Te Puuaha and the Waipaa River from the Puuniu junction down to Ngaaruawaahia.
Key threats/impacts	Lack of awareness. Lack of inspiration. No new talent interested in becoming involved with river restoration.
Project goal/s (SMART)	Within 10 years, 10 river iwi champion dinners have been held. Within 10 years, new river champions have been inspired. Within 10 years, the profile of river iwi and the success stories regarding the restoration of the tuupuna awa is high.
Works required	Works could be implemented by iwi, hapuu, marae, whaanau or in partnership with an organisation. Co-funding contributions from other interested partners to complete this project would be welcomed. **Iwi river champions awards dinner ($100,000)** $10,000 per annual dinner x 10 years = $100,000. 120 guests, food and beverages. **Tohu for river champions ($32,000)** 4 x carved paddle per year at $800 per paddle is $3200 x 10 years = $32,000. **Project management/staffing/incidentals (20%)** A project manager would coordinate the dinner at an appropriate venue, organise call for nominations, create a small selection committee to consider/review the nominations and select the winners

<table>
<tr><td></td><td>based on winning criteria, coordinate with carvers to create paddles/tohu.

20% of overall costs is $2800.</td></tr>
<tr><td>Risks to project success</td><td>None</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Awards dinner</td><td>100,000</td></tr>
<tr><td>Tohu for winners</td><td>32,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>28,000</td></tr>
<tr><td>Total</td><td>160,000</td></tr>
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Waikato-Tainui 4 Priority: High	Mana o te awa – water quality monitoring – Waikato-Tainui
Project summary	The restoration of water quality and exercising kaitiakitanga for mana o te wai were identified as high priorities by hapuu, marae and whaanau from Karapiro ki Ngaaruawaahia. This project will equip ngaa marae and/or a collective marae trust that undertakes an environmental role on behalf of those marae to utilise a Waikato-Tainui maatauranga Maaori Waikato River health sampling app. Waikato-Tainui will conduct water quality testing and use the app to actively monitor water quality and the health and wellbeing of the Waikato River. The areas for water testing will be identified by hapuu, marae, whaanau or Waikato-Tainui as being locations that are historically, culturally, ecologically or spiritually significant to them.
Vision for the project	A Waikato-Tainui maatauranga Maaori Waikato River health sampling app has been developed to be used during in-field sampling, to collate Stream Health Monitoring and Assessments Kit (SHMAK) and water quality field kit sampling data for a central Waikato-Tainui data system. Up to 40 SHMAK and 40 water quality field kits will be purchased for hapuu, marae and whaanau from within the four identified areas, Karapiro ki Ngaaruawaahia, Puuniu junction ki Ngaaruawaahia, Ngaaruawaahia ki Mercer and Mercer ki Te Puuaha. They will undertake an active kaitiakitanga role in monitoring the health and wellbeing of the Waikato-River and restoring customary practices that supports the transfer of knowledge to future generations. SHMAK and specialised sampling equipment will test pH levels, water clarity, conductivity, total dissolved solids, dissolved oxygen and turbidity.
Location	 Project area includes the Waikato River and all tributaries between Lake Karapiro and Port Waikato, including the Waipaa River from Puuniu River junction through to Ngaaruawaahia. Exact sampling site locations are to be

	determined by whaanau, hapuu and/or marae within the mapped area above in locations as being historically, culturally, ecologically or spiritually significant (the identified area is indicative only).
Brief description of site	Monitoring the health and wellbeing of the tuupuna awa is important because the Waikato River and her significant traditional waterways are the life force of Waikato-Tainui hapuu, marae and whaanau. Waikato-Tainui's primary interest in the project is to promote and protect unfettered access of tribal members to exercise mana whakahaere and traditional cultural practices as kaitiaki.
Key threats/impacts	Waikato-Tainui lose the ability to participate, implement and undertake cultural monitoring using water quality assessments and testing of their tuupuna awa. Tikanga and kawa to do with fresh water use and sustainability is lost and forgotten. Hapuu, marae and whaanau of Waikato-Tainui become disconnected from their traditional waterways. Loss of historical water quality data for future generations. Further degradation of water quality remains unmonitored.
Project goal/s (SMART)	Within 10 years, hapuu, marae, whaanau and/or marae Cluster Trust Environmental units of Waikato-Tainui have utilised their freshwater maatauranga Maaori smartphone app to collate water quality data from key identified and GPS locations to contribute to Waikato-Tainui exercising kaitiakitanga and mana whakahaere through quantitative data. Waananga have been held with Waikato-Tainui members at (or near) the completed or identified restoration sites or traditional waterways close to marae, for the transfer of knowledge and tools to marae and track the effects of the restoration projects.
Works required (quantity and description)	Sampling works could be implemented and led by hapuu, marae, whaanau and/or Waikato-Tainui. Co-funding contributions from other interested partners for hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. Develop iwi expertise in monitoring the health and wellbeing of the Tuupuna awa. **SHMAK (Stream health monitoring and assessment kits)** Each marae and marae cluster's environmental unit from Mercer through to Port Waikato along the Waikato River are equipped with a SHMAK, and given training and SHMAK PAK software for logging and recording data. Estimate cost per kit $500. Estimated cost for 40 units $20,000. **Water quality testing field kit**

	Each marae and marae cluster's environmental units from Mercer through to Port Waikato along the Waikato River are equipped with water quality field kits. Marae, including collective marae trusts or management committees, e.g. Huakina Development Trust, are equipped with a basic in-field fresh water monitoring kit and trained to undertake an active role of kaitiakitanga in monitoring the health and wellbeing of the tuupuna awa. Water quality field kit, including but not limited to: - pH meter - $84 - clarity tube - $224 - conductivity meter - $184 - total dissolved solids meter - $265 - dissolved oxygen meter - $1273 - turbidity meter - $2500 - stereo microscope - $390 - digital camera - $450 from TradeMe - collapsible work bench from Bunnings - $80 - plastic sample bottles 50ml with lid - $105/100 pack - dip nets 500 micron mesh homemade - $100 ea - sieves - $50 ea/mesh size - petri dishes - $5/pack 20 - water bottles - used secondhand drink bottles - gloves - $30/box 100 pairs (S M and L) - safety glasses - $25 ea - magnifying glasses - $7 ea - dissecting kit - $30 ea - lab coats - $40 ea - cleaning equipment (buckets, basins, detergent) - $50 - power inverter 12v to 240v - $200 (prices ex www.crescendo.co.nz excl GST) Estimate cost per kit: $8072 Estimated costs for 40 units $322,880 **Capacity development waananga** 40 x marae based waananga will be held annually to deliver training and refresher training over the 10 years: • SHMAK training • data collection and storage • water quality field kit use Estimate cost: $5000 Estimated costs for 40 waananga $200,000 **Develop Waikato-Tainui maatauranga Maaori freshwater sampling app** Estimate $10,000 **Project management/staffing/incidentals (20%)** Estimate 20% total project $120,576
Risks to project success	Lack of experienced practitioners

Knowledge gaps and response	True costs of development of Waikato-Tainui maatauranga Maaori freshwater sampling app are not known. Development may require more funding, and this will be confirmed during investigation. Exact sampling site locations yet to be determined by whaanau, hapuu and/or marae from within Karapiro and Ngaaruawaahia.
Project duration (years)	10 years
Costs	

Work description	Cost ($)
Smartphone app development	50,000
SHMK Kits x 40	20,000
Water quality field kits x 40	322,880
Capacity building and training waananga x 40	200,000
Waikato-Tainui maatauranga Maaori freshwater sampling app	10,000
Project management/staffing/incidentals (20%)	120,576
Total	**723,456**

Work description	Cost ($)
Estimated cost for 1 x SHMK and basic field kit, including 1 x training waananga (excludes app development)	13,572

Waikato-Tainui – Te Puuaha (Mercer ki Te Puuaha o Waikato)

Waikato-Tainui Te Puuaha 1 **Priority: Very high**	**Tuatahi – tuna habitat ponds – Mercer ki Te Puuaha o Waikato**
Project summary	The restoration of tuna abundance was identified as a very high priority by hapuu, marae and whaanau from Te Puuaha o Waikato This project will see the creation of 15 tuna habitat ponds between Mercer and Port Waikato, in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically or spiritually significant to them.
Vision for the project	Tuna (freshwater eels) are plentiful at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations.
Location	 Project area includes the Waikato River and all tributaries between Mercer through to Port Waikato. Exact locations of the 15 individual tuna ponds will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional tuna feeding sites, traditional mahinga kai sites and wetland type areas prone to flooding. This project is significant because tuna is a very significant mahinga kai taonga species for Waikato-Tainui. Hapuu, marae and whaanau from Te Puuaha o Waikato have witnessed a steady decline in tuna abundance in the Te Puuaha o Waikato rohe. For Waikato-Tainui, the restoration of taonga species and the ability to provide these taonga as food for manuwhiri (visitors) is a critical marker of the tribe’s mana and status. It also confirms hapuu, marae and whaanau proficiency in manaaki tangata or the practice of generosity and reciprocity. The abundance of food and other

	resources that were traditionally available to Waikato-Tainui within its tribal rohe are well known by other tribes throughout the motu.
Key threats/impacts	Tuna population will continue to decline. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga and mahinga kai. Ensure that competitive pest species, e.g. carp, are prevented from accessing identified tuna habitat.
Project goal/s (SMART)	Within 10 years, up to 15 tuna ponds have been constructed, fenced and planted, and pest plant releasing programmes have been completed. Tuna waananga have been held with iwi members at (or near) the ponds, transferring knowledge and tools to marae. Tuna from the ponds are being served at significant tribal events, like Poukai, thus contributing to restoring the relationship of the marae with the Waikato River.
Works required	Works are intended to be implemented by whaanau, hapuu and ngaa marae within Ngaaruawaahia through to Mercer. Co-funding contributions will be sourced and welcomed from interested collaborative partners. This project is intended to be undertaken as 15 individual projects but may be undertaken as multiple ponds per project sites where appropriate. Ponds should not be created within existing wetlands where there is significant native flora and fauna. **Cultural practices to ensure cultural safety.** Cultural safety, \$200 per hour or \$1600 for 8 hours. Estimated cost for up to 120 hours \$24,000. **Earthworks** Excavate marginal low lying areas to create shallow ponds/wetlands. • Ponds should be constructed up to a maximum of 5000m2 and approximately 2m deep. Ponds should be no deeper than 3m to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Good quality water is maintained in the constructed ponds. • Ponds are constructed in traditional mahinga kai area/sites identified by hapuu, marae and whaanau. Installing an instream structure (log) that will be secured in place.

Note: Resource consent may be required.

Costs include excavator transport and are based on ponds being 5000m^2 x 2m deep and a 12 tonne excavator moving 150m^3 per hour ($10,000) and returning for one day to reshape the site once excavations have settled ($1800).

Cost per pond $11,800.
Estimated cost across 15 pond $177,000.

Fencing
Ponds should be fenced with a 7-wire post and batten fence to exclude cattle.

Cost per pond: 400m x $20/m = $8000
Estimated fencing cost across 15 ponds $120,000

Planting
Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax).
Native planting 0.3ha per pond $11,865.
Additional weed control for 3 years at each pond $2520.

Planting and releasing cost per pond $14,385.
Estimated planting cost across 15 ponds $215,775.

Resource consent
It is anticipated that most ponds will require a resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately.

A generous cost estimate of $5000 per pond has been used.
Estimated resource consent costs across 15 ponds $75,000.

	 **Capacity development** • Tuna waananga Provide training for tribal members to learn about tuna restoration. Tuna waananga (10) plus tuna tool kits. Cost per waananga $6000. Estimated cost $60,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with whaanau, marae, hapuu or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, confirm consents (if required), project manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated project management cost per pond $12,956. Estimated project management cost across 15 ponds $224,333.
Risks to project success	Lack of access to sites. Resource consents not granted. Lack of experienced practitioners result in incompleted works. Ongoing maintenance to control weed infestation is not undertaken. Commercial eel fishermen fish out completed pond.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Mercer and Port Waikato. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required. Exact location of tuna ponds is to be determined by whaanau, hapuu and /or marae. Size of each pond, including area to be fenced and restored, will differ from site to site.
Project duration (years)	3 years per pond/site, includes construction, planting and weeding programme. 10 year project duration.

Costs

Work description	Cost ($)
Earthworks	177,000
Fencing	120,000
Planting	215,775
Resource consents	75,000
Capacity building	60,000
Project management/staffing/incidentals (30%)	194,332
Total	842,108

Work description	Cost ($)
Total estimate cost per individual pond (excludes capacity development and tertiary scholarships)	56,141

Waikato-Tainui Te Puuaha 2 Priority: Very high	Tuarua – 10ha wetland creation, restoration and protection – Mercer ki Te Puuaha o Waikato
Project summary	Wetland creation, restoration and protection were identified as very high priority by hapuu, marae and whaanau from Te Puuaha o Waikato. This project will see the restoration of 10ha of wetlands between Mercer and Port Waikato in areas identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant to them.
Vision for the project	Wetlands are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting native flora and fauna, including paru, for cultural purposes. Customary practices and knowledge is transferred on to future generations. Ensure the location of the paru within the wetlands have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area includes the Waikato River and all tributaries between Mercer and Port Waikato. Exact locations of the 10ha of wetland restoration will be identified by whaanau, hapuu and ngaa marae within the mapped area above in sites that are historically, culturally, ecologically or spiritually significant to them.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional mahinga kai sites. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices. This includes a broader aspiration regarding the restoration and recovery of wetland taonga species as it is related to the overall health and wellbeing of the Waikato River as captured under the Waikato-Tainui Raupatu River Settlement legislation (2010).

	Tuna is an important cultural fishery for the peoples of Te Puuaha (Port Waikato) especially, and considered to be an important indicator of river health. Stopping the encroachment of non tangata whenua fishers into areas traditionally used by members of Waikato-Tainui is one part of this overall aspiration.
Key threats/impacts	Hapuu, marae and whaanau become disconnected from traditional gathering sites. Further loss of key historic whitebait spawning site due to pest plant infestation. Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access).
Project goal/s (SMART)	Within 10 years, up to 10ha of wetlands have been constructed, restored, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with iwi members at (or near) the restoration sites or at close marae, for the transfer of knowledge and tools to marae.
Works required.	Works could be implemented at the whaanau, hapuu and/or marae level. This project could be undertaken as a whole, or in components. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required from project commencement through to project completion. Based on $200 per hour. Estimate cost per 8 hours $1600. Estimated cost for up to 80 hours $16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the wetland and plant riparian margins with native species. Fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per hectare site: 400m x $20/m = $8000. Estimated fencing cost for 1 site at 10ha: 1270m x $20/m = $25,400. Estimated fencing cost for 10 x individual sites of 1ha = $80,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 1.5m (4444 plants per hectare). Estimated cost per hectare $39,552. Estimated cost for 10ha $395,520. **Resource consent** Resource consents may be required. Estimated cost per consent $5000. Estimated cost for 10 individual consents $50,000. **Capacity development**

	Provide training for tribal members to learn about riparian fencing and planting (includes site visit to champion site). Provide training for tribal members to learn about wetland restoration. Wetland waananga (x 10). Estimate cost $50,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per hectare $17,746 (excludes tertiary scholarships). Estimated cost 10ha $207,456.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Mercer and Port Waikato. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	10 year project
Costs	

Work description	Costs ($)
Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required	16,000
Capacity building – wetland waananga	50,000
Riparian fencing 10 x 1ha sites	80,000
Wetland planting (10ha)	395,520
Resource consent x 10	50,000
Project management/staffing/incidentals (30%)	177,456
Total	**768,976**

Work description	Costs ($)
Estimated cost of 1ha site for wetland restoration project fully completed (excludes tertiary scholarship)	**76,898**

Waikato-Tainui Te Puuaha 3 Priority: Very high	Tuarua – identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 Mercer ki Te Puuaha o Waikato
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 1 of a 2-stage process and will identify the locations and tribal history of each waahi tapu and site of significance from within the area of Mercer through to Port Waikato. Stage 2 will consist of physical restoration and protection works – please refer to PAF for full details of works *(Te Puuaha – Restoration and protection of waahi tapu and sites of significance STAGE 2 – Mercer ki Te Puuaha o Waikato).*
Vision for the project	Waahi tapu and sites of significance have been identified, protected and the historical koorero recorded and archived with Waikato-Tainui and whaanau, hapuu and/or marae. Note: only approved historical koorero will be subject to public access.
Location	 Project area between Mercer car bridge over the Waikato River and the Waikato River mouth at Port Waikato.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for hapuu, marae, whaanau and iwi afterbirth, sites of historic events and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for this waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 3 years, waananga have been held with hapuu, marae, whaanau and/or iwi. One-on-one interviews of kaumatua and key knowledge holders have been held and recordings archived. • Hapuu, marae, whaanau and/or iwi have identified the locations of all waahi tapu and sites of significance within the areas of Mercer through to Port Waikato. • A waahi tapu and sites of significance register, including GIS mapping, is complete and entered into Waikato-Tainui's archiving data system. • Opportunities for iwi capacity development in GIS mapping has been implemented.
Works required	**Waananga** 10 waananga held with hapuu, marae and whaanau to identify waahi tapu, sites of significance and key knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources and present back findings. • Venue, kai and koha per day $1500 • Cultural safety, $200 per hour or $1600 per day • Facilitator $200 per hour or $1600 per day • Travel expenses for participants $40 per person, $600 per waananga Estimated cost per waananga = up to $3700 Estimated waananga cost = $37,000 **Interviews** Interview knowledge holders i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: • Up to 20 kaumatua/kuia interviews at $500 per interview = $10,000 • Film interviews at $700 per day x 14 days $9800 • Editing of interviews at $700 per day x 14 days $9800 • Interviewer/literature reviewer at $800 per day x 21 days $16,800 • Estimated interviewing cost $46,400 **Mapping and photographing waahi tapu sites** Access site/s, map and photograph all significant and waahi tupuna/tapu sites. Enter information into digital database and maps. Assume: • Access and photograph sites at $800 per day x 21 days $16,800 • GIS mapping services at $200 per hour to input maps and develop register x 28 days $44,800 Estimated Interviewing cost $61,600 **Capacity development** Hold 2 x GIS mapping waananga with hapuu, marae and whaanau from

<table>
<tr><td></td><td>Mercer through to Port Waikato, identify and support (2) taiohi to undertake a scholarship to study and formally upskill in GIS/cultural mapping of waahi tapu/historical or related studies.

GIS mapping waananga x 2 $10,000,
Scholarship x 2 taiohi/student $20,000
Estimated capacity development costs $30,000

Vegetation clearance to access sites of significance
Some of the known waahi tapu and site of significance areas need to be cleared of scrub and weeds to allow access for hapuu, marae and whaanau to assess the sites.

Contractor costs to clear weeds from known sites of significance at $700 per day x 28 days
Estimated clearing cost $19,600

Project management/staffing/incidentals (30%)
Project manager to carry out knowledge holder interviews, work with whaanau, marae, hapuu, or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost $58,380

Project delivery
Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Resource consents not granted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Mercer and Port Waikato.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact location to be identified by key knowledge holders i.e. kaumatua, kuia.</td></tr>
<tr><td>Project duration (years)</td><td>3 year project</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Waananga with Waikato-Tainui kaumatua</td><td>37,000</td></tr>
<tr><td>Interview with key knowledge holders</td><td>46,400</td></tr>
<tr><td>Mapping and photography</td><td>61,600</td></tr>
<tr><td>GIS mapping capacity development</td><td>30,000</td></tr>
<tr><td>Clear and remove vegetation</td><td>19,600</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>58,380</td></tr>
<tr><td>Total</td><td>252,980</td></tr>
</table>
</td></tr>
</table>

Waikato-Tainui Te Puuaha 4 **Priority: Very high**	**Tuarua – Restoring and protecting waahi tapu and sites of significance – STAGE 2 – Mercer ki Te Puuaha o Waikato**
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 2 and the final stage to physically restore and protect the waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or iwi during stage 1. *(Tuarua – Identification, restoration and protection of waahi tapu and sites of significance STAGE 1 – Mercer ki Te Puuaha)*
Vision for the project	Identified waahi tapu and sites of significance have been restored and protected with full stock exclusion fencing and appropriate planting of native species. Locations of waahi tapu and sites of significance will be marked by traditional carved Pou, iPou or new technology (e.g. augmented reality technology) that can be adapted to traditional Maaori symbolism. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Mercer and Te Puuaha. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for afterbirth, sites of historic events, traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated and uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 10 years, all identified waahi tapu and sites of significance access, fencing and planting have been completed. • Ongoing weed management has been undertaken by landowners, hapuu, marae, whaanau and/or iwi. • Signage and/or carved iPou have been developed to tell the history of the waahi tapu or sites of significance.
Works required	**Proposed development would include:** Conduct site visit with kaumatua to locate waahi tapu or site of significance. Facilitate cultural practices and ensure cultural safety as per their tikanga and kawa. Fence off and plant native species around each waahi tapu or site of significance. **Cultural practices to ensure cultural safety.** Cultural safety \$200 per hour or \$1600 per day. **Site fencing** Perimeter fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per 1000m^2 site: 130m x \$20/m = \$2600. Estimated fencing cost across 1ha: 400m x \$20/m = \$8000. **Site prep, planting and maintenance** Weedy site prep per hectare \$2000. Plant spacing of 1.5m and 4444 stems per hectare. \$3.50 per plant. Planting cost \$1.50 per plant. 5 x releasing events \$3 per plant. Estimated cost per 1000m^2 \$3955. Estimated cost per hectare \$39,552. **Maaori cultural symbolism** Waahi tapu and sites of significance will be recognised through the development and fabrication of cultural symbolism, to be installed on site and appropriately marking the location. The total number of carved pou or iPou will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). • **Carved pou** *Collate information for carved pou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui.

	Estimated cost per carved pou $1000. *Fabricate and install carved pou onto the sites* (6m length x 0.6m diameter) Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou. Estimated fabrication and installation costs per carved pou $35,000. Timber to be carved into pou (6m length x 0.6m diameter) Cost is highly dependent on availability and species. It is encouraged to shop around. Totara is best suited for fine detailed carving – $15,000 including transport from South Island. H5 treated pine is not suited for fine detailed carving – $1200 including transportation. • **iPou** The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and immediate. It is multi focused, including messaging to river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.  *Collate information for iPou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per iPou $1000 *Fabricate and install 1 iPou onto the sites* Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou or kohatu). Estimated cost per iPou $10,000. *Technology/Information loaded and installed into each iPou* Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology.

	Estimated cost per iPou $2000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $156,098. **Project delivery** Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Mercer and Te Puuaha. Very high likelihood of adoption.
Knowledge gaps and response	Exact location, to be identified by key knowledge holders, i.e. kaumatua and kuia.
Project duration (years)	3 year project

Costs	Individual costing estimates for 1 x 1000m^2 site with **either** 1 x carved totara pou, 1 x carved pine pou or 1 x iPou fabricated and installed onsite; and 20 x 1000m^2 site and cultural practices, including 5 x carved totara Pou and 10 x iPou.

Work description	Cost ($)
Costs are based on 1 x 1000m^2 site	
Cultural practices to ensure cultural safety 8 hours	1600
1000m^2 site fencing	2600
Site prep, planting, maintenance	3955
1 x carved Pou fabrication and installation	35,000
Collate information for carved pou	1000
Totara timber 6m length x 0.6m diameter	15,000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1000
Load information into iPou software	2000
Project management totara carved pou/or	17,747
Project management pine carved pou/or	13,607
Project management for iPou	6,347
Total estimated cost for 1 x totara carved pou	**76,902**
Total estimated cost for 1 x iPou	**27,502**

The cost estimate below includes site prep, planting, weed maintenance and fencing for up to 20 restored waahi tapu or significant sites between Mercer ki Te Puuaha, with up to 15 x fabricated pou installed onsite.

Work description	Cost ($)
Task costs are based on 20 x 1,000m^2 site	
Cultural practices to ensure cultural safety 160 hours	32,000
Site fencing	39,000
Site prep, planting, maintenance	59,325
5 x carved pou fabrication and installation	175,000
Collate information for carved pou x 10	10,000
5 x totara timber 6m length x 0.6m diameter	75,000
10 x iPou fabrication and installation	100,000
Collate information for iPou x 10	10,000
Load information into iPou software x 10	20,000
Project management/staffing/incidentals (30%)	156,098
Total estimated cost for 20 x 1,000m^2 sites	**676,423**

Waikato-Tainui Te Puuaha 5 Priority: High	Tuarua – 30 puna restoration – Mercer ki Te Puuaha o Waikato
Project summary	The restoration of traditional puna was identified as a high priority by hapuu, marae and whaanau from Te Puuaha o Waikato. This project will see the restoration of up to 30 puna between Mercer and Port Waikato. Puna will be restored in areas identified by hapuu, marae, whaanau or Waikato-Tainui as being historically, culturally, ecologically or spiritually significant to them.
Vision for the project	Up to 30 puna are well established and restored at identified sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing their traditional puna. Customary practices and knowledge is transferred onto future generations. Ensure locations of puna have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area includes the Waikato River and all tributaries between Mercer and Port Waikato. The 30 puna restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above, in locations deemed as being historically, culturally, ecologically or spiritually significant.
Brief description of site	Restoration of puna is important because traditional puna were used for drinking water of marae and whaanau whare and sustainable land use. Historically, marae and whaanau kainga were built next to waterways or puna. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional cultural practices.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from traditional puna sites. Further loss of key historic knowledge of each site, pest plant infestation.

	Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access). Traditional puna are depleted due to surrounding activities, e.g. farming.
Project goal/s (SMART)	Within 10 years, up to 30 puna have been restored, enhanced, fenced and planted (including pest plant releasing programmes). Waananga have been held with Waikato-Tainui members at (or near) the restoration sites or at close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led by hapuu, marae, whaanau and/or Waikato-Tainui. Co-funding contributions from other interested partners for hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as, a whole. **Cultural health and safety** Cultural health and safety, in accordance with Waikato-Tainui marae tikanga and kawa, where required from project commencement through to project completion – $200 per hour. Estimate cost per 4 hours $800. Estimated cost for up to 120 hours $24,000. **Restoration fencing and planting** *Estimated cost per puna* Carry out approximately 130m of fencing to protect an approximately 1000m^2 area around each puna. Estimated cost for 130m of 7-wire post and batten fence $2600. Estimated prep, planting and maintenance costs for 1000m^2 $3955. *Estimated cost per puna run off stream/tributary* Carry out approximately 100m of fencing puna run off streams and seep/wet areas, with riparian fencing set back a minimum of 5m from the edge of the streambank, seep/wet areas. Plant riparian margins with native species. Estimated fencing cost for 200m $4000. Estimated prep, planting and maintenance cost for 1000m^2 $3955. Where the puna was historically a known whitebait spawning ground, riparian planting is to be carried out using appropriate native plant species, planted at 0.75m plant spacing. **Capacity development** Provide training for tribal members to learn about riparian fencing and planting. Fencing waananga (x5). Planting waananga (x5). Estimated cost per waananga $5000. Total estimated waananga cost $50,000.

	Project management/staffing/incidentals (30%) Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per puna $4353. Estimated cost for 30 puna $185,790.
Risks to project success	Lack of funding. Access to sites is restricted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui, between Mercer and Port Waikato. Very high likelihood of adoption.
Knowledge gaps and response	Exact puna location to be determined by whaanau, hapuu and /or marae. Size of puna areas to be fenced and restored differ from site to site. Length of fencing required for puna, including run off streams and wet seep areas.
Project duration (years)	Individual projects expected to be 3-5 years in duration. 10 year project.
Costs	(see tables below)

Work description	Cost ($)
Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required	24,000
Fencing off puna for protection (30 puna)	78,000
Puna riparian planting (30 puna)	118,650
Puna stream fencing (30 puna)	120,000
Puna stream riparian planting (5m setback on both banks)	118,650
Capacity building Fencing and planting wananga	50,000
Project management/staffing/incidentals (30%)	152,790
Total	**662,090**

Estimated cost for 1 x puna restoration project fully completed (excludes tertiary scholarship and waananga)	**22,070**

Waikato-Tainui Te Puuaha 6 Priority: High	Tuatoru – 10km riparian and taonga species habitat restoration – Mercer ki Te Puuaha o Waikato
Project summary	The restoration of riparian margins, including the restoration and protection of ngaa taonga species, has been identified as a high priority by hapuu, marae and whaanau from Te Puuaha o Waikato. This project will see the restoration of 10km of riparian margins between Mercer and Port Waikato. Areas will be identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant to them.
Vision for the project	Riparian margins and their ecosystems are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, and enhancing the wellbeing of traditional mahinga kai sites along the Waikato River and tributaries.
Location	 Project area includes the Waikato River and all tributaries between Mercer and Port Waikato. The 10km of riparian restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Sections of the Waikato River, streams, and tributaries are well known to hapuu, marae, whaanau and Waikato-Tainui. They are historically, culturally, ecologically or spiritually significant, e.g. the return of taonga species currently absent or in decline. Waikato-Tainui’s primary interest in the project is to provide and protect unfettered access to riparian margins for tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices.

Key threats/impacts	Taonga species remain absent or in decline in traditional sites where they were once plentiful. Hapuu, marae, whaanau become disconnected from the Waikato River and traditional mahinga kai sites due to poor habitat. Culturally important purakau, tikanga and kawa become less known. Cattle and other browsing species are destroying traditional sites within the riparian margins of the Waikato River and associated wetlands.
Project goal/s (SMART)	Within 10 years, up to 10km of riparian margins suitable for taonga species habitat have been restored, enhanced, fenced and planted, including pest plant releasing programmes. Capacity development waananga have been held with iwi members at or near the restoration sites or at marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led at marae or whaanau level. Co-funding contributions from other interested partners to hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Cultural practices to ensure cultural safety** Cultural safety, \$200 per hour or \$1600 per day. Estimated cost for up to 80 hours \$16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the stream and/or river banks. Fencing will consist of a 7-wire post and batten at \$20 per metre. Estimated cost per 1000m site \$20,000. Estimated cost for 10km \$200,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 1.5m. (4444 plants per hectare) and 5 x plant releasing events. Estimated planting cost per 5000m^2 \$18,776. Estimated planting cost for 5ha \$187,760. **Installation of structures for fish habitat** Carry out approximately 10km of securing in-stream wood structures throughout the identified restoration streams (comprising 4- 6 structures over a 2km length for fish habitat where practicable). Estimate cost per 1km \$10,413. Estimated cost for 10km \$104,130. It is envisaged that whaanau, hapuu and/or marae with the assistance from Waikato Regional Council work collaboratively in terms of site location investigation, design and installation of woody debris structures. This component could be undertaken in conjunction with Waikato Regional Council's river management work. **Capacity development**

<table>
<tr><td></td><td>Provide training for tribal members to learn about riparian fencing and planting.
Fencing waananga (x5).
Planting waananga (x5).
Estimated cost for 10 waananga at $5000 each = $50,000.

Project management/staffing/incidentals (30%)
Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per 1km length $16,737 (excludes tertiary scholarships).
Estimated cost for a 10km site $197,367.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui, between Mercer and Port Waikato.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact locations of each restoration site need to be determined.</td></tr>
<tr><td>Project duration (years)</td><td>10 year project</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui tikanga and kawa throughout each individual project where required</td><td>16,000</td></tr>
<tr><td>Riparian fencing (10km)</td><td>200,000</td></tr>
<tr><td>Riparian planting (5ha)</td><td>187,760</td></tr>
<tr><td>Installation of structures for fish habitat</td><td>104,130</td></tr>
<tr><td>Capacity building – fencing and planting waananga</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>162,567</td></tr>
<tr><td>Total</td><td>704,457</td></tr>
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<table>
<tr><td>Estimated cost to restore 1000m length of riparian margin with a 5m setback (excludes tertiary scholarship).</td><td>72,526</td></tr>
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Waikato-Tainui Te Puuaha 7 Priority: High	Tuatoru – 20 watercress restoration projects – Mercer ki Te Puuaha o Waikato
Project summary	The restoration of traditional watercress sites was identified as a high priority by whaanau, hapuu and ngaa marae between Mercer and Te Puuaha This project will see the creation of 20 restored watercress sites between Mercer and Te Puuaha, in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically significant to them.
Vision for the project	Watercress is plentiful within the restored, traditional gathering locations.
Location	 Project area between Mercer and the Waikato River mouth at Port Waikato.
Brief description of site	Historically, watercress was in abundance and readily available for hapuu, marae and whaanau throughout the Waikato catchment. Now, with the intensification of land use, watercress is either no longer present or the land has been modified for dairy and dry stock. Waatakirihi, or watercress (also called koowhitiwhiti, *Nasturtium officinale* and *N. microphyllum*), is a highly prized food source for Waikato-Tainui and Maaori generally. An aquatic or boggy ground plant associated with drains, small creeks, wetland streams, and the calmer edges of rivers, waatakirihi is a vigorous plant, provided there is a good level of water quality (i.e. lack of sedimentation). It is a member of the mustard family and is highly regarded for its medicinal properties as well as its taste in many cultures across the world. As avid botanists and gardeners, tangata whenua were quick to identify its properties, and it now forms a major component of many traditional dishes. Harvest sites are highly coveted and sometimes known only to whanau (family/families).

	(Dixon, L. 2017 – *the importance of watakirihi* – te reo o te repo – the voice of the wetland)
Key threats/impacts	New plants do not establish, and traditional watercress sites remain barren. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga of their watercress sites.
Project goal/s (SMART)	Within 2 years, watercress is flourishing in up to 20 project sites within the Mercer ki Te Puuaha catchment.
Works required	Works could be implemented at iwi, hapuu, marae or whaanau level. This project could be undertaken as a whole, or in components. It is intended to restore traditional hapuu, marae, whaanau and iwi watercress sites. **Watercress restoration ($100,000)** 20 sites at $5000 per site = $100,000. Includes project management/staffing/incidentals of 25% ($20,000). Project manager to carry out landowner liaison, provide reporting information, negotiate agreements, inspect works, pick up and seed watercress.
Risks to project success	Lack of access to sites. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Mercer and Te Puuaha. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	1-2 year projects
Costs	

Work description	Cost ($)
20 watercress restoration projects	80,000
Project management/staffing/incidentals (25%)	20,000
Total	**100,000**

Waikato-Tainui Ngaaruawaahia ki Mercer 1 Priority: Very high	Tuatahi – 10ha wetland creation, restoration and protection – Ngaaruawaahia ki Mercer
Project summary	Wetland creation, restoration and protection were identified as extremely high priorities by hapuu, marae and whaanau from Ngaaruawaahia through to Mercer. This project will see the restoration of 10ha of wetlands between Ngaaruawaahia and Mercer, in areas identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant to them.
Vision for the project	Wetlands are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting native flora and fauna, including paru, for cultural purposes. Customary practices and knowledge is transferred on to future generations. Ensure the location of the paru within the wetlands have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area includes the Waikato River and all tributaries between Ngaaruawaahia and Mercer. The 10ha of wetland restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above, in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional mahinga kai sites. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices.

	This includes a broader aspiration regarding the restoration and recovery of wetland taonga species as it is related to the overall health and wellbeing of the Waikato River as captured under the Waikato-Tainui Raupatu River Settlement legislation (2010). Tuna is an important cultural fishery for the peoples of Ngaaruawaahia ki Mercer especially, and is considered to be an important indicator of river health. Stopping the encroachment of non tangata whenua fishers into areas traditionally used by members of Waikato-Tainui is one part of this overall aspiration.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from traditional gathering sites. Further loss of key historic whitebait spawning site due to pest plant infestation. Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access).
Project goal/s (SMART)	Within 10 years, up to 10ha of wetlands have been constructed, restored, fenced and planted, including pest plant releasing programmes. Waananga have been held with iwi members at (or near) the restoration sites or close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented at whaanau, hapuu and/or marae level. This project could be undertaken as a whole, or in components. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Based on $200 per hour. Estimate cost per 8 hours $1600. Estimated cost for up to 80 hours $16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the wetland and plant riparian margins with native species. Fenced with a 7-wire post and batten fence to exclude cattle. Estimated fencing cost per hectare site: 400m x $20/m = $8000 Estimated fencing cost for 1 site at 10ha: 1270m x $20/m = $25,400 Estimated fencing cost for 10 individual sites of 1ha each $80,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland, where required, with plant spacing of 1.5m. (4444 plants per hectare). Estimated cost per hectare $39,552. Estimated cost for 10ha $395,520. **Resource consent** Resource consents may be required. Estimated cost per consent $5000.

	Estimated cost for 10 individual consents $50,000. **Capacity development** Provide training for tribal members to learn about riparian fencing and planting (includes site visit to champion site). Provide training for tribal members to learn about wetland restoration. Wetland waananga (x 10). Estimated cost $50,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per 1ha $17,746 (excludes tertiary scholarships). Estimated cost 10ha $207,456.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	10 year project
Costs	

Work description	**Costs ($)**
Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project, where required	16,000
Capacity building – wetland waananga	50,000
Riparian fencing 10 x 1ha sites	80,000
Wetland planting (10ha)	395,520
Resource consent x 10	50,000
Project management/staffing/incidentals (30%)	177,456
Total	**768,976**

Work description	**Costs ($)**
Estimated cost of 1ha site for wetland restoration project fully completed (excludes tertiary scholarship)	**76,898**

Waikato-Tainui Ngaaruawaahia ki Mercer 2 **Priority: Very High**	**Tuatahi – Restoring access to the Waikato River through waka taua – Turangawaewae**
Project summary	Ngaa Waka Taua o Te Kingiitanga   Restoring and protecting Waikato-Tainui's access to traditional kaitiaki customs of waka taua on the Waikato River, and restoring access to historic cultural practices that reconnect hapuu, marae, whaanau and iwi to the physical and spiritual tie between Waikato-Tainui and the Waikato River. This project will ensure the safe storage of the historic taonga through the construction of a shed that will house our taonga and ensure the intergenerational knowledge and waka taua maatauranga Maaori, waka taua tikanga and kawa and the tikanga and kawa on our tuupuna awa, the Waikato River.
Vision for the project	A secure waka taua facility is erected and safely stores waka taua. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing the wellbeing of traditional waka taua ceremonies, while restoring and protecting their relationship with the Waikato River.
Location	Turangawaewae Marae. Turangawaewae Marae is located in the town of Ngaaruawaahia in the Waikato region of the North Island of New Zealand. A very significant marae, it is the headquarters for the Maaori King Movement (Te Kiingitanga) and the official residence and reception centre of the head of the Kiingitanga, currently the Maaori King, Tuheitia Paki.
Brief description of site	**Waikato-Tainui's vision:**

Re-establishment of a new Waikato-Tainui waka taua shed to restore, protect and continue to pass on the ancient knowledge of traditional waka taua construction, the carving of tribal history; the restoration of historic whakapapa, of key tribal connections, including restoring the art of traditional waka building and weaving traditional kaakahu (cloaks).

This shed will ensure safe storage of ngaa taonga tuku iho waka taua, providing safe space for intergenerational knowledge to be transfered from kaumatua to ngaa pakeke and ngaa mokopuna – passing on the important lessons of tikanga and kawa, reconnecting and strengthening our ties to our waka taua and our tuupuna awa, including our history as a River People.

Re-establishment of paa harakeke, planting of specialty flax for cultural weaving of taonga for waka taua and kaihoe (waka taua paddlers).

Restore the traditional waka taua landing site and ramp on the true right bank of the Waikato River. This will allow safe boarding and disembarking of the waka taua along the history-rich banks of Turangawaewae Marae. The large ramp will reduce the risk of damage to the waka taua and ensure they are safely launched and retrieved the during significant tribal events, including:

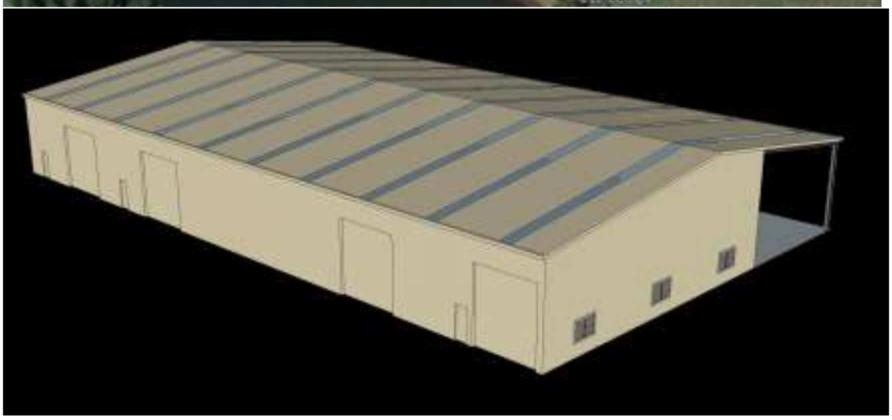
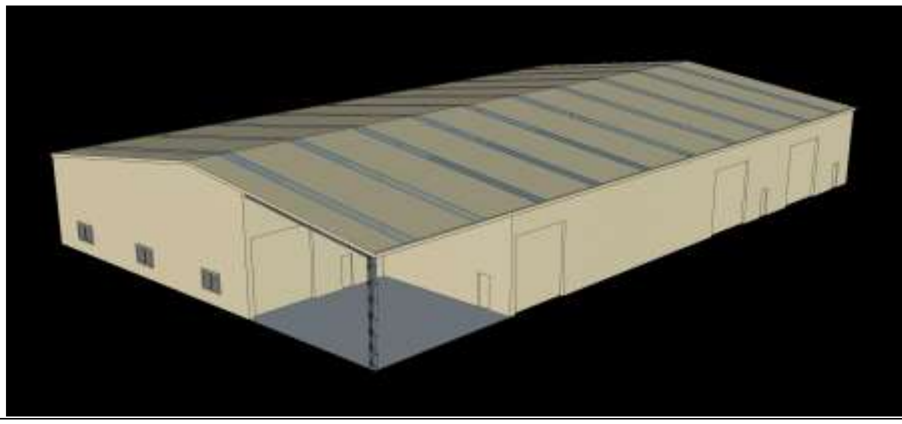
1. the annual Ngaaruawaahia Regatta
2. the annual Koroneihana
3. indigenous ariki and royal visits of the commonwealth
4. Kiingitanga events

The safe launching and retrieval boat ramp will be constructed for 20-40m waka taua.

This project will provide safe access and a safe platform for kaumatua, koroua to mihi and kuia to karanga to the royal flotilla in accordance to Waikato-Tainui tikanga and kawa. Pakeke and rangatahi will witness and re-engage with traditional waka taua ceremonies during annual Poukai, Regatta and special Kingiitanga events. People will be reconnected with their heritage.

	To achieve these objectives, Waka Taua Council's strategy is to restore, enhance and protect their waahi tapu and sites of significance for the purpose of promoting their cultural, spiritual, historic and traditional practices, reconnecting Waikato-Tainui's relationship with waka taua tikanga and kawa on the Waikato River. The Turangawaewae Regatta is an annual event where the gates of Turangawaewae Marae are opened to welcome and unite all people to celebrate in a variety of cultural activities on the banks of the Waikato River. Over the years there have been many different attractions held during the event, including kapa haka performances, waka kopapa and waka ama racing, wood chopping and sawing competitions, rowing, water skiing, power boat racing, horse swimming races across the river, various different bands/entertainers and, more recently, waka tours and marae tours. The Turangawaewae Regatta is a drug and alcohol free event that opens with a dawn flag raising ceremony conducted by Waikato-Tainui kaumatua by the Waikato River. Kiingi Tuheitia holds a special poowhiri for his guests only on the marae grounds, whilst at the same time a whakatau or ceremony is held on the stage by the river, removing all that is tapu and allowing everyone to become one and enjoy the event. Throughout the day there are many different activities on and off the Waikato River, ending with a closing karakia or prayer on the stage. The star of the event has to be the parade of the waka taua or great Maaori war canoes. This experience alone is absolutely breathtaking. *The sound of the Putatara (conch) as the waka taua sweep majestically into view,* *The Karanga by the kuia* *The change by the Kaea (Fugleman)* *The answering response by the crews,* *The rise and fall of the 'eyes' of the canoe* *The flashing white tip of the paddle blades,* *The salute,* *The straining of the muscles as the canoes are turned,* *The return pass the dais,* *The fierce Haka Taparahi by the crews on the barge* This is what gives the event its uniqueness of character, and a pride in the heritage handed down to us by our tupuna or ancestors. This is the cultural wonder of the Turangawaewae Regatta.
Key threats/impacts	Hapuu, marae, whaanau, iwi become disconnected from the Waikato River and culturally important traditional knowledge of waka taua maatauranga Maaori and tikanga and kawa become less known. Waka taua become more degraded and unsafe for traditional ceremonies on the Waikato River.

	Waikato-Tainui are unable to hold special ceremonial waka taua powhiri on the Waikato River for royal guests of the Kiingiitanga, including indigenous ariki and royal visits of the commonwealth. Knowledge of tikanga and kawa for waka taua on the Waikato River is lost, and the relationship between. Tikanga and kawa of Waikato-Tainui traditional knowledge of waka taua construction is lost. Tikanga and kawa of Waikato-Tainui traditional knowledge of ceremonial karakia associated with waka taua construction and use becomes forgotten. Tikanga and kawa of safe keeping and maintaining waka taua becomes lost. Tikanga and kawa of traditional weaving of flax kaakahu for Waka Taua and the kai hoe (paddlers) is not lost.
Project goal/s (SMART)	Within 5 years, a waka taua facility has been constructed and utilised to protect the safety of the Kiingitanga waka taua. Waka taua waananga are able to be facilitated at the facility. Traditional weaving waananga are able to be facilitated to ensure the historic cultural knowledge of weaving is maintained. Plant up to 1ha of select specialty flax for the different types of weaving required for waka taua and kaihoe within Turangawaewae Marae boundary.

Works required	This project assessment form (PAF) is intended to be a template PAF for whaanau, hapuu and/or marae wishing to culturally and appropriately store and protect their waka taua. Identify the exact location of waka taua shed – this is intended to be done by the Waka Taua Council or their representative due to the sensitive nature of tapu associated with waka taua. Steelspan has provided a rough quote of the full construction of the waka taua facility.   

	Waka taua facility Dimensions: 30m x 50m, 10 bay Specification: Supply only, of one 10-bay STEELSPAN Gable shed 50m (5.0m bays) x 30m, with a height of 6.0m at the side rising to 7.975 at the apex, 10˚, fully enclosed. Kitset includes all framing, Zincalume roof and cladding with all fixings as required, plans and producer statements for consent purposes. If required we will help with the council consent building permit application. Roof/Cladding: Corrugated roof and wall cladding is Zincalume. Doors: 8 Zincalume 4.5m H x 4.2m W roller doors. 8 Zincalume heavy duty personnel access door. 7 windows 1m H x 1.5m W. Extras included in quoted price: Zincalume barge, corner and front barge flashings. Zincalume 175mm box gutter with external gutter brackets and PVC 100mm downpipe system. White reflective paper and safety netting to roof. 1 full length clear light sheet per bay. 2 internal walls. **KITSET investment amount** Steelspan Gable as stated above. Delivered to site. Clear site access must be provided for delivery vehicles, and the unloading is the customer's responsibility. A Hiab delivery would be additional to this price but we are happy to discuss and arrange should it be required. Note: This price does not include any fire rating of walls or fire Report. $268,757.35 Subtotal $268,757.35 GST $40,313.60 Total $309,070.95 **Optional extras not in quoted price excluding G.S.T amount** To upgrade this Steelspan building to Coloursteel $27,604.09. An estimate for construction of this building – this is to be confirmed by Builder – $107,500.00 An estimate for concrete floor – this is to be confirmed by a local concrete contractor – $150,000.00. Re-establishment of traditional paa harakeke site of up to 1ha of specialty flax will be planted in the vicinity of the waka taua facility. **Cultural practices and health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Estimate cost $2000.

	The opening and unveiling of the facility. Estimate cost $5000. **Project management/staffing/incidentals (15%)** Project manager to carry out knowledge holder interviews, work with whaanau, marae, hapuu or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be up to 15% of the project cost. Estimated project management cost $65,673
Risks to project success	Resource consent not gained.
Land tenure – likelihood of adoption and adoption circumstances	There are no issues with land tenure.
Knowledge gaps and response	Need to identify the traditional types of flax suited for the different types of weaving required for waka taua
Project duration (years)	5 year project.
Costs	

Work description	Cost ($)
Cultural practices and health and safety, ensuring Waikato-Tainui tikanga and kawa and cultural safety is maintained throughout entire project. Including the unveiling of the completed facility.	7000
Waananga cost for paa harakeke research	$4000
Steelspan buildings, shed 30m x 50m fully constructed onsite, includes resource consent	594,175
Waka taua storage cradle x 14 (2 per waka taua)	14,000
Paa harakeke (1ha)	37,555
Project management/staffing/incidentals (15%)	65,673
Total	**722,400**

Waikato-Tainui Ngaaruawaahia ki Mercer 3 Priority: Very high	Tuatahi – Restoring access to Waikato River and waka taua – Waahi Paa
Project summary	The restoration project restores Waahi Paa’s traditional access to the Waikato River and was identified as a very high priority by hapuu, marae and whaanau from within the area of Ngaaruawaahia through to Mercer. Restoring and protecting Waahi Paa’s access to their culturally and spiritually significant site, and reconnecting and strengthening their relationship with the Waikato River through the restoration of the traditional waka activities and traditional cultural ceremonies undertaken at the identified location. The project will also provide recreational facilities, including toilet and cold water shower for the wider Huntly community and foreign travellers walking the Te Awaroa Trail.
Vision for the project	Safe access for embarking and disembarking of waka, including waka taua, can be undertaken safely and efficiently, the traditional boat ramp has been restored, bank stabilisation has been completed and a waka shed has been constructed onsite at the original waka storage to include smaller waka.
Location	The project site is located on the true left bank of the Waikato River, directly east of Waahi Paa, in Harris Street, Huntly.  Map shows indicative boundaries of project site.

Brief description of site	**Site description** The landing area is currently dilapidated and unsafe. This project will provide safe access and a safe platform for kaumatua, koroua to mihi and kuia to karanga to the royal flotilla in accordance to Waahi Paa and Waikato-Tainui tikanga and kawa. Pakeke and rangatahi will witness and re-engage with traditional waka taua ceremonies during Waahi Paa's annual Poukai; reconnecting the people with their Waikato River and waka taua heritage. This area was known to Waahi Paa as a traditional landing, launching and retrieval site for various waka, including waka taua (large traditional war canoe), and the historic boat ramp was also a a traditional recreation and swimming spot for Waahi Paa. Lake Waahi is located to the west of the project site and discharges to the Waikato River on the northern boundary of the project site, through the Waahi Stream – Ngaa Tapuwae o Te Wherowhero. The Waahi Stream was diverted to its current channel. It used to cross the land further south where the indicative location is for the underpass.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from the Waikato River and traditional waka practices including waka taua. Culturally important purakau, tikanga and kawa regarding waka activities become less known. Area becomes more degraded. Whaanau crossing the road to gain access to restored project site. In the event of a tragedy, eg losing a whaanau member, this will affect the site's mauri.
Project goal/s (SMART)	• Within 5 years, all identified works have been completed and whaanau, hapuu and marae are reconnecting with the Waikato River and waka activities. • Ongoing weed management has been undertaken by hapuu, marae, whaanau and/or iwi. • Carved pou and/or iPou have been develop to tell the history of the waahi tapu or sites of significance.
Works required	Note: Any engineers and geotechnical reports will be sorted and costed during the project application stage.

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Project works

Restore the traditional waka taua landing site to allow safe disembarkment and boarding, and develop flat areas for recreation, build walkways around the reserve and improve river bank stability.
Estimated cost for boat ramp $120,000.
Estimated cost for waka landing site $30,000.

Restore the traditional storage location for Waikato-Tainui waka taua, construct a shed to store and protect waka taua and undertake whakairo repairs, and reconnect the traditional waka channel to the Waikato-River.
Estimated costs for waka taua shed $100,000.
Estimated costs of opening traditional waka channel $20,000.
Estimated costs of recontouring project area for planting $24,000.
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Restoration planting of recontoured area of approximately 5110m^2 of Waikato River bank within the project boundary, while ensuring unrestricted movements of waka taua within the traditional channel.
Site prep $2000 per hectare of weedy site.
Plant spacing based on 1.5m and 4444 stems per hectare.
Plant costs $3.50 per plant.
Planting cost $1.50 per plant.
5 x releasing events $3.00 per plant.
Estimated costs per 1000m^2 $3955.
Estimated cost for the 5110m^2 $20,211.

Develop public recreation facilities, including environmentally friendly vault toilet with cold water shower and park furniture.
Estimated costs $80,000.

Construct an underpass under Harris Street for safe pedestrian access to and from Waahi Paa and the project site. *(It is intended for WDC and/or WRC to assist with the design and funding of this component of the project.)*
Cost TBC.

Maaori cultural symbolism
Waahi tapu and sites of significance will be recognised through the development and fabrication of cultural symbolism to be installed on site at appropriately marked locations.

The total number of carved pou or iPou, will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install Ipou (or other design e.g. carved pou, or kohatu).

Carved Pou
Collate information for carved Pou
Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui
Estimated cost per carved pou $1000.

Fabricate and install carved pou onto the sites (6m length x 0.6m diameter)
Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou.
Estimated fabrication and installation costs per carved pou $35,000.

Timber to be carved into pou (6m length x 0.6m diameter).
Cost is highly dependent on availability and species of timber, and it is encouraged to shop around, e.g. totara is best suited for fine detailed carving – $15,000 including transport from South Island.

iPou
The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and

	immediate. It is multi focused, with messaging for river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.  *Collate information for iPou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per iPou $1000. *Fabricate and install 1 iPou onto the sites* Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design e.g. carved pou, or kohatu). Estimated cost per iPou $10,000. *Technology/information loaded and installed into each iPou* Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology. Estimated cost per iPou $2000. All project boundaries are indicative only. A concept plan has been developed for this area by the Waahi Whaanui Trust Environment manager. **Project management/staffing/incidentals (30%)** A project manager would be required to manage this project. The project manager would be required to work closely with Waahi Paa and Waikato Regional Council. Project management/staffing is estimated to be 30% of the project cost.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	There should be no issues with land tenure. Land is under Maaori title
Project duration (years)	5 year project

Costs	

Work description	**Cost ($)**
Resource consent procurement	TBC
Engineer reports and design	TBC
Landscape design	TBC
Cultural practices to ensure cultural safety	2,000
Traditional boat ramp and waka landing site	150,000
Waka taua shed and reopening traditional channel	144,000
Restoration and bank stabilisation planting	20,211
Park furniture and vaulted toilet	80,000
Construct underpass	TBC
1 x carved pou fabrication and installation	35,000
Collate information for carved pou	1,000
Totara timber 6m length x 0.6m diameter	15,000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1,000
Load information into iPou software	2,000
30% Project management totara carved pou	133,563
30% Project management for iPou	122,763
Total with 6m carved totara pou	**578,774**
Total with iPou	**531,974**

Waikato-Tainui Ngaaruawaahia ki Mercer 4 **Priority: Very high**	**Tuatahi – Identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 Ngaaruawaahia ki Mercer.**
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 1 of a 2-stage process, and will identify the locations and tribal history of each waahi tapu and site of significance from within the area of Ngaaruawaahia through to Mercer. Stage 2 will consist of physical restoration and protection works for Waahi Paa and between Ngaaruawahia and Mercer – please refer to PAF for full details of works: *Restoring and protecting Waahi Paa's waahi tapu – STAGE 2 – Ngaaruawaahia ki Mercer* and *Restoring and protecting waahi tapu and sites of significance – STAGE 2 – Ngaaruawaahia ki Mercer.*
Vision for the project	Waahi tapu and sites of significance have been identified, protected and the historical koorero recorded and archived with Waikato-Tainui and whaanau, hapuu and/or marae. Note: only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Ngaaruawaahia and Mercer. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for hapuu, marae, whaanau and iwi afterbirth, sites of historic events, and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi korero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated, uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 3 years, waananga have been held with hapuu, marae, whaanau and/or iwi. One on one interviews have been held with kaumatua and key knowledge holders, with recordings archived. • Hapuu, marae, whaanau and/or iwi have identified the locations of all waahi tapu and sites of significance within the areas of Ngaaruawaahia and Mercer. • Waahi tapu and sites of significance register, including GIS mapping, is complete and entered into Waikato-Tainui's archiving data system. • Opportunities for iwi capacity development in GIS mapping has been implemented.
Works required	**Waananga** 10 waananga held with hapuu, marae and whaanau to identify waahi tapu, sites of significance and key knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources and present back findings. • Venue, kai and koha per day $1500. • Cultural safety, $200 per hour or $1600 per day. • Facilitator $200 per hour or $1600 per day. • Travel expenses for participants $40 per person per waananga $600. Estimated cost per waananga up to $3700. Estimated waananga cost $37,000. **Interviews** Interview knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: • up to 20 kaumatua/kuia interviews x $500 per interview = $10,000 • film interviews at $700 per day x 14 days = $9800 • editing of interviews at $700 per day x 14 days = $9800 • interviewer/literature reviewer at $800 per day x 21 days = $16,800. Estimated interviewing cost $46,400. **Mapping and photographing waahi tapu sites** Access site/s, map and photograph all significant and waahi tupuna/tapu sites. Enter information into digital database and maps. Assume: • access and photograph sites at $800 per day x 21 days = $16,800 • GIS mapping services at $200 per hour to input maps and develop register x 28 days = $44,800 Estimated interviewing cost $61,600. **Capacity development** Hold 2 x GIS mapping waananga with hapuu, marae and whaanau from

	Ngaaruawaahia ki Mercer, and identify and support (x2) taiohi to undertake a scholarship to study and formally upskill in GIS/cultural mapping of waahi tapu/historical or related studies. • GIS mapping waananga x 2 $10,000, • Scholarship x 2 taiohi/student $20,000 Estimated capacity development costs $30,000. **Vegetation clearance to access sites of significance** Some of the known waahi tapu and site of significance areas need to be cleared of scrub and weeds to allow access for hapuu, marae and whaanau to assess the sites. • Contractor costs to clear weeds from known sites of significance at $700 per day x 28 days. Estimated clearing cost $19,600. **Project delivery** Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $58,380.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	Exact location to be identified by key knowledge holders, i.e. kaumatua, kuia.
Project duration (years)	3 year project.
Costs	

Work description	Cost ($)
Waananga with Waikato-Tainui kaumatua	37,000
Interview with key knowledge holders	46,400
Mapping and photography	61,600
GIS mapping capacity development	30,000
Clear and remove vegetation	19,600
Project management/staffing/incidentals (30%)	58,380
Total	**252,980**

<table>
<tr><td>Waikato-Tainui Ngaaruawaahia ki Mercer 5
Priority: Very high</td><td>Tuarua – Restoring and protecting Waahi Paa's waahi tapu – STAGE 2 – Ngaaruawaahia ki Mercer</td></tr>
<tr><td>Project summary</td><td>Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui.

This project is part of stage 2, the final stage, to physically restore and protect the Waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or iwi during stage 1 (Tuarua – Identification, restoration and protection of waahi tapu and sites of significance STAGE 1 – Ngaaruawaahia ki Mercer.)</td></tr>
<tr><td>Vision for the project</td><td>The historical urupaa adjacent to Waahi Paa has been identified, restored and protected by fencing off the area then planting with appropriate species for minimal soil disturbance. Waahi Paa has erected a cultural symbolism pou to mark the location and the history of the identified urupaa.</td></tr>
<tr><td>Location</td><td>
The area highlighted in the above image is the suspected location of the urupaa, directly south of the Genesis Energy main entrance on a parcel of land between Genesis and Waahi Stream.</td></tr>
<tr><td>Brief description of site</td><td>The site is over grown with predominately willow from the road verge to Waahi Stream. The site is located on the true left bank of the Waahi Stream.

The suspected site is approximately 1.6ha of low lying land sloping from the Heatherington Road down to the Waahi Stream.

This project is significant to ensure Waahi Paa's and Waikato-Tainui's koorero and purakau of their waahi tapu and sites of significance are protected, identified and registered into the tribal data base.</td></tr>
</table>

Key threats/impacts	Waahi Paa remains disconnected from the waahi tapu on the banks of the Waahi Stream near it's confluence with the Waikato River. Culturally important purakau, tikanga and kawa become less known and forgotten. Area becomes more degraded. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 3 years, the Waahi Paa waahi tapu will be fenced and planted with appropriate species. • Ongoing weed management has been undertaken by Waahi Paa and/or Waikato-Tainui. • Signage and/or carved iPou have been developed to tell the history of the waahi tapu.
Works required	**Proposed development would include:** Conduct a site visit with kaumatua to locate waahi tapu or site of significance. Facilitate cultural practices and ensure cultural safety as per their tikanga and kawa. Fence off and plant native species around each waahi tapu or site of significance. **Cultural practices to ensure cultural safety.** Cultural safety \$200 per hour or \$1600 per day. **Site fencing** Perimeter fenced with a 7-wire post and baton fence to exclude cattle. Estimated cost \$17/m x 640m = \$10,880. **Site prep, planting and maintenance** The planted area will be a 5m margin around the outside perimeter of the urupaa, based on an estimated area of 3200m^2. Site prep \$2000 per hectare of weedy site. Plant spacing based on 1.5m and 4444 stems per hectare. Plant costs \$3.50 per plant. Planting cost \$1.50 per plant. 5 x releasing events \$3.00 per plant. Estimated cost per 1000m^2 \$3955. Estimated cost for 3200m^2 \$12,656. **Maaori cultural symbolism** Waahi tapu and sites of significance will recognised through the development and fabrication of cultural symbolism. They will be installed to appropriately mark each location. The total number of carved pou or iPou will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install Ipou (or other design, e.g. carved pou, or kohatu). **Carved Pou** *Collate information for carved Pou* Collate information for the sites identified by hapuu, marae, whaanau

	and/or Waikato-Tainui. Estimated cost per carved pou $1000. *Fabricate and install carved pou onto the sites* (6m length x 0.6m diameter) Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou. Estimated fabrication and installation costs per carved pou $6000. Timber to be carved into pou (2-3m length x 0.6m diameter) Cost is highly dependent on availability and species. It is encouraged to shop around. Totara is best suited for detailed carving. Estimated cost per pou $5000. **iPou** The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and immediate. It is multi focused, with messaging for river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.  *Collate information for iPou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per iPou $1000. *Fabricate and install 1 iPou onto the sites* Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). Estimated cost per iPou $10,000. *Technology/information loaded and installed into each iPou* Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology. Estimated cost per iPou $2000.

	Project delivery Works need to be implemented by Waahi Paa. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $9922.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken. Unable to identify the location of the urupaa.
Land tenure – likelihood of adoption and adoption circumstances	There should be no issues with land tenure.
Knowledge gaps and response	Exact location to be identified by key knowledge holders, i.e. kaumatua, kuia.
Project duration (years)	3 year project
Costs	

Work description	Cost ($)
Task costs are based on 1 x 1,920m^2 site	
Cultural practices to ensure cultural safety 8 hours	1600
640m site fencing	10,880
Site prep, planting, maintenance	7594
1 x carved pou fabrication and installation	6000
Collate information for carved pou	1000
Totara timber 6m length x 0.6m diameter	5000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1000
Load information into iPou software	2000
Project management totara carved pou (30%)	9622
Project management for iPou (30%)	9922
Total estimated cost for 1 x totara carved pou	**41,696**
Total estimated cost for 1 x iPou	**42,996**

Waikato-Tainui Ngaaruawaahia ki Mercer 6 **Priority: Very high**	**Tuarua – Restoring and protecting waahi tapu and sites of significance – STAGE 2 – Ngaaruawaahia ki Mercer**
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 2 and the final stage to physically restore and protect the Waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or iwi during stage 1 *(Tuarua – Identification, restoration and protection of waahi tapu and sites of significance STAGE 1 – Ngaaruawaahia ki Mercer).*
Vision for the project	Identified waahi tapu and sites of significance have been restored and protected with full stock exclusion fencing and appropriate planting of native species. Locations of waahi tapu and sites of significance will be marked by traditional carved pou, iPou or new technology (e.g. augmented reality technology) that can be adapted to traditional Maaori symbolism. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Ngaaruawaahia and Mercer. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for afterbirth, sites of historic events and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 10 years, all identified waahi tapu and sites of significance access, fencing and planting have been completed. • Ongoing weed management has been undertaken by landowners, hapuu, marae, whaanau and/or iwi. • Signage and/or carved iPou have been developed to tell the history of waahi tapu or sites of significance.
Works required	**Proposed development would include:** Conduct a site visit with kaumatua to locate waahi tapu or site of significance. Facilitate cultural practices and ensure cultural safety as per their tikanga and kawa. Fence off and plant native species around each waahi tapu or site of significance. **Cultural practices to ensure cultural safety.** Cultural safety \$200 per hour or \$1600 per day. **Site fencing** Perimeter fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per 1000m^2 site: 130m x \$20/m = \$2600. Estimated fencing cost across 1ha: 400m x \$20/m = \$8000. **Site prep, planting and maintenance** Site prep \$2000 per hectare of weedy site. Plant spacing based on 1.5m and 4444 stems per hectare. Plant costs \$3.50 per plant. Planting cost \$1.50 per plant. 5 x releasing events \$3.00 per plant. Estimated cost per 1000m^2 \$3955. Estimated cost per hectare \$39,552. **Maaori cultural symbolism** Waahi tapu and sites of significance will recognised through the development and fabrication of cultural symbolism to be installed on site in the appropriate location. The total number of carved pou or iPou will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). • **Carved pou** *Collate information for carved pou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui.

	Estimated cost per carved pou $1000. *Fabricate and install carved pou onto the sites* (6m length x 0.6m diameter) Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou. Estimated fabrication and installation costs per carved pou $35,000. *Timber to be carved into pou (6m length x 0.6m diameter)* Cost is highly dependent on availability and species of timber. It is encouraged to shop around. e.g. totora is best suited for fine detailed carving – $15,000 including transport from South Island. H5 treated pine is not suited for fine detailed carving – $1200 including transportation. • **iPou** The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and immediate. It is multi focused, with messaging to river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.  *Collate information for iPou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per iPou $1000. *Fabricate and install 1 iPou onto the sites* Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). Estimated cost per iPou $10,000. *Technology/information loaded and installed into each iPou* Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology.

	Estimated cost per iPou $2000. **Project delivery** Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $156,098.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	Exact location to be identified by key knowledge holders, i.e. kaumatua and kuia.
Project duration (years)	3 year project
Costs	Individual costing estimates for 1 x 1000m^2 site with either 1 x carved totara pou, 1 x carved pine pou or 1 x iPou fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 1 x 1000m^2 site	
Cultural practices to ensure cultural safety 8 hours	1600
1,000m^2 site fencing	2600
Site prep, planting, maintenance	3955
1 x carved pou fabrication and installation	35,000
Collate information for carved pou	1000
Totara timber 6m length x 0.6m diameter	15,000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1000
Load information into iPou software	2,000
Project management totara carved pou/or	17,747
Project management pine carved pou/or	13,607
Project management for iPou	6347
Total estimated cost for 1 x totara carved pou	**76,902**
Total estimated cost for 1 x iPou	**27,502**

The cost estimate below includes site prep, planting, weed maintenance and fencing for up to 20 x 1000m^2 sites, cultural practices, and 5 x carved totara pou and 10 x iPou, fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 20 x 1000m^2 site	

Cultural practices to ensure cultural safety 160 hours	32,000
Site fencing	39,000
Site prep, planting, maintenance	59,325
5 x carved pou fabrication and installation	175,000
Collate information for carved pou x 10	10,000
5 x totara timber 6m length x 0.6m diameter	75,000
10 x iPou fabrication and installation	100,000
Collate information for iPou x 10	10,000
Load information into iPou software x 10	20,000
Project management/staffing/incidentals (30%)	156,098
Total estimated cost for 20 x 1000m^2 sites	**676,423**

Waikato-Tainui Ngaaruawaahia ki Mercer 7 Priority: High	Tuarua – 30 puna restoration – Ngaaruawaahia ki Mercer
Project summary	The restoration of traditional puna was identified as a high priority by hapuu, marae and whaanau from Ngaaruawaahia and Mercer. This project will see the restoration of up to 300 puna between Ngaaruawaahia and Mercer. Puna will be restored in areas identified by hapuu, marae, whaanau or Waikato-Tainui as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Up to 30 puna are well established and restored at identified sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing their traditional puna. Customary practices and knowledge is transferred on to future generations. Ensure the locations of puna have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area between Ngaaruawaahia and Mercer. The 30 puna restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Restoration of puna is important because traditional puna were used for drinking water and sustainable land use by marae and whanau. Historically, marae and whaanau kainga were build next to waterways or puna. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional cultural practices.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from traditional puna sites. Further loss of key historic knowledge of each site, and pest plant infestation.

	Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access). Traditional puna are depleted due to surrounding activities, e.g. farming.
Project goal/s (SMART)	Within 10 years, up to 30 puna are restored, enhanced, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with Waikato-Tainui members at (or near) the restoration sites or at close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led by hapuu, marae, whaanau and/or Waikato-Tainui. Co-funding contributions from other interested partners for hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Based on \$200 per hour. Estimate cost per 4 hours \$800. Estimated cost for up to 120 hours \$24,000. **Restoration fencing and planting** *Estimated cost per puna* Carry out approximately 130m of fencing to protect an approximately 1000m^2 area around each puna. Estimated cost for 130m of 7-wire post and batten fence \$2600. Estimated prep, planting and maintenance costs for 1000m^2 \$3955. *Estimated cost per puna run off stream/tributary* Carry out approximately 100m of fencing puna run off streams and puna seep/wet areas. Setback a minimum of 5m from the edge of the streambank and seep/wet areas. Plant riparian margins with native species. Estimated fencing cost for 200m \$4000. Estimated prep, planting and maintenance cost for 1000m^2 \$3955. Where a puna is historically known to be a whitebait spawning ground, riparian planting is to be carried out using appropriate native plant species planted at 0.75m spacing. **Capacity development** Provide training for tribal members to learn about riparian fencing and planting. Fencing waananga (x5) Planting waananga (x5)

<table>
<tr><td></td><td>Estimated cost per waananga $5000.
Estimate waananga cost $50,000.

Project management/staffing/incidentals (30%)
Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per puna $4353.
Estimated cost for 30 puna $185,790.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui between Ngaaruawaahia and Mercer.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact puna location to be determined by whaanau, hapuu and /or marae.

Size of puna areas to be fenced and restored differ from site to site.
Length of fencing required for puna including run off streams and wet seep areas.</td></tr>
<tr><td>Project duration (years)</td><td>Individual projects can expect 3-5 years duration.
10 year project.</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required</td><td>24,000</td></tr>
<tr><td>Fencing off puna for protection (30 puna)</td><td>78,000</td></tr>
<tr><td>Puna riparian planting (30 puna)</td><td>118,650</td></tr>
<tr><td>Puna stream fencing (30 puna)</td><td>120,000</td></tr>
<tr><td>Puna stream riparian planting (5m setback on both banks)</td><td>118,650</td></tr>
<tr><td>Capacity building
Fencing and planting waananga</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>152,790</td></tr>
<tr><td>Total</td><td>662,090</td></tr>
</table>

<table>
<tr><td>Estimated cost for 1 x puna restoration project fully completed (excludes tertiary scholarship and waananga)</td><td>22,070</td></tr>
</table>
</td></tr>
</table>

Waikato-Tainui Ngaaruawaahi a ki Mercer 8 Priority: High	Tuatoru – Tuna habitat ponds – Ngaaruawaahia ki Mercer
Project summary	The restoration of tuna abundance was identified as a high priority by whaanau, hapuu and ngaa marae between Ngaaruawaahia and Mercer; also, by Waahi Whaanui Trust and Ngaa Muka Development Trust. This project will see the creation of 15 tuna habitat ponds between Ngaaruawaahia and Mercer in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Tuna (freshwater eels) are plentiful. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations.
Location	 Project area includes the Waikato River and all tributaries between Ngaaruawaahia and Mercer. The 15 individual tuna ponds will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional tuna feeding sites, traditional mahinga kai sites and wetland type areas prone to flooding. This project is significant because tuna is a significant mahinga kai taonga species for Waikato-Tainui, Waahi Whaanui Trust and Ngaa Muka Development Trust. Hapuu, marae and whaanau from within Waahi Whaanui Trust and Ngaa Muka Development Trust have witnessed a steady decline in tuna abundance over time.

	For Waahi Whaanui Trust and Ngaa Muka Development Trust, the restoration of taonga species and the ability to again provide these taonga as food for manuwhiri (visitors) is a critical marker of the hapuu, marae and whaanau's mana and status. It also confirms hapuu, marae and whaanau proficiency in manaaki taangata or the practice of generosity and reciprocity. The abundance of food and other resources that were traditionally available to Waikato-Tainui within its tribal rohe are well known by other tribes throughout the motu.
Key threats/impacts	Tuna population will continue to decline and become less abundant. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga and mahinga kai. Ensure that competitive pest species, e.g. carp, are prevented from accessing identified tuna habitat.
Project goal/s (SMART)	Within 10 years, up to 15 tuna habitat ponds are created within the Ngaaruawaahia to Mercer areas to provide an increase in habitat availability for tuna. Tuna waananga have been held with iwi members at (or near) the ponds to transfer knowledge and tools to marae. Tuna from the ponds are being served at significant tribal events, like Poukai, thus contributing to restoring the relationship of the marae with the Waikato River.
Works required	Works are intended to be implemented by whaanau, hapuu and ngaa marae from Ngaaruawaahia through to Mercer. Co-funding contributions will be sourced and welcomed from interested collaborative partners. This project is intended to be undertaken as 15 individual projects but may be undertaken as multiple ponds per project sites where appropriate. Ponds should not be created within an existing wetland where there is significant native flora and fauna. **Cultural practices to ensure cultural safety.** Cultural safety, \$200 per hour or \$1600 per 8 hours. Estimated cost for up to 80 hours \$24,000. **Earthworks** Excavate marginal low lying areas to create shallow ponds/wetlands. • Ponds should be constructed to a maximum of 5000m^2 and approximately 2m deep. They should be no deeper than 3m to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage • Good quality water is maintained in the constructed ponds • Ponds are constructed in traditional mahinga kai area/sites identified by hapuu, marae and whaanau.

	Installing an instream structure (log) that will be secured in place.  **Note: Resource consent may be required** Costs include excavator transport and are based on ponds being $5000m^2$ x 2m deep and a 12 tonne excavator moving $150m^3$ per hour ($10,000), returning for one day to reshape the site once excavations have settled ($1800). Cost per pond $11,800. Estimated cost across 15 ponds $177,000. **Fencing** Ponds should be fenced with a 7-wire post and batten fence to exclude cattle. Cost per pond: 400m x $20/m = $8000 Estimated fencing cost across 15 ponds $120,000 **Planting** Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax). • Native planting 0.3ha per pond $11,865 • Additional weed control for 3 years at each pond $2520 Planting and releasing cost per pond = $14,385 Estimated planting cost across 15 ponds = $215,775 **Resource consent** It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately.

	A generous cost estimate of $5000 per pond has been used. Estimated consents cost for 15 ponds $75,000.  **Capacity development** • Tuna waananga Provide training for tribal members to learn about tuna restoration. Tuna waananga (10) plus tuna tool kits. Cost per waananga $6000. Estimated total cost $60,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with whaanau, marae, hapuu, or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, confirm consents (if required) and project manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated project management cost per pond $12,956. Estimated project management cost across 15 ponds $224,333.
Risks to project success	Lack of access to sites. Resource consents not granted. Lack of experienced practitioners result in incompleted works. Ongoing maintenance to control weed infestation is not undertaken. Commercial eel fishermn fishing out completed pond.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required. Exact locations of tuna ponds are to be determined by whaanau, hapuu and /or marae.

	Size of each pond, including area to be fenced and restored, will differ from site to site.
Project duration (years)	3 years per pond/site, includes construction, planting and weeding programme. 10 year project.
Costs	see tables below

Work description	**Cost ($)**
Earthworks	177,000
Fencing (6km)	120,000
Planting	215,775
Resource consents	75,000
Capacity building	60,000
Project management/staffing/incidentals (30%)	194,332
Total	**842,108**

Work description	**Cost ($)**
Total estimate cost per individual pond (excludes capacity development and tertiary scholarships)	56,141

Waikato-Tainui Ngaaruawaahia ki Mercer 9 **Priority: Very High**	**Tuatoru – 10km riparian and taonga species restoration habitat – Ngaaruawaahia ki Mercer**
Project summary	The restoration of riparian margins, including the restoration and protection of ngaa taonga species, has been identified as a very high priority by hapuu, marae and whaanau from Ngaaruawaahia to Mercer. This project will see the restoration of 10km of riparian margins between Ngaaruawaahia and Mercer. Areas will be identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Riparian margins and the ecosystems within the margins are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing the wellbeing of traditional mahinga kai sites along the Waikato River and tributaries.
Location	 Project area includes the Waikato River and all tributaries between Ngaaruawaahia and Mercer. The 10km of riparian restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Sections of the Waikato River, streams and tributaries that are historically, culturally, ecologically or spiritually significant (e.g. traditional mahinga kai sites) are well known to hapuu, marae, whaanau and Waikato-Tainui. Waikato-Tainui's primary interest in the project is to provide and protect unfettered access to riparian margins for tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices. This includes the broader aspiration of the restoration and recovery of wetland taonga species associated with healthy riparian margins.

Key threats/impacts	Taonga species remain absent or in decline from traditional sites where they were once plentiful. Hapuu, marae and whaanau become disconnected from the Waikato River and traditional mahinga kai sites due to poor habitat. Culturally important purakau, tikanga and kawa become less known. Cattle and other browsing species destroy traditional sites within the riparian margins of the Waikato River and associated wetlands.
Project goal/s (SMART)	Within 10 years, up to 10km of riparian margins suitable for taonga species habita, have been restored, enhanced, fenced, planted, and pest plant releasing programmes have been completed. Capacity development waananga have been held with iwi members at or near the restoration sites or at marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led at marae or whaanau level. Co-funding contributions from other interested partners to hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Cultural practices to ensure cultural safety.** Cultural safety \$200 per hour or \$1600 per 8 hours. Estimated cost for up to 80 hours \$16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the stream and/or river banks. Fencing will consist of a 7-wire post and batten at \$20 per metre. Estimated cost per 1000m site \$20,000. Estimated cost for 10km \$200,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 1.5m (4444 plants per hectare) and 5 x plant releasing events. Estimated planting cost per 5000m^2 \$18,776. Estimated planting cost for 5ha \$187,760. **Installation of structures for fish habitat** Carry out approximately 10km of securing in-stream wood structures throughout the identified restoration streams (4-6 structures over a 2km length for fish habitat where practicable). Estimate cost per 1km \$10,413. Estimated cost for 10km \$104,130. It is envisaged that whaanau, hapuu and/or marae with assistance from Waikato Regional Council work collaboratively in terms of site location investigation, design and installation of woody debris structures. This component could be undertaken in conjunction with Waikato Regional Council's river management work.

	Capacity development Provide training for tribal members to learn about riparian fencing and planting $5000 per waananga. Fencing waananga (x5). Planting waananga (x5). Estimated cost for 10 waananga $50,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per 1km length $16,737 (excludes tertiary scholarships). Estimated cost 10km site $197,367.
Risks to project success	Lack of funding. Access to sites is restricted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	Exact location of each restoration site needs to be determined.
Project duration (years)	10 year project.
Costs	(see tables below)

Work description	Cost ($)
Cultural practices in accordance with Waikato-Tainui tikanga and kawa throughout each individual projects where required	16,000
Riparian fencing (10km)	200,000
Riparian planting (5ha)	187,760
Installation of structures for fish habitat	104,130
Capacity building – fencing and planting waananga	50,000
Project management/staffing/incidentals (30%)	167,367
Total	**725,257**

Estimated cost to restore 1000m length of riparian margin with a 5m setback (excludes tertiary scholarship)	**72,526**

Waikato-Tainui Ngaaruawaahia ki Mercer 10 Priority: High	Tuatoru – 20 watercress restoration projects – Ngaaruawaahia ki Mercer
Project summary	The restoration of traditional watercress sites was identified as a high priority by whaanau, hapuu and ngaa marae between Ngaaruawaahia and Mercer. This project will see the creation of 20 restored watercress sites between Ngaaruawaahia and Mercer in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically significant.
Vision for the project	Watercress is plentiful within the restored, traditional gathering locations.
Location	 Project area between Ngaaruawaahia and Mercer.
Brief description of site	Historically, watercress was in abundance and readily available for hapuu, marae and whaanau throughout the Waikato catchment. Now, with the intensification of land use, watercress is either no longer present or the land has been modified for dairy and dry stock. Waatakirihi, or watercress (also called koowhitiwhiti, *Nasturtium officinale* and *N. microphyllum*), is a highly prized food source for Waikato-Tainui and Maaori generally. An aquatic or boggy ground plant associated with drains, small creeks, wetland streams and the calmer edges of rivers, waatakirihi is a vigorous plant, provided there is a good level of water quality (i.e. lack of sedimentation). It is a member of the mustard family, and is highly regarded for its medicinal properties and its taste in many cultures across the world. As avid botanists and gardeners, tangata whenua were quick to identify its properties, and it now forms a major component of many traditional dishes. Harvest sites are highly coveted and sometimes known only to whaanau (family/families).

	(Dixon, L. 2017 – *the importance of watakirihi* – te reo o te repo – the voice of the wetland)
Key threats/impacts	New plants do not establish and traditional watercress sites remain barren. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga of their watercress sites.
Project goal/s (SMART)	Within 2 years, watercress is flourishing in up to 20 project sites within the Ngaaruawaahia and Mercer catchment.
Works required	Works could be implemented at iwi, hapuu, marae or whaanau level. This project could be undertaken as a whole, or in components. It is intended to restore traditional hapuu, marae, whaanau and iwi watercress sites. **Watercress restoration ($100,000)** 20 sites at $5000 per site $100,000. Includes project management of 25% ($20,000). Project manager to carry out landowner liaison, provide reporting information, negotiate agreements, inspect works, and pick up and seed watercress.
Risks to project success	Lack of access to sites. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Ngaaruawaahia and Mercer. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required
Project duration (years)	1-2 year projects.
Costs	

Work description	Cost ($)
20 watercress restoration projects	80,000
Project management/staffing/incidentals (20%)	20,000
Total	**100,000**

Waikato-Tainui Karapiro ki Ngaaruawaahia 1 Priority: Very high	Tuatahi – 10km riparian and taonga species habitat restoration project – Karapiro ki Ngaaruawaahia
Project summary	The restoration of riparian margins, including the restoration and protection of ngaa taonga species, has been identified as a very high priority by hapuu, marae and whaanau from Karapiro through to Ngaaruawaahia. This project will see the restoration of 10km of riparian margins between Karapiro and Ngaaruawaahia. Areas will be identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Riparian margins and the ecosystems within the margins are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing the wellbeing of traditional mahinga kai sites along the Waikato River and tributaries.
Location	 Project area includes the Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia. The 10km of riparian restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Sections of the Waikato River, streams and tributaries that are historically, culturally, ecologically or spiritually significant (e.g. traditional mahinga kai sites) are well known to hapuu, marae, whaanau and Waikato-Tainui. Waikato-Tainui's primary interest in the project is to provide and protect unfettered access to riparian margins for tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices. This includes the broader aspiration of the restoration and recovery of wetland taonga species associated with healthy riparian margins.

Key threats/impacts	Taonga species remain absent or in decline from traditional sites where they were once plentiful. Hapuu, marae, whaanau become disconnected from the Waikato River and traditional mahinga kai sites due to poor habitat. Culturally important purakau, tikanga and kawa become less known. Cattle and other browsing species destroy traditional sites within the riparian margins of the Waikato River and associated wetlands.
Project goal/s (SMART)	Within 10 years, up to 10km of riparian margins suitable for taonga species habitat have been restored, enhanced, fenced and planted, and pest plant releasing programmes completed. Capacity development waananga have been held with iwi members at or near the restoration sites or marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led at marae or whaanau level. Co-funding contributions from other interested partners to hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Cultural practices to ensure cultural safety** Cultural safety, $200 per hour or $1600 per 8 hours. Estimated cost for up to 80 hours $16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the stream and/or river banks. Fencing will consist of a 7 wire post and batten at $20 per metre. Estimated cost per 1000m site $20,000. Estimated cost for 10km $200,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 1.5m (4444 plants per hectare) and 5 x plant releasing events. Estimated planting cost per 5000m² $18,776. Estimated planting cost for 5ha $187,760. **Installation of structures for fish habitat** Carry out approximately 10km of securing in-stream wood structures throughout the identified restoration streams (4-6 structures over a 2km length for fish habitat where practicable). Estimate cost per 1km $10,413. Estimated cost for 10km $104,130. It is envisaged that whaanau, hapuu and/or marae with assistance from Waikato Regional Council work collaboratively in terms of site location investigation, design and installation of woody debris structures. This component could be undertaken in conjunction with Waikato Regional Council's river management work. **Capacity development**

	Provide training for tribal members to learn about riparian fencing and planting. Fencing waananga (x5). Planting waananga (x5). Estimated cost for 10 waananga at $5000 each $50,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per 1km length $16,737 (excludes tertiary scholarships). Estimated cost 10km site $197,367.
Risks to project success	Lack of funding. Access to sites is restricted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui between Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	Exact location of each restoration site needs to be determined.
Project duration (years)	10 year project.
Costs	

Work description	Cost ($)
Cultural practices in accordance with Waikato-Tainui tikanga and kawa throughout each individual project where required	16,000
Riparian fencing (10km)	200,000
Riparian planting (5ha)	187,760
Installation of structures for fish habitat	104,130
Capacity building – fencing and planting waananga	50,000
Project management/staffing/incidentals (30%)	167,367
Total	**725,257**

Estimated cost to restore 1000 m length of riparian margin with a 5m setback (excludes tertiary scholarship)	**72,526**

Waikato-Tainui Karapiro ki Ngaaruawaahia 2 **Priority: Very high**	**Tuatahi – Identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 Karapiro ki Ngaaruawaahia.**
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 1 of a 2-stage process. Stage 1 includes identifying the locations and tribal history of each waahi tapu and sites of significance from within the area of Lake Karapiro through to Ngaaruawaahia. Stage 2 will consist of physical restoration and protection works (please refer to PAF for full details of works: *Restoration and protection of waahi tapu and sites of significance – STAGE 2 – Lake Karapiro ki Ngaaruawaahia.)*
Vision for the project	Waahi tapu and sites of significance have been identified, protected and the historical koorero recorded and archived with Waikato-Tainui and whaanau, hapuu and/or marae. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for hapuu, marae, whaanau and iwi afterbirth, sites of historic events, and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated, uncared for, and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 3 years, waananga have been held with hapuu, marae, whaanau and/or iwi. One on one interviews have been held with kaumatua and key knowledge holders, and the recordings archived. • Hapuu, marae, whaanau and/or iwi have identified the locations of all waahi tapu and sites of significance between Lake Karapiro and Ngaaruawaahia. • Waahi tapu and sites of significance register, including GIS mapping, is complete and entered into Waikato-Tainui's archiving data system. • Opportunities for iwi capacity development in GIS mapping has been implemented.
Works required	**Waananga** 10 waananga held with hapuu, marae and whaanau to identify waahi tapu, sites of significance and key knowledge holders (i.e. kaumatua/kuia, as appropriate), and collate relevant information from literature sources. All findings to be presented. • Venue, kai and koha per day $1500. • Cultural safety $200 per hour or $1600 or per day. • Facilitator $200 per hour or $1600 per day. • Travel expenses for participants $40 per person, $600 per waananga. Estimated cost per waananga up to $3700. Estimated total waananga cost $37,000 **Interviews** Interview knowledge holders (i.e. kaumatua/kuia, as appropriate), and collate relevant information from literature sources. Assume: • up to 20 kaumatua/kuia interviews at $500 per interview $10,000 • film interviews at $700 per day x 14 days = $9800 • editing of interviews at $700 per day x 14 days = $9800 • interviewer/literature reviewer at $800 per day x 21 days = $16,800. Estimated interviewing cost $46,400. **Mapping and photographing waahi tapu sites** Access, map and photograph all significant and waahi tupuna/tapu sites. Enter information into digital database and maps. Assume: • access and photograph sites at $800 per day x 21 days = $16,800 • GIS mapping services at $200 per hour to input maps and develop register x 28 days = $44,800 Estimated interviewing cost $61,600. **Capacity development** Hold 2 x GIS mapping waananga with hapuu, marae and whaanau from Lake Karapiro to Ngaaruawaahia, identify and support (x2) taiohi to undertake a scholarship to study and formally upskill in GIS/Cultural mapping of waahi tapu/historical or related studies.

	• GIS mapping waananga x 2 $10,000. • Scholarship x 2 taiohi/student $20,000. Estimated capacity development costs $30,000. **Vegetation clearance to access sites of significance** Some of the known waahi tapu and sites of significance areas need to be cleared of scrub and weeds to allow access for hapuu, marae and whanau. Contractor costs to clear weeds at site $700 per day x 28 days. Estimated clearing cost $19,600. **Project delivery** Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $58,380.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Lake Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	Exact locations to be identified by key knowledge holders, i.e. kaumatua and kuia.
Project duration (years)	3 year project.
Costs	(see table below)

Work description	Cost ($)
Waananga with Waikato-Tainui kaumatua	37,000
Interview with key knowledge holders	46,400
Mapping and photography	61,600
GIS mapping capacity development	30,000
Clear and remove vegetation	19,600
Project management/staffing/incidentals (30%)	58,380
Total	**252,980**

Waikato-Tainui Karapiro ki Ngaaruawaahia 3 Priority: Very high	Tuarua – Restoring and protecting waahi tapu and sites of significance – STAGE 2 – Karapiro ki Ngaaruawaahia
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 2, the final stage to physically restore and protect the Waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or iwi during stage 1 *(Identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 – Lake Karapiro ki Ngaaruawaahia).*
Vision for the project	Identified waahi tapu and sites of significance have been restored and protected with full stock exclusion fencing and appropriate planting of native species. Locations of waahi tapu and sites of significance will be marked by traditional carved pou, iPou or new technology (e.g. augmented reality technology) that can be adapted to traditional Maaori symbolism. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for afterbirth, sites of historic events and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 10 years, all identified waahi tapu and sites of significance access, fencing and planting have been completed. • Ongoing weed management has been undertaken by landowners, hapuu, marae, whaanau and/or iwi. • Signage and/or carved iPou have been developed to tell the history of waahi tapu or sites of significance.
Works required	**Proposed development to include:** A site visit with kaumatua to locate waahi tapu or site of significance. Facilitate cultural practices and ensure cultural safety as per their tikanga and kawa. Fence off and plant native species around each waahi tapu or site of significance. **Cultural practices to ensure cultural safety** Cultural safety \$200 per hour or \$1600 per day. **Site fencing** Perimeter fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per 1000m^2 site: 130m x \$20/m = \$2600. Estimated fencing cost across 1 x 1ha: 400m x \$20/m = \$8000. **Site prep, planting and maintenance** Site prep \$2000 per hectare of weedy site. Plant spacing based on 1.5m and 4444 stems per hectare. Plant costs \$3.50 per plant. Planting cost \$1.50 per plant. 5 x releasing events \$3.00 per plant. Estimated cost per 1000m^2 \$3955. Estimated cost per hectare \$39,552. **Maaori cultural symbolism** Waahi tapu and sites of significance will be recognised through the development and fabrication of cultural symbolism, which will be installed to appropriately mark the locations. The total number of carved pou or iPou will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). **Carved Pou** *Collate information for carved Pou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per carved pou \$1000. *Fabricate and install carved pou onto the sites* (6m length x 0.6m

	diameter) Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou. Estimated fabrication and installation costs per carved pou $35,000. *Timber to be carved into pou* (6m length x 0.6m diameter) Cost is highly dependent on availability and species. It is encouraged to shop around. Totara is best suited for fine detailed carving – $15,000 including transport from South Island. H5 treated pine is not suited for fine detailed carving – $1200 including transportation. **iPou** The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and immediate. It is multi focused, with messaging for river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.  *Collate information for iPou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per iPou $1000. *Fabricate and install 1 iPou onto the sites* Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). Estimated cost per iPou $10,000. *Technology/information loaded and installed into each iPou* Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology. Estimated cost per iPou $2000 **Project delivery**

	Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $156,098
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Lake Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	Exact location, to be identified by key knowledge holders i.e. kaumatua, kuia.
Project duration (years)	3 year project per identified waahi tapu or significant site.

Costs	Individual costing estimates for 1 x 1000m^2 site with either 1 x carved totara pou, 1 x carved pine pou or 1 x iPou fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 1 x 1000m^2 site	
Cultural practices to ensure cultural safety 8 hours	1600
1000m^2 site fencing	2600
Site prep, planting, maintenance	3955
1 x carved pou fabrication and installation	35,000
Collate information for carved pou	1000
Totara timber 6m length x 0.6m diameter	15,000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1000
Load information into iPou software	2000
Project management totara carved pou	17,747
Project management pine carved pou	13,607
Project management for iPou	6347
Total estimated cost for 1 x totara carved pou	**76,902**
Total estimated cost for 1 x iPou	**27,502**

The cost estimate below includes site prep, planting, weed maintenance and fencing for up to 20 x 1000m^2 sites, cultural practices, and 5 x carved totara pou and 10 x iPou fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 20 x 1000m^2 site	
Cultural practices to ensure cultural safety 160 hours	32,000
Site fencing	39,000
Site prep, planting, maintenance	59,325
5 x carved pou fabrication and installation	175,000
Collate information for carved pou x 10	10,000
5 x totara timber 6m length x 0.6m diameter	75,000
10 x iPou fabrication and installation	100,000
Collate information for iPou x 10	10,000
Load information into iPou software x 10	20,000
Project management/staffing/incidentals (30%)	156,098
Total estimated cost for 20 x 1,000m^2 sites	**676,423**

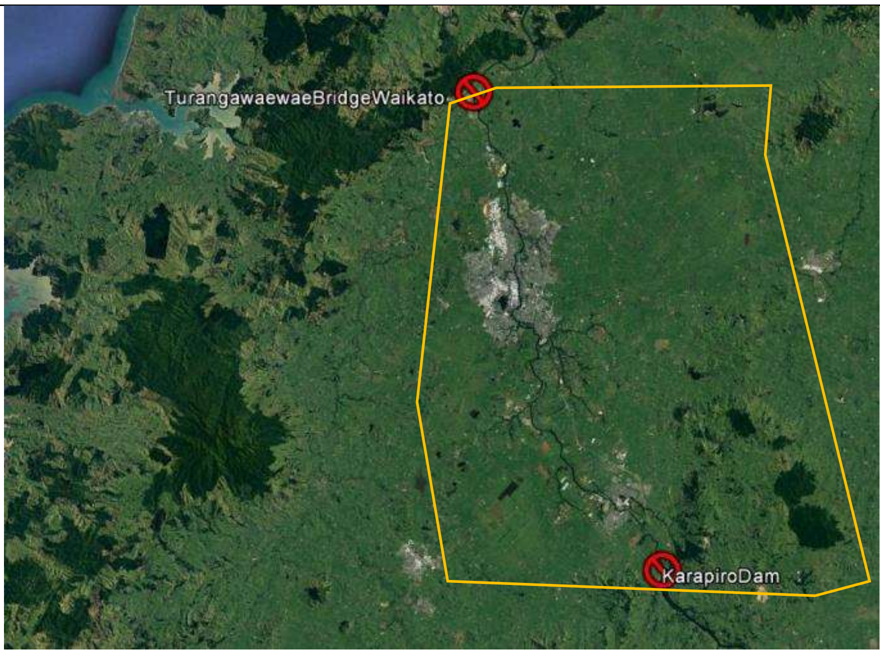
Waikato-Tainui Karapiro ki Ngaaruawaahia 4 **Priority: Very high**	**Tuarua – 10ha wetland creation, restoration and protection – Karapiro ki Ngaaruawaahia**
Project summary	Wetland creation, restoration and protection were identified as very high priorities by hapuu, marae and whaanau from Lake Karapiro through to Ngaaruawaahia. This project will see the restoration of 10ha of wetlands between Karapiro and Ngaaruawaahia in areas identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Wetlands are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting native flora and fauna, including paru, for cultural purposes. Customary practices and knowledge is transferred on to future generations. Ensure the location of paru within the wetlands have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area is between Lake Karapiro and Ngaaruawaahia. The 10ha of wetland restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional mahinga kai sites. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices. This includes the broader aspiration of the restoration and recovery of wetland taonga species, which is related to the overall health and

	wellbeing of the Waikato River as captured under Waikato Raupatu River Settlement legislation (2010). Tuna is an important cultural fishery for the peoples of Karapiro ki Ngaaruawaahia especially, and is considered to be an important indicator of river health. Stopping the encroachment of non tangata whenua fishers into areas traditionally used by members of Waikato-Tainui is one part of this overall aspiration.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from traditional gathering sites. Further loss of key historic whitebait spawning site due to pest plant infestation. Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access).
Project goal/s (SMART)	Within 10 years, up to 10ha of wetlands have been constructed, restored, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with iwi members at (or near) the restoration sites or close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented at whaanau, hapuu and/or marae level. This project could be undertaken as a whole, or in components. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required from project commencement through to project completion. Based on \$200 per hour. Estimate cost for 8 hours \$1600. Estimated cost for up to 80 hours \$16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the wetland and plant riparian margins with native species. Fence with a 7-wire post and batten fence to exclude cattle. Estimated fencing cost per hectare site: 400m x \$20/m = \$8000. Estimated fencing cost for 1 site at 10ha: 1270m x \$20/m = \$25,400. Estimated fencing cost for 10 x individual sites at 1ha each \$80,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 15m (4444 plants per hectare). Estimated cost per hectare \$39,552. Estimated cost for 10ha \$395,520. **Resource consent** Resource consents may be required. Estimated cost per consent \$5000. Estimated cost for 10 individual consents \$50,000. **Capacity development**

	Provide training for tribal members to learn about riparian fencing and planting (includes site visit to champion site). Provide training for tribal members to learn about wetland restoration. Wetland waananga (x 10). Estimate cost $50,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost per 1ha $17,746 (excludes tertiary scholarships) Estimated cost 10ha $207,456
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Lake Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	10 year project.
Costs	(see tables below)

Work description	Costs ($)
Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required	16,000
Capacity building – wetland waananga	50,000
Riparian fencing 10 x 1ha sites	80,000
Wetland planting (10ha)	395,520
Resource consent x 10	50,000
Project management/staffing/incidentals (30%)	177,456
Total	**768,976**

Work description	Costs ($)
Estimated cost of 1ha site for wetland restoration project fully completed (excludes tertiary scholarship)	**76,898**

Waikato-Tainui Karapiro ki Ngaaruawaahia 5 **Priority: Very High**	**Tuarua – Tuna habitat ponds – Karapiro ki Ngaaruawaahia**
Project summary	The restoration of tuna abundance was identified as a very high priority by whaanau, hapuu and ngaa marae between Lake Karapiro and Ngaaruawaahia. This project will see the creation of 15 tuna habitat ponds between Lake Karapiro and Ngaaruawaahia in areas identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Tuna (freshwater eels) are plentiful. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations.
Location	 Project area between Lake Karapiro and Ngaaruawaahia. The 15 individual tuna pond sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional tuna feeding sites, traditional mahinga kai sites and wetland type areas prone to flooding. This project is significant because tuna is a very significant mahinga kai taonga species for Waikato-Tainui. Hapuu, marae and whaanau from Lake Karapiro to Ngaaruawaahia have witnessed a steady decline in tuna abundance over time. For hapuu, marae and whanau, the restoration of taonga species and the ability to again provide these taonga as food for manuwhiri (visitors) is a critical marker of mana and status.

	It also confirms hapuu, marae and whaanau proficiency in manaaki tangata or the practice of generosity and reciprocity. The abundance of food and other resources that were traditionally available to Waikato-Tainui within its tribal rohe are well known by other tribes throughout the motu.
Key threats/impacts	Tuna populations will continue to decline and become less abundant. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga and mahinga kai. Ensure that competitive pest species, e.g. carp, are prevented from accessing identified tuna habitat.
Project goal/s (SMART)	Within 10 years, up to 15 tuna habitat ponds are created within the Karapiro to Ngaaruawaahia area to provide an increase in habitat availability for tuna. Tuna waananga have been held with iwi members at (or near) the ponds to transfer knowledge and tools to marae. Tuna from the ponds are being served at significant tribal events, like Poukai, thus contributing to restoring the relationship of the marae with the Waikato River.
Works required	Works are intended to be implemented by whaanau, hapuu and ngaa marae within Ngaaruawaahia through to Mercer. Co-funding contributions will be sourced and welcomed from interested collaborative partners. This project is intended to be undertaken as 15 individual projects, but may be undertaken as multiple ponds per project where appropriate. A pond should not be created within an existing wetland where there is significant native flora and fauna. **Cultural practices to ensure cultural safety.** Cultural safety $200 per hour or $1600 per 8 hours. Estimated cost for up to 80 hours $24,000. **Earthworks** Excavate marginal low lying areas to create shallow ponds/wetlands. • Ponds should be constructed up to a maximum of 5000m^2 and approximately 2m deep. Ponds should be no deeper than 3m to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Good quality water is maintained in the constructed ponds. • Ponds are constructed in traditional mahinga kai area/sites identified by hapuu, marae and whaanau. Installing an in-stream structure (log) that will be secured in place.

Note: Resource consent may be required.

Costs include excavator transport and are based on ponds being 5000m^2 x 2m deep, and a 12 tonne excavator moving 150m^3 per hour ($10,000), returning for one day to reshape the site once excavations have settled ($1800).

Cost per pond $11,800.
Estimated cost across 15 ponds $177,000.

Fencing
Ponds should be fenced with a 7-wire post and batten fence to exclude cattle.

Cost per pond 400m x $20/m = $8000.
Estimated fencing cost across 15 ponds $120,000.

Planting
Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree and flax).
Native planting 0.3ha per pond $11,865.
Additional weed control for 3 years at each pond $2520.

Planting and releasing cost per pond $14,385.
Estimated planting cost across 15 ponds $215,775.

Resource consent
It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately.

A generous cost estimate of $5000 per pond has been used.
Estimated consents cost across 15 ponds is $75,000.

	 **Capacity development** • Tuna waananga Provide training for tribal members to learn about tuna restoration. Tuna waananga (x 10) plus tuna tool kits. Cost per waananga $6000. Estimated total cost $60,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, confirm consents (if required) and project manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated project management cost per pond $12,956. Estimated project management cost across 15 ponds $224,333.
Risks to project success	Lack of access to sites. Resource consents not granted. Lack of experienced practitioners result in incompleted works. Ongoing maintenance to control weed infestation is not undertaken. Commercial eel fishermen fish out completed pond.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required. Exact location of tuna ponds to be determined by whaanau, hapuu and/or marae. Size of each pond, including area to be fenced and restored, will differ from site to site.
Project duration (years)	3 years per pond/site, includes construction, planting and weeding programme. 10 year project.

Costs

Work description	Cost ($)
Earthworks	177,000
Fencing	120,000
Planting	215,775
Resource consents	75,000
Capacity building	60,000
Project management/staffing/incidentals (30%)	194,332
Total	**842,108**

Work description	Cost ($)
Total estimate cost per individual pond (excludes capacity development and tertiary scholarships)	56,141

Waikato-Tainui Karapiro ki Ngaaruawaahia 6 **Priority: High**	**Tuatoru – 20 watercress restoration projects – Karapiro ki Ngaaruawaahia**
Project summary	The restoration of traditional watercress sites was identified as a high priority by whaanau, hapuu and ngaa marae between Karapiro and Ngaaruawaahia. This project will see the creation of 20 restored watercress sites between Ngaaruawaahia and Mercer in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically significant.
Vision for the project	Watercress is plentiful within the restored, traditional gathering locations.
Location	 Project area between Lake Karapiro and Ngaaruawaahia.
Brief description of site	Historically, watercress was in abundance and readily available for hapuu, marae and whaanau throughout the Waikato catchment. Now, with the intensification of land use, watercress is either no longer present or the land has been modified for dairy and dry stock. Waatakirihi, or watercress (also called koowhitiwhiti, *Nasturtium officinale* and *N. microphyllum*), is a highly prized food source for Waikato-Tainui and Maaori generally. An aquatic or boggy ground plant associated with drains, small creeks, wetland streams and the calmer edges of rivers, waatakirihi is a vigorous plant provided there is a good level of water quality (i.e. lack of sedimentation). It is a member of the mustard family and is highly regarded for its medicinal properties and its taste in many cultures across the world. As avid botanists and gardeners, tangata whenua were quick to identify its properties, and it now forms a major component of many traditional dishes. Harvest sites are highly coveted and sometimes known only to whaanau (family/families).

	(Dixon, L. 2017 – *The importance of watakirihi* – Te reo o te repo – The voice of the wetland)
Key threats/impacts	New plants do not establish and traditional watercress sites remain barren. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga of their watercress sites.
Project goal/s (SMART)	Within 2 years, watercress is flourishing in up to 20 project sites within the Karapiro and Ngaaruawaahia area.
Works required	Works could be implemented at iwi, hapuu, marae or whaanau level. This project could be undertaken as a whole, or in components. It is intended to restore traditional hapuu, marae, whaanau and iwi watercress sites. **Watercress restoration ($100,000)** 20 sites at $5000 per site $100,000. Includes project management of 25% ($20,000). Project manager to carry out landowner liaison, provide reporting information, negotiate agreements, inspect works and pick up and seed watercress.
Risks to project success	Lack of access to sites. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Karapiro and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	1-2 year projects.
Costs	(see table below)

Work description	Cost ($)
20 watercress restoration projects	80,000
Project management/staffing/incidentals (25%)	20,000
Total	**100,000**

Waikato-Tainui Karapiro ki Ngaaruawaahia 7 **Priority: High**	**Tuatoru – 30 puna restoration – Karapiro ki Ngaaruawaahia**
Project summary	The restoration of traditional puna was identified as a high priority by hapuu, marae and whaanau from Lake Karapiro to Ngaaruawaahia. This project will see the restoration of up to 30 puna between Lake Karapiro and Ngaaruawaahia. Puna will be restored in areas identified by hapuu, marae, whaanau or Waikato-Tainui as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Up to 30 puna are well established and restored at identified sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing their traditional puna. Customary practices and knowledge is transferred on to future generations. Ensure the locations of puna have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area between Lake Karapiro and Ngaaruawaahia. The 30 puna restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Restoration of puna is important because traditional puna were used for drinking water and sustainable land use by marae and whaanau whare. Historically, marae and whaanau kainga were build next to waterways or puna. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional cultural practices.
Key threats/issues	Hapuu, marae and whaanau become disconnected from traditional puna sites. Further loss of key historic knowledge of each site, and pest plant infestation. Culturally important purakau, tikanga and kawa become less known.

	Areas become more degraded (unrestricted stock access). Traditional puna are depleted due to surrounding activities, e.g. farming.
Project goal/s (SMART)	Within 10 years, up to 30 puna have been restored, enhanced, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with Waikato-Tainui members at (or near) the restoration sites or close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led by hapuu, marae, whaanau and/or Waikato-Tainui. Co-funding contributions from other interested partners for hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as, a whole. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Based on \$200 per hour. Estimate cost \$800 per 4 hours. Estimated cost for up to 120 hours \$24,000. **Restoration fencing and planting** *Estimated cost per puna* Carry out approximately 130m of fencing to protect approximately 1000m^2 area around each puna. Estimated cost for 130m of 7-wire post and batten fence \$2600. Estimated prep, planting and maintenance costs for 1000m^2 \$3955. *Estimated cost per puna run off streams/tributary* Carry out approximately 100m of fencing puna run off streams, puna seep/wet areas with a minimum 5m setback from the edge of the streambank and seep/wet areas. Plant riparian margins with native species. Estimated fencing cost for 200m \$4000. Estimated prep, planting and maintenance cost for 1000m^2 \$3955. Where a puna is historically known to be a whitebait spawning ground, riparian planting is to be carried out using appropriate native plant species at 0.75m spacing. **Capacity development** Provide training for tribal members to learn about riparian fencing and planting. Fencing waananga (x5). Planting waananga (x5). Estimated cost per waananga \$5000. Estimate total waananga cost \$50,000. **Project management/staffing/incidentals (30%)**

<table>
<tr><td></td><td>Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per puna $4353.
Estimated cost for 30 puna $185,790</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui between Karapiro and Ngaaruawaahia.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact puna location to be determined by whaanau, hapuu and /or marae.

Size of puna areas to be fenced and restored differ from site to site.
Length of fencing required for puna, including run off streams and wet seep areas.</td></tr>
<tr><td>Project duration (years)</td><td>Individual projects expected to take 3-5 years.
10 year project.</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required</td><td>24,000</td></tr>
<tr><td>Fencing off puna for protection (30 puna)</td><td>78,000</td></tr>
<tr><td>Puna riparian planting (30 puna)</td><td>118,650</td></tr>
<tr><td>Puna stream fencing (30 puna)</td><td>120,000</td></tr>
<tr><td>Puna stream riparian planting (5m setback on both banks)</td><td>118,650</td></tr>
<tr><td>Capacity building
Fencing and planting waananga</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>152,790</td></tr>
<tr><td>Total</td><td>662,090</td></tr>
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<tr><td>Estimated cost for 1 x puna restoration project fully completed (excludes tertiary scholarship and waananga)</td><td>22,070</td></tr>
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Waikato-Tainui Puuniu ki Ngaaruawaahia 1 Priority: High	Tuatahi – Tuna habitat ponds – Puuniu ki Ngaaruawaahia
Project summary	The restoration of tuna abundance was identified as a high priority by whaanau, hapuu and ngaa marae along the Waipaa River catchment between Puuniu River junction and the Ngaaruawaahia. This project will see the creation of 15 tuna habitat ponds between Puuniu River junction and Ngaaruawaahia in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Tuna (freshwater eels) are plentiful. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations.
Location	 Project area between the Puuniu River junction and Ngaaruawaahia on the Waipaa River catchment. Exact locations of the 15 individual tuna ponds will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional tuna feeding sites, traditional mahinga kai sites and wetland type areas prone to flooding. This project is significant because tuna is a very significant mahinga kai taonga species for whaanau, hapuu and ngaa marae between Puuniu River junction and Ngaaruawaahia. Hapuu, marae and whaanau between Puuniu River junction and Ngaaruawaahia have witnessed a steady decline in tuna abundance over time. For whaanau, hapuu and ngaa marae between Puuniu River junction and Ngaaruawaahia, the restoration of taonga species and the ability to again provide these taonga as food for manuwhiri (visitors) is a critical marker of mana and status.

	It also confirms hapuu, marae and whaanau proficiency in manaaki tangata or the practice of generosity and reciprocity. The abundance of food and other resources that were traditionally available to Waikato-Tainui within its tribal rohe are well known by other tribes throughout the motu.
Key threats/impacts	Tuna populations will continue to decline and become less abundant. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga and mahinga kai. Ensure that competitive pest species, e.g. carp, are prevented from accessing identified tuna habitat.
Project goal/s (SMART)	Within 10 years, up to 15 tuna habitat ponds are created within the Puuniu to Ngaaruawaahia area to provide an increase in habitat availability for tuna. Tuna waananga have been held with iwi members at (or near) the ponds to trnasfer knowledge and tools to marae. Tuna from the ponds are being served at significant tribal events, like Poukai, thus contributing to restoring the relationship of the marae with the Waikato River.
Works required	Works are intended to be implemented by whaanau, hapuu and ngaa marae within Ngaaruawaahia through to Mercer. Co-funding contributions will be sourced and welcomed from interested collaborative partners. This project is intended to be undertaken as 15 individual projects, but may be undertaken as multiple ponds per project where appropriate. A pond should not be created within an existing wetland where there is significant native flora and fauna. **Cultural practices to ensure cultural safety.** Cultural safety, $200 per or $1600 per 8 hours. Estimated cost for up to 80 hours $24,000. **Earthworks** Excavate marginal low lying areas to create shallow ponds/wetlands. • Construct ponds up to a maximum of 5000m^2 and approximately 2m deep. Ponds should be no deeper than 3m to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Good quality water is maintained in the constructed ponds. • Ponds are constructed in traditional mahinga kai area/sites identified by hapuu, marae and whaanau. Installing an in-stream structure (log) that will be secured in place.

Note: Resource consent may be required

Costs include excavator transport and are based on ponds being 5000m^2 x 2m deep, and a 12 tonne excavator moving 150m^3 per hour ($10,000), returning for one day to reshape the site once excavations have settled ($1800).

Cost per pond $11,800.
Estimated cost across 15 ponds $177,000.

Fencing
Ponds should be fenced with a 7-wire post and batten fence to exclude cattle.

Cost per pond: 400m x $20/m = $8000.
Estimated fencing cost across 15 ponds $120,000.

Planting
Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax).
Native planting 0.3ha per pond $11,865.
Additional weed control for 3 years at each pond $2520

Planting and releasing cost per pond $14,385.
Estimated planting cost across 15 ponds $215,775.

Resource consent
It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately.

A generous cost estimate of $5000 per pond has been used.
Estimated consents cost across 15 ponds = $75,000

	 **Capacity development** • Tuna waananga Provide training for tribal members to learn about tuna restoration. Tuna waananga (10) plus tuna tool kits. Cost per waananga $6000. Estimated total cost $60,000. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, confirm consents (if required) and project manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated project management cost per pond $12,956. Estimated project management cost across 15 ponds $224,333.
Risks to project success	Lack of access to sites. Resource consents not granted. Lack of experienced practitioners result in incompleted works. Ongoing maintenance to control weed infestation is not undertaken. Commercial eel fishermen fish out completed pond.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Puuniu River junction and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required. Exact location of tuna ponds is to be determined by whaanau, hapuu and /or marae. Size of each pond, including area to be fenced and restored, will differ from site to site.
Project duration (years)	3 years per pond/site, includes construction, planting and weeding programme. 10 year project.

Costs

Work description	**Cost ($)**
Earthworks	177,000
Fencing	120,000
Planting	215,775
Resource consents	75,000
Capacity building	60,000
Project management/staffing/incidentals (30%)	194,332
Total	**842,108**

Work description	**Cost ($)**
Total estimate cost per individual pond (excludes capacity development and tertiary scholarships)	56,141

<table>
<tr><td>Waikato-Tainui Puuniu ki Ngaaruawaahia 2
Priority: High</td><td>Tuatahi – 30 puna restoration – Puuniu ki Ngaaruawaahia</td></tr>
<tr><td>Project summary</td><td>The restoration of traditional puna was identified as a high priority by whaanau, hapuu and ngaa marae along the Waipaa River catchment from the Puuniu junction on the Waipaa River and Ngaaruawaahia.

This project will see the restoration of up to 30 puna between Puuniu junction and Ngaaruawaahia. Puna will be restored in areas identified by hapuu, marae, whaanau and/or Waikato-Tainui as being historically, culturally, ecologically or spiritually significant.</td></tr>
<tr><td>Vision for the project</td><td>Up to 30 puna are well established and restored at identified sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing their traditional puna. Customary practices and knowledge is transferred on to future generations.

Ensure the locations of puna have been recorded, protected, enhanced and restored for future cultural use.</td></tr>
<tr><td>Location</td><td>

Project area includes the Puuniu River junction on the Waipaa River to Ngaaruawaahia. The 30 puna restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.</td></tr>
<tr><td>Brief description of site</td><td>Restoration of puna is important because traditional puna were used for drinking water and sustainable land use by marae and whaanau whare. Historically, marae and whaanau kainga were build next to waterways or puna.
Waikato-Tainui’s primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional cultural practices.</td></tr>
<tr><td>Key threats/impacts</td><td>Hapuu, marae, whaanau become disconnected from traditional puna sites. Further loss of key historic knowledge of each site, and pest plant infestation,
Culturally important purakau, tikanga and kawa become less known.</td></tr>
</table>

	Areas become more degraded (unrestricted stock access). Traditional puna are depleted due to surrounding activities, e.g. farming.
Project goal/s (SMART)	Within 10 years, up to 30 puna have been restored, enhanced, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with Waikato-Tainui members at (or near) the restoration sites or close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led by hapuu, marae, whaanau and/or Waikato-Tainui. Co-funding contributions from other interested partners for hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as, a whole. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Based on $200 per hour. Estimate cost $800 per 4 hours. Estimated cost for up to 120 hours $24,000. **Restoration fencing and planting** *Estimated cost per puna* Carry out approximately 130m of fencing to protect an approximately 1000m^2 area around each puna. Estimated cost for 130m of 7-wire post and batten fence $2600. Estimated prep, planting and maintenance costs for 1000m^2 $3955. *Estimated cost per puna run off stream/tributary* Carry out approximately 100m of fencing of puna run off streams, puna seep/wet areas with riparian fencing with a minimum 5m setback from the edge of the streambank, seep/wet areas. Plant riparian margins with native species. Estimated fencing cost for 200m $4000. Estimated prep, planting and maintenance cost for 1000m^2 $3955. Where a puna is historically known to be a whitebait spawning ground, riparian planting is to be carried out using appropriate native plant species and planted at 0.75m spacing. **Capacity development** Provide training for tribal members to learn about riparian fencing and planting. Fencing waananga (x5). Planting waananga (x5). Estimated cost per waananga $5000. Estimate waananga cost $50,000. **Project management/staffing/incidentals (30%)**

<table>
<tr><td></td><td>Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per puna $4353.
Estimated cost for 30 puna $185,790.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui between Puuniu River junction and Ngaaruawaahia
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact puna location to be determined by whaanau, hapuu and /or marae.

Size of puna areas to be fenced and restored differ from site to site.
Length of fencing required for puna, including run off streams and wet seep areas.</td></tr>
<tr><td>Project duration (years)</td><td>Individual projects are expected to take 3-5 years.
10 year project.</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required</td><td>24,000</td></tr>
<tr><td>Fencing off puna for protection (30 puna)</td><td>78,000</td></tr>
<tr><td>Puna riparian planting (30 puna)</td><td>118,650</td></tr>
<tr><td>Puna stream fencing (30 puna)</td><td>120,000</td></tr>
<tr><td>Puna stream riparian planting (5m setback on both banks)</td><td>118,650</td></tr>
<tr><td>Capacity building
Fencing and planting waananga</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>152,790</td></tr>
<tr><td>Total</td><td>662,090</td></tr>
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<tr><td>Estimated cost for 1 x puna restoration project fully completed (excludes tertiary scholarship and waananga)</td><td>22,070</td></tr>
</table>
</td></tr>
</table>

Waikato-Tainui Puuniu ki Ngaaruawaahia 3 **Priority: Very high**	**Tuatahi – Tuna educational ponds – Whatawhata**
Project summary	This project is a very high priority for iwi. The project will restore tuna to a traditional mahinga kai site through the construction of up to three tuna ponds to increase, support, promote quality tuna habitat and provide iwi tuna capacity development and educational opportunities.
Vision for the project	Tuna (freshwater eels) are plentiful at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations through continued ongoing capacity development waananga with hapuu, marae, whanau and iwi educational groups.
Location	 The site is located at 1372A and B State Highway 23, Whatawhata 3285. Diagram shows the downstream passage to Waipaa River from the tuna restoration ponds.
Brief description of site	The site for 3 tuna ponds has been identified at the above address. Currently all 3 areas are wetland type areas that are prone to flooding. The land requires pest plant management for woolly nightshade and vegetation clearance. The identified area is currently fully fenced with no stock. This project is significant because tuna is a very significant mahinga kai taonga species for Waikato-Tainui and Ngaati Maahaanga. Hapuu, marae and whaanau have witnessed a steady decline in tuna abundance over time. This site offers educational opportunities to deliver ongoing tuna waananga for educational purposes and continued monitoring of tuna pond research because of it close proximity to Hamilton and good site access.

Key threats/impacts	• Tuna population will continue to decline and become less abundant. • Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga and mahinga kai.
Project goal/s (SMART)	Within 5 years, 3 tuna habitat ponds have been created. Tuna ponds are utilised as an educational, tuna waananga site for future capacity development of hapuu, marae, whaanau and iwi educational groups. Tuna for the ponds may be served at Poukai, thus contributing to restoring the relationship of the marae with the Waipaa River.
Works required	Works could be implemented at iwi, hapuu, marae or whaanau level. Co-funding contributions from landowner and other interested partners to iwi, hapuu or whaanau to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Earthworks** Excavate marginal low lying wetland areas to create 3 shallow ponds. • Pond 1. Approximately 2000m^2 and 1.5m to 2m deep. Includes 1000m^2 of native riparian planting. • Pond 2. Approximately 4500m^2 and 1.5m to 2m deep. Includes 3500m^2 of native riparian planting. • Pond 3. Approximately 2000m^2 and 1.5m to 2m deep. Includes 800m^2 of native riparian planting. • Ponds are no deeper than 2m deep to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Ponds are located where eels are able to access them (e.g. flow into watercourses where there are no barriers to eel passage).

Note: Resource consent may be required

Costs include excavator transport and are based on all 3 ponds being 8500m^2 x 2m deep, and a 12 tonne excavator moving 150m^3 per hour ($10,000), returning for one day to reshape the site once excavations have settled ($1800).

3 ponds = $20,060.

Fencing
Ponds should be fenced with a 7-wire post and baton fence to exclude cattle.

Total fencing required for all 3 ponds 800m x $20/m = $16,000
Estimated toal cost of fencing $16,000.

Planting
Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax).

- Site prep $2120 (5300m^2 weedy site)
- Planting at 1.5m spacing (4444 stems/ha)
- Plant costs $3.50 per plant
- Planting cost $1.50
- 5 x releasing events $3 per plant

Estimated cost for riparian planting $18,843

Resource consent
It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately.

	A generous cost estimate of $5000 per pond has been used. Estimated cost for 3 ponds $15,000.  **Capacity development** Provide training for tribal members to learn about tuna restoration. • 2 x tuna waananga plus tuna took kits $12,000 • 1 x capacity building waananga on fencing (onsite) $4000 • 1 x capacity building waananga on riparian planting $4000 Estimated cost for capacity building $20,000 **Project management/staffing/incidentals (25%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau, iwi and iwi educational groups (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be up to 25% of the project cost. Estimated cost across 3 ponds $32,389.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	No issues with land tenure. Full landowner support including in-kind contributions towards project.
Knowledge gaps and response	It’s unknown if resource consents are required.
Project duration (years)	3 years

Costs

Work description	Cost ($)
Earthworks	20,060
Fencing	16,000
Planting	18,843
Resource consents	15,000
Capacity building	20,000
Project management/staffing/incidentals (25%)	22,476
Total	**112,379**

Waikato-Tainui Puuniu ki Ngaaruawaahia 4 Priority: Very high	Tuatahi – Identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 Puuniu River ki Ngaaruawaahia.
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 1 of a 2-stage process. This stage identifies the locations and tribal history of each waahi tapu and site of significance from within the area of Puuniu River through to Ngaaruawaahia. Stage 2 will consist of physical restoration and protection works. Please refer to PAF for full details of works *(Restoration and protection of waahi tapu and sites of significance – STAGE 2 – Puuniu River junction ki Ngaaruawaahia).*
Vision for the project	Waahi tapu and sites of significance have been identified and protected, and historical koorero recorded and archived with Waikato-Tainui and whaanau, hapuu and/or marae. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waipaa River and all tributaries between Puuniu junction and Ngaaruawaahia. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for hapuu, marae, whaanau and iwi afterbirth, sites of historic events and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.

Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated, uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for waahi tapu to be left unprotected.
Project goal/s (SMART)	• Within 3 years, waananga have been held with hapuu, marae, whaanau and/or iwi. One on one interviews have been held with kaumatua and key knowledge holders, with recordings archived. • Hapuu, marae, whaanau and/or iwi have identified the locations of all waahi tapu and sites of significance within the areas of Puuniu junction and Ngaaruawaahia • Waahi tapu and sites of significance register, including GIS mapping, is complete and entered into Waikato-Tainui's archiving data system. • Opportunities for iwi capacity development in GIS mapping has been implemented.
Works required	**Waananga** 10 waananga held with hapuu, marae and whaanau to identify waahi tapu, sites of significance and key knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. All findings are presented back. • Venue, kai and koha per day $1500 • Cultural safety, per hour$200 or per day $1600 • Facilitator $200 per hour and $1600 per day • Travel expenses for participants $40 per person and $600 per waananga Estimated cost per waananga $3700. Estimated total waananga cost $37,000. **Interviews** Interview knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: • Up to 20 kaumatua/kuia interviews at $500 per interview – $10,000 • Film interviews at $700 per day x 14 days = $9800 • Editing of interviews at $700 per day x 14 days = $9800 • Interviewer/literature reviewer at $800 per day x 21 days = $16,800 Estimated interviewing cost $46,400. **Mapping and photographing waahi tapu sites** Access, map and photograph all significant and waahi tupuna/tapu sites. Enter information into digital database and maps. Assume: • Access and photograph sites at $800 per day x 21 days = $16,800 • GIS mapping services at $200 per hour to input maps and develop register x 28 days $44,800 Estimated interviewing cost $61,600. **Capacity development**

	Hold 2 x GIS mapping waananga with hapuu, marae and whaanau from Puuniu junction to Ngaaruawaahia, and identify and support (x2) taiohi to undertake a scholarship to study and formally upskill in GIS/cultural mapping of waahi tapu/historical or related studies. • GIS mapping waananga x 2 $10,000, • Scholarship x 2 taiohi/student $20,000 Estimated capacity development costs $30,000. **Vegetation clearance to access sites of significance** Some of the known waahi tapu and site of significance areas need to be cleared of scrub and weeds to allow access for hapuu, marae and whaanau to assess the sites. • Contractor costs to clear weeds from known sites of significance at $700 per day x 28 days Estimated clearing cost $19,600. **Project delivery** Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components. **Project management/staffing/incidentals (30%)** Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $58,380.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Puuniu junction and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	Exact location to be identified by key knowledge holders, i.e. kaumatua, kuia.
Project duration (years)	3 year project
Costs	

Work description	Cost ($)
Waananga with Waikato-Tainui kaumatua	37,000
Interview with key knowledge holders	46,400
Mapping and photography	61,600
GIS mapping capacity development	30,000
Clear and remove vegetation	19,600
Project management/staffing/incidentals (30%)	58,380
Total	**252,980**

Waikato-Tainui Puuniu ki Ngaaruawaahia 5 Priority: Very high	Tuarua – Restoring and protecting waahi tapu and sites of significance – STAGE 2 – Puuniu ki Ngaaruawaahia
Project summary	Enhancement, restoration and protection of waahi tapu and sites of significance were identified as very high priorities by hapuu, marae, whaanau and Waikato-Tainui. This project is stage 2, the final stage, to physically restore and protect the waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or iwi during stage 1. *(Tuarua - Identification, restoration and protection of waahi tapu and sites of significance – STAGE 1 – Puuniu River junction ki Ngaaruawaahia)*
Vision for the project	Identified waahi tapu and sites of significance have been restored and protected with full stock exclusion fencing and appropriate planting of native species. Locations of waahi tapu and sites of significance will be marked by traditional carved pou, iPou or new technology (e.g. augmented reality technology) that can be adapted to traditional Maaori symbolism. Note: Only approved historical koorero will be subject to public access.
Location	 Project area includes the Waikato River and all tributaries between Puuniu River junction and Ngaaruawaahia. Exact locations of waahi tapu will be identified by whaanau, hapuu and ngaa marae.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically and spiritually significant, e.g. waahi tapu, urupaa, sites of significance, burial sites for afterbirth, sites of historic events and traditional historic walkways between hapuu, marae, whaanau and iwi. This project is significant to ensure hapuu, marae, whaanau and/or iwi koorero and purakau of their waahi tapu and sites of significance.
Key threats/impacts	Waahi tapu and sites of significance become disconnected from hapuu, marae, whaanau and the Waikato River. Waahi tapu remain isolated, uncared for and become more degraded and infested with weeds. Culturally important purakau, tikanga and kawa become less known. Culturally unsafe for this waahi tapu to be left unprotected.

Project goal/s (SMART)	• Within 10 years, all identified waahi tapu and sites of significance access, fencing and planting have been completed. • Ongoing weed management has been undertaken by landowners, hapuu, marae, whaanau and/or iwi. • Signage and/or carved iPou have been developed to tell the history of the waahi tapu or sites of significance.
Works required	**Proposed development would include:** A site visit with kaumatua to locate waahi tapu or site of significance. Facilitate cultural practices and ensure cultural safety as per their tikanga and kawa. Fence off and plant native species around each waahi tapu or site of significance. **Cultural practices to ensure cultural safety.** Cultural safety \$200 per hour or \$1600 per day. **Site fencing** Perimeter fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per 1000m^2 site: 130m x \$20/m = \$2600. Estimated fencing cost across 1 x 1ha: 400m x \$20/m = \$8000. **Site prep, planting and maintenance** Site prep \$2000 per hectare of weedy site. Plant spacing 1.5m (4444 stems per hectare) Plant costs \$3.50 per plant Planting cost \$1.50 per plant. 5 x releasing events \$3.00 per plant. Estimated cost per 1000m^2 \$3955. Estimated cost per hectare \$39,552. **Maaori cultural symbolism** Waahi tapu and sites of significance will be recognised through the development and fabrication of cultural symbolism to be installed on site, appropriately marking the location. The total number of carved pou or iPou, will be determined by the number of waahi tapu and sites of significance identified by hapuu, marae, whaanau and/or Waikato-Tainui. Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). • **Carved Pou** *Collate information for carved Pou* Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui. Estimated cost per carved pou \$1000. *Fabricate and install carved pou onto the sites* (6m length x 0.6m diameter) Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install pou. Estimated fabrication and installation costs per carved pou \$35,000. *Timber to be carved into pou* (6m length x 0.6m diameter)

Cost is highly dependent on availability and species. It is encouraged to shop around.
Totara is best suited for fine detailed carving – $15,000 including transport from South Island.
H5 treated pine is not suited for fine detailed carving – $1200 including transportation.

- **iPou**

The project will allow everyone with a mobile device to engage and have an educational and informative cultural experience that is measurable and immediate. It is multi focused, with messaging for river iwi and their beneficiaries, other iwi, local and government agencies, environmental partners and stakeholders, public, visitors and international guests.

Collate information for iPou
Collate information for the sites identified by hapuu, marae, whaanau and/or Waikato-Tainui
Estimated cost per iPou $1000.

Fabricate and install 1 iPou onto the sites
Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu).
Estimated cost per iPou $10,000.

Technology/information loaded and installed into each iPou
Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/Install the technology.
Estimated cost per iPou $2000.

Project delivery
Works need to be implemented by hapuu, marae and whaanau. This project could be undertaken as a whole, or in components.

Project management/staffing/incidentals (30%)

	Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost. Estimated cost $156,098.
Risks to project success	Lack of funding. Access to sites is restricted. Resource consents not granted. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Puuniu River junction and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	Exact location to be identified by key knowledge holders, i.e. kaumatua or kuia.
Project duration (years)	3 year project per identified waahi tapu or significant site.

Costs	Individual costing estimates for 1 x 1000m^2 site with either 1 x carved totara pou, 1 x carved pine pou or 1 x iPou fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 1 x 1000m^2 site	
Cultural practices to ensure cultural safety 8 hours	1600
1000m^2 site fencing	2600
Site prep, planting, maintenance	3955
1 x carved pou fabrication and installation	35,000
Collate information for carved Pou	1000
Totara timber 6m length x 0.6m diameter	15,000
1 x iPou fabrication and installation	10,000
Collate information for iPou	1000
Load information into iPou software	2000
Project management totara carved pou	17,747
Project management pine carved pou	13,607
Project management for iPou	6347
Total estimated cost for 1 x totara carved Pou	**76,902**
Total estimated cost for 1 x iPou	**27,502**

The cost estimate below includes site prep, planting, weed maintenance and fencing for up to 20 x 1000m^2 sites, cultural practices, and 5 x carved totara pou, and 10 x iPou, fabricated and installed onsite.

Work description	Cost ($)
Task costs are based on 20 x 1000m^2 site	
Cultural practices to ensure cultural safety 160 hours	32,000
Site fencing	39,000
Site prep, planting, maintenance	59,325
5 x carved pou fabrication and installation	175,000
Collate information for carved pou x 10	10,000
5 x totara timber 6m length x 0.6m diameter	75,000
10 x iPou fabrication and installation	100,000
Collate information for iPou x 10	10,000
Load information into iPou software x 10	20,000
Project management/staffing/incidentals (30%)	156,098
Total estimated cost for 20 x 1000m^2 sites	**676,423**

Waikato-Tainui Puuniu ki Ngaaruawaahia 6 Priority: Very high	Tuarua – 10ha wetland creation, restoration and protection – Puuniu ki Ngaaruawaahia
Project summary	Wetland creation, restoration and protection were identified as very high priorities by hapuu, marae and whaanau from Puuniu junction on the Waipaa River through to Ngaaruawaahia. This project will see the restoration of 10ha of wetlands between Puuniu junction and Ngaaruawaahia, in areas identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Wetlands are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting native flora and fauna, including paru, for cultural purposes. Customary practices and knowledge is transferred on to future generations. Ensure locations of paru within the wetlands have been recorded, protected, enhanced and restored for future cultural use.
Location	 Project area includes the Waipaa River and all tributaries between the Puuniu River junction and Ngaaruawaahia. The 10ha of wetland restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	The sites will be areas known to whaanau that are historically, culturally, ecologically or spiritually significant, e.g. traditional mahinga kai sites. Waikato-Tainui's primary interest in the project is to protect unfettered access of tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices.

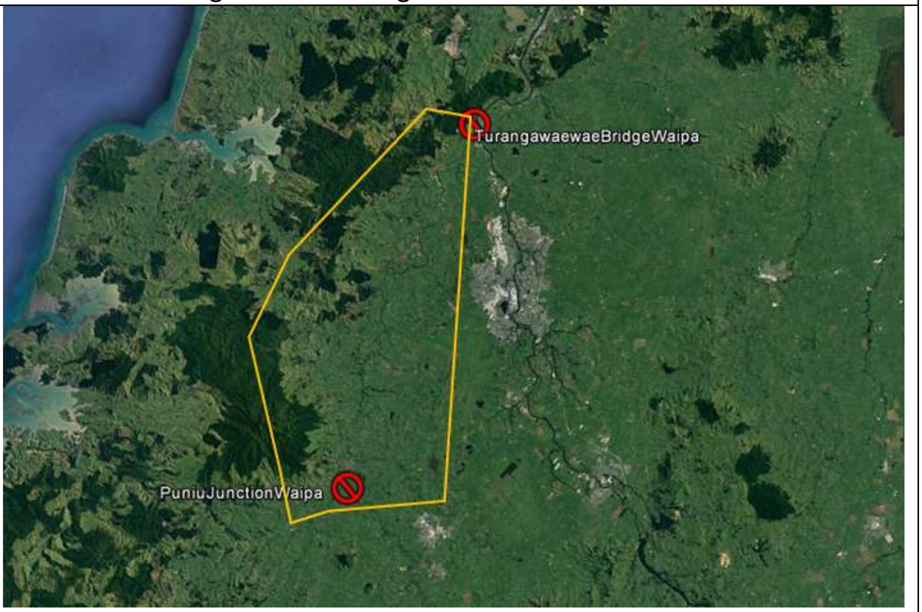
	The project also includes the restoration and recovery of wetland taonga species as that is related to the overall health and wellbeing of the Waikato River as captured under the Waikato Raupatu River Settlement legislation (2010). Tuna is an important cultural fishery for the peoples of Puuniu ki Ngaaruawaahia especially, and is considered to be an important indicator of river health. Stopping the encroachment of non tangata whenua fishers into areas traditionally used by members of Waikato-Tainui is one part of this overall aspiration.
Key threats/impacts	Hapuu, marae, whaanau become disconnected from traditional gathering sites. Further loss of key historic whitebait spawning site due to pest plant infestation. Culturally important purakau, tikanga and kawa become less known. Areas become more degraded (unrestricted stock access).
Project goal/s (SMART)	Within 10 years, up to 10ha of wetlands have been constructed, restored, fenced and planted, and pest plant releasing programmes have been completed. Waananga have been held with iwi members at (or near) the restoration sites or close marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented at whaanau, hapuu and/or marae level. This project could be undertaken as a whole, or in components. **Cultural health and safety** Cultural health and safety in accordance with Waikato-Tainui marae tikanga and kawa, where required, from project commencement through to project completion. Based on \$200 per hour. Estimate cost \$1600 per 8 hours. Estimated cost for up to 80 hours \$16,000. **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the wetland and plant riparian margins with native species. Fenced with a 7-wire post and baton fence to exclude cattle. Estimated fencing cost per hectare site: 400m x \$20/m = \$8000. Estimated fencing cost for 1 site at 10ha: 1270m x \$20/m = \$25,400. Estimated fencing cost for 10 x individual sites at 1ha each = \$80,000. **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with plant spacing of 1.5m (4444 plants per hectare). Estimated cost per hectare \$39,552. Estimated cost for 10ha \$395,520. **Resource consent** Resource consents may be required. Estimated cost per consent \$5000. Estimated cost for 10 individual consents \$50,000.

<table>
<tr><td></td><td>Capacity development
Provide training for tribal members to learn about riparian fencing and planting (includes site visit to champion site).

Provide training for tribal members to learn about wetland restoration.
Wetland waananga (x 10).
Estimate cost $50,000.

Project management/staffing/incidentals (30%)
Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per 1ha $17,746 (excludes tertiary scholarships).
Estimated cost 10ha $207,456.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Resource consents not granted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Puuniu River junction and Ngaaruawaahia.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown whether consents or authorisations are required.</td></tr>
<tr><td>Project duration (years)</td><td>10 year project.</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Costs ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui marae tikanga and kawa throughout project where required</td><td>16,000</td></tr>
<tr><td>Capacity building – wetland waananga</td><td>50,000</td></tr>
<tr><td>Riparian fencing 10 x 1ha sites</td><td>80,000</td></tr>
<tr><td>Wetland planting (10ha)</td><td>395,520</td></tr>
<tr><td>Resource consent x 10</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>177,456</td></tr>
<tr><td>Total</td><td>768,976</td></tr>
</table>

<table>
<tr><th>Work description</th><th>Costs ($)</th></tr>
<tr><td>Estimated cost of 1ha site for wetland restoration project fully completed. (excludes tertiary scholarship)</td><td>76,898</td></tr>
</table>
</td></tr>
</table>

Waikato-Tainui Puuniu ki Ngaaruawaahia 7 Priority: High	Tuarua – 10km riparian and taonga species habitat restoration – Puuniu ki Ngaaruawaahia
Project summary	The restoration of riparian margins, including the restoration and protection of ngaa taonga species, have been identified as a high priority by hapuu, marae and whaanau from the Puuniu junction through to Ngaaruawaahia. This project will see the restoration of 10km of riparian margins between the Puuniu junction and Ngaaruawaahia. Areas will be identified by hapuu, marae, whaanau or iwi as being historically, culturally, ecologically or spiritually significant.
Vision for the project	Riparian margins and the ecosystems within the margins are well established at the sites. Whaanau are able to exercise their mana whakahaere through restoring, protecting and enhancing the wellbeing of traditional mahinga kai sites along the Waikato River and tributaries.
Location	 Project area includes the Waikato River and all tributaries between the Puuniu junction and Ngaaruawaahia. The 10km of riparian restoration sites will be identified by whaanau, hapuu and ngaa marae within the mapped area above in locations that are historically, culturally, ecologically or spiritually significant.
Brief description of site	Sections of the Waikato River, streams, and tributaries are historically, culturally, ecologically or spiritually significant, e.g. traditional mahinga kai sites, and well known to hapuu, marae, whaanau and Waikato-Tainui. Waikato-Tainui's primary interest in the project is to provide and protect unfettered access to riparian margins for tribal members to exercise mana whakahaere and undertake traditional mahinga kai practices. This includes the broader aspiration of the restoration and recovery of wetland taonga species associated with healthy riparian margins.

Key threats/impacts	Taonga species remain absent or in decline from traditional sites where they were once plentiful. Hapuu, marae, whaanau become disconnected from the Waikato River and traditional mahinga kai sites due to poor habitat. Culturally important purakau, tikanga and kawa become less known. Cattle and other browsing species are destroying traditional sites within the riparian margins of the Waikato River and associated wetlands.
Project goal/s (SMART)	Within 10 years, up to 10km of riparian margins suitable for taonga species habitat have been restored, enhanced, fenced and planted, and pest plant releasing programmes completed. Capacity development waananga have been held with iwi members at or near the restoration sites or marae, for the transfer of knowledge and tools to marae.
Works required	Works could be implemented and led at marae or whaanau level. Co-funding contributions from other interested partners to hapuu, marae, whaanau and/or Waikato-Tainui to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Cultural practices to ensure cultural safety.** Cultural safety, \$200 per hour or \$1600 per day. Estimated cost for up to 80 hours \$16,000 **Riparian fencing** Carry out riparian fencing with a minimum 5m setback from the edge of the stream and/or river banks. Fencing will consist of a 7-wire post and batten at \$20 per metre. Estimated cost per 1000m site \$20,000. Estimated cost for 10km \$200,000 . **Wetland planting** Carry out planting of native wetland species within the internal areas of the wetland where required, with a plant spacing of 1.5m (4444 plants per hectare) and 5 x plant releasing events. Estimated planting cost per 5000m^2 \$18,776. Estimated planting cost for 5ha \$187,760. **Installation of structures for fish habitat** Carry out approximately 10km of securing in-stream wood structures throughout the identified restoration streams (4-6 structures over a 2km length for fish habitat where practicable). Estimate cost per 1km \$10,413. Estimated cost for 10km \$104,130. It is envisaged that whaanau, hapuu and/or marae, with assistance from Waikato Regional Council, work collaboratively in terms of site location investigation, design and installation of woody debris structures. This component could be undertaken in conjunction with Waikato Regional Council's river management work.

<table>
<tr><td></td><td>Capacity development
Provide training for tribal members to learn about riparian fencing and planting.
Fencing waananga (x5).
Planting waananga (x5).
Estimated cost for 10 waananga at $5000 each, $50,000.

Project management/staffing/incidentals (30%)
Project manager to carry out knowledge holder interviews, work with hapuu, marae, whaanau and/or Waikato-Tainui (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be 30% of the project cost.
Estimated cost per 1km length $16,737 (excludes tertiary scholarships).
Estimated cost 10km site $197,367.</td></tr>
<tr><td>Risks to project success</td><td>Lack of funding.
Access to sites is restricted.
Lack of experienced practitioners results in incompleted works.
Ongoing maintenance to control weed infestation is not undertaken.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and Waikato-Tainui, between the Puuniu junction and Ngaaruawaahia.
Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Exact locations of each restoration site need to be determined.</td></tr>
<tr><td>Project duration (years)</td><td>10 year project.</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Cultural practices in accordance with Waikato-Tainui tikanga and kawa throughout each individual projects where required.</td><td>16,000</td></tr>
<tr><td>Riparian fencing (10km)</td><td>200,000</td></tr>
<tr><td>Riparian planting (5ha)</td><td>187,760</td></tr>
<tr><td>Installation of structures for fish habitat</td><td>104,130</td></tr>
<tr><td>Capacity building – fencing and planting waananga</td><td>50,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>167,367</td></tr>
<tr><td>Total</td><td>725,257</td></tr>
</table>
<table>
<tr><td>Estimated cost to restore 1000m length of riparian margin with a 5m setback (excludes tertiary scholarship)</td><td>72,526</td></tr>
</table>
</td></tr>
</table>

Waikato-Tainui Puuniu ki Ngaaruawaahia 8 Priority: High	Tuatoru – 20 watercress restoration projects – Puuniu ki Turangawaewae
Project summary	The restoration of traditional watercress sites was identified as a high priority by whaanau, hapuu and ngaa marae between Puuniu River junction and Ngaaruawaahia. This project will see the creation of 20 restored watercress sites between Puuniu and Ngaaruawaahia in areas identified by hapuu, marae, whaanau and iwi as being historically, culturally, ecologically significant.
Vision for the project	Watercress is plentiful within the restored, traditional gathering locations.
Location	 Project area between the Puuniu River junction and Ngaaruawaahia.
Brief description of site	Historically, watercress was in abundance and readily available for hapuu, marae and whaanau throughout the Waikato catchment. Now, with the intensification of land use, watercress is either no longer present or the land has been modified for dairy and dry stock. Waatakirihi, or watercress (also called koowhitiwhiti, *Nasturtium officinale* and *N. microphyllum*) is a highly prized food source for Waikato-Tainui and Maaori generally. An aquatic or boggy ground plant associated with drains, small creeks, wetland streams and the calmer edges of rivers, waatakirihi is a vigorous plant provided there is a good level of water quality (i.e. lack of sedimentation). It is a member of the mustard family and is highly regarded for its medicinal properties as well as its taste in many cultures across the world. As avid botanists and gardeners, tangata whenua were quick to identify its properties and it now forms a major component of many traditional dishes. Harvest sites are highly coveted and sometimes known only to whaanau (family/families).

	(Dixon, L. 2017 – *the importance of watakirihi* – Te reo o te repo – The voice of the wetland)
Key threats/impacts	New plants do not establish and traditional watercress site remains barren. Hapuu, marae and whaanau will become less engaged with the practices of kaitiakitanga of their watercress sites.
Project goal/s (SMART)	Within 2 years, watercress is flourishing in up to 20 project sites within the Puuniu ki Ngaaruawaahia catchment.
Works required	Works could be implemented at iwi, hapuu, marae or whaanau level. This project could be undertaken as a whole, or in components. It is intended to restore traditional hapuu, marae, whaanau and iwi watercress sites. **Watercress restoration ($100,000)** 20 sites at $5000 per site $100,000. Includes project management of 20% ($20,000). Project manager to carry out landowner liaison, provide reporting information, negotiate agreements, inspect works, and pick up and seed watercress.
Risks to project success	Lack of access to sites. Lack of experienced practitioners results in incompleted works. Ongoing maintenance to control weed infestation is not undertaken.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whaanau, hapuu, ngaa marae and iwi between Puuniu and Ngaaruawaahia. Very high likelihood of adoption.
Knowledge gaps and response	It is unknown whether consents or authorisations are required.
Project duration (years)	1-2 year projects.
Costs	(see table below)

Work description	Cost ($)
20 watercress restoration projects	80,000
Project management/staffing/incidentals (25%)	20,000
Total	**100,000**

APPENDIX 10 - Raukawa Iwi Cultural Priorities

WAIKATO AND WAIPĀ RIVER CATCHMENT RESTORATION STRATEGY

RAUKAWA PRIORITIES

Report

Prepared for

Raukawa Charitable Trust

By Pūtake Taiao

April 2017

INTRODUCTION

PURPOSE

The purpose of this report is to identify the cultural priority areas for Raukawa (Raukawa priorities) for the restoration of the Waikato River and Waipā River catchments. These priorities will be presented to the Waikato River Authority (WRA) to sit alongside the Waikato and Waipā River Restoration Strategy (the Strategy).

OBJECTIVE

The primary objective for the Raukawa priorities is to assist funding and project providers with future work requirements and likely funding allocations for projects identified as being a priority for the restoration of the Waikato and Waipā River catchments.

BACKGROUND

The Strategy is being developed through a partnership between the Waikato Regional Council, the Waikato River Authority and Dairy NZ. The purpose of the Strategy is to deliver a strategic approach to restoration activities within the Waikato and Waipā River catchments. The Strategy is intended to guide how the Waikato River Clean-Up Trust administers funding within the two catchments over the next 5-15 years.

In the planning of the Strategy, it is considered that a separate iwi priorities work stream should be developed to take account of the unique relationship of Māori with the catchment. As a result, four master's scholarships were created through collaboration between the Waikato River Authority, Waikato-Tainui College for Research and Development, the University of Waikato and respective River iwi. Students from each of the River iwi were selected and tasked with identifying iwi priorities and projects in collaboration with their respective iwi organisations. (Note: As a student from Tūwharetoa was not available, this work was undertaken directly by the staff at Tūwharetoa Māori Trust Board).

Anaru Begbie is the recipient of the master's scholarship for the Raukawa Charitable Trust.

WAIKATO AND WAIPĀ RIVER RESTORATION STRATEGY

The Strategy has been developed with two main focus areas – the first addressing the physical restoration of the Waikato and Waipā Rivers, and the second aiming to identify priorities for iwi while at the same time ensuring iwi involvement remains across all aspects of the Strategy.

Physical restoration

The first focus area is the physical restoration of the rivers and seeks to ensure that this occurs in an ongoing and integrated manner using the best available and achievable information. Investment in this area of work aims to identify projects that will address physical restoration, such as water quality, erosion and sedimentation, riparian management, habitat and biodiversity, access and recreational use of the catchment using non-regulatory methods.

The projects outlined in this focus area are all tangible restoration works comprising specific, achievable and prioritised activities that have been developed through consultation with catchment stakeholders. Priorities in this focus area will be assessed using the INFFER (Investment Framework for Environmental Resources) model which provides a cost-benefit analysis to assist organisations with funding decisions.

The Strategy will be separated into four core units – Waipā, Upper Waikato, Central and Lower Waikato and Shallow Lakes. Each unit will cover:

- A summary of the current state of the unit.
- The aspirations and goals of stakeholders for achieving the Te Ture Whaimana o Waikato – The Vision and Strategy for the Waikato River (Te Ture Whaimana).
- A prioritised list of projects required for achieving catchment goals over the next 5-15 years.

Iwi Priorities

The second area of focus for the Strategy is the iwi priorities work stream. This stream of work was developed to recognise the unique connection of River iwi with the catchment, as well as acknowledging the role that Te Ture Whaimana plays in connecting iwi with the awa. It is also recognised that a number of iwi priorities may not fit within the parameters of traditional western science and management. The work stream was developed using a separate source of funding. Projects that are in scope will not go through the INFER assessment process.

Four Masters Scholarships were created through collaboration between the Waikato River Authority, Waikato-Tainui College for Research and Development, University of Waikato and respective river iwi. Students from each of the river iwi (with the exception of Tūwharetoa) have been tasked with identifying iwi priorities and projects in collaboration with their respective iwi organisations.

METHODOLOGY

The methodology adopted for the development of the Raukawa Prioritises consisted of the following steps:

1. Literature review: Is the Raukawa literature on the restoration of the Waikato and Waipā River Catchments still current and relevant?
2. Engaging Raukawa uri to participate throughout the creation of the Raukawa priorities.
3. Ensuring wānanga enables a fair representation of Raukawa uri as possible.
4. Transforming priorities taken from uri korero into potential projects that will contribute to achieving the Raukawa priorities.

This methodology was adopted as it was felt it provided the most opportunity for Raukawa uri to be involved throughout the initial process of collecting data and information.

Literature Review

It is acknowledged that a substantial amount of work by Raukawa uri has already gone into the creation of various literature around the restoration of the Waikato and Waipā rivers. This literature was reviewed and formed the base information for wānanga. The literature review included the plans, strategies and reports listed below and identified goals, and linkages that relate to the in-scope area of the Waikato and Waipā River Restoration Strategy:

- Raukawa Deed in Relation to a Co-Management Framework for the Waikato River 2009.
- Te Ture Whaimana o Te Awa o Waikato – The Vision and Strategy for the Waikato River (Te Ture Whaimana).
- Te Rautaki Taiao a Raukawa – Raukawa Environmental Management Plan 2015 (Te Rautaki Taiao).
- Raukawa Fisheries Plan 2012 (the Fisheries Plan).
- Waikato River Independent Scoping Study 2010.
- Waikato Regional Council – Upper Waikato Zone Plan.

The literature review identified five very clear and reoccurring themes. The themes are all consistent with each section of Te Rautaki Taiao and the Raukawa Fisheries Plan. They provide very decisive outcomes for Raukawa whanau. These themes are interconnected and will feed into each other to achieve the desired outcomes. The key themes identified were:

I. Restoration and protection of the relationship between Raukawa and the Waikato River.
II. The restoration and recognition of mātauranga Māori.
III. The restoration and enhancement of the mauri of the Waikato River.

IV. Growing and strengthening Raukawa whanau capacity (in both knowledge and participation) in fresh water.
V. The restoration and protection of mahinga kai practices.

PROCESS

At the start of the project, the focus was on the identification of priority projects for Raukawa. The Restoration Strategy required this approach in order to assist funders with decision making, and to assist potential project implementers in deciding on projects to undertake. In turn, this influenced the approach taken in the five wānanga.

On the completion of the wānanga it became apparent that the specific projects that had been identified all fell under the themes identified above. It was decided that focus on priority areas would allow for a broader and more comprehensive range of projects that would enable more effective outcomes to be achieved.

The wānanga were carried out using a kaupapa Māori theoretical and methodological framework. This approach is consistent with the approach used for the creation of other Raukawa documents, such as Te Rautaki Taiao, and the Fisheries Plan.

The kaupapa Māori framework means that the research, primarily, must be useful and relevant to the 'research community'. In this case, Raukawa Kaupapa Māori research is orientated toward benefiting all the research participants and their collectively determined agendas, defining and acknowledging Māori aspirations for research, while developing and implementing Māori theoretical and methodological preferences and practices for research.[1] The framework is based on the understanding that the Māori means of accessing, defining and protecting knowledge existed before European arrival in New Zealand.[2]

The framework also provides for a 'research whanau'[3] advisory group made up of peers (other river iwi scholarship students) and iwi advisors (including kaumātua and iwi environmental advisors) who can discuss the research, and any potential issues that could arise. It is for those reasons that a collaborative kaupapa Māori approach was chosen.

A kaupapa Māori approach for the management of the Restoration Strategy will also be used when dealing with Raukawa priorities. This approach encourages consultation with marae, hapū, whanau, and will seek the guidance of Raukawa kaumātua.

Wānanga

Five wānanga were held in the following locations:

- Paparaamu Marae – 15 February 2017.
- Tokoroa Events Centre – 18 February 2017.
- Ongaroto Marae – 21 February 2017.
- Whakamārama Marae – 23 February 2017.
- Pūtake Taiao office, Tokoroa – 3 March 2017.

The locations of the wānanga were strategically selected to give Raukawa uri throughout the Waikato and Waipā catchments the opportunity to participate.

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1 Bishop, R (1999) 'Kauapapa Māori Research: A indigenous apporach to creating knowledge' in Robertson, N (Ed.), (1999), Māori and psychology: research and practice - The proceedings of a symposium sponsered by the Māori and Psychology Research Unit. (Hamilton: Māori and Psychology Research Unit).

2 Bishop, R. Glenn, T (1999) 'Culture Counts: Changing Power Relations in Education'.

3 Ibid.

For the purposes of the wānanga, the themes identified in the literature review were introduced with whanau to discuss and identify what they meant to them. When the korero stalled, or became unproductive, questions were introduced to stimulate more korero and/or redirect the korero (if needed).

Participants were given stickers and asked to place them on the projects they thought were a priority for them. There was no limit to the number of stickers they could place on a priority as the more stickers that were on a priority, the more significant that priority became.

The following themes were tested to see if they were still relevant and whether they were a priority for Raukawa for the restoration of the Waikato and Waipā River catchments.

I. Restoration and protection of the relationship between Raukawa and the Waikato River.
   - What is your current connection with the Waikato River?
   - Do you have a spiritual/physical connection with the Waikato River?
   - How do we enhance our relationship with the Waikato River?

II. The restoration and recognition of mātauranga Māori.
   - What does mātauranga Māori mean to you?
   - What does mātauranga restoration look like on the ground?

III. The restoration and enhancement of the mauri of the Waikato River
   - What does mauri mean to you?
   - What does mauri restoration mean to you?
   - What areas of mauri restoration would you see as priorities?

IV. Growing and strengthening Raukawa whanau capacity in fresh water.
   - What is your current knowledge around fresh water?
   - Are there specific areas where you would like to know more? E.g. funding applications, project planning, monitoring.

V. The restoration and protection of mahinga kai practises
   - Does your whanau still participate in mahinga kai practises within the Waikato and Waipā river catchments?
   - Are there any kai that currently are not in the Waikato and Waipā River catchment that you would like to see return?

VI. General questions for the wānanga
   - Do you agree/disagree with the themes that have been highlighted?
   - Do you have any amendments?
   - What would each of these themes/goals look like as a project?
   - Are there any locations for these projects that you think will be suitable/most appropriate?
   - Which of these projects do you see as the most urgent?

Korero was recorded, and from this, the results were turned into potential projects that the facilitators thought reflected that korero. These projects would contribute to achieving the objectives whanau had discussed. They were then tested by participants, who were given the opportunity to adjust the project list as they saw fit.

KEY FINDINGS

The wānanga identified that there is a diverse level of involvement and connection with the Waikato and Waipā rivers across the iwi. Some uri felt the connection to the awa had been lost; while other whanau who have a connection with the awa felt that the degradation of the awa had affected their relationship.

Overall, the relationship with the awa was of paramount importance. The findings showed the themes drawn from the literature review are still very relevant and important. From the results, the following was identified:

- Fostering a mātauranga Māori, mātauranga Raukawa approach to the restoration work is important.
- Reconnection and protecting the relationship with the Waikato and Waipā rivers, both physically and spiritually, also needs to restore and enhance the tikanga and kawa of Raukawa.
- Reconnecting with the awa includes utilising it for recreational purposes, like swimming.
- Mahinga kai practices, which plays a significant role in the Raukawa relationship with the awa, has diminished as a result of the condition of the awa, therefore the state of the awa needs to be addressed for these practices to flourish again.
- To ensure that, education programmes need to incorporate mātauranga Raukawa.
- This mahi is long term and needs to be driven by rangatahi with the support of kaumātua.

FUNDING PRIORITIES

Based on the key findings there are two distinct priorities areas. These are:

I. <u>Raukawa relationship</u> – this funding priority centres on maintaining and enhancing the relationship of Raukawa uri, whanau with the Waikato River.
II. <u>Education/mātauranga</u> – central to this priority is the capacity building of Raukawa uri in western and cultural knowledge.

FUNDING PRIORTY ONE: RELATIONSHIP

The objective for funding priority one is the enhancement and restoration of the relationship between Raukawa uri, whanau, marae, hapū, iwi and the Waikato and Waipā river catchments.

POTENTIAL PROJECTS AREAS

In the table below, there are a selection of projects that are considered to contribute to achieving the above objective. This is not a definitive list of potential projects, but is intended to act as guidance to potential persons or organisations seeking funding or making funding decisions in the above priority area.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Mahinga kai restoration	<u>Tuna restoration:</u> The restoration of tuna stocks within the catchment. The objective could include increasing tuna habitats within the Raukawa takiwā and would need to include wānanga on traditional methods of gathering and preparing tuna. <u>Watercress restoration:</u> Raukawa uri are able to harvest watercress from their traditional and/or hydroponic sites. <u>Koura restoration:</u> Investigate why koura populations have decreased in areas. Establishing fenced riparian margins in areas which support healthy koura populations and monitor koura.
Reconnection to ngā awa o Raukawa	Restoring the relationship between Raukawa marae/hapū with the various awa that surround marae, this could include disability access ways from marae to awa; enhancing and restoring the mauri by riparian planting and fencing; and the restoration of traditional swimming holes.
Raukawa waka hauora	The creation of a Raukawa waka hauora programme. It could include a wānanga programme that utilises the healing qualities of the Waikato River to aid the health and wellbeing of the Raukawa uri utilising Raukawa tikanga and kawa.
Raukawa marae waka ama	Raukawa to assert their mana whakahaere along the awa through waka ama. Raukawa iwi/marae/hapū to regularly use the awa for recreational purposes and allowing uri to gain an understanding of the importance of the awa to the iwi.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Raukawa kaitiaki enhancement	Raukawa marae/hapū become more effective kaitiaki as guardians, educators and nurturers of life. This could include the creation of nurseries to enable marae to undertake riparian planting while creating a whakapapa for plants to whakahono marae to the awa, along with ensuring that Raukawa Kaitiaki are trained to carry out these activities, which would include putting kaitiaki through the New Zealand Certificate in Conservation.
Raukawa historical site visualisation	Raukawa historical site visualisation will provide cultural assets that may be displayed and kept in a Raukawa Taonga room and/or for inclusion on a future website. The project will help facilitate a connection to the history and land for the people. It will provide visual narratives of sites along the Waikato River as they would have appeared historically. This will be achieved through the use of latest computer technologies available, including 3D modelling.
Raukawa reconnection with Ngā Wāhi Tūturu	Restoring the relationship between Raukawa marae/hapū with the various historical sites of significance within the catchment. The project would see improved access to sites throughout the takiwa, and ensure the cultural integrity of the sites are restored and protected (where appropriate). This may be achieved through legacy planting, site identification, or whare korero.

FUNDING PRIORITY TWO: MĀTAURANGA RAUKAWA AND KNOWLEDGE

The objective of funding priority two is the enhancement and restoration of mātauranga Raukawa, knowledge and its application. For this purpose of this priority, mātauranga Raukawa is defined in Te Rautaki Taiao and is set out below. Knowledge is defined as all other sources of information.

Mātauranga Raukawa

Mātauranga is ancestral and traditional information and knowledge that has been developed through the centuries and generations. Mātauranga Māori is a term that describes the body of knowledge originating from ancestors, including the Māori worldview and perspectives, Māori creativity and cultural practices. Mātauranga Māori embraces individual, local, and collective knowledge, Māori values, cultural expressions, perspectives, observations, being traditional, historical, and contemporary.

For Raukawa, mātauranga Raukawa would include:

- practical common sense, based on teachings and experience passed on from generation to generation
- knowledge of the whenua, covering knowledge of the environment and the relationship between things
- a holistic perspective. It cannot be compartmentalised and cannot be separated from the people who hold it. It is rooted in the spiritual health, culture and language of the people. It is a way of life
- an authority system. It sets out the rules governing the use of resources; respect; an obligation to share. It is dynamic, cumulative and stable
- a way of life. Wisdom is using knowledge in good ways. It is using the heart and the head together. It comes from the spirit in order to survive; and gives credibility to people.

POTENTIAL PROJECTS AREAS

Below is a selection of potential project areas that are considered to achieve or contribute to the achievement of the above objectives. The following are not a definitive list of potential projects, but are meant to act as a guide to potential persons or organisations seeking funding or making funding decisions in the above areas.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Mātauranga Raukawa restoration	A series of wānanga held annually throughout the year. Each wānanga will focus on certain aspects of mātauranga Māori.
Mātauranga Raukawa; Matea ako o Raukawa Kaitiaki Raukawa Education; the Learning Needs of Raukawa Kaitiaki	Developing a new approach to education that embodies the unique place of the awa in Raukawa cultural identity. This approach would also need to recognise the opportunities for new knowledge to be created through collaboration for our awa, our iwi, our people. A multi-year programme will see the establishment of an education programme that will see mātauranga Raukawa and the latest scientific technology applied to deliver the programme.
He Tira Hoe O Nga Iwi O Te Awa O Waikato	Iwi waka on a tira hoe along the awa, beginning at the source and travelling along its length to Te Pūaha. The tira hoe will provide the opportunity for iwi to exercise and share their mana whakahaere, mātauranga, korero. This could be a biannual event.
Mātauranga Raukawa pukapuka	Investigates the creation of a mātauranga Raukawa pukapuka. The pukapuka could share and record mātauranga Raukawa to ensure this knowledge is retained for future generations.
Marae monitoring station	Marae monitoring stations to assist marae/hapū to become more effective kaitiaki by giving marae the tools and knowledge to monitor the condition of their awa. This will include the development and testing of CHIs for the Raukawa areas of interest in the Waikato River catchment.
Mobile monitoring station	An extension of the marae monitoring programme will see a more advanced marae monitoring station established. The station will utilise the latest scientific methods and cultural indicators to monitor the health and wellbeing of the Waikato and Waipā rivers.

DECISION MAKING

There are a number of considerations that need to be taken into account when considering priorities for delivering on the Raukawa priorities. The overarching consideration is whether a project contributes to the restoration and protection of the health and wellbeing of the Waikato and Waipā rivers as required under Te Ture Whaimana.

For Raukawa, it is sought that the essence of the Ngā Mana O Ngā Atua model as well as the Raukawa values and principles must be given effect, and any funding decisions within the Raukawa takiwa must be consistent with these if they are to deliver on the Raukawa priorities. Both of these elements are outlined below.

Ngā Mana o Ngā Atua[4]

Ngā Mana O Ngā Atua model is the framework which guides contemporary Raukawa environmental and resource management. Mana (prestige, integrity) is attributed in the Raukawa view within three spheres – Ngā Mana O Ngā Atua, Ngā Mana o Te Whenua and Ngā Mana o Ngā Tangata.

Ngā Mana o Ngā Atua is bestowed from the gods or spiritual realm with *Ngā Mana o te Whenua* coming from the earth or Papa-tū-ā-nuku, the earthly realm. *Ngā Mana o Ngā Tāngata* comes from belonging to an extended family. In this way, the people of Raukawa understand that all realms of the spiritual, the land and the people are inherently interconnected. For example, the whenua, or afterbirth of a baby is buried in

4 Refer to section 1.5 of Te Rautaki Taiao.

ancestral land and thus brings the circle to a close – it closes the connection between the giving or birth of life and the connection between the land and the spiritual domains of life.

As individuals, we as Raukawa identify through the realms of the mana bestowed by the atua, or spiritual realm, the land of our tūpuna/ancestors, its life giving mana; and through our extended whānau/ hapū/iwi, or tangata. Raukawa do not identify ourselves as isolated individuals. We identify with our communities that encompass both living members and ancestors who have passed away.

Raukawa values and principles

Te Rautaki Taiao discusses in detail the values and principles of Raukawa and where these originated.[5] For Raukawa, the land and landforms remind us of our histories, genealogies, and ultimately of Papa-tū-ā-nuku. How we should operate with and use our environment remains firmly within our histories, geographies, and cosmologies.

The values and tikanga that govern our relationship with the natural world are applicable in today's context and can provide a roadmap for the iwi moving into the future. These values and tikanga assist us in defining and/or regulating acceptable or unacceptable behaviour in relation to the use and management of the environment. These values and tikanga can also provide opportunities and potential for the growth and prosperity of the iwi and the community moving forward.

These tikanga and oral forms of communication will continue to be significant and will influence how Raukawa moves forward in the environment through restoration, and incorporating the values and tikanga into the decision-making of whānau, hapū and iwi.

The values and tikanga remain unchanged. They are as relevant in the modern world as they were in the times of our ancestors. They are the foundations for the principles of operation for resource management today. These principles are highly interdependent and interconnected, and reflect the inextricability of people from the environment and from the spiritual realm.

These values and principles, as guided and informed by our worldview, influence and impact on all decisions pertaining to environmental and resource management issues. They guide us in how we conduct ourselves and our long term aspirations. They remind us to consider the environment and our footprint on it at all times.

These key values and principles are:

- *mātauranga Raukawa*.
- *whenua*, *mana whenua* and *tangata whenua.*
- *tikanga*.
- *whakapapa*.
- *whanaungatanga*.
- *rangatiratanga*.
- *kaitiakitanga*.
- *Manaakitanga*
- *ūkaipō*
- *pūkenga.*
- *kotahitanga.*

The background outlined above illustrates how Raukawa makes decisions in respect of its guardianship role over the environment. These values and principles provide guidance and essential considerations that are

5 Refer to section 1.6.

taken into account when considering the use and management of the many ecosystems which make up the environment.

It is expected that projects will recognise and give effect to Raukawa values and principles. It is also expected that projects will address the following:

1. How will the proposed activity/project contribute to the vision and objectives of Te Ture Whaimana. That is, how will the activity/project contribute to the restoration and protection of the health and wellbeing of the Waikato and Waipā rivers.
2. How the proposed activity/project contributes to the integrated restoration and management of the Waikato and Waipā river catchments. This reflects the interconnected and integrated approach required under Ngā Mana o Ngā Atua.
3. Is the proposed activity consistent with the values and principles of Raukawa? Discussion with Pūtake Taiao at Raukawa Charitable Trust is strongly encouraged.

FUNDING CONSIDERATIONS

The funding considerations below are intended to assist funding and project providers with the information that should be addressed if they are looking to assist in delivery of Raukawa priorities. The considerations should be applied to both funding priority one 'relationships' and funding priority two 'mātauranga Raukawa and knowledge'.

Objective

To ensure that all applications and funding decisions recognise and provide for the Raukawa values and principles.

Criteria

There are three criteria that are seen as essential by Raukawa to be met through applications for proposed funding. These are:

1. discussions by the applicant with Raukawa Charitable Trust over the proposed activity/project
2. recognition of and provision for mātauranga Māori
3. that the effects from the proposed activity/project do not adversely affect or destroy a site of cultural significance.

Where relevant, the following considerations will need to be achieved in any application proposing to deliver on Raukawa priorities:

1. To ensure water quality is maintained and enhanced as a result of the proposed activity.
2. Seek to enhance existing access to cultural sites of significance and kai gathering places.
3. Provide access to sites where there is currently no access; where appropriate, an activity should provide access.
4. Provide the ability for Raukawa to carry out its cultural practices as appropriate.
5. Recognises and provides for Raukawa ability to exercise its mana whakahaere.
6. Provide, where possible, the opportunity for Raukawa to have ongoing involvement with the proposed activity. For example, Raukawa marae could assist in the monitoring of water quality.
7. The restoration and enhancement of existing ecosystems occurs.
8. Where the activity is adjacent to a waterbody, riparian planting is undertaken where required.
9. Where possible, provide educational opportunities on mātauranga Māori and Raukawa tikanga and kawa.
10. Assist with the restoration of sites used traditionally for certain purposes, where appropriate. For example, the restoration of traditional waterholes.

11. Provides training opportunities for marae and hapū to develop capacity in a number of different areas, including but not limited to project management, funding applications and resource management.
12. Actively provides educational opportunities for Raukawa through schooling and tertiary education.

Outcomes

Raukawa seeks the following outcomes.

- That all parties have an inherent understanding of the mauri of the Waikato River.
- Raukawa uri are regularly accessing and using the awa and its resources for recreational and cultural purposes.
- All Raukawa uri are knowledgeable of the traditional practices of tūpuna and are able to apply these practices in a contemporary setting.
- Raukawa uri are able to enjoy the awa in a manner that fits their cultural memory.
- Raukawa values and principals are known, upheld and expressed.
- Raukawa uri are able to practise their tikanga and kawa and maintain their mana whakahaere.
- Raukawa uri are knowledgeable on western science and are able to apply it to the restoration of the awa in conjunction with mātauranga Raukawa.
- Raukawa is involved in decision making in their areas of interest and association.

APPENDIX 11 - Te Arawa River Iwi Project Assessments

Contents

NKNT & TNW 1 Ngāti Kearoa-Ngāti Tuarā Priority: High	Ngāti Kearoa-Ngāti Tuarā kōura and tuna restoration
Project summary	This project was rated a high priority by Ngāti Kearoa-Ngāti Tuarā at the wānanga held to identify restoration priorities. Traditionally, the Ngāti Kearoa-Ngāti Tuarā area was abundant with mahinga kai, including tuna and kōura. This project will restore and enhance tuna and kōura access within the Ngāti Kearoa-Ngāti Tuarā rohe.
Vision	Kōura and tuna are abundant, healthy and available for customary use.
Location	The project is located on a Māori owned farm site known to Ngāti Kearoa-Ngāti Tuarā Trust, adjacent to a Waikato River tributary within the Ngāti Kearoa-Ngāti Tuarā rohe.
Brief description of site	 This project is significant as historically the waterways of Ngāti Kearoa-Ngāti Tuarā were full of eels and kōura, and water birds abounded. The bush was also full of birds and, at that time, the people lived well due to the plentiful resources. Ngāti Kearoa-Ngāti Tuarā customary taonga fish species include tuna (longfin eel), kōura, kōaro, kōkopu and morihana. These species are no longer as abundant as they previously were. This project aligns with the TARIT Fisheries Portfolio Accord 2010 which outlines aspirations to restore these important taonga (tuna and kōura) fisheries species.
Key threats/impacts	Loss of mātauranga Māori/traditional knowledge of taonga species. Disconnection from customary fishing practices and knowledge. Fish stocks have declined significantly as a result of barriers (e.g. hydro dams, culverts), degraded water quality and habitat loss. Aquatic pests (animals and plants) having an adverse impact on taonga fish species. Access to waterways.
Project goal/s (SMART)	Within 3 years of the project commencing, kōura and tuna ponds are constructed on the site. Within 5 years of the project commencing, tuna and kōura are being utilised by Ngāti Kearoa-Ngāti Tuarā for customary purposes.

Project actions/works required	Works could be implemented at Ngāti Kearoa-Ngāti Tuarā or Te Arawa River Iwi Trust level. Co-funding contributions from other interested partners to assist Ngāti Kearoa-Ngāti Tuarā or TARIT with completing this project would be welcomed. **Project plan ($20,000)** Develop detailed project and construction plan for tuna ponds, and obtain any consents as necessary. **Construct tuna and kōura ponds ($97,211)** Complete earthworks ($23,600). Riparian planting around pond (1 hectare at $44,881). Fencing 800m at $20 per metre ($16,000). Add wood or punga structure for kōura habitat enhancement (kōura food and shelter) ($5000). **Transfer of tuna and kōura ($10,000)** Obtain transfer authorisation as necessary (ie Upper River Fisheries Regulations). This would require engagement with upper river iwi and Ministry for Primary Industries. Complete transfers. **Capacity building ($21,000)** Whakarite ceremonies including koha for kaumatua and kuia ($6000). 10 tuna and kōura wananga at $1500 ($15,000) **Project management/staffing/incidentals (26%)** Manage the project; engage with Ngāti Kearoa-Ngāti Tuarā/TARIT; landowner liaison to access site; engage with experts to construct ponds; engage with nurseries and planting crews; provide monitoring and milestone reports over a 4 year period.
Risks to project success	Failure to gain consent for translocations
Land tenure – likelihood of adoption and adoption circumstances	Owned by the iwi. Very high likelihood of adoption.
Knowledge gaps and response	Final design of ponds is still to be confirmed
Project duration (years)	4 years

Costs	

Work description	Cost ($)
Project plan	20,000
Construct tuna and kōura ponds (earthworks)	23,600
Fencing 800m x $20 per metre	23,730
Planting around pond (1 hectare)	44,881
Install wood structure	5000
Transfer of tuna/kōura	10,000
Capacity building (tuna and kōura wānanga)	21,000
Project management/staffing/incidentals (26%)	39,485
Total	**187,696**

NKNT & TNW 2 Ngāti Kearoa-Ngāti Tuarā Priority: High	Ngāti Kearoa-Ngāti Tuarā watercress restoration
Project summary	This project was identified as a high priority by Ngāti Kearoa-Ngāti Tuarā. It would see an important traditional kai restored at up to 20 traditional watercress sites around the marae and papakainga in the Ngāti Kearoa-Ngāti Tuarā rohe.
Vision	Whanau are able to harvest watercress from their traditional and/or hydroponic sites and continue the cultural practices of transferring intergenerational knowledge whilst re-establishing their relationship with their tupuna awa.
Location	The project is located within the Ngāti Kearoa-Ngāti Tuarā rohe in the Waikato River catchment.
Brief description of site	 Up to 20 sites will be selected and restored as determined by Ngāti Kearoa-Ngāti Tuarā.
Key threats/impacts	Loss of Ngāti Kearoa-Ngāti Tuarā mahinga kai knowledge and ability to transfer that knowledge.
Project goal/s (SMART)	Within 2 years, watercress is flourishing in up to 20 project sites within the rohe of Ngāti Kearoa-Ngāti Tuarā.
Works required (quantity and description)	Works could be implemented at iwi, hapū, marae or whānau level. This project could be undertaken as a whole, or in components. **Watercress restoration ($100,000)** 20 sites at $5000 per site = $100,000. Includes project management of 25% ($20,000). Project manager to carry out landowner liaison, provide reporting information, negotiate agreements, inspect works and pick up and seed watercress. Includes purchase, transport and installation of seedstock (watercress) into 20 sites identified by Ngāti Kearoa-Ngāti Tuarā ($80,000). Watercress could be purchased from hydrophonic suppliers for reinstallation into the wild (in protected areas).

Risks to project success	Ensuring sites are protected from cattle or other browsing animals. Flooding of identified mahinga kai areas.
Land tenure – likelihood of adoption and adoption circumstances	Predominantly owned by the iwi. Very high likelihood of adoption.
Knowledge gaps and response	Unknown why there has been a decline of watercress from traditional sites.
Project duration (years)	2 years
Costs	

Work description	**Cost ($)**
Watercress restoration	80,000
Project management/staffing/incidentals (25%)	20,000
Total	**100,000**

NKNT & TNW 3 **Ngāti Kearoa-Ngāti Tuarā** **Priority: High**	**Sharing our story – The Ngāti Kearoa and Ngāti Tuarā/Tarit River iPou project**
Project summary	This project was identified as a high priority by Ngāti Kearoa and Ngāti Tuarā. It provides a means of sharing our knowledge, connection and relationship with the Waikato River and its tributaries, which otherwise could be lost. The project will create a physical network of interactive pou connected to a contextualised database that delivers cultural, historical, spiritual and ecological layers to smart phones and devices, leveraging new developments in apps and content delivery experiences.
Vision	Information/kōrero regarding the restoration and protection of the health and wellbeing of the awa, and the significant connection and mātauranga Māori of Ngāti Kearoa and Ngāti Tuarā with the Waikato River and its tributaries, is available and shared through the use of iPou. This contributes to the ongoing connection of Ngāti Kearoa and Ngāti Tuarā with the awa, whilst also providing an educational and informative cultural experience for all.
Location	The project location is the Waikato River and its tributaries within the Ngāti Kearoa and Ngāti Tuarā rohe.
Brief description of the site	The specific iPou sites will be determined by Ngāti Kearoa and Ngāti Tuarā at locations along the Waikato River and its tributaries within the Ngāti Kearoa and Ngāti Tuarā rohe. Up to 20 sites may be selected due to historical, cultural, spiritual or ecological significance, as determined by Ngāti Kearoa and Ngāti Tuarā. 
Key threats/issues	Loss of Ngāti Kearoa and Ngāti Tuarā knowledge and connection with the Waikato River and its tributaries.
Project goal/s (SMART)	Within 3 years of the project commencing, up to 20 iPou will be

	standing along the Waikato River within the rohe of Ngāti Kearoa and Ngāti Tuarā.
Project actions/works required	Works could be implemented at Ngāti Kearoa and Ngāti Tuarā or Te Arawa River Iwi Trust level. Co-funding contributions from other interested partners to assist Ngāti Kearoa and Ngāti Tuarā or TARIT with completing this project would be welcomed. **Collate information for iPou ($20,000)** Collate information for the sites identified by Ngāti Kearoa and Ngāti Tuarā/TARIT Assume: - $1000 per site to undertake this task. **Fabricate and install up to 20 iPou onto the designated river/tributary sites ($200,000)** Engage experienced Māori arts and crafts expert to fabricate and install iPou (e.g. carved pou, or kohatu). Assume: - $10,000 per iPou (fabrication and installation costs) per site = $200,000. **Technology/information loaded and installed into iPou ($40,000)** Engage iPou developer to install information collated through interviews and literature review into the fabricated pou. Upload/install the technology. Assume: - $2000 per pou = $40,000 **Cultural safety ($10,000)** Assume: - Whakarite ceremonies/cultural advisors/tohunga to ensure cultural safety of the project. **Hui costs ($7000)** Assume: - Initial hui with Ngāti Kearoa and Ngāti Tuarā/TARIT to introduce project ($500 venue/kai). - Reporting back hui (x3) with Ngāti Kearoa and Ngāti Tuarā/TARIT regarding project progress ($1500 venue/kai). - Unveiling celebration for the iPou ($5000) **Project management/staffing/incidentals (25%)** Manage the project; engage with Ngāti Kearoa and Ngāti Tuarā/TARIT to identify sites of significance; landowner liaison; negotiate agreements and engage with iPou developer and iPou fabricator; inspect completed works; organise hui to unveil iPou – catering, venue; provide monitoring and milestone reports over a 3 year period.

<table>
<tr><td>Risks to project success</td><td>- Access to sites.

- Access to knowledge.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Predominantly owned by the iwi. Very high likelihood of adoption.</td></tr>
<tr><td>Knowledge gaps and response</td><td>Permit requirements for iPou installation.</td></tr>
<tr><td>Project duration (years)</td><td>3 years</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Collate information for iPou</td><td>20,000</td></tr>
<tr><td>Fabricate and install up to 20 iPou onto the designated river/tributary sites</td><td>200,000</td></tr>
<tr><td>Technology/information loaded and installed into iPou</td><td>40,000</td></tr>
<tr><td>Cultural safety costs</td><td>10,000</td></tr>
<tr><td>Hui costs</td><td>$7000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>83,100</td></tr>
<tr><td>Total</td><td>360,100</td></tr>
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</td></tr>
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NKNT & TNW 4 Ngāti Kearoa-Ngāti Tuarā Priority: Very high	Identification and protection of Ngāti Kearoa and Ngāti Tuarā sites of significance project.
Project summary	This project was identified as a very high priority by Ngāti Kearoa and Ngāti Tuarā because it is very important to collate, map, record their traditional knowledge and data before it is lost forever. The project will build the capacity of Ngāti Kearoa and Ngāti Tuarā through recording important historical information relating to important sites of significance along the Waikato River and its tributaries within the Ngāti Kearoa and Ngāti Tuarā rohe. It will include a series of interviews, maps, photographs, literature review and wānanga. This will enable Ngāti Kearoa and Ngāti Tuarā to reconnect with the awa and their tribal history and customs, utlilising this information to inform future restoration and activities.
Vision	Ngāti Kearoa and Ngāti Tuarā can utilise a wāhi tapu register which has all significant wāhi tupuna/tapu sites clearly identified, mapped, recorded, and as a result the sites are now being accessed. Historic river korero is available which has enabled iwi to become more effective kaitiaki by learning cultural knowledge associated with the tributaries in the Waikato River within the rohe of Ngāti Kearoa and Ngāti Tuarā.
Location	The project location is Area B of the Waikato River and its tributaries within the Ngāti Kearoa and Ngāti Tuarā rohe. The principal waterway is the Pokaitu Stream, just north of Pōhaturoa.
Brief description of site	 The traditional rohe of Ngāti Kearoa-Ngāti Tuarā falls partly within the Waikato River catchment. Within that catchment, the relevant land blocks over which Ngāti Kearoa-Ngāti Tuarā hold traditional interests include Patetere South, Tikorangi and Horohoro, and part of the Tokoroa Block eastward of a line from the western tip of the Patetere South Block to Te Uraura on the boundary of the Tokoroa and Whakamaru Maungaiti blocks. The lands at Horohoro and Patetere South have been continuously occupied by Ngāti Kearoa and Ngāti Tuarā for generations. Their principal waterway is the Pokaitū Stream just north of Pōhaturoa.

	This project is significant as these waterways and traditional lands are inextricably linked to and contribute to the very life of the mighty Waikato River. In their original state the catchments were covered in pristine native forests, swamp lands, undulating hills of aruhe (fern) and rolling to easy fertile flats.
Key threats/impacts	Loss of traditional knowledge. Sites of significance infested with weeds. Loss of connection with the sites and the river. Unintended risks to sites of significance as locations are unknown.
Project goal/s (SMART)	- Within 3 years of the project commencing, the Ngāti Kearoa-Ngāti Tuarā wāhi tapu register is completed. - Within 2 years of the project commencing, the kaumatua/kuia interviews have been completed and filmed. - Within 3 years of the project commencing, sites of significance are being utilised and accessed by Ngāti Kearoa-Ngāti Tuarā. - Within 3 years of the project commencing, the capacity of Ngāti Kearoa-Ngāti Tuarā has been developed in terms of sites of significance/GIS mapping knowledge.
Project actions/works required	Works could be implemented at Ngāti Kearoa-Ngāti Tuarā or Te Arawa River Iwi Trust level. Co-funding contributions from other interested partners to assist Ngāti Kearoa-Ngāti Tuarā or TARIT with completing this project would be welcomed. **Cultural safety ($7000)** Cultural practices are applied and adhered to, to ensure cultural safety of this project. Assume: - Initial hui with Ngāti Kearoa-Ngāti Tuarā/TARIT to introduce project ($500 venue/kai). - Reporting back hui (x3) with Ngāti Kearoa-Ngāti Tuarā/TARIT regarding project progress ($1500 venue/kai). - Final hui to unveil wāhi tapu register and present kaumatua/kuia interviews ($5000). **Interviews and literature review ($32,000)** Interview knowledge holders ie kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: - 8 kaumatua/kuia interviews at $500 per interview = $4000 - Film and editing of interviews at $800 per day x 2 weeks (14 days) = $11,200 - Interviewer/literature reviewer at $800 per day x 3 weeks (21 days) = $16,800 **Mapping and photographing wāhi tapu sites ($37,600)** Access site/s, map and photograph all significant and wāhi tupuna/tapu sites. Enter information into digital database and maps.

	Assume: - Access and photograph sites at $800 per day x 1 week (7 days) = $5600. - GIS mapping services at $200 per hour to input maps and develop register x 20 days = $32,000. **Restoration/clearance of sites of significance ($7000)** Some of the known sites of significance areas need to be cleared of scrub and weeds to allow access. Assume: - Contractor costs to clear weeds from known sites of significance at $700 per day x 10 days. **Capacity building ($25,000)** Hold GIS mapping wānanga with Ngāti Kearoa-Ngāti Tuarā whanau at $5000. Identify (x2) Ngāti Kearoa-Ngāti Tuarā taiohi (youth) to undertake further study to formally upskill in GIS/cultural mapping, wāhi tapu/historical or related studies as determined by Ngāti Kearoa-Ngāti Tuarā at $10,000 scholarship per taiohi/student = $20,000. **Project management/staffing/incidentals (20%)** Manage the project; engage with Ngāti Kearoa-Ngāti Tuarā/TARIT to identify sites of significance and identify key knowledge holders; landowner liaison to access sites; engage with 8 kaumatua/kuia to organise interviews; identify Ngāti Kearoa-Ngāti Tuarā students to upskill in GIS; organise ongoing progress update hui with Ngāti Kearoa-Ngāti Tuarā; organise contractors as appropriate to clear sites of significance; provide monitoring and milestone reports over a 3 year period.
Risks to project success	Land access. Access to information may take longer than anticipated.
Land tenure – likelihood of adoption and adoption circumstances	Mixed ownership. Sites could be located on iwi, private and/or public lands.
Knowledge gaps and response	Actual number of sites of significance yet to be confirmed. Project has to allow for flexibility.
Project duration (years)	3 years
Costs	

Work description	Cost ($)
Hui costs	7000
Knowledge holder interviews	32,000
Mapping and photography of sites	37,600
Restoration/clearance to enable access to sites of significance	7000
Capacity building	25,000

	Project management/staffing/incidentals (20%)	27,150
	Total	**135,750**

NKNT & TNW 5 **Priority: Very high**	**Te Arawa river iwi champions**
Project summary	This project would be shared between the affiliates of Te Arawa river iwi by celebrating and acknowledging river champions (iwi members who have achieved great things on the ground – planting projects, protecting taonga species, creating enhancement opportunities or education of whanau, etc). The celebration would grow awareness about inspirational work that is happening with the awa and inspire future river iwi champions. This project will fund an annual iwi river champions awards dinner to be held at a venue nominated by the affiliates of Te Arawa river iwi, with carved tohu to be awarded to 4 successful river champions.
Vision	Greater awareness of inspiring successful river iwi champions and their mahi on, in and around the river. The next generation of river champions are inspired to achieve even greater things.
Location	This project is located within the Waikato River catchment and tributaries within the Te Arawa river iwi rohe.
Brief description of site	N/A
Key threats/issues	Lack of awareness. Lack of inspiration. No new talent interested in becoming involved with river restoration.
Project goal/s (SMART)	Within 10 years, 10 river iwi champion dinners have been held. Within 10 years, new river champions have been inspired. Within 10 years, the profile of river iwi and success stories regarding the restoration of the tupuna awa are high.
Works required	Works could be implemented by iwi, hapū, marae, whanau or in partnership with Te Arawa River Iwi Trust. Co-funding contributions from other interested partners to complete this project would be welcomed. **Te Arawa river champions awards dinner ($80,000)** $8000 per dinner per year x 10 years = $80,000. **Tohu for Te Arawa river iwi champions ($32,000)** 4 x carved paddle per year at $800 per paddle = $3200 x 10 years = $32,000 **Project management/staffing/incidentals (25%)** Project manager would coordinate dinner with appropriate venue, organise call for nominations, create a small selection committee to consider/review the nominations and select the winners based winning criteria, coordinate with carvers to create paddles/tohu. 25% of overall costs = $2800 per year to coordinate.

<table>
<tr><td>Risks to project success</td><td>In the early years of project, building momentum for nominations if there are to be 4 different winners each year.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>N/A</td></tr>
<tr><td>Knowledge gaps and response</td><td>Award categories and criteria have not yet been established and this would be done in the early stages of project planning.</td></tr>
<tr><td>Project duration (years)</td><td>10</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Awards dinner</td><td>$80,000</td></tr>
<tr><td>Tohu for winners</td><td>$32,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>$28,000</td></tr>
<tr><td>Total</td><td>140,000</td></tr>
</table>
</td></tr>
</table>

NKNT & TNW 6 Tuhourangi – Ngāti Wahiao Priority: Very high	Enabling Tuhourangi-Ngāti Wahiao to reconnect with the Waikato River
Project summary	This project is about Tuhourangi-Ngāti Wahiao reconnecting, re-establishing and reasserting their mana whakahaere along the Waikato River. The project will see Tuhourangi-Ngāti Wahiao reconnect by means of waka ama, and improving the health and wellbeing of whanau through exercise. The waka ama will also be utilised for wānanga along the river and further enhancing the cultural and spiritual relationship between Tuhourangi-Ngāti Wahiao and the Waikato River, whilst increasing mātauranga Māori.
Vision	Whanau are able to assert their mana whakahaere on the awa through waka ama. Whanau are able to restore their connection with the awa, and ensure future generations are able to form a lasting connection to the awa, and while doing so improve the hauora of Tuhourangi-Ngāti Wahiao. This will enable wānanga on the awa, visiting ngā wāhi tapu and offering an opportunity for intergenerational knowledge sharing at sites.
Location	The project location is the Waikato River and its tributaries within the Tuhourangi-Ngāti Wahiao rohe.
Brief description of site	
Key threats/issues	Loss of connection has led to a detachment of the whanau to the awa. Knowledge of significant sites along the Waikato River are lost to Tuhourangi-Ngāti Wahiao due to a lack of knowledge transfer.
Project goal/s (SMART)	- Marae to have access to waka ama by 2019. - Create safe lockable storage for waka by 2019. - Marae (and wider community) training to be initiated once waka have been purchased. - Tuhourangi-Ngāti Wahiao to have at least 10 affiliated waka ama members by 2020.

	- Hold ngā wāhi tapu wānanga along the entire length of the awa, utilising the waka as a means of transport by 2020.
Works required (quantity and description)	- Purchase of 4 (6 man) waka ama and associated equipment e.g.trailer - Purchase of 24 life jackets - Purchase of 24 paddles - Purchase of safety boat - Safety kits: flares, rope, etc - Create safe lockable storage for waka - Establishing training for marae - Establishing wānanga
Risks to project success	- Vandalising - Theft
Land tenure – likelihood of adoption and adoption circumstances	Crown or Māori owned land that is suitable to use for waka access to the Waikato River.
Knowledge gaps and response	Whether council would be willing to permit storage sheds on site.
Project duration (years)	Reviewed in 2025
Costs	(see table below)

Work description	**Cost ($)**
Waka ama x 4	68,000
Life jackets x 30 (mix of kids and adult sizes)	1800
Paddles x 30 (mix of kids and adult sizes)	3600
Safety boat	4600
Safety kits: flares, rope,	2000
Lockable storage shed	10,000
Wānanga and training costs x 1	15,000
Trailer	11,786
Total	**121,786**

NKNT & TNW 7 **Ngāti Kearoa-Ngāti Tuarā** **Priority: Very high**	**Enabling Ngāti Kearoa-Ngāti Tuarā to reconnect with the Waikato River**
Project summary	This project is about Ngāti Kearoa-Ngāti Tuarā reconnecting, re-establishing and reasserting their mana whakahaere along the Waikato River. The project will see Ngāti Kearoa-Ngāti Tuarā reconnect by means of waka ama, and improving the health and wellbeing of whanau through exercise. The waka ama will also be utilised for wānanga along the river, and further enhancing the cultural and spiritual relationship between Ngāti Kearoa-Ngāti Tuarā and the Waikato River, whilst increasing mātauranga Māori.
Vision	Whanau are able to assert their mana whakahaere on the awa through waka ama. Whanau are able to restore their connection with the awa, and ensure future generations are able to form a lasting connection to the awa, and while doing so improve the hauora of Ngāti Kearoa-Ngāti Tuarā. This will enable wānanga on the awa, visiting ngā wāhi tapu, and offer an opportunity for intergenerational knowledge sharing of these sites.
Location	The project location is the Waikato River and its tributaries within the Ngāti Kearoa-Ngāti Tuarā rohe.
Brief description of site	
Key threats/impacts	Loss of connection has led to a detachment of the whanau to the awa. Knowledge of significant sites along the Waikato River are lost to Ngāti Kearoa-Ngāti Tuarā due to a lack of knowledge transfer.
Project goal/s (SMART)	- Marae to have access to waka ama by 2019. - Create safe lockable storage for waka by 2019. - Marae (and wider community) training to be initiated once waka have been purchased.

	- Ngāti Kearoa-Ngāti Tuarā Marae to have at least 10 affiliated waka ama members by 2020. - Hold ngā wāhi tapu wānanga along the entire length of awa, utilising the waka as a means of transport by 2020.
Works required	- Purchase of 4 (6 man) waka ama and associated equipment eg. trailer - Purchase of 24 life jackets - Purchase of 24 paddles - Purchase of safety boat - Safety kits: flares, rope, etc - Create safe lockable storage for waka - Establishing training for marae - Establishing wānanga
Risks to project success	- Vandalising - Theft
Land tenure – likelihood of adoption and adoption circumstances	Crown or Māori owned land that is suitable to use for waka access to the Waikato River.
Knowledge gaps and response	Whether council would be willing to permit storage facilities on site.
Project duration (years)	Reviewed in 2025
Costs	

Work description	Cost ($)
Waka ama x 4	68,000
Life jackets x 30 (mix of kids and adult sizes)	1800
Paddles x 30 (mix of kids and adult sizes)	3600
Safety boat	4600
Safety kits: flares, rope,	2000
Lockable storage shed	10,000
Wānanga and training costs x 1	15,000
Trailer	11,786
Total	**121,786**

<table>
<tr><td>NKNT & TNW 8
Tuhourangi-Ngāti Wahiao

Priority: Very high</td><td>Kōrero taonga tuku iho</td></tr>
<tr><td>Project summary</td><td>This project was identified as a very high priority by Tuhourangi-Ngāti Wahiao because it is very important to collate, map, record their traditional knowledge and data before it is lost forever.
This project will build the capacity of Tuhourangi -Ngāti Wahiao through recording important historical information relating to important sites of significance along the Waikato River and its tributaries within the Tuhourangi-Ngāti Wahiao rohe. It will include a series of interviews, maps, photographs, literature review and wānanga. This will enable Tuhourangi-Ngāti Wahiao to reconnect with the awa and their tribal history and customs, utilising this information to inform future restoration and activities.</td></tr>
<tr><td>Vision</td><td>Tuhourangi-Ngāti Wahiao can utilise a wāhi tapu register which has all significant wāhi tupuna/tapu sites clearly recorded, and as a result the sites are now being accessed. Historic river korero is available, which has enabled the iwi to become more effective kaitiaki through learning cultural knowledge associated with the tributaries in the Waikato River within the rohe of Tuhourangi-Ngāti Wahiao.</td></tr>
<tr><td>Location</td><td>The project location is the Waikato River and its tributaries within the Tuhourangi-Ngāti Wahiao rohe.</td></tr>
<tr><td>Brief description of site</td><td>


The Tuhourangi-Ngāti Wahiao interests in the Waikato River commence upstream at the mouth of Akatarewa Stream downstream to the Ohakuri Road crossing, and includes part of the southwestern boundary of the former Rotomahana Parekarangi 6A Block.
This project is significant as these waterways and traditional lands are inextricably linked to and contribute to the life of the mighty Waikato River. In their original state, the catchments were covered in pristine native forests, swamp lands, undulating hills of aruhe (fern) and rolling</td></tr>
</table>

	to easy fertile flats.
Key threats/impacts	Loss of traditional knowledge. Sites of significance infested with weeds. Loss of connection with the sites and the river.
Project goal/s (SMART)	Within 3 years of the project commencing, the Tuhourangi-Ngāti Wahiao wāhi tapu register is completed. Within 2 years of the project commencing, the kaumatua/kuia interviews have been completed and filmed. Within 3 years of the project commencing, sites of significance are being utilised and accessed by Tuhourangi-Ngāti Wahiao. Within 3 years of the project commencing, the capacity of Tuhourangi-Ngāti Wahiao has been developed in terms of sites of significance/GIS mapping knowledge.
Project actions/works required	Works could be implemented at Tuhourangi-Ngāti Wahiao or Te Arawa River Iwi Trust level. Co-funding contributions from other interested partners to assist Tuhourangi-Ngāti Wahiao or TARIT with completing this project would be welcomed. **Cultural safety/hui costs ($7000)** Cultural practices are applied and adhered to, to ensure cultural safety of this project. Assume: - Initial hui with Tuhourangi-Ngāti Wahiao/TARIT to introduce project ($500 venue/kai). - Reporting back hui (x3) with Tuhourangi-Ngāti Wahiao/TARIT regarding project progress ($1500 venue/kai). - Final hui to unveil wāhi tapu register and present kaumatua/kuia interviews ($5000). **Interviews and literature review ($32,000)** Interview knowledge holders ie kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: - 8 kaumatua/kuia interviews at $500 per interview = $4000. - Film and editing of interviews at $800 per day x 2 weeks (14 days) = $11,200. - Interviewer/literature reviewer at $800 per day x 3 weeks (21 days) = $16,800. **Mapping and photographing wāhi tapu sites ($37,600)** Access site/s, map and photograph all significant and wāhi tupuna/tapu sites. Enter information into digital database and maps. Assume:

	- Access and photograph sites at $800 per day x 1 week (7 days) = $5600. - GIS mapping services at $200 per hour to input maps and develop register x 20 days = $32,000. **Restoration/clearance of sites of significance ($7000)** Some of the known sites of significance areas need to be cleared of scrub and weeds to allow access. Assume: - Contractor costs to clear weeds from known sites of significance at $700 per day x 10 days. **Capacity building ($25,000)** Hold GIS mapping wānanga with Tuhourangi-Ngāti Wahiao whanau at $5000. Identify (x2) Tuhourangi-Ngāti Wahiao taiohi (youth) to undertake further study to formally upskill in GIS/cultural mappin, wāhi tapu/historical or related studies as determined by Tuhourangi-Ngāti Wahiao at $10,000 scholarship per taiohi/student = $20,000. **Project management/staffing/incidentals (25%)** Manage the project; engage with Tuhourangi-Ngāti Wahiao /TARIT to identify sites of significance and identify key knowledge holders; landowner liaison to access sites; engage with 8 kaumatua/kuia to organise interviews; identify Tuhourangi-Ngāti Wahiao students to upskill in GIS; organise ongoing progress update hui with Tuhourangi-Ngāti Wahiao, organise contractors as appropriate to clear sites of significance; provide monitoring and milestone reports over a 3 year period.
Risks to project success	Land access. Access to information may take longer than anticipated.
Land tenure – likelihood of adoption and adoption circumstances	Mixed ownership. Sites could be located on iwi, private and/or public lands.
Knowledge gaps and response	Total number of sites and specific location are not yet known and costs have been based on judgement of those with local knowledge.
Project duration (years)	3 years

Costs

Work description	Cost ($)
Cultural safety/hui costs	7000
Knowledge holder interviews	32,000
Mapping and photography of sites	37,600
Restoration/clearance to enable access to sites of significance	7000
Capacity building	25,000
Project management/staffing/incidentals (25%)	27,150
Total	**135,750**

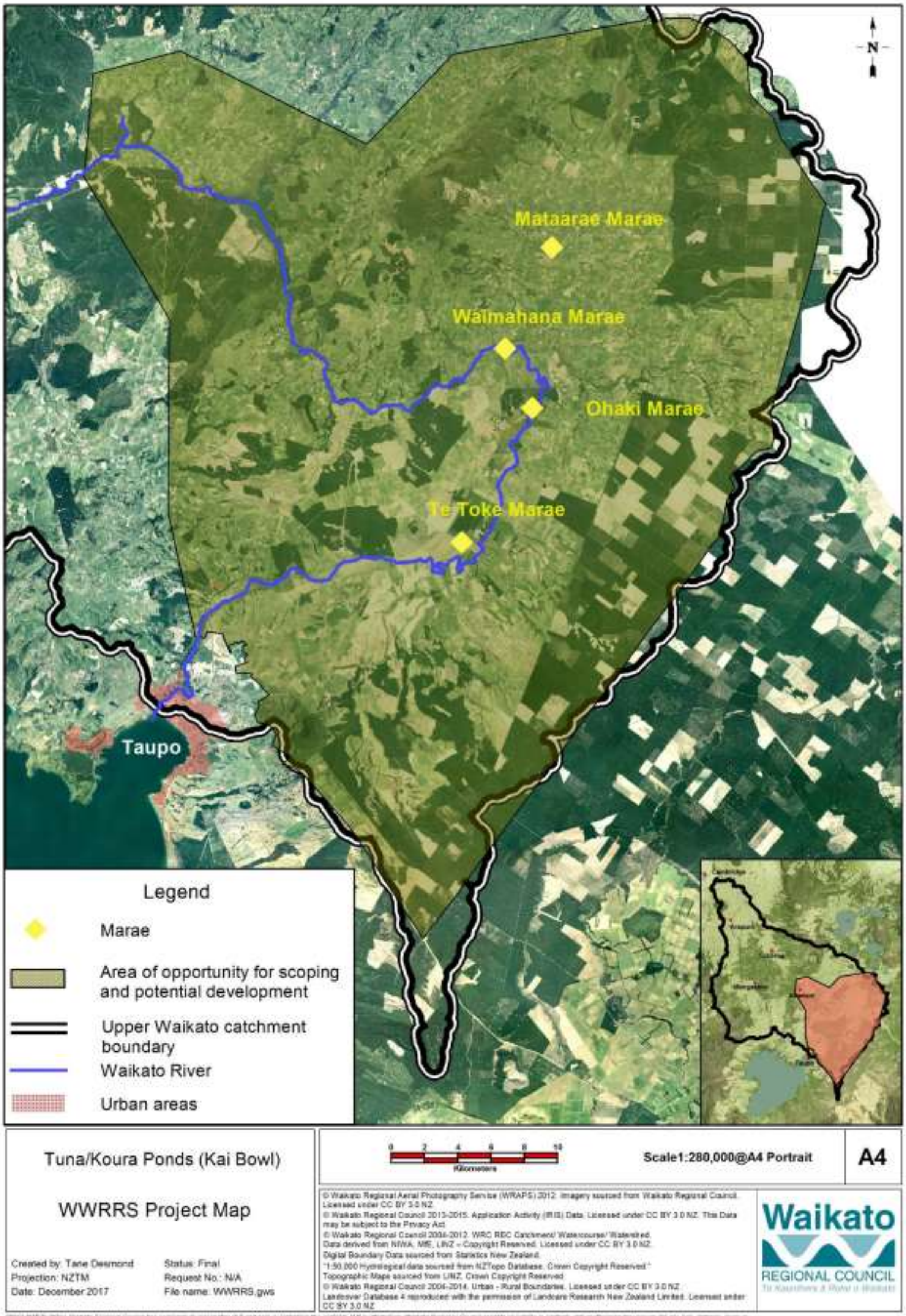
NTNW 1 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Investigation and construction of tuna/kōura ponds (kai bowl) for cultural harvest**
Vision	To be able to provide healthy and plentiful mahinga kai for the Ngati Tahu-Ngati Whaoa people, visitors and cultural events, tangi and other important occasions. Ngati Tahu-Ngati Whaoa consider this as part of their heritage and pride of the iwi. The ability of the Waikato River to sustain and provide for the Ngati Tahu-Ngati Whaoa people is integral to the iwi's wellbeing.
Location	Throughout Ngati Tahu-Ngati Whaoa rohe along and within Te Awa o Waikato catchment.
Brief description of site	Over 81 kilometres of the main stem of Te Awa o Waikato and approximately 2200 kilometres of tributaries fall in the Ngati Tahu-Ngati Whaoa rohe. Ngati Tahu-Ngati Whaoa's relationship with the river includes extensive use of the fisheries for sustenance of our people – both historically and in a contemporary sense. In response to concerns from iwi members about the state of our fisheries, the runanga undertook a comprehensive report on mahinga kai in the rohe during 2015. The report collated matauranga, explored historic fisheries, identified changes and issues and offered opportunities and strategies for Ngati Tahu-Ngati Whaoa to enhance mahinga kai in our rohe. A key finding in the report was that for the Waikato River (particularly the main stem) the challenges for mahinga kai and the river in general are large and will likely require long term solutions and significant resourcing. Te Ture o Whaimana is focused on achieving these long term changes. As part of this, Ngati Tahu-Ngati Whaoa continue to be involved in co-management of the river, and to use influence and input to help achieve improvements in this area. In the meantime, there were two key aspects in the recent report identified where there may be opportunities for some tangible gains to be made in relation to improvements in mahinga kai for the Ngati Tahu-Ngati Whaoa people. The first was to focus efforts on restoration and rehabilitation of the tributaries in the rohe. Ngati Tahu-Ngati Whaoa continue to do this through projects and participation in co-management for the river. The second finding focused on the potential to farm key freshwater kai species for cultural harvest purposes. The idea is to look at providing a kai bowl approach and investigate what may be possible over several species. The focus of this project is examining low cost initiatives

<table>
<tr><td></td><td>which enhance or only slightly modify the existing environment and require minimal input and maintenance.
There are some barriers to this approach and an initial scoping exercise will need to be undertaken to identify sites which have potential and provide the necessary attributes to ensure the success of pond implementation.</td></tr>
<tr><td>Key threats/issues</td><td><table>
<tr><th>Key threat</th><th>Impact on value/feature</th></tr>
<tr><td>Loss of kai species and abundance</td><td>Availability of healthy and abundant mahinga kai for Ngati Tahu-Ngati Whaoa people</td></tr>
<tr><td>Loss of access</td><td>Ability to harvest in some areas and practice kaitiakitanga</td></tr>
</table></td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 5 years, six off-river ponds provide a sustained source of healthy tuna, kōura and watercress for use by Ngati Tahu-Ngati Whaoa to achieve their vision in relation to mahinga kai. Off-river ponds provide a reliable source of mahinga kai to complement measures to improve the natural fishery in the Waikato River</td></tr>
<tr><td>Works required</td><td>Ngati Tahu-Ngati Whaoa would like to investigate the feasibility and requirements of “farming”/aquaculture of key mahinga kai species (tuna, kōura and watercress) as an alternative to, and to compliment, fishing within the main river and wider Waikato catchment. This development would be undertaken at one key site in the rohe once a suitable site is identified through investigations.

Two staged approach
1) Project scoping and feasibility
- Contractors with specialist consultant input to undertake scoping report, assess feasibility of sites and undertake site planning $25,000.

2) Implementation
- Development/construction of 6 ponds (5000m^2 x 2m deep) – $70,800
- Fencing of 6 ponds (minimum 5 wire – 2 electric) – $19,200.
- Planting of 6 ponds and associated maintenance $86,310.
- Resource consents 6 ponds $30,000.</td></tr>
<tr><td>Risks to project success</td><td>The approach proposed for this project substantially reduces the risk through thorough investigations of options and limitations to implementation in the scoping report. The highest risk to the overall project and implementation of stage two would be not finding a suitable site or if there are barriers to overcome, such as permitting, access to elvers or other requirements.</td></tr>
<tr><td>Land tenure</td><td>Scoping would identify suitable sites for implementation. Preference will be to implement the project on iwi land, however this may not be</td></tr>
</table>

<table>
<tr><td></td><td>possible given the potential requirements for implementation. Land tenure would not be known until stage one is complete</td></tr>
<tr><td>Knowledge gaps and response</td><td>There are existing knowledge gaps as to where potential ponds may be located. Mitigating factors in selecting a suitable site include avoiding geothermal discharges and securing a location in close proximity to a suitable water source. These gaps would be addressed in stage one during the scoping report.</td></tr>
<tr><td>Project duration</td><td>5 years (fully constructed and operating)</td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Scoping of options (stage one)</td><td>25,000</td></tr>
<tr><td>Stage two:</td><td>-</td></tr>
<tr><td>Earthworks – 6 ponds</td><td>70,800</td></tr>
<tr><td>Fencing – 6 ponds</td><td>19,200</td></tr>
<tr><td>Planting – 6 ponds</td><td>86,310</td></tr>
<tr><td>Resource consents – 6 ponds</td><td>30,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>46,262</td></tr>
<tr><td>Total</td><td>277,572</td></tr>
</table>
</td></tr>
</table>



N
Mataarae Marae
Waimahana Marae
Ohaki Marae
Te Toke Marae
Taupo
Legend
Marae
Area of opportunity for scoping and potential development
Upper Waikato catchment boundary
Waikato River
Urban areas
Tuna/Koura Ponds (Kai Bowl)
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 2 4 6 8 10
Kilometers
Scale1:280,000@A4 Portrait
A4
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Waikato
REGIONAL COUNCIL

Mahinga kai Wananga (Ngati Tahu-Ngati Whaoa Runanga Trust, 2017)

NTNW 2 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Restoration/rehabilitation of key mahinga kai sites**
Vision	To be able to provide healthy and plentiful mahinga kai for the Ngati Tahu-Ngati Whaoa people, visitors and for cultural events, tangi and other important occasions. Ngati Tahu-Ngati Whaoa consider this as part of their heritage and pride of the iwi. The ability of the Waikato River to sustain and provide for the Ngati Tahu-Ngati Whaoa people is integral to the iwi's wellbeing
Location	The following mahinga kai harvest sites/streams in the Ngati Tahu-Ngati Whaoa rohe: Mangahoanga, Mangakara, Kawaunui, Orakonui, Mangatoetoe, Pueto, Torepatutahi, Mangamingi and the mouths of all inflowing streams into Te Awa o Waikato.
Brief description of site	Over 81 kilometres of the main stem of Te Awa of Waikato and approximately 2200 kilometres of tributaries fall in the Ngati Tahu-Ngati Whaoa rohe. Ngati Tahu-Ngati Whaoa's relationship with the river includes extensive use of the fisheries for sustenance of our people – both historically and in a contemporary sense. Te Awa o Waikato and its catchment is a resource of great cultural, historical, traditional and spiritual significance to the people of Ngati Tahu-Ngati Whaoa. Our relationship with Te Awa o Waikato and its tributaries, and our respect for it, gives rise to our responsibilities to protect the river and all it encompasses, and to exercise our mana whakahaere in accordance with long established tikanga to ensure the wellbeing of the river. In response to concerns from iwi members about the state of our fisheries, the runanga undertook a comprehensive report on mahinga kai in our rohe during 2015. The report collated matauranga, explored historic fisheries, identified changes and issues and offered opportunities and strategies for Ngati Tahu-Ngati Whaoa to enhance mahinga kai in our rohe. A key finding in the report was that for the Waikato River (particularly the main stem), the challenges for mahinga kai and the river in general are large and will likely require long term solutions and significant resourcing. Te Ture o Whaimana is focused on achieving these long term changes. As part of this, Ngati Tahu-Ngati Whaoa continue to be involved in co-management of the river and to use influence and input to help achieve improvements in this area. In the meantime, there were two key aspects identified in the recent report where there are opportunities for some tangible gains to be made with mahinga kai for the Ngati Tahu-Ngati Whaoa people. The first was to focus efforts on restoration and rehabilitation in the

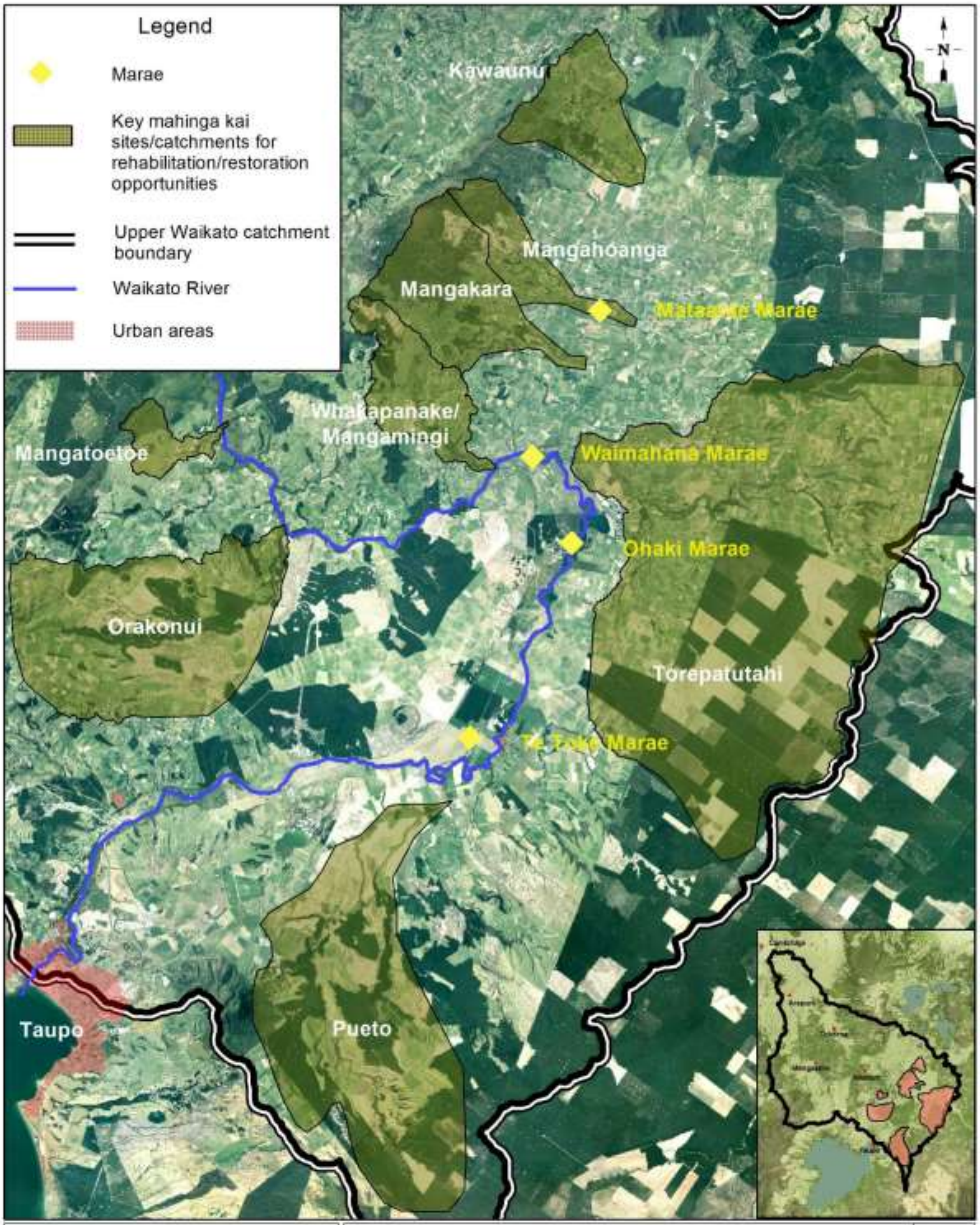
	tributaries in the rohe and the second was to farm mahinga kai in off-river ponds for cultural harvest. This project focuses on the opportunity to restore and rehabilitate historic fishery sites in the tributaries of Te Awa o Waikato in our rohe. Our iwi environmental plan, *Rising above the mist – Te Aranga ake i te taimahatanga*, also documents our long term goals in regard to improving mahinga kai in our rohe: - Kai sources restored, including opportunities for migration. - Stock excluded from all waterways in the rohe, and river and streambanks/lake edges restored with natives.
Key threats/issues	(see table below)
Project goal/s (SMART)	Within 2 years, the historic use of mahinga kai sites is documented and the current state of these wetland areas is known. Issues impacting on cultural values are identified. Within 20 years, work to remediate these issues is planned, funded and implemented in collaboration with others. NTNW iwi are engaged in restoration, learning and restoring cultural traditions and values.
Works required (quantity and description) .	The work would involve a two staged approach: **Stage one:** Step one: Collation of historic information/matauranga on the use of these sites, the mahinga kai resources they contained, what they were used for. - Review of existing information by NT-NWRT staff/contractor – 100 hours at $100 per hour – $10,000.

Key threats/issues:

Key threat	Impact on feature
Loss of kai species and abundance	Availability of healthy and abundant mahinga kai for Ngati Tahu-Ngati Whaoa people.
Loss of access	Ability to harvest in some areas and practice kaitiakitanga.
Erosion/sediment	Contribution to sediment loads to the Wai-O-Tapu stream and the main Waikato River.
Stock access to seeps, wetland areas	Reduced water quality and soil compaction, and loss of wetland vegetation and habitat.
Unfenced areas of native vegetation	Reduced biodiversity opportunities, and reduced opportunity for native corridors between tributaries and main river.
Lack of riparian cover and associated fish habitat	Reduced habitat for tuna and kōura.
Other weeds (including willow)	Compete with other native species and alter ecological processes.

	Step two: Assessment of the state of these areas, identification of issues at these sites impeding/impacting on these cultural values, site visits. Development of options is undertaken for remedial measures and assessment of approaches to enhance fisheries/restore mauri at these sites. - Consultant/contractor – development of management plan and options – $30,000. **Stage two** Step one: Implementation of remedial/enhancement measures is undertaken in collaboration with others. **Costs for this component will remain unquantified until step one is complete and options/costings are known. These works are likely to include fencing, planting, weed control and potentially instream enhancement of some sites.** Step two: Information shared with Ngati Tahu-Ngati Whaoa iwi and traditional use revived. - Wananga x 2 – venue/kai/koha $1500; facilitator $1000; travel expenses $600. - Sharing of information with iwi/public (resource for application through website) $5000 setup costs and development of output/content (in conjunction with various other projects/information – costs may be less).
Risks to project success	There is minimal risk to success in the initial stages of this project. Given the uncertainty about what remedial works may be required at particular sites, one of the key risks is that future funding to implement works may not be available. It is anticipated that these works and costings would be included in the first review of the Restoration Strategy.
Land tenure – likelihood of adoption and adoption circumstances	Some of the mahinga kai sites included in this project are either on land owned by Ngati Tahu-Ngati Whaoa Runanga or land trusts, or on land owned by the Crown and administered by the Department of Conservation or Land Information New Zealand. Some areas will be on private land. The adoption of this project and ongoing measures of protection and enhancement may be supported from agencies and land trusts, but the response by private landowners is unknown and will strongly depend on what type of works and access arrangements are proposed.
Knowledge gaps and response	There is limited information on some of these historic fishery sites, their current state and suitability for restoration or rehabilitation. It is

	relatively unknown (at this time) the status of current or future access to these sites, and what works will be required to enhance them.
Project duration (years)	Initial work – (both steps) 2 years Second stage – (both steps) 20 years
Up-front cost – total for implementation phase/project duration	<table><tr><th>Work description</th><th>Cost ($)</th></tr><tr><td>Stage one, step one</td><td>10,000</td></tr><tr><td>Stage one, step two</td><td>30,000</td></tr><tr><td>Stage two, step one</td><td>Cost Unknown</td></tr><tr><td>Stage two, step two</td><td>11,200</td></tr><tr><td>Project management/staffing/incidentals (30%)</td><td>15,360</td></tr><tr><td>Total</td><td>66,560</td></tr></table>



Restoration/rehabilitation of key mahinga kai sites

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale1:210,000@A4 Portrait

A4

Waikato
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Mangakara Stream (Ngati Tahu-Ngati Whaoa Runanga Trust)


Mangahoanga Stream (Ngati Tahu-Ngati Whaoa Runanga Trust 2016)


Mangatoetoe Stream (Ngati Tahu-Ngati Whaoa Runanga Trust 2017)

NTNW 3 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Geothermal matauranga**
Vision	That geothermal sites in the Ngati Tahu-Ngati Whaoa rohe are well understood from both a matauranga and western science perspective. Understanding promotes holistic management through planning and implementation of remedial and enhancement measures. Management achieves understanding and preservation across multiple values and assists in achieving Ngati Tahu-Ngati Whaoa aspirations.
Location	The following geothermal sites in the Ngati Tahu-Ngati Whaoa rohe (associated with Te Awa o Waikato): Orakei Korako, Waihunuhunu, Red Hills, Wai-O-Tapu, Maunga Kakaramea, Waikite, Mangaongaonga, Rotokawa, Ohaki, Whangairorohea, Ngatamariki, Golden springs, Waimahana, Te Kopia, Atiamuri.
Brief description of site	Ngati Tahu-Ngati Whaoa has a historical, cultural and contemporary association with geothermal resources within our traditional rohe. They are a special feature of our rohe and were prized by our tupuna for various uses. Geothermal areas were favoured by our tupuna for settlements, providing precious warmth and hot bathing, natural cooking and preserving, and sites for ritual purposes and healing. These geothermal areas are linked to Te Awa o Waikato and were used in conjunction with the river to provide resources to our iwi. Our iwi traded unique geothermal materials such as kokowai, the clay pigment generated by geothermal activity. Our iwi built large papakainga and pa at these sites and extensive cultivations were often established around these taonga, such as at Orakei Korako and Ohaki. Orakei Korako is the ukaipo (birthplace) of our iwi and was the first traditional settlement of Tahu-Matua. Orakei Korako was the principle home for the tribe and from there the people dispersed across the rohe. Many of the remaining geothermal sites within our rohe have been impacted by various development, land use, physical or ecological threats. These developments have at times compromised our values associated with these taonga, and in some cases destroyed some sites, such as at Orakei Korako with inundation for generation of electricity. Some sites and their geothermal fields (Te Kopia, Waikite, Wai-O-Tapu, Orakei Korako) are currently protected through legislation. We consider it important to enable this ongoing protection to continue and the sites be enhanced where possible. Our iwi environmental plan, *Rising above the mist – Te Aranga ake I te taimahatanga*, documents this project as an opportunity for us to engage as kaitiaki and be proactive in the identification of methods to improve cultural associations at these sites. *“Mapping the features that exist in the rohe and also the traditional uses in different sites would provide a sound knowledge base from which to plan use, protection and restoration activities.”*

<table>
<tr><td></td><td>The majority of these sites also have high ecological and geodiversity values which this work seeks to complement and enhance.</td></tr>
<tr><td>Key threats/issues</td><td>
<table>
<tr><th>Key threats</th><th>Impact on feature</th></tr>
<tr><td>Loss of knowledge</td><td>Links to historic cultural use of geothermal sites is lost. Compromises the ability to assess and implement remedial/ enhancement work across multiple values. Less ability to advocate for protection /enhancement without collation of information and fully engage in kaitiakitanga.</td></tr>
<tr><td>Weeds/wilding conifers</td><td>Compete with native plant communities and alter geothermal vegetation.</td></tr>
<tr><td>Stock access to features/lack of fencing</td><td>Damage to geothermal vegetation and features.</td></tr>
<tr><td>Feral pigs</td><td>Uprooting of geothermal vegetation, features.</td></tr>
<tr><td>Geothermal development/ inappropriate use</td><td>Decline in geothermal field integrity affects surface manifestations.</td></tr>
</table>
</td></tr>
<tr><td>Project goal/s</td><td>Within 2 years of project commencement, the historic use of geothermal resources at these sites is documented and properties/use compared with western science to increase understanding across a range of values. The current state of these geothermal areas is known and the issues impacting on cultural values are identified.

Within 20 years, work to remediate these issues is planned, funded and implemented. NTNW iwi are engaged in restoration, learning and restoring cultural traditions and values. Information is shared and available to others.</td></tr>
<tr><td>Works required</td><td>The work would involve a two staged approach:

Stage one:
Step one:
Ngati Tahu-Ngati Whaoa matauranga is captured and documented for each site through document review, interviews and wananga.
- Review of existing information by NT-NWRT staff/contractor – 100 hours at $100 per hour – $10,000.

- One on one interviews – 10 interviews at $800 per interview (2 hours all inclusive).

- Filming and film editing x 2 days each at $1400 per day.

Step two:
- Matauranga is compared with western science regarding ngawha and feature composition. Connections are made across the two</td></tr>
</table>

	disciplines to understand and preserve the resource across multiple values. - Information allows for the assessment of the current state of these sites and identification of issues impeding/impacting on cultural values. - Development of options is undertaken for remedial measures and assessment of approaches to restore mauri at these sites. - Consultant/contractor – development of report to address issues raised in step two – $30,000. **Stage two** Step one: Implementation of remedial/enhancement measures are undertaken in collaboration with others. **Costs for this component will remain unquantified until step one is complete and options/costings are known. Works are likely to involve fencing, weed control (including wilding pine control) and animal pest control.** Step two: Information shared with Ngati Tahu-Ngati Whaoa iwi and traditional use revived. - Wananga x 2 – venue/kai/koha $1500; facilitator $1000, travel expenses $600 - Sharing of information with iwi/public (resource for application through website) $5000 setup costs and development of output/content (in conjunction with various other projects/information – costs may be less).
Risks to project success	There is minimal risk to the success of this project. The geothermal systems of our rohe are of high importance to various agencies through both legislative/planning means and ecological/conservation perspectives.
Land tenure	Many of the geothermal sites included in this project are either on land owned by Ngati Tahu-Ngati Whaoa Runanga or land trusts or on land owned by the Crown and administered by the Department of Conservation. The adoption of this project and ongoing measures of protection and enhancement are likely to be supported by most landowners.
Knowledge gaps and response	There is extensive information already existing from a western science perspective. There is some existing cultural information collated from a Ngati Tahu-Ngati Whaoa perspective, however more will be required.
Project duration	Initial work – (stage one) 2 years Second stage – (stage two) 20 years and ongoing

<table>
<tr>
<td>Up-front cost</td>
<td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Stage one, step one</td><td>20,800</td></tr>
<tr><td>Stage one, step two</td><td>30,000</td></tr>
<tr><td>Stage two, step one</td><td>Cost unknown</td></tr>
<tr><td>Stage two, step two</td><td>11,200</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>18,600</td></tr>
<tr><td>Total</td><td>80,600</td></tr>
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</tr>
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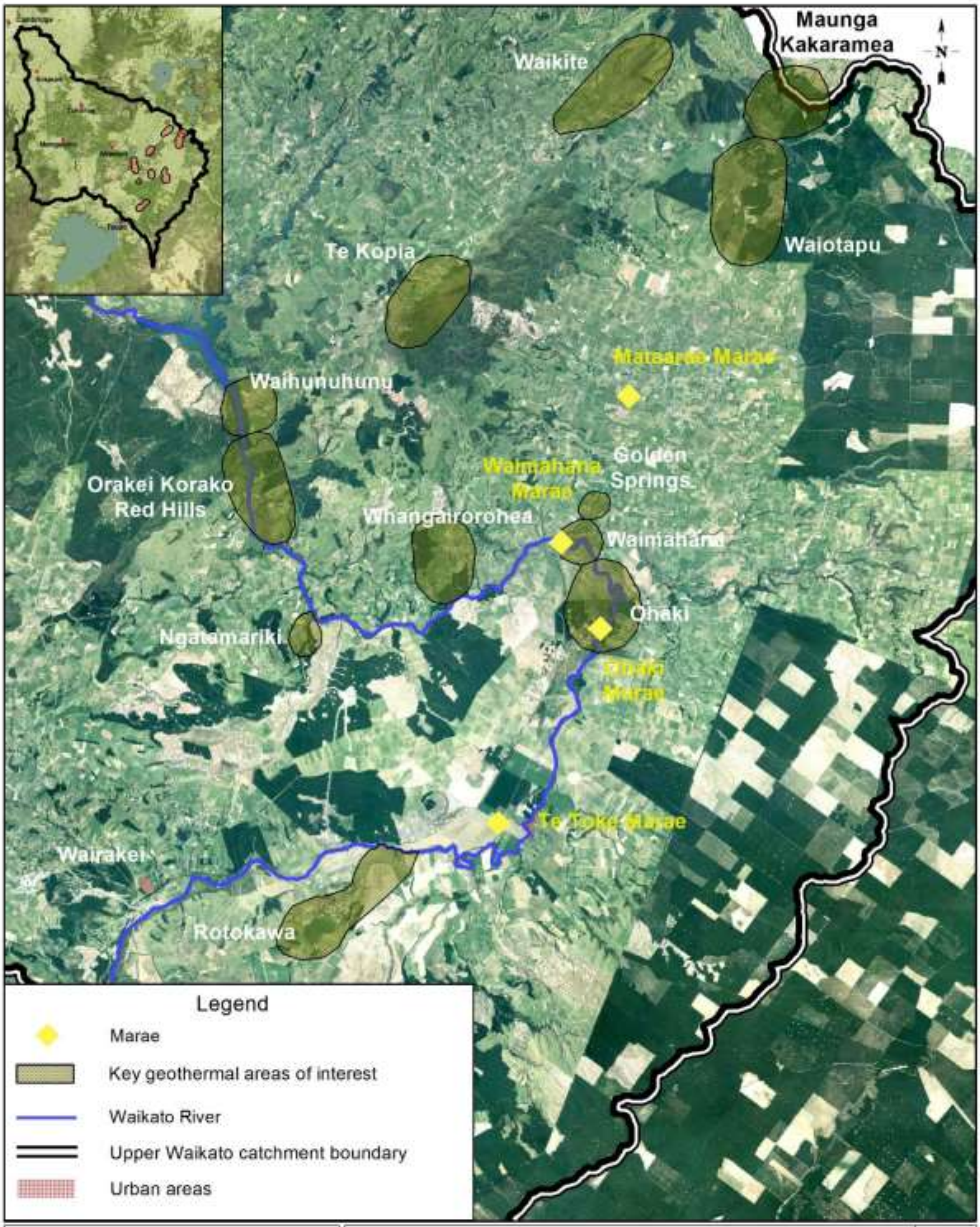

Geothermal matauranga

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale1:210,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL

Rotokawa Lake margins (Ngati Tahu-Ngati Whaoa Runanga Trust photo)

Wai-o-Tapu Scenic Reserve (Department of Conservation photo 2008)

Maunga Kakaramea – Lake Rotowhero (Department of Conservation photo 2014)

Orakei Korako (Ngati Tahu-Ngati Whaoa Runanga Trust Photo 2014)

NTNW 4 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Wetlands, Ngati Tahu-Ngati Whaoa mātauranga - Rongoa, weaving**
Vision	That wetland sites in the Ngati Tahu-Ngati Whaoa rohe are well understood from both a matauranga and western science perspective. Understanding promotes holistic management through planning and implementation of remedial and enhancement measures. Management achieves understanding and preservation across multiple values and assists in achieving Ngati Tahu-Ngati Whaoa aspirations.
Location	The following wetland sites in the Ngati Tahu-Ngati Whaoa rohe: Red Hills Conservation Covenant, Deep Creek/Torepatutahi, Waikite, Ngahewa, Ohaki, Tutukau Z East, Takapou/Te Toke, Wai-O-Tapu, Ruatawiri.
Brief description of site	Wetlands were once abundant within the rohe prior to European land clearance and drainage for residential, forestry and agricultural development. Many wetlands, particularly in the Reporoa Basin, have been extensively drained for agricultural use since European settlement. The extent of wetlands remaining in the rohe is now only 1100 ha or 0.005% of the total land area. It is unknown what the historical extent of wetland coverage was, but the entire Reporoa Basin consisted of large areas of floodplain and rich soils, and the translation of the name Reporoa is “long swamp”. The Waikato River meandered and was historically much wider in some areas such as around Ohaki and Mihi, enabling the establishment of large areas of either permanently or periodically inundated wetland areas. Wetlands historically were utilised by the Ngati Tahu-Ngati Whaoa people for harvest of mahinga kai (fish, birds and plants), use of rongoa species and harvest of harakeke and other materials for weaving and construction of various tools. They formed part of the mosaic of areas and resources associated with Te Awa o Waikato that the iwi moved between to sustain our people. The remaining wetlands in the rohe are now limited in extent and integrity. These remaining areas are considered of high importance to protect, enhance and restore where possible to facilitate ecological gains as well as the preservation and enhancement of cultural values. Land tenure of these sites is mixed, however the majority occur on both Ngati Tahu-Ngati Whaoa Runanga land and trust blocks, land administered by the Department of Conservation and some on private land. The sites range in size, integrity and values. The issues at each site also vary, however as with most wetlands the key issues include

	hydrological integrity, plant and animal pests, and in some cases issues with flow ramping for the operation of the hydro system on the Waikato River. Our iwi environmental plan, *Rising above the mist – Te Aranga ake I te taimahatanga*, has the following long term goals in regards to wetlands: *"More wetland areas reinstated; Native species associated with wetlands are abundant; Fewer exotic plant and animal pests in wetland areas; Traditional practices associated with wetlands are revived."*
Project goal/s (SMART)	Within 2 years of project commencement, the historic use of wetland sites is documented and the current state of these areas is known. Issues impacting on cultural values are identified. Within 20 years, work to remediate these issues is planned, funded and implemented in collaboration with others. NTNW iwi are engaged in restoration, learning and restoring cultural traditions and values.
Works required (quantity and description)	The work would involve a two staged approach: **Stage one:** Step one: Collation of historic information/matauranga on the use of various wetland areas in the rohe, the resources they contained, what they were used for. - Review of existing information by NT-NWRT staff/contractor - 100 hours at $100 per hour - $10,000 - One on one interviews – 10 interviews at $800 per interview (2 hours all inclusive) - Filming and film editing x 2 days each at $1400 per day Step two: Assessment of the state of these areas, identification of issues at these sites impeding/impacting on cultural values. Development of options for remedial measures and assessment of approaches to restore mauri at these sites. - Consultant/contractor – development of management plan/options $30,000. **Stage two:** Step one: Implementation of remedial/enhancement measures is undertaken in collaboration with others. **Costs for this component will remain unquantified until step one is complete and options/costings are known. Works will include fencing, planting, weed control and animal pest control.** Step two:

<table>
<tr><td></td><td>Information shared with Ngati Tahu-Ngati Whaoa iwi and traditional use revived.
- Wananga x 2 – venue/kai/koha $1500; facilitator $1000, travel expenses $600.
- Sharing of information with iwi/public (resource for application through website) $5000 setup costs and development of output/content (in conjunction with various other projects/information – costs may be less).</td></tr>
<tr><td>Risks to project success</td><td>There is minimal risk to success in the initial stages of this project. Given the uncertainty about what remedial works may be required at particular sites, one of the key risks is that future funding to implement works may not be available as this is not included in this Project Assessment Form at this stage. It is anticipated that these works and costings would be included in the first review of the Restoration Strategy.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Many of the wetland sites included in this project are either on land owned by Ngati Tahu-Ngati Whaoa Runanga or land trusts, or on land owned by the Crown and administered by the Department of Conservation or Land Information New Zealand.
The adoption of this project and ongoing measures of protection and enhancement may be supported by agencies and land trusts but the response by private landowners is not known and will strongly depend on what type of works and access arrangements are proposed.</td></tr>
<tr><td>Knowledge gaps and response</td><td>There is limited information on some of these wetland areas, their current state and suitability for restoration or rehabilitation. The status of access to these sites is currently relatively unknown.</td></tr>
<tr><td>Project duration (years)</td><td>Initial work – (both steps) 2 years
Second stage – (both steps) 20 years</td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Stage one, step one</td><td>20,800</td></tr>
<tr><td>Stage one, step two</td><td>30,000</td></tr>
<tr><td>Stage two, step one</td><td>Cost unknown</td></tr>
<tr><td>Stage two, step two</td><td>11,200</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>18,600</td></tr>
<tr><td>Total</td><td>80,600</td></tr>
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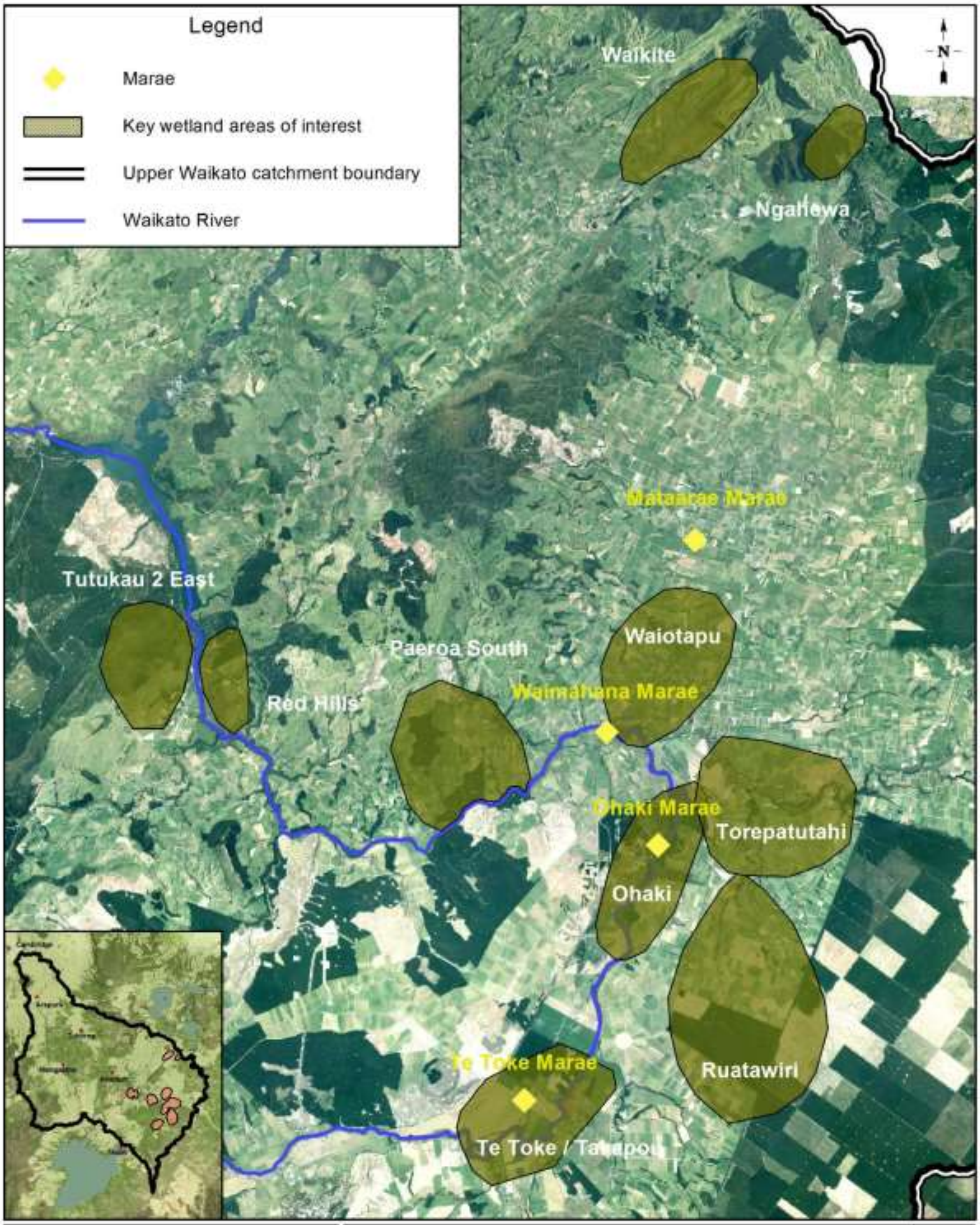

Wetlands matauranga rongoa/weaving

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale1:160,000@A4 Portrait

A4

Waikato
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Lake Ngahewa Wetland (Department of Conservation – Paul Cashmore 2017)

Torepatutahi Wetland (Ngati Tahu-Ngati Whaoa Runanga Trust – 2015)


Waikite Wetlands (Department of Conservation 2009)

NTNW 5 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Cultural history research and documentation**
Vision	Cultural history of Ngati Tahu-Ngati Whaoa association with Te Awa o Waikato is well known, documented and utilised by Ngati Tahu-Ngati Whaoa. Ngati Tahu-Ngati Whaoa awa history is preserved, and significance applied and used in river management decision making processes.
Location	Throughout Ngati Tahu-Ngati Whaoa rohe along and within Te Awa o Waikato catchment
Brief description of site	Over 81 kilometres of the main stem of Te Awa of Waikato and approximately 2200 kilometres of tributaries fall in the Ngati Tahu-Ngati Whaoa rohe. Te Awa o Waikato and its catchment is a resource of great cultural, historical, traditional and spiritual significance to the people of Ngati Tahu-Ngati Whaoa. Our relationship with Te Awa o Waikato and its tributaries, and our respect for it, gives rise to our responsibilities to protect the river and all it encompasses, and to exercise our mana whakahaere in accordance with long established tikanga to ensure the wellbeing of the river. The awa holds many sites of significance to the Ngati Tahu-Ngati Whaoa people. Many of these sites have been highly impacted through development of the river and many connections have been lost through loss of land and access to sites In particular the following are key areas for knowledge collation: - Many historic names relate to resource abundance and use in various areas. Many of these are neither documented nor currently used or understood. - Historic marae and kainga locations and their associations with resources. Many of these are not formally documented and few are formally recognised for iwi members. - Island pa (in the river) were extensively used by Ngati Tahu-Ngati Whaoa, historically. Many of these island pa have been lost in the creation of hydro dams, and their history and significance have not been fully documented. - Many other cultural sites and geothermal areas were also lost during inundation of areas by hydro dam creation. These sites' history and significance have not been fully documented.

<table>
<tr><td></td><td>Our iwi environmental plan, Rising above the mist – Te Aranga ake i te taimahatanga, documents this project as an opportunity in the following korero:

"It is essential that knowledge and history and identity is kept alive as part of continuing cultural existence. Opportunities lie in resurfacing and sharing the knowledge of significant sites, ensuring iwi members can access these sites, and making time and space to learn the korero about them"

Our long term goals (from the IEMP) are:
- Wahi tapu and their history are known by the iwi
- All wahi tapu are appropriately managed
- Historical knowledge of significant sites is retained, widely known and appreciated
- Significant sites to the iwi are restored where feasible

This project would contribute to achieving these goals</td></tr>
<tr><td>Key threats/issues</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Loss of knowledge</td><td>Links to historic cultural use of resources and sites is lost. Compromises the ability to assess and implement remedial/enhancement work across multiple values.</td></tr>
<tr><td>Loss of connection with Te Awa o Waikato</td><td>Cultural values of sites are not well understood. Management of these areas does not fully encompass consideration of these values.
Management of these sites is not holistic.
Some cultural sites may be destroyed due to lack of knowledge.</td></tr>
</table></td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 5 years of project commencement, the cultural history of Ngati Tahu-Ngati Whaoa's resource and historic sites is well known, documented, shared and utilised by Ngati Tahu-Ngati Whaoa iwi and others. History is preserved, and significance applied and used in river management decision making processes.</td></tr>
<tr><td>Works required</td><td>Collation of cultural history regarding the meaning and purpose of the locations of old marae and island pa. Documentation of place name association with resources within areas.
- Review of existing information by staff/contractor – 100 hours at $100 per hour – $10,000.
- One on one interviews – 10 interviews at $800 per interview (2 hours all inclusive).
- Filming and film editing x 2 days each at $1400 per day.

Work with landowners where old marae sites were present to install 6 kohatu or other recognition of their historic cultural importance</td></tr>
</table>

<table>
<tr><td></td><td>- $10,000 per site – 6 sites.

Providing this information in formats available to Ngati Tahu-Ngati Whaoa iwi.
- Wananga x 2 – venue/kai/koha $1,500; facilitator $1000, travel expenses $600.

- Sharing of information with iwi/public (resource for application through website) $5000 setup costs and development of output/content.</td></tr>
<tr><td>Risks to project success</td><td>Lack of cooperation by landowners for access and recognition of sites.
Inability to locate information relevant to the kaupapa of this project.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>Most information will be collated regardless of land ownership.
Some sites will be on private land for potential installation of kohatu or site identification. The likelihood of adoption may vary between landowners and this will assessed on a site by site basis.</td></tr>
<tr><td>Knowledge gaps and response</td><td>The project is focused on filling these knowledge gaps in relation to this kaupapa. These costings have been based on best estimate of time and resources.</td></tr>
<tr><td>Project duration</td><td>5 years</td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Review of existing information</td><td>10,000</td></tr>
<tr><td>One on one interviews</td><td>8000</td></tr>
<tr><td>Filming and film editing</td><td>2800</td></tr>
<tr><td>Development and installation of 6 kohatu</td><td>60,000</td></tr>
<tr><td>Wananga to share findings</td><td>6200</td></tr>
<tr><td>Sharing of information with iwi/public (resource for application through website)</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>27,600</td></tr>
<tr><td>Total</td><td>119,600</td></tr>
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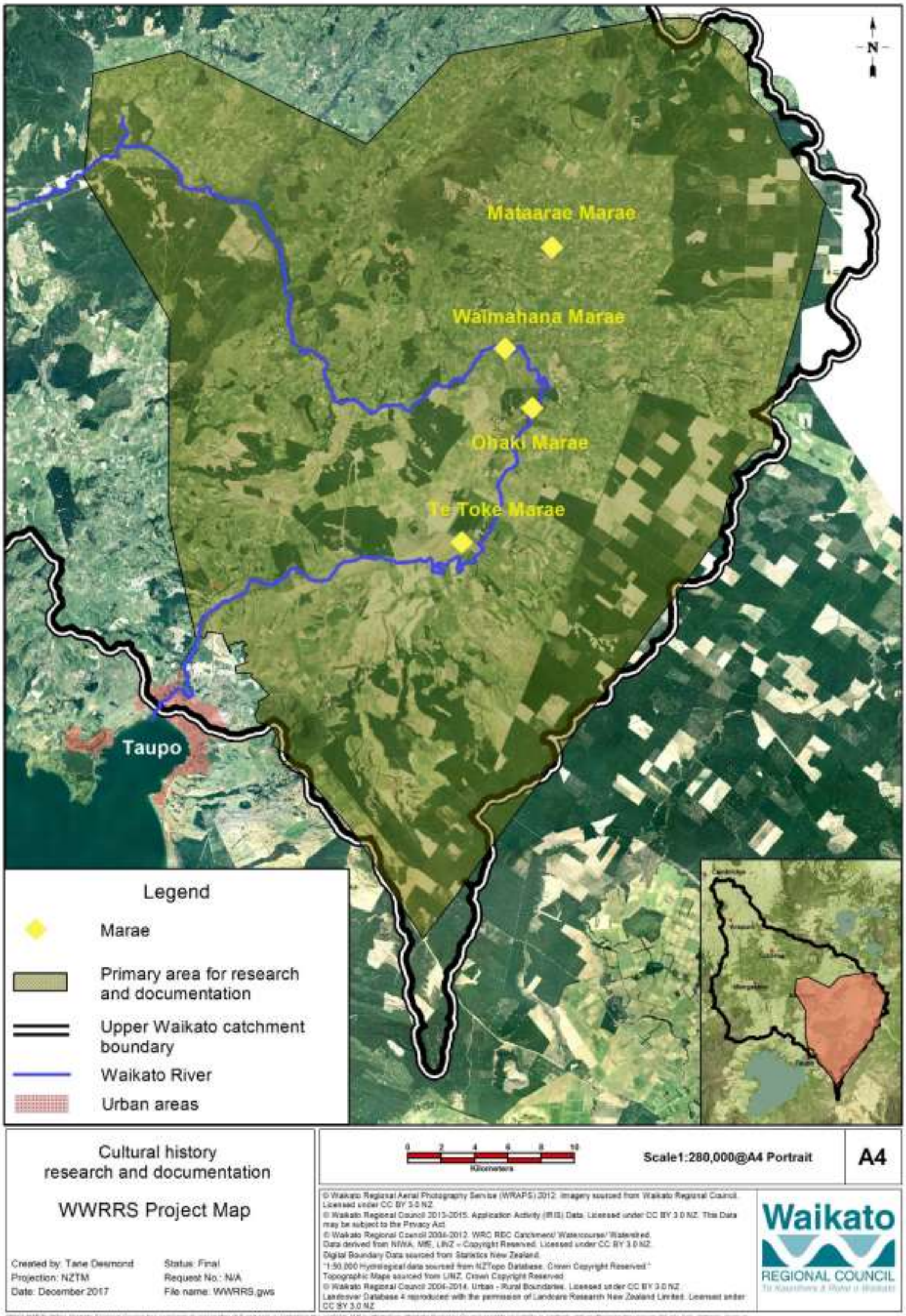

Mataarae Marae
Waimahana Marae
Ohaki Marae
Te Toke Marae
Taupo
N
Legend
Marae
Primary area for research and documentation
Upper Waikato catchment boundary
Waikato River
Urban areas
Cultural history research and documentation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0 2 4 6 8 10
Kilometers
Scale1:280,000@A4 Portrait
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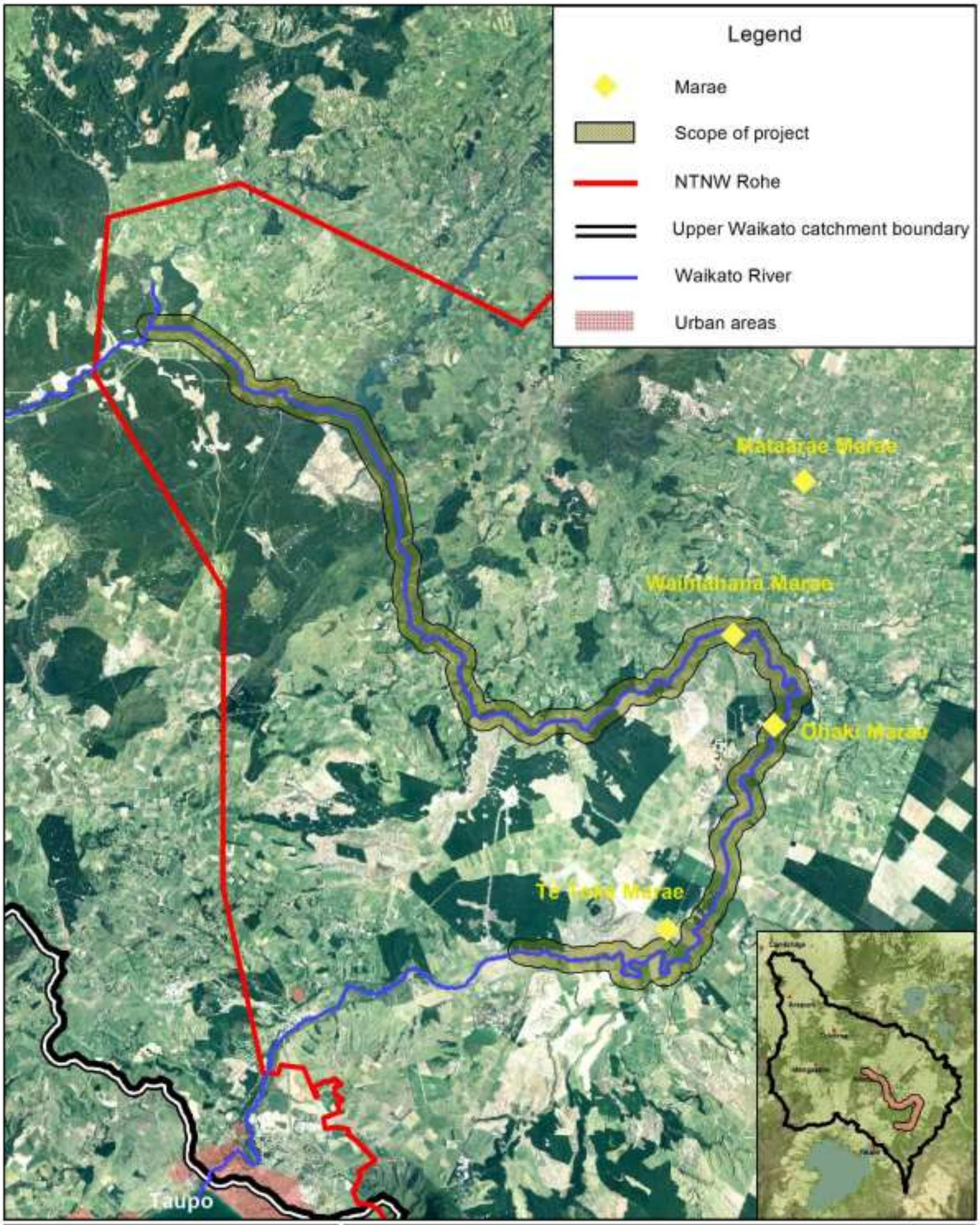
Waikato
REGIONAL COUNCIL

NTNW 6 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Waka paddle, korero sharing and building connection with Te Awa o Waikato**
Vision	Ngati Tahu-Ngati Whaoa connections to our ancestral awa are enhanced, our culture of waka use is enacted and preserved, and our korero is shared.
Location	Parts of the main stem of the Waikato river in the rohe – Nga Awa Purua to Atiamuri.
Brief description of site	Over 81 kilometres of the main stem of Te Awa o Waikato fall in the Ngati Tahu-Ngati Whaoa rohe. The sections of the river which are able to be paddled range from below Nga Awa Purua to Atiamuri Dam (approximately 70 kilometres of river). Te Awa o Waikato and its catchment is a resource of great cultural, historical, traditional and spiritual significance to the people of Ngati Tahu-Ngati Whaoa. Our relationship with Te Awa o Waikato and its tributaries, and our respect for it, gives rise to our responsibilities to protect the river and all it encompasses, and to exercise our mana whakahaere in accordance with long established tikanga to ensure the wellbeing of the river. These sections of Te Awa o Waikato which form part of the site to be paddled include a range of ancestral sites including kainga, pa, tuahu, cultivations, harvest areas and wahi tapu sites. This project is for a biennial event where Ngati Tahu-Ngati Whaoa will paddle Te Awa o Waikato within the rohe and learn about cultural history and connect with the awa. This activity assists in reinforcing the relationship between our people and our ancestral river. This project provides an opportunity for our kaumatua to share their stories with others and be on the river with our people. It seeks to encourage participation in our tradition of waka paddling and use of the river.
Key threats/issues	(see table below)
Project goal/s (SMART)	At least 80 Ngati Tahu-Ngati Whaoa people are involved every two years with the event, with many paddling and others assisting.

Key threat	Impact on feature
Loss of knowledge	Links to historic waka routes and use of the river is lost. Cultural sites only accessible from the river are not known.
Loss of connection	Ngati Tahu-Ngati Whaoa intrinsic links as a river iwi are not fully enabled through being “on” the river.
Loss of waka skills	Opportunity for practices and techniques for waka paddling are compromised and diminished within the iwi.

	Korero and history are shared through engagement in traditional cultural practices. Opportunity and ability to fully engage with the river is increased. Use of waka and associated skills are increased and maintained amongst the Ngati Tahu-Ngati Whaoa people.
Works required (quantity and description)	For each event the following is required: - A training/safety day prior to the paddle day – tutors/trainers $2000 per day. - Provision of waka (in addition to Ngati Tahu-Ngati Whaoa waka) – for paddle day. Up to 6 boats at $150 per day. - Safety boats (x3) for a day $4500. - Catering for 100 people at $50 per person per event. - Incidentals for event – water bottles, sunscreen, petrol vouchers – $1000 per event. - Participation T-shirts – 100 x $25 per event. - Koha for marae use $500 per day.
Risks to project success	There are minimal risks to this project. Ngati Tahu-Ngati Whaoa have an active waka group and paddlers. This type of event has been successfully run before so the issues and barriers are well known.
Land tenure – likelihood of adoption and adoption circumstances	The sections of river to paddle and access are open to the public so there are no tenure issues. Any boat ramps to be used or existing infrastructure are publicly owned or relevant permissions obtained from landowners. Adoption of access by private landowners is relatively high at key access points.
Knowledge gaps and response	There are minimal knowledge gaps. The river sections to be paddled are well known, access points and limitations are well understood. Ngati Tahu-Ngati Whaoa have been involved and organised similar events before and are aware of all requirements.
Project duration (years)	15 years – event held biennually (7 events)
Up-front cost – total for implementation phase/project duration	

Works description	**Cost ($)**
Training/safety day x 7 events	14,000
Hire of additional waka x 7 events	6300
Safety boat hire x 7 events	31,500
Catering x 7 events	35,000
Koha x 7 events	3500
Incidentals x 7 events	24,500
Project management/staffing/incidentals (25%)	28,700
Total	**143,500**



Waka paddle, korero sharing and building connection with Te Awa o Waikato

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Kilometers

Scale1:200,000@A4 Portrait

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Waka (Ngati Tahu-Ngati Whaoa Runanga Trust 2015)


Te Awa o Waikato – Vaile Road (Ngati Tahu-Ngati Whaoa Runanga Trust 2015)

NTNW 7	

Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Ngatamariki Scenic Reserve / Orakonui catchment rehabilitation and enhancement**
Vision	The cultural, ecological, geothermal and recreational values of Ngatamariki Scenic Reserve and the lower Orakonui catchment are rehabilitated, enhanced and protected.
Location	Lower Orakonui Stream Catchment/Ngatamariki Scenic Reserve
Brief description of site	The Ngatamariki Scenic Reserve is Crown land administered by the Department of Conservation. It is approximately 50ha in size and follows the Orakonui Stream as a long, narrow strip. The Orakonui Stream (and the reserve) join Te Awa o Waikato at Tutukau Bridge. There are several geothermal sites of significance within and close to the reserve which support geothermal vegetation and geodiversity values. A Rehabilitation and Enhancement Plan has been developed for the reserve and surrounding lower Orakonui catchment to identify opportunities to achieve gains in rehabilitation of ecological, geothermal, mahinga kai, recreational and cultural values at this site. The scope of the area is approximately ~1300ha, however rehabilitation primarily focuses on the reserve. But by working with adjacent landowners and encouraging activities on private land, it is hoped to enhance this work. Ngati Tahu-Ngati Whaoa wish to be instrumental in their role as kaitiaki of the cultural and natural resources in our rohe; to practice kaitiakitanga and what it means to us. We are committed to working with others to achieve this. Our vision and aspirations in regards to this are captured in our IEMP and outlined below: **Hauora: Taiao Ora, Whanau Ora, Mauri Ora** **Flourishing nature – thriving families – the essence of vitality** Our vision is created by: **Whakangakautanga – Aspirations:** - *To see iwi fully involved* - *To begin the process of restoration* - *To see people enjoy places under our management* - *To establish good working relationships with others* - *To generate opportunities for the Ngati Tahu-Ngati Whaoa iwi* - *To see resources managed in accordance with the tikanga of our iwi.* We actively look for sites and partnerships where we can work with others to enable us to achieve our vision and aspirations. We see Ngatamariki Scenic Reserve and the lower Orakonui Stream/margins of

<table>
<tr><td></td><td>Te Awa o Waikato as one site where this is achievable. We wish to take a lead on rehabilitation opportunities at this site and work with others to achieve this.

The site holds high cultural values for the Ngati Tahu-Ngati Whaoa people. The stream was a harvest site for mahinga kai, there are pa in close proximity, and other key cultural sites in vicinity of the Waikato river. There were cultivation areas in the surrounds along with ngawha, which were suitable for bathing and other purposes.</td></tr>
<tr><td>Key threats/issues</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Weeds in geothermal areas (pampas, wilding conifers)</td><td>Impact on native vegetation, affect geothermal values.</td></tr>
<tr><td>Weeds in native forest areas, stream buffers</td><td>Inhibit native forest regeneration, reduce riparian habitat and suitable habitat for forest birds and taonga species.</td></tr>
<tr><td>Soil erosion/sediment from steep incised nature of areas around reserve</td><td>Deposition of sediment into geothermal areas and stream results in diminished geothermal values, and impacts on water quality in the Orakonui Stream.</td></tr>
<tr><td>Lack of access to stream, cultural sites, geothermal</td><td>Ability to visit the site, share in cultural history, and ngawha limited for iwi members.</td></tr>
</table>
</td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 5 years of project commencement, work at high priority rehabilitation sites in the reserve is underway and ecological integrity has improved. Adjacent landowners are active in assisting with rehabilitation measures on their land which adds value to work in the reserve.

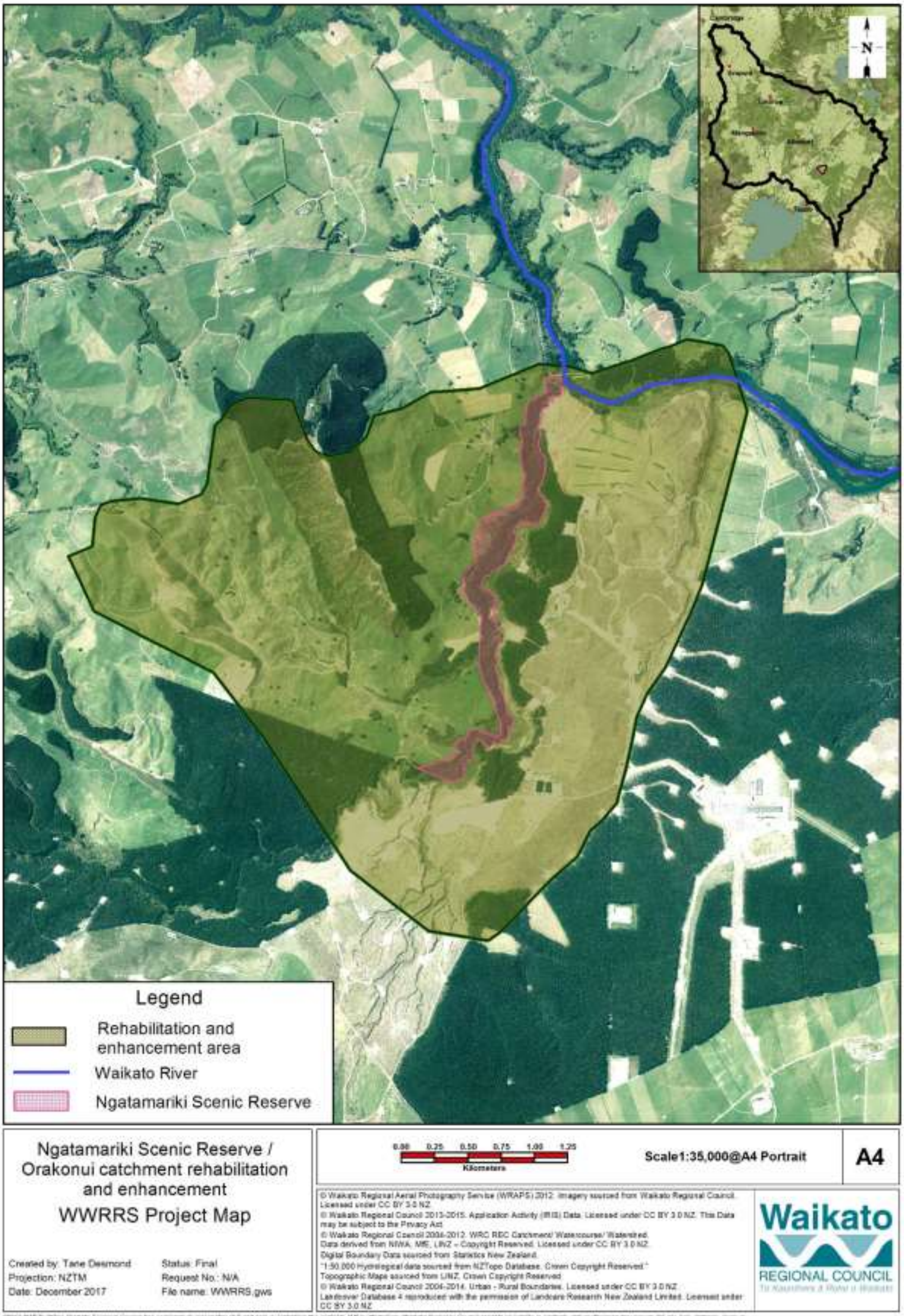
Within 5 years, opportunities for increasing recreational opportunities and sharing cultural values have become part of the work. The public and iwi have access to some areas of the reserve and Ngati Tahu-Ngati Whaoa history and stories are being shared.
Within 10 years key rehabilitation, areas are being actively managed for weeds, planting has occurred and native vegetation is recovering.</td></tr>
<tr><td>Works required (quantity and description)</td><td>Control of weeds in key rehabilitation areas as per management plan (6 years). Total cost $83,398.
Plants for key rehabilitation areas as per management plan (6 years). Total cost $105,760.

Plant maintenance/weed control for key rehabilitation areas as per management plan (6 years). Total cost $37,317.

Signage at entrance to reserve or adjacent Tutukau Road Reserve, to share values and information, $10,000.</td></tr>
</table>

	Walkway in reserve to geothermal area – construction. Cost estimate only and would need to be scoped further, $260,000 (does not include maintenance).
Risks to project success	Landowners surrounding the reserve may not support the work in the reserve. Work in the reserve may be compromised by activities/weeds or other land use issues on surrounding land. Costs may be more than originally budgeted due to higher infestation of weed species, increases in price and unknown issues in rehabilitation. Track construction costs and ongoing maintenance are relatively unknown and have been based on a broad costing. Cost may be significantly more once an alignment is selected and scoped.
Land tenure – likelihood of adoption and adoption circumstances	The land tenure in Ngatamariki Scenic Reserve is Crown land administered by the Department of Conservation. Adoption of proposed remediation works is likely as DOC has been supportive of this project to date. Surrounding landownership is private. There may be support for initiatives by surrounding landowners, however this may vary between properties.
Knowledge gaps and response	The information used in this project assessment is based on preparation of a rehabilitation plan which has focused on the scenic reserve. This information has been well researched. Some information from surrounding private land is well known and has been incorporated, however the extent and costs for rehabilitation in some areas within the lower Orakonui are not currently well known. Track construction costs are also broad estimates and no scoping of location or issues have been undertaken.
Project duration (years)	20 years
Up-front cost – total for implementation phase/project duration	(see table below)

Works description	**Cost ($)**
Control of weeds in key rehabilitation areas as per management plan	83,398
Plants for key rehabilitation areas as per management plan Plant maintenance/weed control for key rehabilitation areas as per management plan	143,077
Signage at entrance to reserve or adjacent Tutukau Road Reserve – values, information	10,000
Construction of walkway (does not include maintenance)	260,000
Project management/staffing/incidentals (30%)	148,942
Total	**645,417**


Legend
Rehabilitation and enhancement area
Waikato River
Ngatamariki Scenic Reserve
Ngatamariki Scenic Reserve / Orakonui catchment rehabilitation and enhancement
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Orakonui South geothermal feature (Photo supplied by Mercury, 2016)


Orakonui South geothermal feature (Photo supplied by Mercury, 2016)


Orakonui Stream (Photo supplied by Mercury, 2016)

NTNW 8 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Support of Ngati Tahu-Ngati Whaoa land blocks to achieve sustainability outcomes**
Vision	Hauora: Taiao Ora- Whanau Ora – Mauri Ora. "Flourishing nature, thriving families – the essence of vitality." All land under Ngati Tahu-Ngati Whaoa iwi ownership is enhanced, iwi are active kaitiakitanga and the land is preserved for future generations.
Location	All Ngati Tahu-Ngati Whaoa land blocks/trusts in the rohe. These land trusts include those specifically listed below, along with other smaller whanau blocks not included on the attached PAF map. Tutukau Z East, Takapou, Ohaki Tribal Trust, Tauhara No 2 Trust, Paeroa South, Tahorakuri 2, Whanau trusts, Tauhara Moana.
Brief description of site	A total of approximately 5000ha of land in the Ngati Tahu-Ngati Whaoa rohe is owned by iwi through various land trusts. Land use of these areas include the following: - Drystock farming - Dairy farming - Geothermal power generation - Tourism - Leased to others. There are many opportunities on iwi land to realise environmental opportunities and empower iwi to actively practice kaitiakitanga. Our iwi environmental plan, *Rising above the mist – Te Aranga ake I te taimahatanga*, identified the following opportunity: *"There are opportunities for land Trust to identify further areas of land they wish to protect, either because they have wahi tapu or because they are unproductive or vulnerable to erosion. There are opportunities to retire less productive land and re-establish tree cover on it and then concentrate farm inputs on the more productive land without losing profit."* Our IEMP also states the following goal in relation to whenua: *The land is providing resources, income and wellbeing for the iwi and others without environmental degradation.* To identify and work towards achieving these additional environmental benefits (above relevant legislative requirements), several restoration strategies/enhancement plans have already been completed for some Ngati Tahu-Ngati Whaoa land trusts. Some activities identified in these plans have also already been implemented.

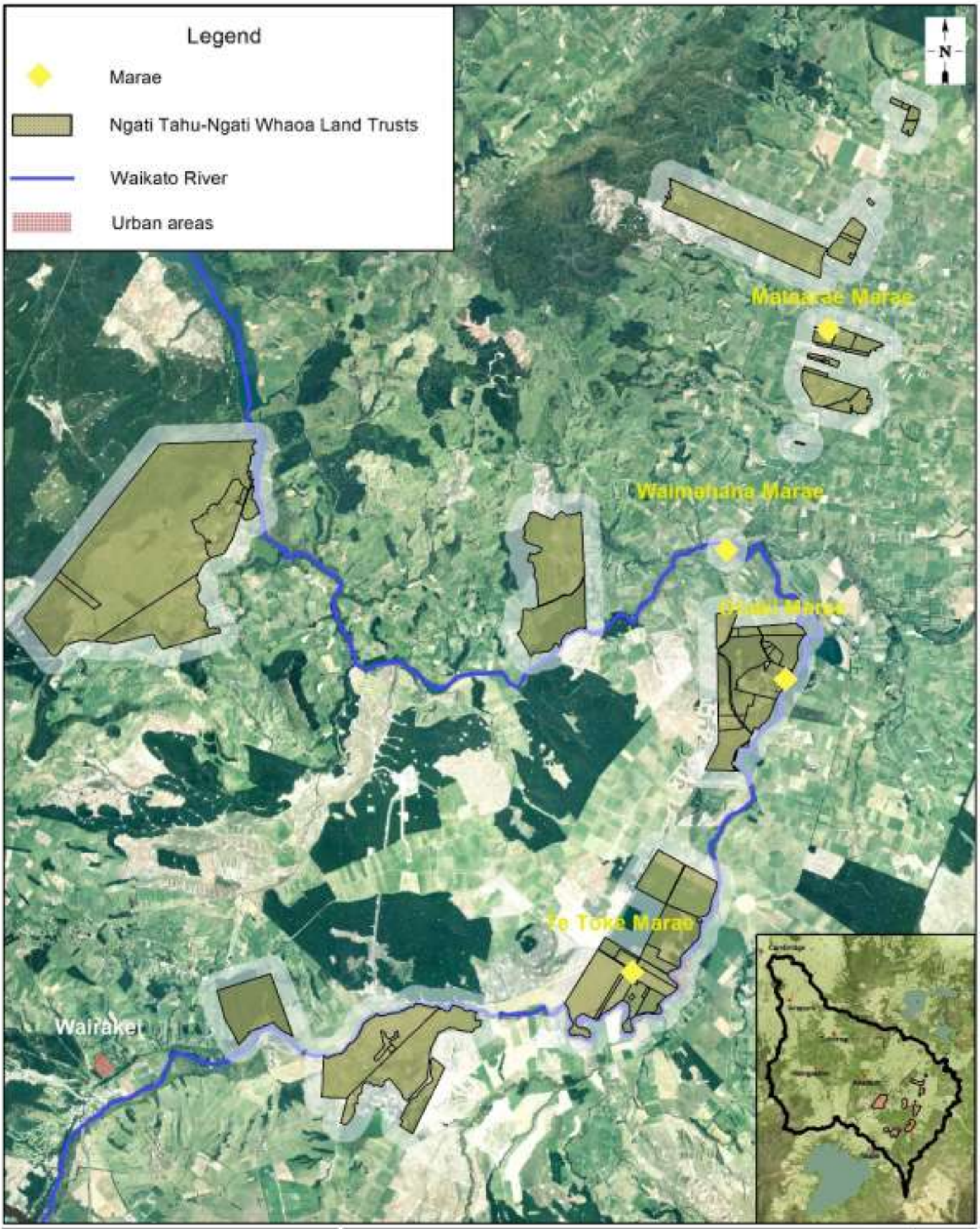
<table>
<tr><td></td><td>The runanga would like to be the leader/co-ordinator of this work to help the land trusts play their role in achieving the Vision and Strategy for Te Awa o Waikato.</td></tr>
<tr><td>Key threats/issues</td><td>In general the following threats and issues may be found at some trust lands:
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Erosion/sediment</td><td>Contribution to sediment loads to the Wai-O-Tapu stream and the main Waikato River.</td></tr>
<tr><td>Stock access to seeps, wetland areas</td><td>Reduced water quality and soil compaction. Loss of wetland vegetation and habitat.</td></tr>
<tr><td>Unfenced areas of native vegetation</td><td>Reduced biodiversity opportunities, reduced opportunity for native corridors between tributaries and main river.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for tuna and koura.</td></tr>
<tr><td>Wilding conifers</td><td>Compete with native communities, particularly in geothermal areas.</td></tr>
<tr><td>Other weeds (including willow)</td><td>Compete with other native species and alter ecological processes.</td></tr>
</table></td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 10 years of project commencement, at least 75% of Ngati Tahu-Ngati Whaoa land trusts are implementing aspects of agreed restoration strategies. Ngati Tahu-Ngati Whaoa are active kaitiaki in the rohe, on their land, and have the knowledge and tools to play a role in achieving Te Ture Whaimana o te awa o Waikato.</td></tr>
<tr><td>Works required</td><td>A project liaison officer to work with Ngati Tahu-Ngati Whaoa land trusts to guide development of restoration strategies and implementation plans for environmental enhancement and protection. Provide support for planning, seeking funding and assisting with implementation of enhancement activities to help achieve active kaitiakitanga. Work would involve working with trusts who already have restoration plans, to implement these, as well as working with other trusts to develop restoration plans and implement.

Project liaison officer – 12 hours per week for 6 years. Contractor at $100 per hour.

Development of strategies and implementation plans for environmental enhancement and protection – 10 plans at $5000 each. These plans would address opportunities and measures above and beyond what is likely to be required through the Healthy Rivers Plan change.</td></tr>
<tr><td>Risks to project success</td><td>Some land trusts may not be willing to participate.
Funding may not be available for implementation of some projects (once identified).</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>All land is owned by Ngati Tahu-Ngati Whaoa land trusts. The rate of willingness to adopt environmental initiatives is not known and may vary between trusts. Adoption is likely to increase if we provide a key point of contact and ongoing support to trusts to identify opportunities and assist</td></tr>
</table>

	with planning, seeking funding and implementation of enhancement activities.
Knowledge gaps and response	Knowledge of restoration opportunities for land trusts who have already had management plans is well known. For many smaller land trusts this information and what would be required is relatively unknown and would need to be ascertained.
Project duration	6 years
Up-front cost – total for implementation phase/project duration	(see table below)

Works description	Cost ($)
Engagement with land trusts for restoration strategies and management plans/support Project liaison officer – contactor $100 per hour up to 12 hours per week for 6 years	374,400
Restoration strategies and management plans for some land trusts developed (10 trusts at average $5000 each)	50,000
Project management/staffing/incidentals (20%)	84,880
Total	**509,280**



Support of Ngati Tahu-Ngati Whaoa land blocks to achieve sustainability outcomes

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Kilometers

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NTNW 9 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Establish fenced and planted corridors for all streams from the Paeroa Range within the catchment**
Vision	All streams running from the Paeroa Range are fenced and planted and are providing biodiversity/riparian corridors, improved habitat for mahinga kai, and soil conservation and water quality benefits for Te Awa o Waikato.
Location	Paeroa Range and associated tributaries flowing from the range within the NTNW rohe.
Brief description of site	The Paeroa Range encompasses the largest remaining area of native vegetation in the rohe is and one of the larger ranges in the Upper Waikato catchment. The range is dominated by Te Kopia Scenic Reserve administered by the Department of Conservation (~2000ha), Ruatihi-o-Paeroa Scenic Reserve owned and administered by Ngati Tahu-Ngati Whaoa Runanga Trust (~90ha), and some privately owned areas of native vegetation contiguous with the reserves. The range has numerous tributaries flowing to the Whirinaki Stream, the Wai-O-Tapu Stream and directly into the main awa. The vegetation of the range consists of the following associations: - kamahi-rewarewa - rimu/black maire - rimu-northern rata/tawa-hinau-rewarewa-mangeao-kamahi - rimu/kamahi - Hall's totara/kamahi-broadleaf-tawheowheo. There are also populations of the mistletoe *Peraxilla tetrapetala* and *Dactylanthus taylorii* in the area, along with most common forest birds. In a report commissioned for the Department of Conservation in 1995[6], the Te Kopia reserve ranked as one of the North Island's most important because: - it has a range of vegetation types - it represents a once extensive area of forest which formed the transition between the hardwood forests north of Rotorua and the podocarp forests of the Taupō region - its relatively large in size

[66] Vegetation and Flora of Lands Administered by Bay of Plenty Conservancy – 1995, Written by Sarah Beadle

	- it has a high value area of geothermal features and vegetation on its western side. Much of the remaining high value stream habitat is located in the tributaries close to the range. There are numerous existing soil conservation areas providing sediment and riparian values on areas which drain into the Reporoa Basin (and the Wai-O-Tapu Stream) or into the Whirinaki Arm. The Paeroa Range has high cultural values for the Ngati Tahu-Ngati Whaoa people. All areas within the wider rohe of Ngati Tahu-Ngati Whaoa were linked and our people used these various areas seasonally or for specific purposes. There were many kainga (settlements), cultivations, urupa, tuahu and other locations which were used for different purposes, including provision of food and materials, warmth, protection and refuge. The original forests in the area provided an abundance of kai sources such as fern root and birds, and the native trees provided materials for making waka, tools and whare. Ngawha around the area provided warmth and bathing. Various locations also provided micro climates for planted cultivations, including the growing of kumara. Areas around the wider Paeroa Range and Maunga Kakaramea held pa which were places of refuge and battles. Burial grounds are also present in different areas, including the burial site of one of the prominent ancestors of Ngati Tahu-Ngati Whaoa – Maaka, who is a direct descendant of Tahumatua. Tahumatua is the eponymous ancestor from whom the tribe derive part of its name. Large areas of flax and wetlands would have been historically present in and around both the Reporoa Basin and the nearby Waikite Valley (adjacent to the Paeroa Range). These areas would have provided birds for food and flax for weaving. Various tracks linked these resources and areas together, with many streams used as pathways. Tracks also provided links to the rest of the Ngati Tahu-Ngati Whaoa rohe to the west, east and south of these sites and between the lowlands and the Paeroa Range. Ngati Tahu-Ngati Whaoa have a desire to see the links from the Paeroa Range extended and improved. The idea of corridors to link the range and the streams will provide reinstatement for seed dispersal, wildlife corridors, facilitate mahinga kai movement and habitat, link geothermal areas, assist in reinstating tupuna tracks, and recognise key pa, kainga, and mahinga kai sites.

<table>
<tr><td></td><td>Ngati Tahu-Ngati Whaoa wish to facilitate and work with others to achieve our vision. We wish to work with relevant agencies and the community to develop and coordinate a process and method to achieve this long term vision.

This project will draw together and build on existing upper Waikato River priorities identified in the Restoration Strategy, while also looking at sites which are not covered in the Restoration strategy.

This work will not replace any requirements of regulatory processes on private landowners. This project seeks to build on additional opportunities which fall outside of these processes.</td></tr>
<tr><td>Key threats/issues</td><td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Loss of kai species and abundance</td><td>Availability of healthy and abundant mahinga kai for Ngati Tahu-Ngati Whaoa people.</td></tr>
<tr><td>Loss of access</td><td>Ability to harvest in some areas and practice kaitiakitanga.</td></tr>
<tr><td>Erosion/sediment</td><td>Contribution to sediment loads to the Wai-O-Tapu and Whirinaki streams and the main Waikato River.</td></tr>
<tr><td>Stock access to seeps, wetland areas</td><td>Reduced water quality and soil compaction. Loss of wetland vegetation and habitat. Increased nutrient loads to streams.</td></tr>
<tr><td>Unfenced areas of native vegetation</td><td>Reduced biodiversity opportunities, reduced opportunity for native corridors between tributaries and main river.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for tuna and koura.</td></tr>
<tr><td>Other weeds (willow, blackberry, wilding pine)</td><td>Compete with other native species and alter ecological processes of streams and native riparian areas.</td></tr>
</table>
</td></tr>
<tr><td>Project goal/s (SMART)</td><td>Ngati Tahu-Ngati Whaoa are influential in working with others in developing mechanisms and frameworks to achieve the following long term goals:
- All streams from the Paeroa Range are fully fenced (where pastoral) to exclude stock and protect erosion prone areas.
- All streams from the Paeroa Range are fully planted in natives or other appropriate species.
- Plantings are maintained and are providing suitable corridors for movement of species.
- Overall increase in riparian habitat facilitates a greater abundance, diversity and integrity of native species (mahinga kai, birds, invertebrates, plants) within the rohe.</td></tr>
</table>

	- Increased riparian links are contributing to soil conservation measures and water quality improvements in Te Awa o Waikato.
Works required (quantity and description)	This project is focused on Ngati Tahu-Ngati Whaoa having the ability and resource to advocate and work with others to achieve these outcomes. This work would be a two stage approach: Stage 1: Project liaison officer to work with others (agencies, community) to assess current state, needs, opportunities and risks to achieving the vision. Development of an overarching plan to achieve the vision. Investigation of potential frameworks and methods for implementation. 3 years – contractor costs $100 per hour for 8 hours per week. Total cost $124,800. Stage 2: Implementation of works and sourcing of funding. **Costs for this component will remain unquantified until step one is complete and options and work requirements are known.**
Risks to project success	There is some risk to being able to fully implement this project. Given the uncertainty about the extent of what works may be required to achieve this goal, one of the key risks is that future funding to implement works may not be available or considered a priority to achieve this goal. The adoption of this project and ongoing measures of protection and enhancement may be supported by agencies and land trusts the response of private landowners is unknown. This will depend on what type of works and access arrangements are proposed.
Land tenure – likelihood of adoption and adoption circumstances	A mixture of land ownership is present in and around the Paeroa Range. There are some sites on land owned by Ngati Tahu-Ngati Whaoa land trusts or on land owned by the Crown. Much of the area is in private land ownership.
Knowledge gaps and response	The detailed information on the current condition and protection of the relevant streams is currently unknown. Therefore the extent of the work required to achieve this vision is unknown. The willingness of others (community and agencies) to be part of this project is currently unknown. Current legislative changes may also impact what works may be required by others to achieve this vision (eg, Healthy Rivers Plan Change 1).
Project duration	Stage one – 3 years Stage two – unknown

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>

Works description	Cost ($)
Stage one – project liaison officer	$124,800
Stage two project costs unknown	-
Project management/staffing/incidentals (20%)	$24,960
Total	**$149,760**

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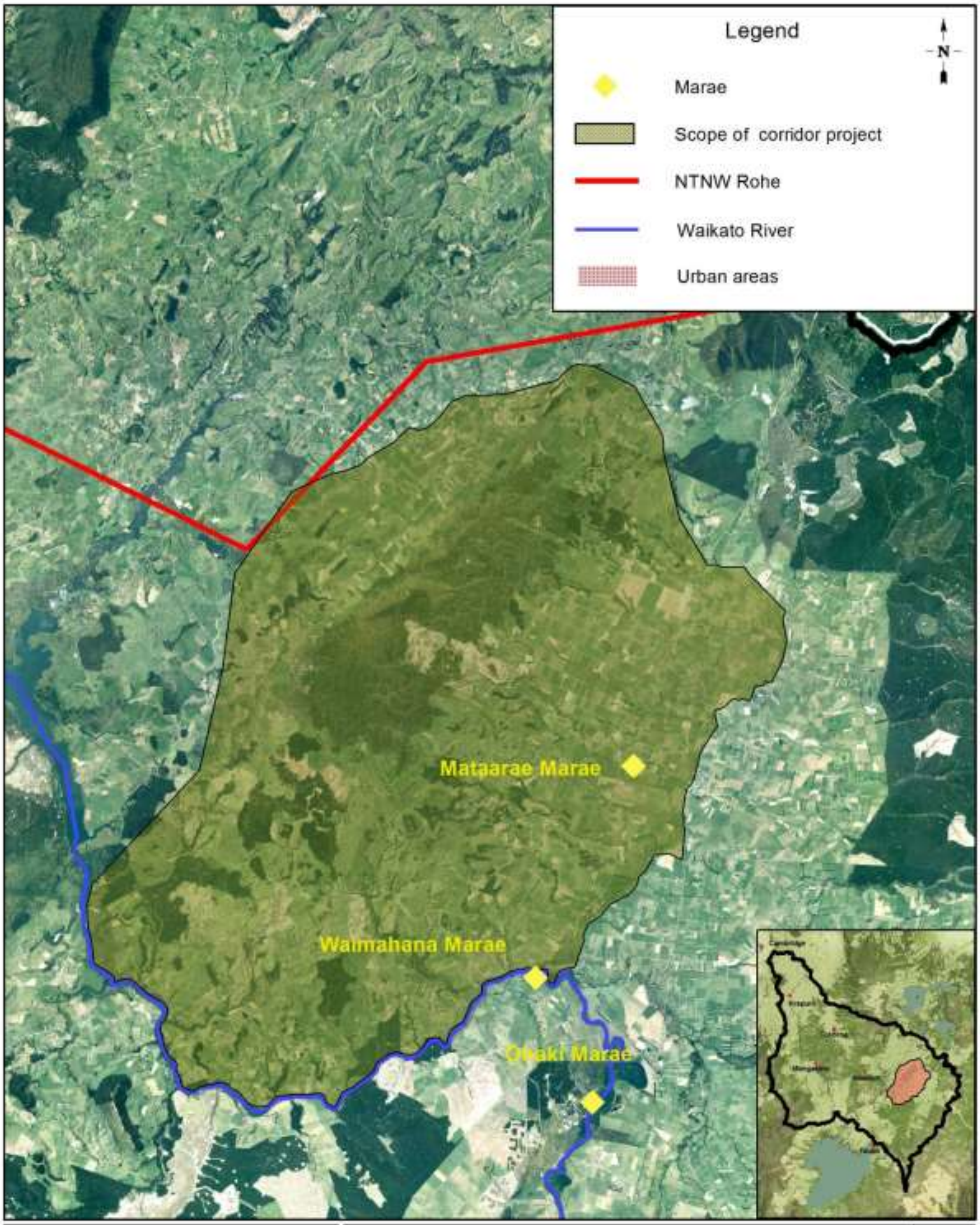

Establish fenced and planted corridors for all streams from the Paeroa Range within the catchment

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Waikato REGIONAL COUNCIL

Paeroa Range (Ngati Tahu-Ngati Whaoa Runanga Trust – 2013)

NTNW 10 Ngati Tahu-Ngati Whaoa **Priority: Very high**	**Ohaki Wetland enhancement and restoration**
Vision	Ohaki Wetland is fully planted and provides the following: - A source of materials for cultural purposes - Maximum habitat for water fowl - Protects and enhances natural values of the land - Assists in playing a role in enhancing water quality in this area - Extends wetland habitat and biodiversity for the upper Waikato River. - Access to enhance iwi, community and general public appreciation, knowledge and enjoyment of wetlands.
Location	Ohaki Wetland, Broadlands Road, Broadlands
Brief description of site	Ohaki Wetland is a 36ha constructed wetland adjacent and connected to Te Awa o Waikato. The wetland is owned by Ngati Tahu-Ngati Whaoa Runanga Trust and protected by a conservation covenant. The wetland is jointly managed by the Runanga and Fish & Game Eastern Region. The wetland was created in 2010 by Fish & Game and Contact Energy with funding from WCEET and others. The wetland is located at a site of previous natural wetlands and in an area which has been subject to subsidence from operation of the Ohaki Power plant. The wetland was created to provide further wetland habitat in an area of the awa which was once rich and abundant with these ecosystems. Some planting has occurred already at the site and various interpretation and signage is provided for visitors. The site is used for gamebird hunting purposes during hunting season. There is currently a network of existing pest animal control in place over approximately half the wetland area. Ohaki Wetland adds value and connectivity to the other wetlands in the area, including Rawhiti to the south and the associated wetlands on the western side of the river at Ohaki Marae, as well as Hardcastle Lagoon which bounds the northern end of Ohaki Wetland. The predominant land use in the catchment is pastoral farming. The wetland is fed from a small inflowing stream to the east and from groundwater. The wetland is fully fenced (3.01km boundary fence) with fencing in variable condition. The total land area within the wetland (excluding the open water areas) is 22.4ha. Of this, approximately 7ha is already planted and another 1ha planned in 2017. A total of approximately 15ha remains in grass. A proportion of this grass area is currently grazed as a management tool to

<table>
<tr><td></td><td>minimise pest plant growth. With planting grazing will be gradually reduced with the intent to be fully stock free upon planting completion.

The area has strong cultural associates for the Ngati Tahu-Ngati Whaoa people. The Ohaki and Waimahana areas were places of large kainga, pa and cultivations for the iwi. The geothermal areas were used for bathing and other purposes, while the river and associated wetlands provided food, materials and transport pathways.</td></tr>
<tr><td>Key threats/issues</td><td><table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Willow invasion(from other sites)</td><td>Loss of open water habitat within the wetland, shading of other plant species and spread within wetland areas.</td></tr>
<tr><td>Potential for further enhancement of site not realised</td><td>Potential of wetland enhancement and associated values not realised.</td></tr>
<tr><td>Iwi ability to use the site for harakeke and other plant harvest not realised</td><td>Site remains not fully vegetated and full potential of the wetland is unrealised. Opportunities for cultural harvest are reduced.</td></tr>
</table></td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 20 years of project commencement, Ohaki Wetland is fully planted and stock continue to be excluded. The wetland increases the available habitat for bird species and contributes to a network and corridor of wetland habitats in the Upper Waikato catchment.</td></tr>
<tr><td>Works required</td><td>Continue to plant and enhance the 36ha constructed wetland located at Ohaki adjacent/connected to the Waikato River to facilitate fauna, flora and ecological values. This work would involve:
- Planting and maintenance of remaining areas in wetland (15ha) at $37,552 per hectare. Planting will be at 1.5m spacing and some plants will be clumped. Areas to be planted will be “ripped” prior to planting to loosen pumice soils. Mulch will be used and native planting fertiliser tablets to enhance survival. Planting times factor in frosts and dry summers to enhance plant survival.
- Maintenance of invasion of willow within the wetland (from the main river). Willow control (2ha total over 20 years) at $4000 per hectare (ground control).
- Maintenance of existing fences to ensure stock exclusion – average of $1000 per year for 20 years for removal of windfalls, repair of fencing, and some replacement if required.</td></tr>
<tr><td>Risks to project success</td><td>There are minimal risks to the project success.
The runanga is the landowner and continued enhancement measures are supported by Fish & Game. The wetland is protected by a conservation covenant.</td></tr>
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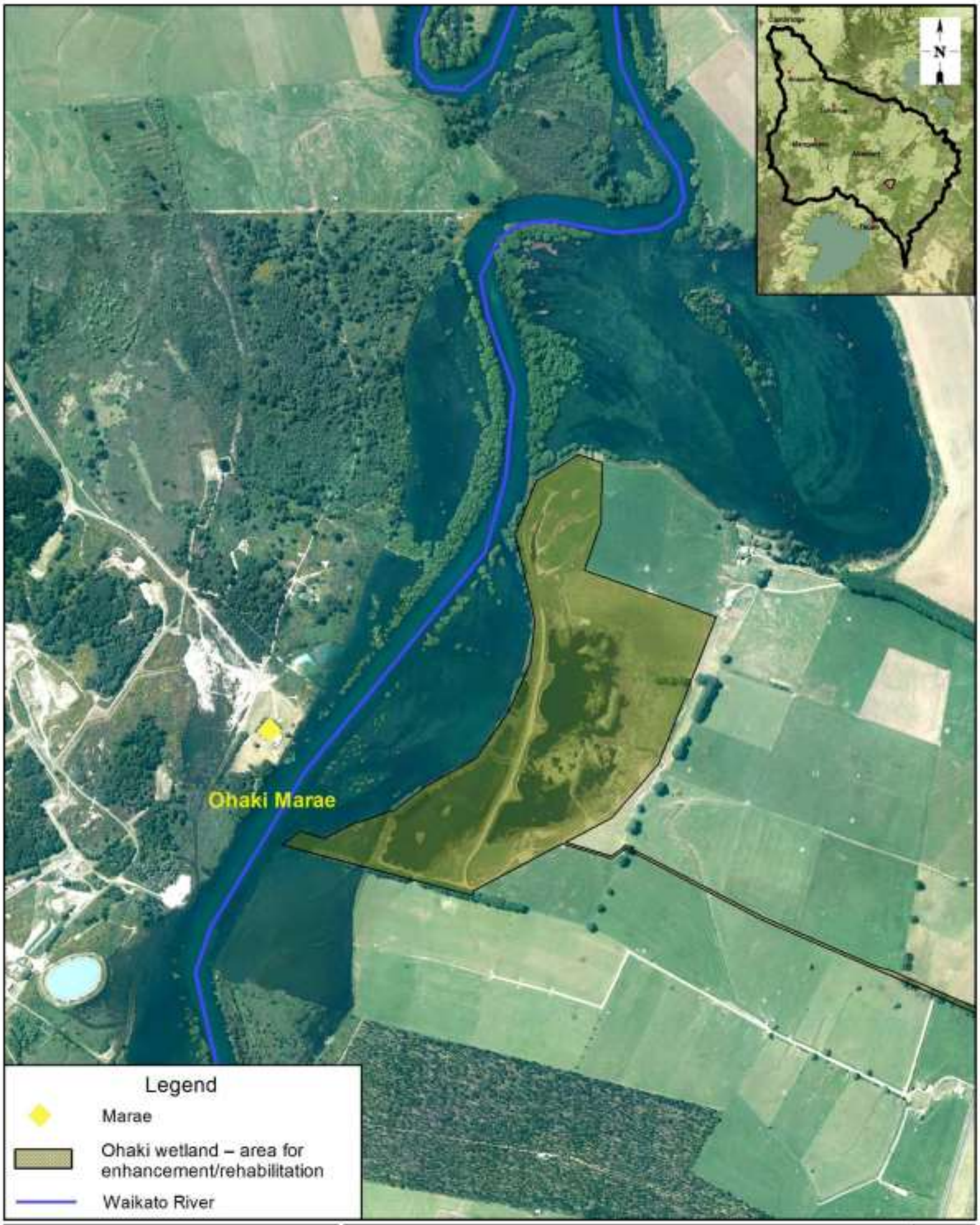
<tr><td></td><td>The site is difficult to ensure planting success, however both the runanga and Fish & Game have developed methods to achieve plant survival in the upper catchment. This knowledge and these techniques should be applied to this project to reduce plant loss.</td></tr>
<tr><td>Land tenure</td><td>Land is owned by Ngati Tahu-Ngati Whaoa Runanga Trust. There are no barriers to adoption. The site is co-managed in conjunction with Fish & Game who are supportive of continued enhancement to achieve the goals of the covenant.</td></tr>
<tr><td>Knowledge gaps and response</td><td>The site is well known and there is extensive knowledge available to provide background to this project. The limitations and issues with enhancement/restoration are already known for this site.</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Works description</th><th>Cost ($)</th></tr>
<tr><td>Planting and maintenance of remaining areas in wetland ($37,552 per hectare)</td><td>563,280</td></tr>
<tr><td>Willow control (2ha total over 20 years) at $4000 per hectare</td><td>8000</td></tr>
<tr><td>Maintenance of existing fences – average of $1000 per year for 20 years</td><td>20,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>118,256</td></tr>
<tr><td>Total</td><td>709,536</td></tr>
</table>
</td></tr>
</table>



Ohaki Wetland enhancement and restoration

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

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Waikato REGIONAL COUNCIL

Ohaki Wetland graphic (Fish & Game, 2010)


Ohaki Wetland (Fish & Game, 2011)

APPENDIX 12 - Ngāti Tūwharetoa River Iwi Project Assessments

Contents

Tūwharetoa 1 Priority: High	Enabling descendants of Ngāti Tūwharetoa to enhance the mauri o ngā whenua me te taiao
Project summary	This project aims to provide Area B Ngāti Tūwharetoa descendants with the skills they require to fulfil their functions, roles, responsibilities and aspirations as kaitiaki o te taiao. Furthermore, it also aims to build the capacity of Area B families who whakapapa to the Area B Waikato River marae by allowing them to gain the New Zealand Certificate in Conservation (Operations) (Level 4).
Vision for the project	Educate 30 people over 10 years (3 per year) to the level of the New Zealand Certificate in Conservation (Operations) (Level 4). Also, with the aid of MoUs and potential internships, support these graduates in finding employment with key partners.
Location of training	Taupō and surrounds. Area B primarily but flexibility to train with Ngāti Tūwharetoa rohe will be an advantage. When appropriate, training will be undertaken on marae or within areas of significance. However, when this is not possible, at a site to be determined by the trainer and training establishment.
Brief description of the project	Encourage Area B Ngāti Tūwharetoa marae descendants to enhance mana whenua and build capacity within the Waikato River marae iwi. When possible, training will be undertaken in the field to ensure that as many learning opportunities as possible include a real world component of working in the rohe. Dialogue will occur with organisations such as the Department of Conservation, Waikato Regional Council and Taupō District Council, among other TMTB partners relating to providing employment opportunities for the graduates once they have finished.
Key threats/issues	- Descendants leaving the Ngāti Tūwharetoa rohe to pursue work in other localities. This would lead to further disconnection with the land, river and general environment. - Kaitiakitanga and tino rangatiratanga may be diminished as whanau leave and works are potentially undertaken by people who do not whakapapa to Ngāti Tūwharetoa.
Project goal/s (SMART)	Within 10 years, up to 30 (3 per year) Area B descendants (as outlined above) are trained to industry standards to enable mana whenua and kaitiakitanga while building capacity and maintaining tino rangatiratanga. Upon completion of each course, students will be helped to secure internships with area B organisations. Furthermore, when possible, students undertake internships during the programme to gain employment skills and marketability while also undertaking work within the catchment. This could be reviewed after five years to ensure continuity of this project.

Works required (quantity and description)	**Programme cost** The Toi Ohomai Institute of Technology currently offers the New Zealand Certificate in Conservation (Operations) (Level 4) in Taupō and Turangi. Contained within this programme are the following unit standards: - Health and safety training - Chainsaw training - Fencing - Quad bike use - Plant identification (to ensure any past plantings are not killed) - Agrichemical and pest control training - Project management Discussions with significant stakeholders has identified that Ngāti Tūwharetoa descendants who have a qualification such as the New Zealand Certificate in Conservation (Operations) (Level 4) can obtain contracts to undertake works. As an example, the recent devastation caused by Cyclone Cook resulted in a significant amount of damage to the environment. Unfortunately, one external stakeholder organisation was unable to allow whanau to undertake works because they did not have the appropriate 'tickets', and therefore caused a perceived health and safety risk to the organisation. $5679 per student, per annum x three students = $17,037. When extended out to 10 years = **$170,370** (as per outline provided from the Toi Ohomai Institute of Technology). **Travel grants** for each participant of $3000 per annum. Some participants will be driving long distances to attend this training in the hopes of obtaining employment skills, while also having high expectations placed on them to build the capacity of the marae. A travel grant will help to ease this burden while providing a gesture aimed to encourage them to stay enrolled. This amount is not intended to be paid as a lump sum, but may be offered to participants in the form of petrol vouchers which can be 'topped up' regularly. Broken down over the entire course, the $3000 is the equivalent of $93.75 per week, or $18.75 per day. 3 x students per year = $9000 Over 10 years = **$90,000.** **Legal and engagement costs** to establish MoUs with partner stakeholders **$20,000.** **IT** work for online applications at $1000 per annum = **$10,000.** Applicants who wish to apply for funding from the Tūwharetoa Māori Trust Board to undertake this training will be required to apply online. Therefore,

	the appropriate platform will need to be generated and maintained over the 10 years of this project. **Personal protective equipment** Allowance for personal protective equipment such as gumboots for spraying, steel cap boots for chainsaw work, safety glasses, etc at $1000 per year = **$30,000.** A regulation may be put in place requiring the selected participants to obtain quotes from preferred suppliers (yet to be identified, but will be of industry standard), which Ngāti Tūwharetoa can then pay for from this amount. **Project management/staffing/incidentals (20%)** This initiative will cover the costs incurred in delivering this project. Such things will include iwi liaison, media, stakeholder engagement (initial MoU development), recruitment of participants, identification of 'real world' opportunities for the implementation of unit standards earned, and other things as they arise.
Risks to project success	- Participants pulling out - Partners/stakeholders leaving the programme - Drop in applicants - Low numbers graduating - No suitable training provider - Failure of memorandums of understanding to be established between the Tūwharetoa Māori Trust Board and key organisations including but not limited to the Ministry of Social Development, Department of Conservation and training organisations. - Flooding the employment market with newly qualified graduates. For this reason, the annual intake is expected to have no more than 3 Ngāti Tūwharetoa descendants.
Land tenure – likelihood of adoption and adoption circumstances	N/A
Knowledge gaps and response	No known knowledge gaps.
Project duration (years)	10 year project, to be reviewed after 5 years.

Costs	**New Zealand Certificate in Conservation (Operations) (Level 4)** — **Cost ($) per annum**

New Zealand Certificate in Conservation (Operations) (Level 4)	**Cost ($) per annum**
Programme cost	$170,370
Travel grants	$90,000
Personal protective equipment	$30,000
Legal costs	$20,000
IT	$10,000
Project management/staffing/incidentals (20%)	$64,074
Total	**$384,444**

Tūwharetoa 2 Priority: Very high	Wānanga for all 8 Ngāti Tūwharetoa Area B marae
Project summary	This project seeks to find the current views of Ngāti Tūwharetoa Area B marae in order to update its River Action Plan as required. Also, the aim of these wānanga are to find sites of significance that require acknowledgement and potential remediation.
Vision for project	Provide Ngāti Tūwharetoa descendants with an opportunity to contribute to identifying future works within the Area B catchment that ensure the principles, hopes and aspirations outlined in Te Ture Whaimana are implemented.
Location	Ōruanui Marae and Waipāhīhī Marae due to the location of both marae being central for attendees from all Ngāti Tūwharetoa Area B marae. However, other marae may be considered based on availability.
Brief description of site	N/A
Key threats/issues	Historically, people may not have had the opportunity to participate and contribute to this process.
Project goal/s (SMART)	Within one year, Ngāti Tūwharetoa descendants have had the opportunity to contribute to identification of future priority works in relation to the catchment. Dialogue surrounding mana whenua is enhanced with Ngāti Tūwharetoa Waikato Awa Area B Marae descendants, leading to more accurate recording of concerns within the Waikato River marae members. Within one year, accurate GIS spatial maps (ghost layers may be considered) will be produced for Ngāti Tūwharetoa's upper Waikato River marae showing sites of significance to be worked on.
Works required	These wānanga are primarily an information gathering exercise. They are also an opportunity for marae members to contribute to potential future works, while feeling heard and connected with the awa. The wānanga will be up to two days duration and preferably held in the weekend to allow whanau who work the opportunity to attend. However, if marae are booked then a mid-week wānanga may be considered. Whanau will gather at Ōruanui and Waipāhīhī marae (dates to be decided upon). After proper tikanga and kawa is adhered to, the wānanga will begin with an appropriately trained and experienced facilitator (yet to be sourced) who will run mini wānanga to target sought after information. Wānanga may run in a way that gathers information on the first day, and provides a summary on the second day, with an opportunity for clarification. Large maps will be sourced for use at the wānanga for

	identification of significant sites. If the maps are not detailed enough then GOOGLE Earth may be used. Questions to be asked may include: - What significant sites are you aware of within the rohe? - What do you think should be done to protect them? - Can you list: mahinga kai, taniwha, puna, awa and tributaries of significance? - Mapping exercise - Others to be identified but will be decided upon in collaboration with the marae working group for the Waikato River, Te Kaihautu o te Awa o Waikato. The **GIS** analyst will create maps to show sites of significance to Tūwharetoa river hapū. They will also make maps to identify the local and overall catchment. This is of particular importance as some whanau may not be aware of the extent of the catchment and how the wider environment impacts upon sites of significance. The GIS analyst will also be required to make themselves available to answer any questions asked by whanau while at the wānanga. There may also be an opportunity for the analyst to show whanau members how to use GIS apps from the app store to help them, and projects, in the future. Costings - Kaikaranga and kaikōrero $1000 per pōwhiri (total of 2 pōwhiri – **$2000**). - Pōwhiri costs for each set of wānanga **$18,000** ($1500 per 20 people at each marae including kōha, kai and venue – 2 days). - Facilitator **$6400** (2 days x 2 wānanga). - GIS spatial mapping consultant to generate maps **$10,000.** - Travel expenses for approximately < 60 people per wānanga **$4000.** **Project management/staffing/incidentals (15%)** A project manager will be required to coordinate all facets of this project. This is estimated to be 15% of project costs.
Risks to project success	- Whanau not being able to make it to the wānanga due to external commitments or lack of funding for fuel. - There is a risk that none of the younger generation will feel comfortable adding their thoughts due to potentially clashing with kaumatua. - GIS analyst not being available on the weekend that the wānanga run.
Land tenure – likelihood of adoption and adoption circumstances	N/A
Knowledge gaps and response	This project relies on being able to contract an appropriately trained and capable facilitator and capable GIS analyst.
Project duration (years)	1 year project

Costs	

Works description	Cost ($)
Kaumatua (kaikaranga and kaikōrero)	2000
Transport	4000
Pōwhiri	18,000
Facilitator	6400
GIS mapping consultant	10,000
Project management/staffing/incidentals (15%)	6060
Total Cost	**$46,460**

<table>
<tr><td>Tūwharetoa 3

Priority: Very high</td><td>Multi phased Ngāti Tūwharetoa archives project</td></tr>
<tr><td>Project purpose and summary</td><td>The purpose of this project is to identify, collect, collate, describe, reformat, reproduce and preserve Ngāti Tūwharetoa's documentary sources of significant historical and cultural information pertaining to the taonga tuku iho (natural resources) of the upper Waikato River, including their management and utilisation.

The project is segmented into 3 phases. Phases 1 and 2 are of very high priority for Ngāti Tūwharetoa. Phase 3 is important but is intended for implementation over the longer term.

Phase 1 is intended to commence with urgency to prevent further erosion of oral historical information as a result of debilitation or the passing of elders who are the living holders of this information. This phase will focus on identifying and obtaining the consent of living pakeke and kaumatua for the purpose of recording their memories of lifetime events and experiences and focus on information pertaining to kaitiakitanga o Te Awa o Waikato, surrounding whenua and related taonga.

Phase 2 is also high priority because it seeks to identify important and recorded but not obviously or readily available sources of historical and cultural information pertaining to kaitiakitanga and sustainable use practices and experiences relating to Te Awa o Waikato and its related taonga.

There is urgency to identify, collate and access this information because it provides verification of Ngāti Tūwharetoa mātauranga, values and tikanga. This is the baseline starting point to enable Ngāti Tūwharetoa hapū to implement the vision and objectives of Te Ture Whaimana within a Ngāti Tūwharetoa cultural and spiritual context, verify their legitimacy and achieve a basis from which to evaluate 'success' within the transformative arrangements of co-governance and co-management under the Waikato River statutes.

Due to the urgency of phase 1 and 2 it is proposed that they both run concurrently.

The purpose of phase 3 is primarily to reformat, reproduce and preserve Ngāti Tūwharetoa's documentary sources so that they can be accessed, utilised and transmitted in appropriate medium. Given the differing time sequences involved in collating information within phases 1 and 2, and the need to access and utilise this information to</td></tr>
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	progress objectives and processes for the implementation of Te Ture Whaimana, parts of phase 3 may begin prior to the completion of phase 1 and phase 2.
Project engagement	**Phase 1** Engage Ngāti Tūwharetoa elders and persons who whakapapa to hapū and marae contained within Area B of the settlement legislation. In addition, elders and wananga participants who have lived in Area B or along the Waikato River may also be engaged for recordings where their lifetime experiences and knowledge is relevant to the purpose of this phase. **Phase 2** Primary sources of information relating directly to Te Awa o Waikato and its taonga include: - Ngāti Tūwharetoa trusts' and incorporations' private 'archives' that may or may not be in any systematic form and for which many have not been identified - Hapū, whanau, individuals' and working committees' archives. Many of these are in different states of care and consent for access is necessary. External sources of relevant information: - government agencies and state owned enterprises - external institutional archives – records from local, regional and national government agencies - research organisations – NIWA, Landcare NZ, GNS, Scion, etc - libraries - academic institutions, including universities, technical institutes (sources include research projects, theses and dissertations for advanced degrees, as well as the results of funded research web search engines) - news media (newspapers, magazines, and radio and TV archives may hold recordings or articles) - business and industry institutions, eg Genesis, Mercury, tourist companies - advocates and watchdog organisations may collect relevant data, including community activists and individuals may have useful information, Museums and National Archive.

	Some of the types of repositories mentioned above may incorporate a museum or contain libraries and/or archives. **Phase 3** Reformatting, reproduction and preservation of documentary sources requires engagement with and the consent of each organisation or individual from which material is sourced. It also requires expert advice on options, conditions and protocols.
Location	Phase 1 will see the majority of the works being undertaken around the countryside depending on where the kaumatua are living. Occasionally interviews can be filmed on marae, however some individuals who are ill or infirm, or simply unable to travel, may need to be interviewed at their place of residence. All archives gathered will be relevant to Area B (of the upper Waikato River) in relation to the river settlement legislation.
Brief Description of site	N/A
Key threats	**Phase 1** - The loss of information to establish the vital Ngāti Tūwharetoa knowledge that is necessary to validate and substantiate tikanga, kawa, mātauranga pertaining to taonga tuku iho within Area B (upper Waikato River, its tributaries, adjoining whenua, water body habitat (fishery and biophysical), metaphysical attributes). - Loss of knowledge and information of events and experiences of persons who witnessed or were recipients of information of particular practices, rituals, events relating to kaitiakitanga and rangatiratanga or its application to taonga tuku iho within Area B or other parts of te rohe o Ngāti Tūwharetoa. - Further delays would put at risk the opportunity to gather information from elderly and those who may be debilitated through illness. - Further loss of the above information erodes the ancestral connection between Ngāti Tūwharetoa and their ancestral taonga. - River/water and adjoining land activities within Area B are allowed to be undertaken without taonga tuku iho being subjected to representative due diligence (identification and articulation of values and cultural and metaphysical attributes or their representation within planning, management and monitoring documents), that properly reflects and enables delivery of Ngāti Tūwharetoa expectations, co-governance and co-management processes. - Sites and features left unidentified may become irreparably damaged or forgotten as features of past hapū or whanau experience, occupation, use and history.

	- No base system or format has yet been created to enable Ngāti Tūwharetoa descendants of specific taonga within the rohe. **Phase 2** Information may exist as paper files (manuscripts, letters, photographs, books, and diaries), recorded form (moving image and sound materials), artwork, artifacts, and as digital equivalents of all of these on electronic storage – computer disks, CDs, DVDs, etc. - All key threats identified in phase 1 are applicable to phase 2. - Loss, destruction or damage to all forms of relevant documentation is a risk without detection of, or delays in, identifying sources. - Archives have <u>specific guidelines</u> for how people may access and use collections. The sources of information being collated or contained within them must be appropriately and securely protected from physical damage and theft. **Phase 3** - Archives may become progressively damaged and/or indecipherable. - External stakeholders may redecorate, renovate or inadvertently destroy taonga (e.g. letters, photographs, books and reports) without being aware of the significance of those taonga.
Project goals (SMART)	**Phase 1** - Within one year of project commencement, information gathering has been successfully undertaken and interviews have been recorded for up to 30 kaumatua. - Data has been secured in the Tūwharetoa archives and mapped as required. - Within the two years of project commencement, the physical resource (booklet) has been created and distributed to key stakeholders (interviewees, Area B marae, potentially made available online (decision pending) and the Tūwharetoa Māori Trust Board). **Phase 2** - Within one year of project commencement, the archives held at the Tūwharetoa Māori Trust Board's storage area in Turangi have been reviewed for data relating to Area B of the Waikato River and its catchment. - Archives held at the Tūwharetoa Māori Trust Board's offices in Taupō have been collected and collated, or made known for phase 3. - External stakeholders have been identified along with sources of information known to or held by them.

	- External stakeholders have been identified for further exploration in phases 2 and 3. **Phase 3** - Within four years of the commencement of this project, all available archive information has been sourced, secured and recorded in the database with successful, key relationships built between internal and external stakeholders. - Data collected has been incorporated into literature which may influence the Ngāti Tūwharetoa River Action Plan. - Taonga held at various whare-taonga has been visited, recorded, and appropriate respects paid.
Works Required	Engage Ngāti Tūwharetoa elders and persons who whakapapa to hapū and marae contained within Area B of the settlement legislation. In addition, elders and wānanga participants who have lived in Area B or along the Waikato River may also be engaged for recordings where their lifetime experiences and knowledge is relevant to the purpose of this phase. **Phase 1** Current archives that Ngāti Tūwharetoa hold will be explored for information relevant to the Waikato River. When found, information will be: - secured and maintained in digital format - translated and transcribed as required - regularly updated and made available to the Tūwharetoa Māori Trust Board and Te Kaihautu o te Awa o Waikato (formerly Marae Working Group). Information gathering - Kaikāranga and kaikōrero for up to eight pōwhiri ($500 per person = $1000.00 x 8) **$8000.** - Potential pōwhiri costs for each set of interviews (marae including kōha, kai and venue hireage of $1500 per pōwhiri) **$12,000.** - Koha of $500 for each of the 30 kaumatua being interviewed **$15,000.** - Contractor to video record and edit interviews **$15,000.** - Interviewer ($100 per hour x 5 hours per interview) **$10,000.** - GIS consultant to spatially map any identified significant sites **$10,000.** Development of booklets - Translation and transcription of interviews (up to 4 hours for each hour of recording when needing translation) **$30,000.**

	- Design contractor to design booklets **$7000** (based on a quoted price). - Contractor to print 500 booklets **$9000** (based on a quoted price). Phase one amount required **$116,000.** **Phase 2** Information gathering - Kaikāranga and kaikōrero for up to eight pōwhiri ($500 per person = $1000 x 8) **$8000.** - Potential pōwhiri costs (marae including kōha, kai and venue hireage of $1500 per pōwhiri) **$12,000.** - One-on-one hui with stakeholders collating data at $100 per day for approximately half of the project with the other half being undertaken in the office. Therefore, half of eight months is approximately 16 weeks at $100 per working day **$8,000.** Information processing - Pro rata ($60,000) archivist to collect and safely collate and store documents for up to eight months **$40,000.** - Storage containers to store documents at $23 x 30 = **$690.** - GIS Consultant **$10,000.** Phase two amount required = **$78,690.** **Phase 3** Information gathering - Kaikāranga and kaikōrero for up to eight pōwhiri ($500 per person = $1000 x 8) **$8000.** - Potential pōwhiri costs (marae including kōha, kai and venue hireage of $1500 per pōwhiri) = **$12,000.** Information processing - GIS consultant **$25,000** - Archivist to collect and collate data, and find new sources to grow our archives. This person should be of Ngāti Tūwharetoa descent so the iwi can continue to grow its capacity. They will have a minimum of a Bachelor of Arts **$150,000.** Phase 3 amount = **$195,000.** Grand total = **$389,690.** **Project management/staffing/incidentals (25%)**

	Project management for this project is estimated to be 25% of the project cost and will cover the costs associated with organising hui, iwi liaison, procurement of contractors and project co-ordination. It will also cover incidentals such as printing and stationery.
RISKs to project success	- Kaumatua may be resistant as some similar projects have been done in the past (if this occurs, they will be reassured that phase 2 will focus on accessing this data) - Descendants of people who have now passed, or will pass, may not allow taonga to be collected or copied for use in decision making. These include but are not limited to in-house decisions, RMA applications and Environmental Court hearings. - Internal political concerns as some hapū may be reluctant to share their taonga (or copies of), regardless of this project being in aid of securing its mātauranga for Ngāti Tūwharetoa. - Unwillingness to share if archiver is not of Ngāti Tūwharetoa descent. - General reluctance to cooperate.
Land tenure and likelihood of adoption	N/A
Knowledge gaps and response	No known knowledge gaps.
Project duration (months)	**Phase 1 -** 24 months **Phase 2 -** 8 months **Phase 3 -** 36 months
Costs	Phase 1

Works description	**Cost ($)**
Information gathering	
Kaikaranga and kaikōrero for pōwhiri	$8000
Pōwhiri/hui costs	$12,000
Koha for kaumatua being interviewed as experts	$15,000
Filming and editing	$15,000
Interviewer	$10,000
GIS consultant	$10,000
Booklet development	
Translation and transcription	$30,000
Booklet design	$7000
Booklet printing	$9000
Total	**$116,000**

Phase 2

Information gathering	
Kaikaranga and kaikōrero for pōwhiri	$8000
Pōwhiri/hui costs	$12,000

One- on-one hui with stakeholders	$8000
Information processing	
GIS consultant	$10,000
Archivist	$40,000
Storage bins	$690
Total	**$78,690**

Phase 3

Information gathering	
Kaikaranga and kaikōrero for pōwhiri	$8,000
Pōwhiri costs	$12,000
Information processing	
GIS consultant	$25,000
Archivist	$150,000
Total	**$195,000**

Subtotal = $389,690
Project management/staffing/incidentals (25%) = $116,907
Grand total = $506,597

<table>
<tr><td>Tūwharetoa 4</td><td rowspan="2">Fencing of Ngāti Tūwharetoa sites of significance</td></tr>
<tr><td>Priority: High</td></tr>
<tr><td>Project summary</td><td>This project aims to provide up to 80km of fencing at sites of significance within Area B of the Waikato River.</td></tr>
<tr><td>Vision for project</td><td>Sites of significance are well fenced, to a minimum of five wire (2 electric), to safeguard significant sites from further mistreatment and disturbance. Fencing will improve the health and safety of taonga when used by tāngata whenua.</td></tr>
<tr><td>Location</td><td>Various marae and tributaries throughout the catchment from Te Toka a Tia to Waipapa River. This potential project has been identified via several hui and wānanga.

In particular, sites of significance must be related to the waterways via the main stem or associated tributaries, which include:
- uru pā
- wāhi tapu
- wāhi tupuna
- mahinga kai
- māra
- kainga
- puna
- taniwha
- caves
- wetlands
- battle sites
- Treaty sites
- rivers
- streams
- lakes
- borrow pits
- avian corridors
- swimming holes and bathing sites
- geothermal fields
- marae.</td></tr>
<tr><td>Brief description of site</td><td>Sites noted above within Area B.</td></tr>
</table>

<table>
<tr><td>Key threats/issues to the sites</td><td>
<table>
<tr><th>Threat</th><th>Impact on sites</th></tr>
<tr><td>Access to sites</td><td>Ideally tāngata whenua will be able to access all sites of significance without any issues arising with owners preventing access. However, this is unlikely to occur so:
- tāngata whenua become less connected with their significant sites and are less likely to visit and maintain them
- animosity builds between the landowners and tāngata whenua
- taonga are irreparably damaged and/or destroyed.</td></tr>
<tr><td>Environmental conditions from the upper catchment</td><td>- Some environmental conditions, such as flooding, slips and overgrown accessways may cause health and safety concerns for people wanting to access significant sites.
- High levels of sediment suspension and deposition within streams and rivers can damage significant sites and sensitive organisms.</td></tr>
<tr><td>Vegetation</td><td>Overgrown exotic vegetation can shade out native vegetation. Weeds could also cause issues with site access and safety while navigating waterways and pathways. Many noxious and introduced weeds are spread by animals. By excluding animals this would help to prevent this from occurring.</td></tr>
<tr><td>Animals (e.g. pigs, cows, deer, etc)</td><td>- Trampling and pugging of soils leads to increased erosion impacting upon growth of plants and sedimentation of waterways that were historic kai gathering sites. This also includes fisheries.
- Increased levels of E. coli in the ecosystem.
- Selective grazing can occur leading to exotic plants overgrowing endemic vegetation.</td></tr>
</table>
</td></tr>
<tr><td>Project goal/s (SMART)</td><td>Within 10 years of project commencement, 80km of fencing has been completed protecting sites of significance.</td></tr>
<tr><td>Works required</td><td>Fencing
Construct up to 80km of fencing to a minimum of 5 wire (2 electric) fencing ($8 per metre over 80km = 80,000 meters) to protect significant sites $640,000. Note, 80km is an estimate and actually fencing requirements may differ.

GIS mapping
This would involve mapping all the work that has been undertaken and ground truthing the works to ensure maps have been done correctly. GIS</td></tr>
</table>

	can also be used to cost projects due to the undulating surface features on the environment, \$2500 per annum. Total cost **\$25,000.** **Project management/staffing/incidentals (20%)** A project manager will be required to manage the delivery of this project. This will include iwi liaison, media, stakeholder engagement and liaison. Liaison will be undertaken between iwi, hapū, owners and GIS analysts to ensure all works are being undertaken to an appropriate and acceptable standard.
Risks to project success	- Lack of access to streams and farms as some private landowners may not provide permission to access priority sites and undertake works. - Lack of tāngata whenua involvement in identifying sites for protection. - Farm stock may cause concern if they are aggressive and left in the same area.
Land tenure – likelihood of adoption and adoption circumstances	Sites are still yet to be identified but are likely to include a mix of private, Crown and iwi owned lands. It is anticipated that fencing will be strongly adopted by stakeholders.
Knowledge gaps and response	- Sites of significance that require fencing have not yet been identified. This will need to be undertaken prior to this project taking place. - Identification of sites can cause concerns – contact with marae committees will occur and media (social media and newspapers) will be used to identify sites to fence for protection and restoration.
Project duration (years)	10 year project
Costs	

Works description	Cost (\$)
80km fencing	640,000
GIS mapping	25,000
Project management/staffing/incidentals (15%)	99,750
Total	**\$764,750**

Tūwharetoa 5 Priority: High	Ngāti Tūwharetoa mātauranga and science educational wānanga
Project summary	This project aims to provide Ngāti Tūwharetoa descendants with the skills that they require as kaitiaki to restore and protect the environment. Furthermore, this project seeks to build ongoing, collaborative relationships with Taupō nui a Tia and Tauhara high schools. Also, this project seeks to provide a platform where students and teachers can incorporate project data in standards and achieve NCEA level 1, 2 or 3 credits resulting in mutually beneficial outcomes. Alongside the implementation of citizen science through respective school involvement, fisheries experts will demonstrate fish sampling techniques, including electrofishing. It is intended that students may be inspired to continue into higher education to build their, and the iwi's, capacity.
Vision for project	- Reconnect Ngāti Tūwharetoa tamariki and whanau to sites of significance. - Identify traditional mahinga kai sites for ongoing investigation. - Use traditional methods, eg tau koura and/or hīnaki, and possibly others to sample the waterways. - Employ the use of western sampling methodologies, such as electrofishing techniques, to sample waterways. - Wānanga with schools teaching students how to use mātauranga and western science to identify and potentially reinvigorate mahinga kai. - Work with Ngāti Tūwharetoa rangatahi, through their schools, to develop their knowledge of taonga tuku iho, korero tupuna and whakapapa through tailored education and cultural programmes. - Work collaboratively with other Iwi associated with the catchment, such as Ngāti Tahu-Ngāti Whaoa, to build and maintain relationships.
Location	A local stream (yet to be identified, but hoped to be the Pueto Stream) and the two largest high schools in Taupō (Taupō nui a Tia and Tauhara colleges).
Brief description of site	To be discussed and agreed with the two high schools, however, the Pueto Stream has high cultural capital and has been identified for works via the Waikato River Restoration Strategy process and also by Ngāti Tahu-Ngāti Whaoa.
Key threats/issues	- People become less connected with Pueto Stream and less likely to visit and maintain. - Loss of cultural connection with the site and therefore a decreased level of identifying to the Pueto Stream. - Education that does not meld the local environment into education outside the classroom (EOTC) opportunities can lead to students of Tūwharetoa descent becoming less engaged.

Project goal/s (SMART)	- Annually, students have been taught how to incorporate basic scientific and mātauranga Māori tools for fisheries management. - Annual implementation of citizen science and school monitoring of the sites where the information gathered can then be used for reporting. - Within two years of commencement, students are achieving NCEA credits in science and possibly other subjects. These 'schemes' will deliberately be integrated into the school's curriculum where the teachers can align EOTC and credits. Note: This project is not designed to deliver NCEA credits, but to engage with schools who will deliver their own material in conjunction with the NCEA standards. Once the data is obtained, the schools can then use it to create long-term data sets which can be used at their leisure. - Every two years, students participate in field sampling techniques and are able to engage with scientists and contractors.
Works required.	**Experts/contractors** - Experts and kaumatua will be required on each fieldtrip to ensure all tikanga and kawa are followed – 10 years at 6 visits each year ($500 per day) = **$30,000.** - Transport for kaumatua ($100 per day) **$6000.** - Contractors to undertake fisheries research using traditional mātauranga Māori methods and electrofishing methodologies (6 days – 3 with each high school) per year at $2000 per day ($12,000 p.a) = **$120,000.** **Venue** - Hireage of Taupō nui a Tia school marae to re/train students in the use of tau koura $100 per day prior to them undertaking EOTC. For use twice a year over 10 years = **$2000.** - Hireage of Tauhara school marae to re/train students in the use of tau koura $92 per day prior to them undertaking EOTC. For use twice a year over 10 years = **$1840.** - Development of SMART goals with targeted schools to ensure alignment with NCEA standards = **$5000.** **Technical equipment** Equipment required to undertake works in the environment and gather field data: - vernier callipers with protective case to measure the occipital carapace length of koura, $53.29 each x 10 = **$532.90** - digital scales to weigh koura (5 year warranty) x 4 (2 every 5 years) at $55.00 = **$220** - shelter x 3 (1 x for instruments and 2 for kaumatua) at $500 each = **$1500** - folding table **$259.98** - hi-viz vest for students, kaumatua and others at $15 x 100 = **$1500** - 54L fish bins for the transport of field equipment and the holding of any fish and koura while being processed x 4 at $19.99 each = **$79.96.**

	Project management/staffing/incidentals (30%) This project requires the development of targeted educational opportunities. The project manager will work alongside Taupō nui a Tia and Tauhara colleges to design curriculum schemes that teachers are happy to deliver. Further, the project manager will introduce and facilitate engagement with scientists and/or contractors who are working in these fields. The project manager will be responsible for landowner engagement. The project manager may be required to help the teachers develop teaching resources and field sheets in conjunction with contractors. Most of the work and liaison with training providers can be directed from the Tūwharetoa Māori Trust Board offices in Taupō.
Risks to project success	- Lack of school participation. - Landowners no longer allowing access to selected stream.
Land tenure – likelihood of adoption and adoption circumstances	N/A
Knowledge gaps and response	Knowledge gaps: - Principals – school principals may be unaware and cautious of such projects. - Tikanga, kawa and historical – all advice regarding sites of significance relating to the Pueto Stream is to be delivered by kaumatua who have standing within their communities. - Scientific – all scientific education to be delivered by experts who are knowledgeable and relatable. Preferably they will be knowledgeable in mātauranga and western science practices. - Schools – schools do not have a unit standard that can use this project. - Resources – schools do not have required resources. Responses: - Liaison with school principals and subject heads to build excitement surrounding this project. - Build in-house capability within Ngāti Tūwharetoa to deliver the material. Contract mātauranga and science work to a contractor with the required skills. - Use Ngāti Tūwharetoa descendants who have the skills required, or have upskilled themselves as much as possible. - Liaison with schools to identify suitable unit/achievement standards where data from this project can create 'project based' outcomes. - Liaison should occur with schools to develop the required resources and aim in scheme development.

Project duration (years)	10 year project
Costs	

Works description	Cost ($) per annum
Experts	
Expert advice – kaumatua	$30,000
Expert advice – fisheries scientist(s)	$120,000
Transport for kaumatua	$6000
Venue hireage for EOTC prep	
Hireage of school marae Tauhara Taupō nui a Tia	 $1840 $2000
Development of SMART goals that align with curriculum	$5000
Technical equipment	
Digital callipers	$532.90
Digital scales	$220
Shelter x 3	$1500
Folding table	$259.98
Hi-viz vests	$1500
Fish bins	$79.96
Project management/staffing/incidentals (30%)	$50,679.85
Total	**$219,612.69**

APPENDIX 13 - Maniapoto Iwi Project Assessments

Contents

<table>
<tr><td>Maniapoto 1

Priority: High</td><td>Marae and community water supply: protection, enhancement and education programme – Mangapū River catchment</td></tr>
<tr><td>Project summary</td><td>This project contains three core elements:
1. To identify and protect known puna, associated waterways and swimming holes of significance to Maniapoto.
2. To collect and display information on the history of these sites.
3. To develop a programme across the Mangapū River catchment that monitors the use and quality of water supplies for communities and marae in the catchment as the main source of water for swimming, washing and drinking.

During the Maniapoto priorities wānanga, it was raised that whānau are concerned about water quality for marae use and that over time this water quality may deteriorate. Marae need to ensure that any changes to water quality are measured in order to be addressed.</td></tr>
<tr><td>Vision for the project</td><td>That there is sufficient and quality water supply (for swimming, washing and drinking) for marae in the Mangapū River catchment. Puna are restored and protected.</td></tr>
<tr><td>Location</td><td>Puna locations
-38.25003, 175.1728 (WAI 9) – Waitomo Caves Road, Waitomo
-38.23385, 175.1875 (WAI 15) – Golf Road, Waitomo
-38.31609, 175.11829 (WAI 22) – Oparure Road, Oparure.

Swimming locations
-38.24495, 175.1844 (SWIM 3) – Oparure Road, Oparure.
-38.33257, 175.1012 (SWIM 14) – Oparure Road, Oparure.
-38.31933, 175.1158 (SWIM 15) – Oparure Road, Oparure.
-38.31558, 175.1214 (SWIM 17) – Oparure Road, Oparure.</td></tr>
<tr><td>Brief description of site</td><td>Puna sites
Kaputuhi Marae located on Waitomo Caves Road, Waitomo, is linked ancestrally to the Mangapū River and is directly opposite the road to the puna identified at (WAI 9).

Rereāmanu Marae is closely connected to the puna known as Te Puna o te Roimata (WAI 15) located at 41 Golf Rd, Waitomo, where the first Māori King, Pōtatau Te Wherowhero, is said to have been confirmed by the Maniapoto leaders of the day, as the first Māori King.

The puna located at WAI 22 is opposite the Oparure Marae (Waipatoto Marae) on a little stream where a whānau urupā is situated.

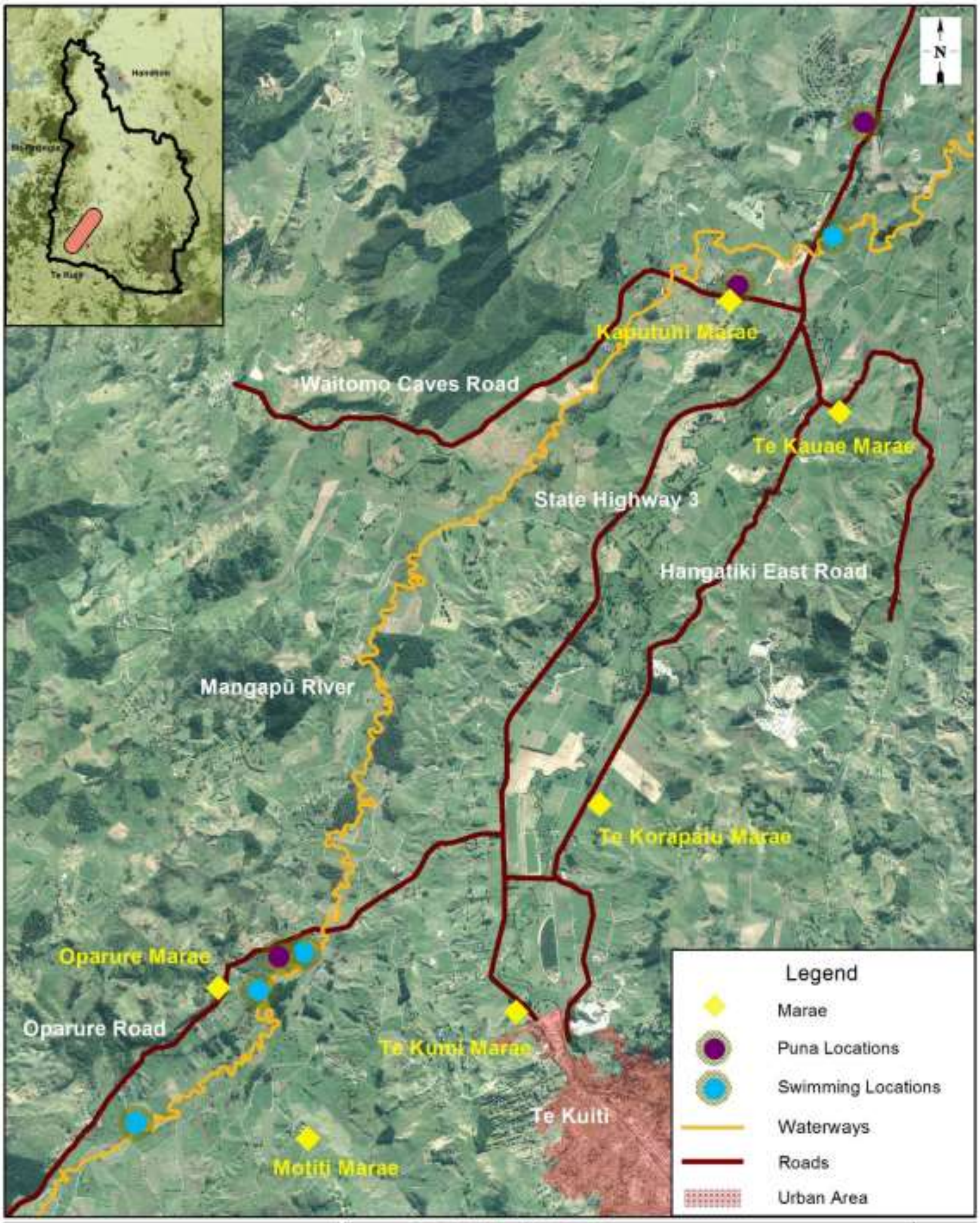
Swimming sites
The Oparure Marae (Waipatoto Marae) is within close proximity of both SWIM 17 and SWIM 15 sites. The Te Kura Kaupapa Maori o Oparure school is located opposite both of these sites and both the marae and kura use the river for swimming. Further along the river is SWIM 14 located on Gadsby Road, which is a further swimming area for local hapū.

Rereāmanu Marae is also located along the Mangapū River and linked to SWIM 3 where whānau would swim, wash, eel and have picnics.</td></tr>
</table>

Key threats/impacts	These particular puna and swimming areas are full of historical significance for the iwi, hapū and local whānau. The key pressure at WAI 9 is farming and its effects on the waters. It was noted that the kaitiaki for this specific puna was transferred to another area because of the high pollution. At SWIM 3, water quality is an issue as the river is silted up and very shallow. Willow management and sedimentation are issues raised for SWIM 14 and again sedimentation is identified as a concern at SWIM 15.
Project goal/s (SMART)	- The protection/restoration of existing puna within the Mangapū River catchment. - Ensure sufficient and quality water supply (for washing and drinking) for marae communities and 3 marae in the Mangapū River catchment. - Through the use of signage, educate the public about the locations of the puna and swimming areas to avoid further degradation and instead encourage their restoration and protection.
Project actions/works required	1. It is anticipated that all of the puna and swimming holes will need to be correctly identified and located within the Mangapū River catchment and this would include a desktop assessment, interviews with marae whānau and some field visits. 2. Fencing off 3 x puna (7 wire post and batten) with works being led or supported by marae or local whanau. 3. Fencing off of 4 x swimming holes. 4. Native planting and landscaping for puna and swimming holes. 5. Gather mātauranga Māori from people from the local marae about the puna within the catchment and swimming areas along the Mangapū River to create a baseline for the water supply monitoring. 6. Work with marae affiliated with the Mangapū River to undertake riparian planting to improve water quality. 7. Develop training to protect, enhance and educate people on the water supply monitoring programme that monitors the use and quality of water supplies for communities and marae in the catchment as the main source of water for washing and drinking. 8. Develop interpretation panels for the puna and swimming areas from the mātauranga Māori gathered from the people at local marae with historical significance to those places. 9. Investigate opportunities to provide legal protection for puna that have been protected and restored. Look at potential to place puna into reserves as a form of protection.
Risks to project success	- Marae whanau without capacity/capability to engage in the project. - This project will rely on the collaboration of a number of key stakeholders and requires commitment to the project. - Access to sites.
Land tenure	Tenure for puna is a mix of privately owned and iwi owned lands. Swimming holes are on Crown administered land and will require talking with the Commissioner of Crown Lands.
Knowledge gaps and response	- The size of puna areas to be fenced and restored is unknown, however we know of 3 confirmed puna at the site descriptions. There may be more. - The length of fencing for puna is unknown, however fencing is proposed for the length of the Mangapū River through Waipā Project X.
Project duration	5 years.

(years)	
Costs	

Works description	Cost ($)
Capacity building and information capture - Fencing and planting wānanga 2x ($2500 each x 2 wānanga) Capture of mātauranga Māori interviews (3 marae x 4 kaumātua/kaitiaki interviews per marae/$600 per interview x 12 interviews)	12,200
Weed control	12,540
Fencing off puna (3x) for protection	1500
Fencing off of swimming areas (4x) for protection	2000
Puna/swimming areas riparian planting (5,000 plants)	23,750
Information panels ($1500 each x 7)	10,500
Development of monitoring programme	6000
Project management/staffing/incidentals (25%)	17,122.50
Total	**85,612.50**



Marae and Community Water Supply: protection, enhancement and education programme – Mangapū River Catchment

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
Request No.: N/A
File name: WWRRS.gws

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<table>
<tr><td>Maniapoto 2

Priority: High</td><td>Marae and community water supply: protection, enhancement and education programme – Waipā River catchment</td></tr>
<tr><td>Project summary</td><td>This project contains three core elements:
1. To identify and protect known puna, associated waterways and swimming holes of significance to Maniapoto.
2. To collect and display information on the history of these sites.
3. To develop a programme across the Waipā River catchment that monitors the use and quality of water supplies for communities and marae in the catchment as the main source of water for swimming, washing and drinking.
During the Maniapoto priorities wānanga, it was raised that whānau are concerned about water quality for marae use and that over time this water quality may deteriorate. Marae need to ensure that any changes to water quality need to be measured in order to be addressed.</td></tr>
<tr><td>Vision for the project</td><td>Ensure sufficient and quality water supply (for washing and drinking) for communities and marae in the Waipā River catchment. Restoration and protection of puna.</td></tr>
<tr><td>Location</td><td>Puna locations
-38.15284, 175.20439 (WAI 12)
-38.06225, 175.2061 (WAI 20)

Swimming locations
-38.19107, 175.2129 (SWIM 2)
-38.06325, 175.20579 (SWIM 4)
-38.15304, 175.2082 (SWIM 6)
-38.28205, 175.3533 (SWIM 7)
-38.18571, 175.20079 (SWIM 13)
-38.06398, 175.2001 (SWIM 16)
-38.19815, 175.25299 (SWIM 18)</td></tr>
<tr><td>Brief description</td><td>Puna sites
Kahotea Marae located on Kahotea Road, Ōtorohanga, is located directly on the puna identified as WAI 12 which gives this puna a higher level of importance as a water supply and should be monitored, particularly if it is currently used for the marae water supply.

WAI 20 has been signalled by whanau as a site that has three puna wai Māori located within the same area. Te Kopua Marae is located right next to one of the puna and there are two further puna situated just below the marae on the flat. The puna by Te Kopua Marae was used for ceremonial purposes (blessings or baptisms), whereas the remaining two puna were used for washing clothes and bathing.

Swimming sites
Te Kotahitanga Marae located on Otewa Road, Ōtorohanga, is within close proximity to the swimming area SWIM 2, which was once said to have a sandy bottom and clear water. The area is still used for swimming, however the water is murky and dirty looking. As the river heads towards Ōtorohanga South School, SWIM 13 appears and is opposite the Taarewaanga Marae</td></tr>
</table>

	located by Ōtorohanga College. This swimming area is known as the Red Bridge and many whanau swam her and recalled when the water was clear. Te Kopua Marae is situated near both SWIM 4 (which was known by the marae whanau as the 'local swimming hole') and SWIM 16 (where swimming and fishing took place). The SWIM 6 area is located at the back of Kahotea Marae just outside of Ōtorohanga – it had a lagoon with a sandy bottom and was a popular swimming spot. Unfortunately, the water is now stagnant and unhealthy to swim in. Further up from Otewa Marae (also referred to as Ko Te Hokingamai ki te Nehenehenui marae) is SWIM 7. Te Keeti Marae is located on Phillips Ave, Ōtorohanga, which becomes Rangiatea Road where SWIM 18 is situated.
Key threats/impacts	These four particular puna are full of historical significance for the iwi, hapū and local whanau of Te Kopua Marae and Kahotea Marae, where one puna is located on site at the marae. The proximity and importance of the puna to the marae calls for them to be preserved, restored and/or maintained. At SWIM 4 there is native bush of mainly kahikatea trees near a local whanau property. Protection of the remnants of native bush and kahikatea is key. Flood control and deforestation has decreased the quality of the water at SWIM 6 and natives have been removed in favour of poplars and willows on the banks. At SWIM 7 there are flood control, farming and erosion pressures. Pollution from farming has contributed to the lack of swimming holes in use. SWIM 18 is below the drop of the Parapara Stream and can be dangerous in terms of increasing water levels if there have been rainfall in the upper catchment of the Rangitoto Range.
Project goal/s (SMART)	- The protection/restoration of existing puna within the Waipā River catchment. - Ensure sufficient and quality water supply (for washing and drinking) for communities and marae in the Waipā River catchment. - Through the use of signage, educate the public about the locations of the puna and swimming areas to avoid further degradation and instead encourage their restoration and protection.
Project actions/works required	1. It is anticipated that all of the puna and swimming holes will need to be correctly identified and located within the Waipā River catchment and this would include a desktop assessment, interviews with marae whānau and some field visits. 2. Fencing off 2 x puna (7 wire post and batten) with works being led or supported by marae or local whanau. 3. Fencing off of 7 x swimming holes. 4. Native planting and landscaping for puna and swimming holes. 5. Gather mātauranga Māori from people from the local marae about the puna within the catchment and swimming areas along the Waipā River to create a baseline for the water supply monitoring. 6. Work with marae affiliated with the Waipā River to undertake riparian planting to improve water quality. 7. Develop training to protect, enhance and educate people on the water supply monitoring programme that monitors the use and quality of water supplies for communities and marae in the catchment as the main source of water for washing and drinking. 8. Develop interpretation panels for the puna and swimming areas from the mātauranga Māori gathered from the people at local marae with historical

<table>
<tr><td></td><td>significance to those places.
9. Investigate opportunities to provide legal protection for puna that have been protected and restored. Look at potential to place puna into reserves as a form of protection.</td></tr>
<tr><td>Risks to project success</td><td>- Marae whanau without capacity/capability to engage in the project.
- This project will rely on the collaboration of a number of key stakeholders and requires commitment to the project.
- Access to sites.</td></tr>
<tr><td>Land tenure</td><td>Tenure for puna is a mix of privately owned and iwi owned lands. Swimming holes are on Crown administered land and will require talking with the Commissioner of Crown Lands.</td></tr>
<tr><td>Knowledge gaps and response</td><td>- The size of puna areas to be fenced and restored is unknown, however we know of 3 confirmed puna at the site descriptions. There may be more.
- The length of fencing for puna is unknown, however fencing is proposed for the length of the Waipā River through Waipā Project X.</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td></tr>
<tr><td>Costs</td><td>
<table>
<tr><th>Works description</th><th>Cost ($)</th></tr>
<tr><td>Capacity building and information capture
- Fencing and planting wānanga 2x ($2500 each x 2 wānanga)
Capture of mātauranga Māori interviews (6 marae x 4 kaumātua/kaitiaki interviews per marae at $600 per interview x 24 interviews)</td><td>19,400</td></tr>
<tr><td>Weed control</td><td>12,540</td></tr>
<tr><td>Fencing off puna (2x) for protection</td><td>1000</td></tr>
<tr><td>Fencing off of swimming areas (7x) for protection</td><td>3500</td></tr>
<tr><td>Puna/swimming areas riparian planting (5000 plants)</td><td>23,750</td></tr>
<tr><td>Information panels ($1500 each x 9)</td><td>13,500</td></tr>
<tr><td>Development of monitoring programme</td><td>6000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>19,922</td></tr>
<tr><td>Total</td><td>99,612</td></tr>
</table>
</td></tr>
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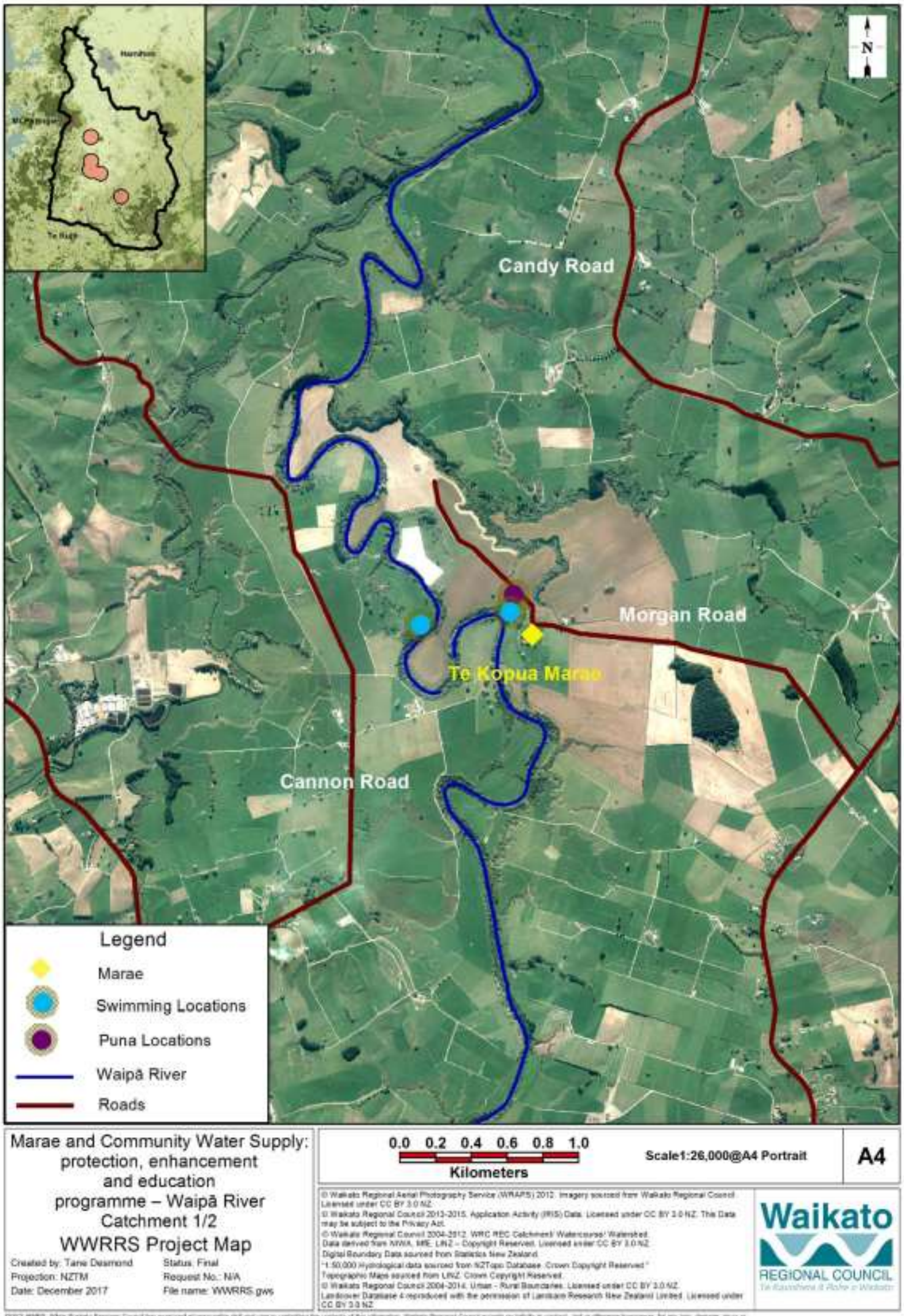
N
Hamilton
Te Kuiti
Candy Road
Morgan Road
Te Kopua Marae
Cannon Road
Legend
Marae
Swimming Locations
Puna Locations
Waipā River
Roads
Marae and Community Water Supply: protection, enhancement and education programme – Waipā River Catchment 1/2
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Kilometers
Scale1:26,000@A4 Portrait
A4
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Maniapoto 3	

Priority: High	Waitomo Stream – Erosion protection and remediation with riparian planting
Project summary	Erosion and sedimentation has been identified as having a significant impact on the Waitomo River, degrading the water and kai that can be safely taken by the local marae situated near the river. This project will involve identifying remediation measures for river margins that are prone to erosion and implementing river erosion controls and riparian planting of indigenous species to stabilise the riverbanks, reduce erosion and enhance aquatic biodiversity.
Vision for the project	The vision for the Waitomo Stream (from the Waitomo Caves to Ōtorohanga) is to improve the water quality and reduce erosion by undertaking fencing and riparian planting. The reduction of E. coli and sediment levels in the stream will result in improved swimmability for the community and safe gathering of kai by the local marae.
Location	Waitomo Stream
Brief description of	The Waitomo Stream runs from Waitomo village to the Waipā River at Ōtorohanga and is approximately 21km long. The streambanks require more vegetation for stabilisation, particularly during periods of high flow which exacerbates flooding and sediment movement. **Kai** Whānau noted at KAI 44 that koura were plentiful in Waitomo Stream and watercress was particularly plentiful along the smaller tributaries by Pōhatuiri Marae. The Waitomo Stream is known for its tuna at all three sites (KAI 11, KAI 44 and KAI 47), however it was noted at PRESSURE 43 that commercial eel fishers had overfished these sites many years ago and the tuna fishery has not recovered since. At site KAI 47 trout was once present in the stream. **Swimming** At KAI 47, Tokikapu Marae whanau recall that the Waitomo Stream was a special place for swimming. **Puna** A puna is located at WAI 13 near Pōhatuiri Marae used by the whanau.
Key threats/impacts	The key threats are: - The riverbank erosion which has been estimated to cause more than 1000 tonnes of sediment per year to the Waitomo Stream and effectively the Waipā River. The levels of sediment can increase when there are major flooding events. - Stock access to the Waitomo Stream reduces the water quality and destroys the existing riparian vegetation. - The lack of riparian cover and associated fish habitat reduces adult fish habitat which has ongoing effects for the whanau from the local marae in Waitomo Valley.

Project goal/s (SMART)	The project goal is to prevent further erosion of Waitomo streambanks to reduce sedimentation load. This can be achieved by fencing and riparian planting (with 5m setback) for the entire 21km of the Waitomo Stream over an 8-10 year period, and constructing erosion control structures where planting alone will not be sufficient to stabilise banks. This will effectively reduce the sediment from the Waitomo Stream by 15% over a 15 year period. With the reduction of sediment, the restoration and preservation of kai and swimming areas is envisaged for the Waitomo Stream.
Project actions/works required	The project seeks to influence landowners along the Waitomo Stream to: 1. allow fencing of target streams with at least a 5m wide riparian margin 2. allow planting of this margin with native plant species or (where appropriate) exotic plant species 3. allow river stabilisation works to be undertaken where required 4. allow fencing of existing indigenous vegetation to exclude stock 5. implement works by marae whanau and organisations that marae and whanau are keen to work with. A project manager and staff will be needed to undertake co-ordination of the project, landowner and marae engagement, provide reporting and information and manage other aspects of the project. This project could be undertaken as a whole, or in components. **Riverbank erosion protection and remediation** Nearly the entire length of the stream (18.6km) is erosion prone and effectively unmanaged. Erosion protection structures may be required regularly along the stream. The structures should be created in a way that it also provides habitat for fish species. Approximately 18.6km of the river is currently unmanaged for erosion. It is estimated that this would require between 0-6 erosion protection structures per kilometre at a cost of $15,000/km ($279,000). Note that Waikato Regional Council holds an existing consent for erosion protection structures along this stream and therefore proposed works should be discussed with WRC during the planning stage. **Riparian management of rivers/streams for fish habitat and soil conservation purposes** 1. Carry out riparian fencing with at least a margin of 5m from the top of the streambank (at least 5 wire with 2 electric wires at $8/m) along 25km of streambank (12.5km of stream length). 2. This would also include any adjoining wetland areas within the riparian fencing. 3. Undertake a mix of native and exotic (where appropriate) soil conservation riparian planting within the fenced area (where it doesn't exist naturally). 4. There is estimated to be approximately 12.5ha of planting, and associated weed control and maintenance. **Project management/staffing/incidentals (25%)**

<table>
<tr><td></td><td>This is a multi-faceted project involving multiple landowners and stakeholders. Project management/staffing is estimated to 25% of the project cost.</td></tr>
<tr><td>Land tenure – likelihood of adoption and adoption circumstances</td><td>This land is predominantly privately owned.</td></tr>
<tr><td>Risks to project success</td><td>- If it is found that there is already a large amount of fencing close to the streambank (i.e. with a narrow riparian margin), landowners may be unwilling to move fences back to allow room for native planting.
- Landowners may not allow access to fence/plant along the streambank.</td></tr>
<tr><td>Knowledge gaps and response</td><td>- Identifying where there is already fencing along the stream. Fencing estimates have been made using information from WRC catchment surveys and examining aerial photographs.
- Investigating how close existing fences are to the stream edge and whether they provide for the 5m riparian margin.
- Identifying where the erosion structures are required and can be placed on the stream.</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td></tr>
<tr><td>Costs</td><td><table>
<tr><th>Works description</th><th>Cost ($)</th></tr>
<tr><td>18.6km river erosion control ($15,000/km)</td><td>279,000</td></tr>
<tr><td>25km of streambank fencing, 5 wire (2 electric)</td><td>200,000</td></tr>
<tr><td>Riparian planting river/streams 12.5ha</td><td>469,400</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>237,100</td></tr>
<tr><td>Total</td><td>1,185,500</td></tr>
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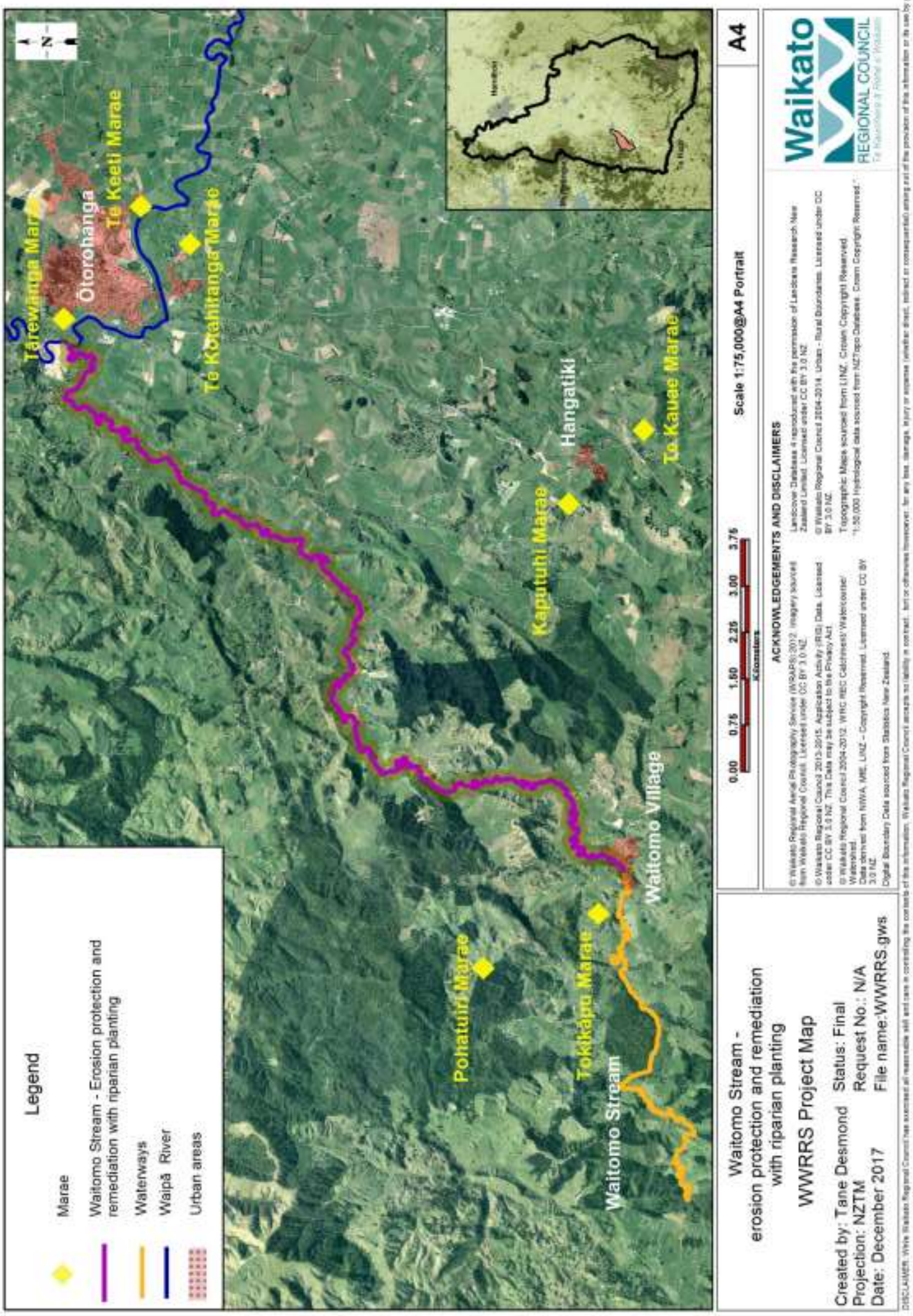
Legend
Marae
Waitomo Stream - Erosion protection and remediation with riparian planting
Waterways
Waipā River
Urban areas
Ōtorohanga
Tārewānga Marae
Te Keeti Marae
Te Kōtahitanga Marae
Hangatiki
Kaputuhi Marae
Te Kauae Marae
Waitomo Village
Tokikapu Marae
Pohatuiri Marae
Waitomo Stream
N
Waitomo Stream -
erosion protection and remediation
with riparian planting
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
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Kilometers
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A4
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Maniapoto 4 Priority: High	Middle Pūniu River – erosion protection and remediation with riparian planting
Project Summary	Erosion and sedimentation has been identified as having a significant impact on the middle Pūniu River, degrading the water and kai that can be safely taken by the local marae situated near the river. This project will involve identifying river margins that are prone to erosion and implementing remediation measures, including riparian planting of indigenous species to stabilise the riverbanks, reduce erosion and enhance aquatic biodiversity.
Vision for the project	The vision for the middle Pūniu River is to improve the water quality and reduce erosion by undertaking fencing and riparian planting. The reduction in E. coli and sediment levels in the stream will result in improved swimmability for the community and safe gathering of kai by the local marae.
Location	Middle section of the Pūniu River
Brief description of site	There are two marae along the Pūniu River, Mangatoatoa Marae (Maniapoto) and Rawhitiroa/Owairaka Marae (Raukawa). The area from Seafund Road to Brill Road is approximately 37km. Erosion control plantings have already been done in 25% of this area. The upper portion has a gravel and stony river bed which becomes a mix of gravel and silt further downstream. There are significant lengths of river that are unfenced and unvegetated. Some erosion control structures have been constructed (by private landowners and regional council).
Key threats/impacts	The key threats are: - Riverbank erosion along this reach generally occurs during high flow events and particularly where there is no stabilising vegetation. It's estimated that approximately 7200 tonnes per year of sediment is added to the Waipā River from the Pūniu River, excluding major flood events. - There is lateral bank erosion in the upper reach and bank slumping in the lower reaches. - The lack of riparian cover and associated fish habitat reduces adult fish habitat, which has ongoing effects for the whanau from the local marae who would like to harvest fish. - Due to the lack of fencing along significant lengths of the river, stock access to the Pūniu River has reduced water quality, trampled banks and destroyed riparian vegetation. - Crack willow causes blockages and flow diversion causing erosion. - Devegetated banks cause bank slumping and increased sediment to water.

Project goal/s (SMART)	Within 10 years of project commencement, a 37km reach of the Pūniu River is stable, fenced and vegetated (5m setback), providing increased shade, shelter and food for native fish. Stock are 100% excluded from the Pūniu River. The river is swimmable, fishable and has access for recreation and use.
Project actions/ works required	The project seeks to influence landowners along the Pūniu River to: 1. allow fencing of the river where it is currently unfenced 2. allow planting to be undertaken along the river margin and target streams with at least a 5m wide riparian margin, and planting of this margin with native or (where appropriate) exotic plant species. 3. allow river stabilisation works to be undertaken where required 4. implement works by marae whanau and partnering organisations. A project manager and staff will be needed to undertake co-ordination of the project, landowner and marae engagement, provide reporting and information and manage other aspects of the project. This project could be undertaken as a whole, or in components. **River erosion protection and remediation** Approximately 8km of the stretch has already been managed for erosion. Of the remaining 16km it is estimated that 8km requires erosion protection works at 5 structures per kilometre ($12,500/km) for a total cost of $100,000. Note that Waikato Regional Council holds an existing consent for erosion protection structures along this stream and therefore proposed works should be discussed with WRC during the planning stage. Based on aerial photographs and on-the-ground knowledge of the reach, it is estimated that 8km of this reach would require willow control at $20/m of river ($160,000). Willow disposal (burning) is estimated to be 20% of the removal costs ($32,000). **Riparian management of rivers/streams for fish habitat and soil conservation purposes** 1. Carry out an estimated 32km (bank length) of riparian fencing (5 wire, 2-electric) along this reach ($256,000). 2. This should have a minimum of a 5m set back from the top of the bank and include adjoining wetland areas. 3. Native planting – 5m planted margin on both sides of the stream for 32km of bank length would require 16ha of native planting ($600,832). Riparian planting with should be a mix of native species with exotics where required for stability. It is estimated that willow poles would be required at 15m intervals over 8km of streambank length (533 poles = $7462). **Project management/staffing/incidentals (25%)** This is a moderately complex project involving multiple landowners and stakeholders. Project management/staffing is estimated to be 25% of the project cost.
Land tenure – likelihood of adoption	This land is predominantly privately owned.

and adoption circumstances	
Risks to project success	- If it is found that there is already a large amount of fencing close to the streambank (i.e. with a narrow riparian margin), landowners may be unwilling to move fences back to allow room for native planting. - Landowners may not allow access to fence/plant along the streambank.
Knowledge gaps and response	- Identifying where, along the stream, there is already fencing. Fencing estimates have been made using information from WRC catchment surveys and examining aerial photographs. - Investigating how close existing fences are to the stream edge and whether they provide for the 5m riparian margin. - Identifying where the erosion structures are required and can be placed on the stream, and the design of these structures
Project duration (years)	10 years
Costs	(see table below)

Works description	**Cost ($)**
River erosion management and protection	100,000
Willow/poplar management	160,000
Willow/polar disposal	32,000
Fencing 32km 5 wire (2 electric)	256,000
Willow pole planting	7462
Native planting 16ha	600,832
Project management/staffing/incidentals (25%)	289,073
Total	**1,445,367**

Maniapoto 5 **Priority: High**	**Piharau restoration and protection – upper Waipā River catchment**
Project summary	During the development of the Maniapoto Fisheries Plan for the upper Waipā River catchment, it was identified that Piharau populations have diminished significantly. Piharau was once part of the traditional Maniapoto lifestyle.

	Fresh water has a deep spiritual significance to Maniapoto; it is the wellspring of life. The physical and spiritual nourishment has sustained generations, and maintained the functions of marae for many years. The health and wellbeing of the people of Maniapoto is closely linked to the health and wellbeing of freshwater resources. While the quality of the water in the river has changed, and the times of abundant fish and kai have gone, the commitment of the people of Maniapoto remain the same. It is this inherent obligation of the river kaitiaki that has driven the development of the Maniapoto Fisheries Plan for the upper Waipā River catchment. Freshwater fish, including but not limited to tuna, piharau and kanae, were significant to the traditional Maniapoto lifestyles and knowledge was handed down from generation to generation.
Vision for the project	Restoration, preservation and protection of piharau in the upper Waipā River catchment, and Maniapoto being active managers of the upper Waipā River piharau fishery.
Location	**Piharau locations (waterways upstream and downstream of each location)** 1. Site -38.18256, 175.2032 (KAI 12) – opposite Waipā Esplanade, Ōtorohanga (Kahotea Marae) 2. Site -38.18883, 175.22199 (KAI 23) – Phillips Ave, Ōtorohanga (Te Keeti Marae) 3. Site -37.99217, 175.19489 (KAI 20) – O'Shea Road, Pirongia (Purekireki Marae) 4. Site -38.0475, 175.1706 (KAI 6) – Ormsby Road, Puketotara (Purekireki Marae) 5. Site -38.12474, 175.1453 (KAI 10) – Turitea Road, Ōtorohanga (Hiona Marae) 6. Site -38.09092, 175.1617 (KAI 35) – Kawhia Road, Tihiroa (Hiona Marae) 7. Site -38.09339, 175.08989 (KAI 55) – Kawhia Road, Te Rauamoa (Hiona Marae) 8. Site -38.25203, 175.18397 (KAI 29) – Mangarino Road, Waitomo (Te Kauae Marae)
Brief description of sites	**Piharau sites** Piharau is now considered a delicacy as it is a scarce kai source in the Waipā River. It was once plentiful – piharau would run in their season and there was a multitude. However, nowadays, it is rarely seen in much of the upper Waipā River. Some kaitiaki as recent as 2015 noted that they still catch piharau in the Waipā River, however it is kept a highly guarded secret so that the remaining piharau aren't exploited to extinction. Kahotea Marae, Ōtorohanga, is located close to KAI 12 and Te Keeti Marae, which is directly in front of KAI 23, is located quite close to the township of Ōtorohanga. Two of the Pirongia based marae are associated with two or more sites: Purekireki Marae (KAI 20 and KAI 6) and Hiona Marae (in the vicinity of KAI 10, KAI 35 and KAI 55). Te Kauae Marae, Hangatiki, is very close to KAI 29 on Mangarino Road, Waitomo.

Key threats/impacts	Piharau were once plentiful in Maniapoto rohe and now they are at threat of becoming extinct. The gathering of piharau is already a specialised practice and certain whānau were given the traditional knowledge. Not many whanau still uphold their kaitiaki responsibilities to harvest piharau. There is an issue that this information may not be transferred and will be lost for future generations. There is also concern that access may be an issue, where some of the piharau sites are. The key pressure is farming and its effects on the waters. At KAI 12 there is willow, flood control and wastewater discharge. Further upstream from (KAI 20) are stopbanks for flood control. Erosion and flood control are key pressures around KAI 6. There is a weir located behind Te Keeti Marae, which is also next to Piharau site KAI 23.
Project goal/s (SMART)	- The protection/restoration of existing piharau populations within the upper Waipā River catchment. - Within 2 years, cultural knowledge/history of piharau is recorded, transcribed. - Within 5 years, a transfer of knowledge and experience from Maniapoto whanau who have undertaken the kaitiakitanga related to the protection, preservation and harvest of piharau to the next generation of kaitiaki. - Through wānanga, educate the public about the general locations of piharau in order to avoid further degradation to their habitat and encourage their restoration and protection. - Within 10 years, marae having piharau back on the kaihakari tables for Poukai and other special events.
Project actions/works required	1. It is anticipated that all of the 8 x piharau sites will need information gathered from marae whānau associated with those sites. 2. Each of the 8 sites will have up to 3 interviews to gather the mātauranga Māori related to piharau practices at each specific site. 3. Work with marae affiliated with each piharau site to undertake riparian planting to improve water quality at that habitat to encourage piharau regeneration. 4. Develop training to protect, enhance and educate people on piharau in the upper Waipā River. 5. Hold 5 x wānanga, one at each marae near Piharau sites, to share knowledge with other Maniapoto whanau and kaitiaki on the seasons for piharau, harvesting methods, habitat and the preservation and restoration of piharau.
Risks to project success	- Marae whanau without capacity/capability to engage in the project. - This project will rely on the collaboration of a number of key stakeholders and requires commitment to the project. - Access to sites.
Land tenure	Tenure for land where piharau exist is a mix of privately owned, Crown and Iwi land.
Knowledge gaps and response	- There may be a gap in the remaining knowledge about piharau in Maniapoto. - Piharau lifecycle, etc, may need an external expert to provide expert advice at wānanga.

Project duration (years)	3 years
Costs	(see cost table below)

Works description	Cost ($)
Collate information for 8 piharau sites	8000
Puna/swimming areas riparian planting (5000 plants)	23,750
Capacity building and information capture - Piharau wānanga 2x ($2500 each x 2 wānanga) - Capture of matauranga Māori interviews – 5 marae x 3 kaumātua/kaitiaki interviews per marae ($600 per interview x 15 interviews) - External expert to attend wānanga x 2 ($8000 each x 2 wānanga)	30,000
Piharau training programme	6000
Project management/staffing/incidentals (25%)	16,937.50
Total	**84,687.50**

Maniapoto 6 Priority: High	Pou whenua – upper Waipā River catchment (iPou project)
Project summary	This project aligns to an existing Maniapoto Taonga Register project where GIS is used to map areas of significance to Maniapoto throughout the upper Waipā River catchment. Interviews are held and data is recorded, transcribed, mapped and stored with narratives. It also aligns with the Maniapoto Restoration Priorities Report, where sites of significance have been identified through wānanga. The project will extend on the work done through the Taonga Register project and enable a certain level of knowledge about the upper Waipā River and its waterways to be shared. This information transfer will prevent future loss. An interactive pou (iPou) will be installed at each of the 20 locations throughout the upper Waipā River catchment. The iPou are linked through a

	QR code that can be scanned using a smart phone QR reader to display content (historical/environmental). The code is linked to a database, and the information can be easily and regularly updated or added to.
Vision for the project	The transfer of knowledge to the people of Maniapoto and the wider community in regard to places of significance for Maniapoto is crucial to understanding the importance of a waahi tapu. This project is focused on knowledge transfer and ensuring that Maniapoto iwi and hapū understand their connection to the upper Waipā River and its waterways, and provides opportunity for whanau to reconnect. The promotion of education and connection to the upper Waipā River for Maniapoto people is significant.
Location	Upper Waipā Catchment
Brief description of site	The specific iPou sites will be determined by Maniapoto at locations along the upper Waipā River and its waterways within the Maniapoto rohe. Twenty sites may be selected due to historical, cultural, spiritual or ecological significance as determined by Maniapoto.
Key threats/impacts	- Many sites are known to Maniapoto through the Taonga Register and Priorities Report, however permissions or consents are likely to be required. - Cultural safety surrounding the iPou.
Project goal/s (SMART)	- Within 3 years of the project starting, the installation of up to 20 iPou along the Upper Waipā River within the Maniapoto rohe. - The transfer of cultural knowledge. - Through the use of the iPou, the ability to educate the public about the river locations (e.g. the puna and swimming areas nearby) to avoid further degradation and instead encourage their restoration and protection.
Project actions/works required	1. Maniapoto already have a wide collection of sites and historical knowledge available through the Taonga Register project, which could be easily transferred to the iPou project. 2. Identify 20 sites using the Taonga Register. 3. Hold a wānanga to discuss the 20 sites with Maniapoto whanau and introduce the project. 4. Collate information for iPou identified by Maniapoto. 5. Create database of knowledge associated with each iPou. 6. Engage with landowners to negotiate agreements for an iPou to be established at each of the 20 sites. 7. Engage an iPou developer and iPou fabricator to create iPou. 8. Organise a hui to discuss the unveiling of each iPou and cultural safety of the entire project. 9. Organise the physical unveiling of the 20 iPou. 10. Install the 20 iPou. 11. Unveil the 20 iPou. 12. Provide monitoring and milestone reports.
Risks to project success	1. Marae whanau without capacity/capability to engage in the project. 2. This project will rely on the collaboration of a number of key stakeholders and requires commitment to the project. 3. Access to sites and consent to install each iPou.
Land tenure	Tenure for land where iPou will be installed is a mix of privately owned and iwi owned land.
Knowledge gaps and	Consent process for installation of the iPou at each of the 20 sites.

response	
Project duration (years)	3 years.
Costs	

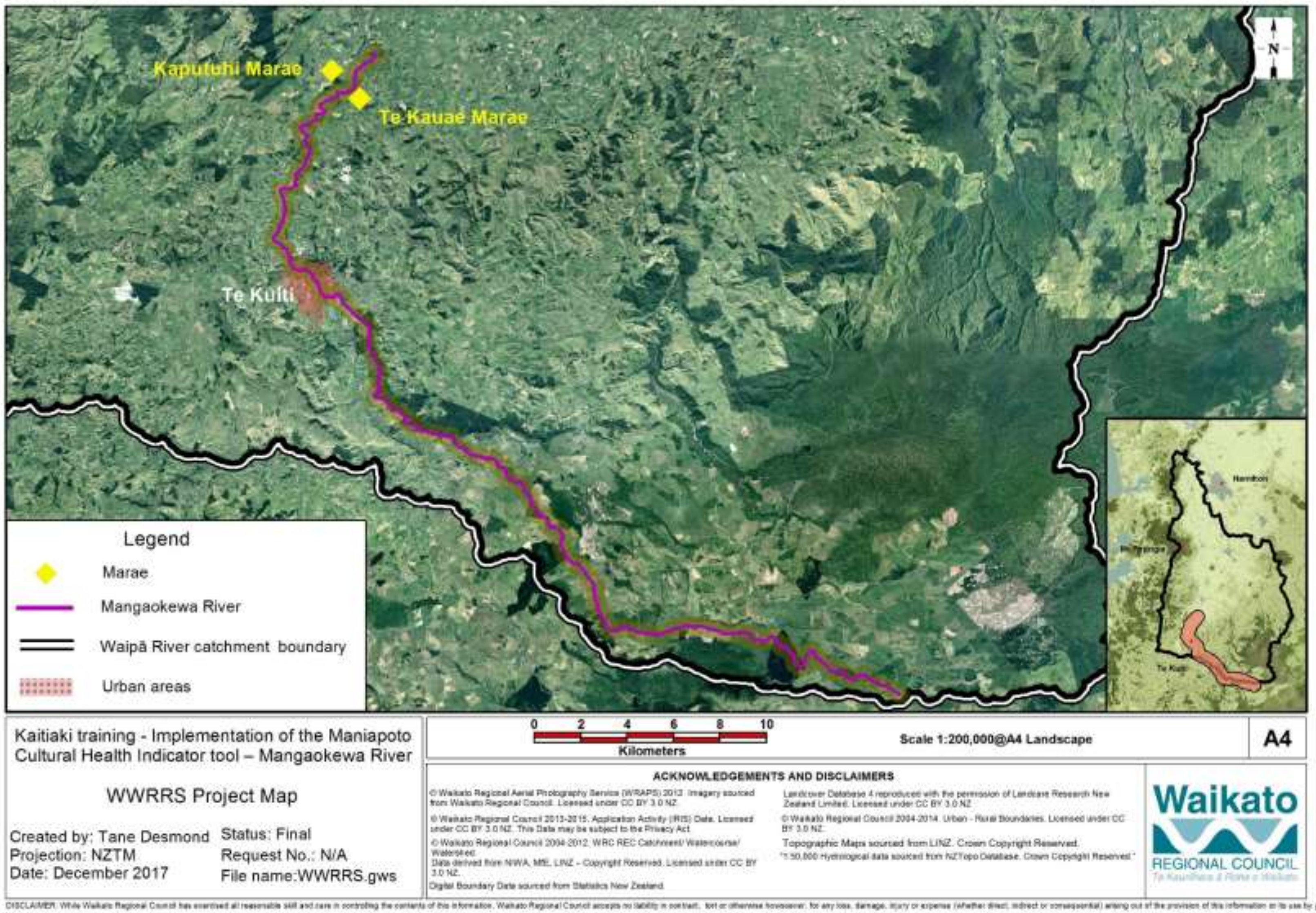
Works description	Cost ($)
Collate Information for iPou	20,000
Fabricate and install up to 20 iPou onto the designated river/tributary sites (at $25,000 each)	500,000
Information loaded and installed into iPou	40,000
Cultural safety costs	10,000
Hui costs	7000
Project management/staffing/incidentals (25%)	144,250
Total	**721,250**

Maniapoto 7 Priority: High	Kaitiaki training – implementation of the Maniapoto cultural health indicator tool – Mangaōkewa River
Project summary	Implement the cultural health indicator tool on the Mangaōkewa River as a pilot to be replicated to other marae throughout the upper Waipā River catchment. Promote opportunities and learning about the Mangaōkewa River through projects, wānanga and kaitiaki practices. Develop tools that will contribute to the Maniapoto Tiaki Taiao Toolbox to support kaitiaki in management of important mahinga kai areas and freshwater management. Build capacity and capability within Maniapoto kaitiaki to ensure that the people understand environmental values and resource use. Kaitiaki practices must be captured and taught so that information will not be lost for future generations. Build relationships between kaitiaki and local authorities for the protection of the environment.
Vision for the project	- Increase numbers of rangatahi and whanau knowledgeable in Maniapoto kaitiakitanga practices along the Mangaōkewa River to ensure strong connection to the awa and its cultural history. - To contribute to the Maniapoto Tiaki Taiao Toolbox of resources for kaitiaki. Protection and management of mahinga kai areas and monitoring of freshwater management. Build strong relationships and engagement between local authorities and mana whenua.
Location	Mangaōkewa River.
Project description	The first stage of the cultural health indicators project will be completed at the end of 2017 and will require implementation from 2018 onwards. The following kaitiaki have been involved to date: 1. Te Wharekura ō Maniapoto 2. Mau Maniapoto 3. Te Kawau Māro ō Maniapoto 4. Iti a Rata Kōhanga Reo 5. Puawai ki Te Awamutu Kōhanga Reo 6. Te Hokinga Mai ō Te Nehenehenui marae 7. Te Kohanga Reo ō Nga Kakano 8. Te Mara Kai ō Te Kuiti 9. Te Korapatu Marae 10. Oparure Marae 11. Motiti Marae 12. Te Kuiti Pa 13. Te Keeti Marae This project focuses on the next steps of implementation. Wānanga-ā-marae and wānanga-ā-hapū. This would involve working with kaitiaki to develop tools and training for their use (e.g. SHMAK), and implementing the kaitiaki tools through the wānanga with marae and hapu.

	Building capacity and capability amongst marae and hapu by engaging and building strong relationships with local authorities and natural resources agencies (e.g. DOC and MPI).
Vision	- For Maniapoto kaitiaki to have capacity and capability to effectively manage their mahinga kai areas and freshwater management. - For rangatahi and whanau to have a strong connection to the river and perform kaitiaki practices.
Key threats/impacts	The key threats are the deterioration of Ngāti Maniapoto values in the practice of kaitiakitanga due to a lack of knowledge transfer and succession planning. In order for Maniapoto to uphold the values as stated in the Ngā wai o Maniapoto (Waipā River) Act 2012: - Te Mana o te Awa o Waipā - Te Mana o te Wai - Te Mana tuku iho o Waiwaia. Maniapoto Kaitiaki need to improve capacity and capability. The implementation of this CHI project provides this opportunity.
Project goal/s (SMART)	- Implement the cultural health indicator tool on the Mangaōkewa River. - Share and present the findings and learnings of the CHI tool with other marae and hapu. - Promote opportunities and learning about our awa through projects, wānanga and practices. - Develop tools that will contribute to the Maniapoto Tiaki Taiao Toolbox to support kaitiaki in the management of important mahinga kai areas and freshwater management. - To initiate and continue two-way capacity and capability building to ensure that any effects from resource use on the people of Maniapoto, or on environmental values, are appropriately avoided or mitigated to a mutually agreed level.
Project actions/works required	**Year 1** **Wānanga-ā-marae, wānanga-ā-hapū** • 3 x kaitiaki tools wānanga • 3 x wānanga to implement kaitiaki and CHI tools **Capacity and capability building with local authorities** • 3 x wānanga to influence engagement with local authorities **Year 2** **Wānanga-ā-marae, wānanga-ā-hapū** • 3 x kaitiaki tools wānanga – what impacts you? • 3 x wānanga to implement kaitiaki and CHI tools **Capacity and capability building with local authorities** • 3 x wānanga – engagement with local authorities **Year 3** **Wānanga-ā-marae, wānanga-ā-hapū** • 3 x kaitiaki tools wānanga – RMA 101 • 3 x wānanga to implement kaitiaki and CHI tools **Capacity and capability building with local authorities** • 3 x wānanga – engagement with local authorities

	Wānanga will be recorded, transcribed, mapped, stored and held for use so Maniapoto kaitiaki, iwi planning documents and future marae and hapu can replicate this project.
Risks to project success	- Requires collaboration with key stakeholders and commitment. - Sensitivity of the information/access to information and information sharing.
Land tenure	Mixed ownership by private/crown/iwi.
Knowledge gaps and response	Understanding how many kaitiaki/mana whenua already engage with local authorities and the relationships that they currently have.
Project duration (years)	3 years
Costs	

Works description – year 1	**Cost ($)**
Kaitiaki tool training noho marae (15 people)	
2 x expert speakers (NIWA) at $8000 per wānanga x 3	24,000
Venue, kai and koha x 3 (2 day workshop)	9000
Facilitator x 3 wānanga	3000
Participants travel (15 participants per wānanga)	1800
One day wānanga for CHI tool (15 people)	
2 x expert speakers (NIWA) at $4000 per wānanga x 3	4000
Venue, kai and koha x 3	1500
Facilitator x 3 wānanga	1500
Participants travel (15 participants per wānanga)	1800
Filming (6 days filming)	3600
Film editing (9 days editing)	6300
Project management/staffing/incidentals (10%)	5650
Total for year 1	**62,150**
Total for year 2	**62,150**
Total for year 3	**62,150**
Total	**186,450**


Kaputuhi Marae
Te Kauae Marae
Te Kuiti
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Legend
Marae
Mangaokewa River
Waipā River catchment boundary
Urban areas
Hamilton
Te Kuiti
Kaitiaki training - Implementation of the Maniapoto Cultural Health Indicator tool – Mangaokewa River
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
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Kilometers
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Maniapoto 8 **Priority: High**	**Better farming practices programme for governors/managers of Māori land blocks – upper Waipā River catchment**
Project summary	Develop a programme across the upper Waipā River catchment that works with governors and managers of Māori land blocks to educate them on better farming practices and land utilisation to potentially reduce the sedimentation and other land use impacts from Māori land trusts in the upper Waipā River catchment.
Vision for the project	- Leadership development for governors and managers on Māori land trusts to enhance governance capability and decision making and ultimately lead to improved land utilisation. - At least 3 upper Waipā River catchment Māori land trusts undergoing the programme per year.
Location	All Māori land trusts within the upper Waipā River catchment.
Project Summary	The Maniapoto Priorities Report identifies farming as a significant pressure within the upper Waipā River catchment. Throughout the report there is reference to native bush land being cleared for farming purposes, which impacted the ability of Maniapoto to manage and protect historic resources. This project will focus on creating a governance programme for the current land use of Māori land trusts within the upper Waipā River catchment. The programme will focus on better farming practices (particularly for farms bordering waterways) than the existing land use, and modelling new environmentally and economically feasible forms of land use. It will investigate land options that will protect traditional values and heritage and strengthen the relationship between the governors/managers/owners and their lands and waterways. The programme will also look to provide facilitated support and regular progress monitoring and mentoring for the duration of the programme to participants.
Vision	For governors and managers on Māori land trusts in the upper Waipā River catchment to ensure best practice farming, enhanced governance capability and decision making to reduce sedimentation, E. coli and nitrates into the river and waterways. The vision is to reduce degradation of the Waipā River through farming and land use practices.
Key threats/impacts	The key threats are to Ngāti Maniapoto values. The Ngā Wai o Maniapoto (Waipā River) Act 2012 (Act) clearly illustrates the vision and overarching purpose of the Act and the aspirations of Maniapoto to restore and maintain the quality and integrity of the waters that flow into and form part of the Waipā River for present and future generations, and the care and protection of the mana tuku iho o Waiwaia. The values include: - Te Mana o te Awa o Waipā - Te Mana o te Wai - Te Mana tuku iho o Waiwaia.
Project goal/s (SMART)	- Increased governance capability development within the participating Māori land trusts. - Greater relationship with key stakeholders and community through participating in the programme.

	- More environmentally friendly use of upper Waipā River catchment land and its production. - Collaborative relationship building and growing external networks. - Record cultural history of each participating Māori land trust (governors/managers) in the upper Waipā River catchment. - Provide training on best farming practices incorporating improved environmental and economic benefits. - Better future strategic planning with environmental considerations incorporated.
Project actions/works required	1. 3 x Māori land trusts (governors/managers) in the upper Waipā River catchment complete this programme. 2. Interview 3 x (governors/managers) from 3 x Māori land trusts participating in the programme. 3. Record, film, transcribe, store and make available this information for iwi planning projects, e.g. waahi tapu on Māori land trust land. 4. Develop a governance training programme for Māori land trusts within the upper Waipā River catchment on best farming practices. 5. Where appropriate, identify alternative land use options and conduct feasibility studies on environmental/economic benefits vs conventional land use.
Risks to project success	- Lack of capacity/ finance or motivation to engage by Māori land trusts within the upper Waipā River catchment. - Reluctant governors/managers. - Requires collaboration with key stakeholders and commitment. - Sensitivity of the information/access to information and information sharing.
Land tenure	Iwi and Māori land trust land.
Knowledge gaps and response	- Number of Māori land trusts in the upper Waipā River catchment. - There may be minimal knowledge of active land management and environmental issues. - Limited governance experience. - Limited knowledge of effects of existing farming practices on the environment and waterways. - Lack of external networks within the upper Waipā River catchment and other Māori land trusts. - Opportunity to collaborate and share traditional knowledge of land history with external partners.
Project duration (years)	2 years

Costs	(see table below)

Works description	Cost ($)
Programme development	6000
Programme resources (30 resource packs)	3000
Venue, kai and koha x 3 (1 day workshop)	4500
Facilitator	4800
Expert advice/presenters x 6 (3 workshops)	1200
Participants travel (10 participants per workshop)	1200
Governor/manager interviews (3 trusts x 3 interviews per trust = 9)	4500
Interviewer x 9 interviews	3600
Travel/kai ($100 per interview)	900
Filming (3 days filming)	2400
Film editing (9 days editing)	6300
Project management/staffing/incidentals (20%)	7680
Total	**46,080**

APPENDIX 14 - Iwi Priorities for Shallow Lakes – Project Assessments

Contents

Shallow Lakes 1 Priority: High	Waikato-Tainui shallow lakes project – collecting, storing and sharing of traditional korero regarding our lakes.
Project summary	This project was identified as a high priority by iwi at the iwi priorities wananga as it will contribute towards reconnecting whanau and passing on their history and knowledge of our significant lakes. It involves recording our traditional mātauranga regarding the shallow lakes and making it available for iwi in digital and print media format.
Vision for the project	Intergenerational knowledge and practices of shallow lakes are recorded, stored, shared and transferred.
Location	This project is located within the Waikato-Tainui rohe.
Brief description of site	The lakes within the Waikato-Tainui rohe are included in this project. Waikato-Tainui and the Waikato River (including the lakes) are inextricably linked. The creation of mātauranga resources that record and share our history and knowledge of the lakes will be a valuable resource now and for generations to come.
Key threats/impacts	• Loss of knowledge. • No transfer of customs and practices between generations.
Project goal/s (SMART)	Within 2 years of the project commencing, interviews and literature review will be completed. Within 3 years of the project commencing, resources will be developed (digital platform and print media) and available for iwi and others (where appropriate) to use.
Works required (quantity and description)	Works could be implemented at iwi, hapū, marae or whanau level. Co-funding contributions from other interested partners to iwi, hapū, or whanau to complete this project would be welcomed. **Project management ($33,000)** Project manager would be required to manage the project. Includes coordinating up to 30 interviews, engaging researchers/writers, publishing documents, monitoring and milestone reporting. Project management/staffing is estimated to be 25% of the project cost. **Mātauranga interviews ($59,400)** Interview knowledge holders, i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume • 30 kaumatua/kuia interviews at $500 per interview = $15,000. • Film and editing of interviews at $800 per day x 28 days = $22,400. • Interviewer at $800 per day x 20 days = $16,000. • Transcribe interviews at $200 per interview x 30 = $6000. **Mapping and photographing lake sites (digital platform) ($37,600)** Map and photograph all significant lake sites. Enter information (and

	interviews) into digital database and maps. Assume • Access and photograph sites at $800 per day x 7 days = $5600. • GIS mapping services at$200 per hour to input maps and develop digital platform x 20 days = $32,000. **Publish printed resource regarding traditional knowledge/mātauranga of Waikato shallow lakes ($35,000)** • Literature review (archives, Māori text, early explorers etc) = $10,000. • Use literature review and interview content as basis to write shallow lakes book = $10,000. • Publish book = $15,000. **Book and digital platform launch ($5000)**
Risks to project success	May be difficult to find 30 knowledge holders.
Project duration (years)	3 years
Costs	

Work description	Cost ($)
Project management (25%)	33,000
Mātauranga interviews	59,400
Photographing and mapping sites (digital platform)	37,600
Publish printed resource	35,000
Launch book/digital platform	5000
Total	**170,000**

Shallow Lakes 2 **Priority: High**	**Kainui lakes – paa harakeke and other native plant restoration and enhancement project.**
Project summary	This project was identified as a high priority by local tangata whenua. This project will enable paa harakeke to be re-established around the margins of the Kainui lakes; additionally other suitable trees, shrubs, rushes and sedges will be planted to restore riparian plant communities in key areas identified by mana whenua. If appropriate, watercress will be seeded into sites surrounding both lakes.
Vision for the project	Mana whenua are able to further fulfil their role as kaitiaki, utilise paa harakeke and other plant based resources as appropriate, thus continuing with their cultural practices and intergenerational transfer of indigenous knowledge.
Location	Kainui (Horsham Downs) peat lakes. Lakes are Whakatangi, Kaituna, Komakorau, Kainui, Tunawhakaheke, Pikopiko, Hotoangana and Areare.
Brief description of site	**Lake Kainui (Horsham Downs) peat lakes** Lake Kainui is highly peat-influenced as it is located within the Kainui peat bog in the Horsham Downs area. Previously no submerged vegetation has been recorded in this lake (Champion et al., 1993), however, the presence of charophytes was recorded during a recent survey. Lake Kainui suffers from regular cyanobacterial blooms, which can become a hindrance to recreational activities such as power boating. The original Māori name for the lake was Rotokauri meaning 'kauri tree lake'. Kainui means 'abundance of food' and relates to the lake being used to stockpile fish. The land between Turangawaewae and Kirikiriroa (Hamilton) was called the Whenua Momona by Māori, meaning 'fat land for food'. Maori used this whole area, including the Horsham Downs area, for food production purposes. Some of the food produced within this area was transported by waka along the Waikato River to the Auckland area. Flax mills were also located within the area, and produced rope and other flax products. A pa site was located close to Lake Areare and Lake Pikopiko, and contained a reasonable sized population. Lake Kainui was used for food gathering purposes and Lake Areare was utilised for spiritual purposes. Lake Kainui was used largely to stockpile fish caught from the Waikato River. As fish within the lake started to become ready to migrate, some were let back into the Waikato River. Food from the lake was used to supply the Kingitanga. Lake Kainui was also a water source for Māori.

	Medicinal plants surrounding the lake, such as kawakawa, were used by Māori. Reed branches were used for building purposes (roof thatching and creating walls for houses). Watercress would have also been used as a food source. Lake Kainui is one of a series of peat lakes in this area. This project relates to all of the lakes.
Key threats/impacts	• Loss of the ability to practice kaitiakitanga. • Weed species. • Loss of knowledge.
Project goal/s (SMART)	• Areas of up to 4ha (across all of the Kainui lakes) around the lake margins (and associated wetlands) are cleared of exotic weeds and planted in native plants (including paa harakeke) within 3 years of the project commencing. • 5 protected sites have been reseeded with watercress (if appropriate) within 3 years of the project commencing.
Works required	Works could be completed at the whanau, marae, hapū or iwi level. We welcome co-funding opportunities/partnerships. **Project management:** Manage the project, engage with marae, hapū, iwi, land owners, arborists, planting crews, nurseries, pest control, liase with land care groups, land care trust, DOC and complete reporting. ($54,684.8) 20% of project costs. **Site preparation:** Willow control should be undertaken using ground based methods to minimise off-target damage. Willows are densely populated. Assume $30,000. **Riparian planting:** Assumes 4ha of planting, including paa harakeke, across the 8 lakes at $179,524. **Animal pest control** (for plant establishment) over 3 years at $3900. **Watercress seeding:** 10 sites per lake at $5000 per site x 10 = $50,000. **Restoration wananga**: Marae or hapū based restoration wananga x 2 at $5000 per wananga = $10,000.
Risks to project success	• Land ownership (privately owned) • Insufficient funding
Land tenure – likelihood of adoption and adoption circumstances	Private and public land.
Knowledge gaps and response	Specific locations suitable for planting and establishing water cress have not yet been identified and this would need to be done during project planning.
Project duration (years)	5 years

Costs	

Work description	Cost ($)
Project management (20%)	54,684.80
Site preparation (willow control)	30,000
Riparian planting (paa harakeke) 4ha	179,524
Animal pest control	3900
Watercress seeding	50,000
Wananga	10,000
Total	**328,108.80**

Shallow Lakes 3 Priority: High	Kainui (Horsham Downs) lakes project – collection, storing and sharing of traditional korero regarding our lakes.
Project summary	This project was identified as a high priority by iwi at the iwi priorities wananga. It will contribute towards reconnecting whanau and the history and knowledge of our significant lakes. It involves recording our traditional mātauranga regarding the Kainui (Horsham Downs) peat lakes and making it available for iwi in digital and print media format. This is for the eight lakes situated in the Kainui rohe.
Vision for the project	Intergenerational knowledge and practices of Kainui (Horsham Downs) peat lakes are recorded, stored, shared and transferred.
Location	This project is located within the Waikato-Tainui rohe and focused on the eight Kainui lakes: Whakatangi, Kaituna, Komakorau, Kainui, Tunawhakaheke, Pikopiko, Hotoangana and Areare.
Brief description of site	The Kainui (Horsham Downs) peat lakes within the Waikato-Tainui rohe are included in this project. Waikato-Tainui and the Waikato River (including the lakes) are inextricably linked. The creation of mātauranga resources that record and share our history and knowledge of the lakes will be a valuable resource now and for generations to come.
Key threats/impacts	• Loss of knowledge. • No transfer of customs and practices between generations.
Project goal/s (SMART)	Within 2 years of the project commencing, the interviews, literature review will be completed. Within 3 years of the project commencing, the resources will be developed (digital platform and print media).
Works required	Works could be implemented at iwi, hapū, marae or whanau level. Co-funding contributions from other interested partners to iwi, hapū, or whanau to complete this project would be welcomed. **Project management ($33,000):** Project manager would be required to manage the project. Including coordinating up to 20 interviews, engaging researchers/writers, publishing document. Monitoring and milestone reporting. Project management/staffing is estimated to be 25% of the project cost. **Mātauranga interviews ($52,400):** Interview knowledge holders i.e. kaumatua/kuia (as appropriate), and collate relevant information from literature sources. Assume: • 20 kaumatua/kuia interviews at $500 per interview = $10,000. • Film and editing of interviews at $800 per day x 28 days = $22,400. • Interviewer at $800 per day x 20 days = $16,000. • Transcribe interviews at $200 per interview x 20 = $4000.

	Mapping and photographing lake sites (digital platform) ($37,600): Map and photograph all significant lake sites. Enter information (and interviews) into digital database and maps. Assume: • Access and photograph sites at $800 per day x 7 days = $5600. • GIS mapping services at $200 per hour to input maps and develop digital platform x 20 days = $32,000. **Publish printed resource regarding traditional knowledge/mātauranga of Waikato shallow lakes ($35,000):** • Literature review (archives, Māori text, early explorers, etc) at $10,000. • Use literature review and interview content as basis to write Kainui (Horsham Downs) peat lakes booklet at $10,000. • Publish book at $15,000. **Book and digital platform launch ($5000)**
Risks to project success	Maybe difficult to find 20 knowledge holders.
Land tenure – likelihood of adoption and adoption circumstances	Not applicable.
Knowledge gaps and response	All knowledge holders are yet to be identified. This should be carried out during project planning in order to refine expected costs.
Project duration (years)	3 years
Costs	(see table below)

Work description	Cost ($)
Project management (25%)	32,500
Mātauranga interviews	52,400
Photographing and mapping sites (digital platform)	37,600
Publish printed resource	35,000
Launch book/digital platform	5000
Total	**162,500**

Shallow Lakes 4	Recognising and honouring our sites of significance – Kainui (Horsham Downs) lakes IPOU project
Priority: High	
Project summary	This project was identified as a high priority by iwi. It provides a means of sharing our knowledge, connection, history and relationship with the significant shallow lakes in the lower Waikato River catchment, which otherwise could be lost. The project will create a physical network of interactive pou (iPou) connected to a database that delivers cultural, historical, spiritual and ecological layers to smart phones and devices. The pou will also act as a physical presence to acknowledge the sites.
Vision for the project	Sites of significance are acknowledged through iPou (or some other appropriate tohu for the place, e.g. kohatu or carved pou) and the korero that is able to be shared with whanau.
Location	The project location is the eight Kainui (Horsham Downs) peat lakes in the Waikato River catchment: Whakatangi, Kaituna, Komakorau, Kainui, Tunawhakaheke, Pikopiko, Hotoangana and Areare.
Brief description of the site	The specific iPou sites will be determined by iwi, but could include waahi tapu sites, traditional fishing sites, traditional paa sites and/or any other significant sites determined by tangata whenua. Ten iPou sites may be selected due to historical, cultural, spiritual or ecological significance as determined by iwi. This project is significant because it enables iwi to tell their story as kaitiaki to acknowledge and share knowledge of the Kainui (Horsham Downs) peat lakes. This project would complement the project on Kainui lakes cultural history, with the history used to inform iPou content.
Key threats/impacts	• Connections and important history will be lost. • Sites won't be appropriately recognised and acknowledged. • Cultural safety.
Project goal/s (SMART)	Within 3 years of the project commencing, up to 10 iPou will be standing at Kainui (Horsham Downs) peat lakes.
Works required	Works could be implemented at iwi, hapū, marae, or whanau level. Co-funding contributions from other interested partners to assist with completing this project would be welcomed. **Project management ($42,000):** Manage the project; engage with iwi, hapū, marae to identify sites of significance; landowner liaison; negotiate agreements and engage with iPou developer and iPou fabricator, inspect completed works;

	organise hui to unveil iPou (catering and venue); provide monitoring and milestone reports over a 3 year period. **Collate Information for iPou ($10,000):** Collate information for the sites. Assume: • $1000 per site to undertake this task. **Fabricate and install up to 10 iPou onto the designated shallow lakes sites ($100,000):** Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou or kohatu). Assume: • $10,000 per iPou (fabrication and installation costs) per site = $100,000. **Technology/information loaded and installed into iPou ($20,000):** Engage iPou developer to install information collated into the fabricated pou. Upload/install the technology. Assume: • $2000 per pou = $20,000. **Cultural safety ($10,000):** Cultural advisors and practices to ensure cultural safety of this project.
Risks to project success	• Access to sites. • Access to knowledge.
Land tenure – likelihood of adoption and adoption circumstances	iPou to be located in lakes with public access.
Knowledge gaps and response	Permit requirements for iPou installation. Specific number of iPou would need to be determined once landowner consultation had been completed.
Project duration (years)	3 years
Costs	

Work description	Cost ($)
Project management (30%)	42,000
Collate information for iPou	10,000
Fabricate and install up to 10 iPou onto the designated shallow lakes sites	100,000
Technology/information loaded and installed into iPou	20,000
Cultural safety costs	10,000
Total	**182,000**

Shallow Lakes 5 Priority: High	Lake Kimihia, Lake Whangape and Lake Waikare tuna ponds
Project summary	The restoration of tuna abundance was identified as a high priority by iwi. This project will see the creation of 15 tuna habitat ponds and areas associated with Lakes Waikare, Lake Kimihia and Lake Whangape (and their tributaries).
Vision for the project	Tuna (freshwater eels) are plentiful. Whanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred onto future generations.
Location	Lake Kimihia, Huntly Lake Waikare, Rangiriri/Te Kauwhata Lake Whangape, Huntly
Brief description of site	The sites will be areas that are suitable for tuna habitat ponds. This project is significant because tuna are a very significant mahinga kai taonga species for Waikato-Tainui. Downes (1918) noted that "the Mangatawhiri, the Maramarua, the Whangamarino, the Mangawara, the Waipā, the Awaroa, the Opuatia, and the two lakes Waikare and Whangape, all in middle Waikato, were famed for their eels. Along all these streams (most of them navigable) the Māoris in former times erected enormous eel-weirs, which have now been destroyed by floods or removed to admit of navigation by launches and barges. On the Maramarua there were most extensive pa-tuna, the main posts of which were frequently 2 ft in diameter, with roughly carved tops. How the old Māoris, without mechanical means of driving, ever got these heavy posts into position is not known, but it must have been a strenuous work".
Key threats/impacts	Tuna population will continue to decline and become less abundant. Whanau, hapū and marae will become less engaged with the practices of kaitiakitanga and mahinga kai.
Project goal/s (SMART)	Within 10 years, up to 15 tuna habitat ponds are created within the areas adjacent to Lakes Whangape, Lake Kimihia and Lake Waikare to provide an increase in habitat availability for tuna. Tuna wananga have been held with iwi members at (or near) the ponds transferring knowledge and tools to marae. Tuna from the ponds are being served at Poukai, thus contributing to restoring the relationship of the marae with the Waikato River.
Works required	Works are intended to be implemented by whanau, hapū and ngaa marae. Co-funding contributions will be sourced and welcomed from interested collaborative partners.

	This project is intended to be undertaken as 15 individual projects, but may be undertaken as multiple ponds per project where appropriate. **Cultural practices to ensure cultural safety:** Cultural safety, \$200 per hour or \$1600 per 8 hours. Estimated cost for up to 80 hours = \$24,000. **Earthworks:** Excavate marginal low lying areas to create shallow ponds/wetlands. • Ponds should be constructed up to a maximum of $5000m^2$ and approximately 2m deep. They should be no deeper than 3m to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Good quality water is maintained in the constructed ponds. • Ponds are constructed in traditional mahinga kai area/sites identified by whanau, hapū and marae.  **Note: Resource consent may be required** Costs include excavator transport and are based on ponds being $5000m^2$ x 2m deep and a 12 tonne excavator moving $150m^3$ per hour (\$10,000), returning for one day to reshape the site once excavations have settled (\$1800). Cost per pond: \$11,800. Estimated cost across 15 ponds: \$177,000. **Fencing:** Ponds should be fenced to exclude cattle and sheep with a 7-wire post and baton fence. Cost per pond: 400m x \$20/m = \$8000.

	Estimated fencing cost across 15 ponds: $120,000. **Planting:** Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax). • Native planting 0.3ha per pond = $11,865. • Additional weed control for 3 years at each pond = $2520. Planting and releasing cost per pond = $14,385. Estimated planting cost across 15 ponds = $215,775. **Resource consent:** It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately. A generous cost estimate of $5000 per pond has been used. Estimated resource consent cost across 15 ponds: $75,000.  **Capacity development:** • Tuna wananga Provide training for tribal members to learn about tuna restoration. Tuna wananga (10) plus tuna tool kits. Cost per wananga: $6000. Estimated cost: $60,000. **Project management** Project manager to carry out knowledge holder interviews, work with whanau, marae, hapū, or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works, project

	manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated project management cost per pond: $12,235.50. Estimated project management cost across 15 ponds: $234,533.
Risks to project success	• Access to sites. • Resource consents not granted. • Inexperienced practitioners and/or in-completed works. • Ongoing maintenance to control weed infestation. • Commercial eel fisherman, fishing out completed pond.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership, public and private (by agreement), but predominantly land owned by whanau, hapū, ngaa marae and iwi. Very high likelihood of adoption.
Knowledge gaps and response	Whether consents or authorisations are required. Exact location of tuna ponds is to be determined by whanau, hapū and/or marae. Size of each pond including area to be fenced and restored will differ from site to site.
Project duration (years)	3 years per pond per site includes construction, planting and weeding programme. 10 year project.
Costs	

Work description	Cost ($)
Earthworks	177,000
Fencing (6km)	120,000
Planting (4ha)	215,775
Resource consents	75,000
Capacity development (tuna wananga)	60,000
Project management (30%)	194,332.50
Total	**842,107.50**

Work description	Cost ($)
Total estimate cost per individual pond (excludes capacity development and tertiary scholarships)	56,140.50

Shallow Lakes 6 Priority: High	Lake Ngaroto and Lake Mangakaware paa harakeke and other native plant restoration and enhancement.
Project summary	This project was identified as a very high priority by local tangata whenua. This project will enable paa harakeke to be re-established around the margins of the lake; additionally, other suitable trees, shrubs, rushes and sedges will be planted to restore riparian plant communities in key areas identified by mana whenua. If appropriate, watercress will be seeded into sites surrounding both lakes.
Vision for the project	Mana whenua are able to further fulfil their role as kaitiaki, utilise paa harakeke and other plant based resources as appropriate. Thus, continuing with their cultural practices and intergenerational transfer of indigenous knowledge.
Location	Lake Ngaroto, Te Awamutu Lake Mangakaware, Paterangi.
Brief description of site	**Lake Ngaroto** The area of Ngaroto is steeped in ancient traditional history, being one of the more significant settlement regions following the migration of ancient Māori inland from the Kāwhia shorelines circa 1400-1500 (Hingakaka-Ngaroto Iwi Management Plan). The region was settled by various tribes and hapū over the next two to three hundred year settlement period. At the time of the Hingakaka battle the Apakura, Hikairo, and Puhiawe tribes were the principle resident iwi of the Ngaroto area. The dominance of that occupation remained until the departure of Hikairo to Kawhia in the 1820-21 period and the eventual departure of Apakura to the Taupo region as a consequence of the confiscation of their ancestral lands by colonial Pakeha invasionary forces in 1864 (Hingakaka-Ngaroto Iwi Management Plan). The late 1700-1800s period saw turmoil and warfare beset the Tainui tribes in the Waipā region and as a consequence of raid and counter raid between the tribal factions of Tainui, and inter-iwi conflicts with external tribes in the North Island, invasionary forces from throughout the North Island converged on the Te Awamutu area to engage in battle with the Waikato-Maniapoto tribes of Tainui. Thus the ground for the epic battle of Hingakaka was set (Hingakaka-Ngaroto Iwi Management Plan). Archaeological evidence from five pa sites around Lake Ngaroto indicates people lived here and they cultivated their own food, using the nearby forest and lake as a food source and as a resource for building materials, medicine, and traditional rituals and ceremony. Lake Ngaroto is also where Uenuku was recovered from.

	Accordingly, Lake Ngaroto has national, historical, customary, cultural and spiritual significance for tangata whenua as kaitiaki of the region. It is the largest of the Waipā peat lakes. It is located 19km south of Hamilton city and 8km northwest of Te Awamutu. It has a maximum depth of 4 metres and an average depth of less than 2 metres. Lake Ngaroto has poor water quality, however a major effort has been launched to return this lake to a more natural state, surrounded by native vegetation. The lake catchment is mainly pastoral. Lake Ngaroto is hypertrophic. It has: • very high levels of nutrients • high levels of microscopic algae (phytoplankton) • high levels of suspended sediment • low water clarity. **Lake Mangakaware** Lake Mangakaware Recreation Reserve is very culturally significant and is located within a north-south orientated shallow valley, ringed by Anderson, Kakaramea and Meadways roads at Paterangi. It is the western most of the 16 Waipā peat lakes and drains west into Mangakaware Stream and eventually joins Waipā River at Te Rore. Three sites are registered by the NZ Archaeological Society, and all are swamp pa. Extensive surveys of these sites together with the lake bed were commissioned by the society during four periods between August 1968 and December 1970. Extracts from published reports referred to: "… the dwelling areas of the site were built up from sand lenses laid on the original peat surface and the whole unit would have been defended by the surrounding lake and swamp as well as man made palisades. The site dates to the sixteenth and seventeenth centuries A.D. and is one of the best preserved examples of a classic Māori habitation site to be excavated in New Zealand …" (Bellwood, P 1978). At least three canoes/waka found by divers during the survey lie in the mud and sediment of the lake bed. These were recorded, but left undisturbed. There are also examples of palisades still present at two sites although they are now in poor condition through lowering ground water levels and drying peat. Water levels are crucial for the preservation of organic materials within and around the three pa on the shores of the lake. Levels determine the degree to which archaeological deposits/artifacts are saturated and the rate of aerobic decomposition. Just making a note to the project team to note the connection between this project and the Mangakaware/Ngaroto projects in the general priorities section. These projects are complimentary and the other PAFs need to note the importance of inclusion of this project.

Key threats/impacts	• Loss of the ability to practice kaitiakitanga. • Weed species. • Loss of knowledge.
Project goal/s (SMART)	Per lake: • Areas of up to 2ha (identified as important by tangata whenua) around the lake margins and associated wetlands are cleared of exotic weeds and planted in native plants (including paa harakeke) within 3 years of the project commencing. • 5 protected sites have been reseeded with watercress (if appropriate) within 3 years of the project commencing.
Works required	Works could be completed at whanau, marae, hapū or iwi level. We welcome co-funding opportunities/partnerships. **Project management:** Manage the project, engage with marae, hapū, iwi, land owners, arborists, planting crews, nurseries and pest control, liase with land care groups and Waipā District Council, and complete reporting at $64,118.50. 25% of project costs. **Site preparation:** Willow control should be undertaken using ground based methods to minimise off-target damage. Willows are densely populated. Assume $15,000 for Lake Ngaroto. **Riparian planting:** Assumes 2ha of planting, including paa harakeke, per lake. $89,762 (for 2ha) x 2 lakes = $179,524. **Animal pest control** (for plant establishment): Over 3 years. Assume $1950 for Lake Ngaroto. **Watercress seeding:** 5 sites per lake at $1000 per site x 10 = $50,000. **Restoration wananga**: Marae or hapū based restoration wananga x 2 (1 per lake) at $5000 per wananga = $10,000.
Land tenure – likelihood of adoption and adoption circumstances	Both lakes have significant publicly owned margins that are managed by Waipā District Council.
Knowledge gaps and response	These lakes are of very high cultural significance and have archaeological remains. Investigation of preservation methods would be beneficial.
Project duration (years)	5 years

Costs	

Work description	Cost ($)
Project management (25%)	64,118.50
Site preparation (willow control)	15,000
Riparian planting (paa harakeke)	179,524
Animal pest control	1950
Watercress seeding	50,000
Wananga	10,000
Total	**320,592.50**

Shallow Lakes 7 Priority: Very high	Restoration of paa harakeke, watercress and raupo around Lake Waahi lake margins.
Project summary	This project was identified as a very high priority by tangata whenua in the Lower Waikato River catchment. Much of the Lake Waahi lake margin has been fenced and planted through previous restoration projects, but there is still approximately 6km of lake edge and associated wetlands left to fence and plant. This project will see the Lake Waahi lake margin and associated wetlands fully fenced and planted with native plants. Through the native plantings, paa harakeke will be re-established; raupo will be specifically planted onto the northern shore of Lake Waahi which is prone to erosion, and watercress will be seeded into 10 seeps, puna, wetlands and tributaries surrounding the lake.
Vision for the project	The whole of the Lake Waahi lake margin is fenced to exclude cattle and a thriving riparian margin (including paa harakeke) is planted around the whole lake. Raupo beds have established on the northern shore of Lake Waahi in erosion prone areas. Watercress is readily available for wild harvest for ngaa whanau and marae o Rahui Pokeka
Location	Lake Waahi, Huntly
Brief description of site	Lake Waahi is culturally very significant for Waikato-Tainui and is the third largest lake in the Waikato region. It has suffered from high levels of suspended sediment entering the lake, originating from both pastoral and mine drainage. Currently, the lake is considered to be hypertrophic. At times, 90% of the sediment entering the lake resulted from coal mining. Mine discharge, increased agriculture, clearing of native forest and the resulting increase in nutrient and suspended sediment levels are the primary cause of water quality decline. Lake Waahi became dominated by exotic macrophytes prior to 1978 and in 1978-79 the macrophyte populations crashed. This was attributed to low lake levels due to low rainfall, high nutrient concentrations and continued sediment input from mining (Dell et al., 1988). Currently, Lake Waahi remains unvegetated and is extremely turbid, which renders it undesirable for recreational activities.
Key threats/issues	• Loss of the ability to practice kaitiakitanga. • Erosion and floods. • Stock access. • Weed species.
Project goal/s (SMART)	• The remaining areas of Lake Waahi's lake margin and associated wetlands (approx. 6km) is cleared of exotics and replanted with riparian margin species (including paa harakeke) within 3 years of the project commencing. (Note:

	two significant wetlands on the Lake Waahi lake margin are covered in a different project in the strategy.) • Two (1km x 5m) stretches of raupo have been planted on the northern shore of Lake Waahi in erosion prone areas within 2 years of the project commencing. • 10 protected sites have been reseeded with watercress within 3 years of the project commencing.
Works required	Works could be completed at whanau, marae, hapū or iwi level. We welcome co-funding opportunities/partnerships. **Project management:** Manage the project, engage with marae, hapū, iwi, land owners, arborists, planting crews, nurseries and pest control, and complete reporting at $74,868. 25% of project costs. **Fencing:** The lake margin shall be fully fenced primarily to exclude stock and should occur on the landward extent of the wetlands. Most of the lake is fenced but assume 2km requires fencing i.e. around wetlands. Assume $40,000. **Site preparation:** Willow control should be undertaken using ground based methods to minimise off-target damage. Willows are densely populated, Assume $30,000. **Riparian planting:** Assumes 3ha of planting including paa harakeke at $134,643. **Animal pest control** (for plant establishment): Over 3 years. Assume $1950. **Raupo planting**: Assume 1 hectare at $44,881. Additional resources to support raupo establishment (warrens/wire etc) at $2000. **Watercress seeding:** 10 sites x $5000 per site = $50,000. **Restoration wananga**: Marae or hapū based restoration wananga. Assume $5000.
Risks to project success	Land ownership (although with previous projects around Lake Waahi this has not been a problem).
Land tenure – likelihood of adoption and adoption circumstances	Private and public land.
Knowledge gaps and response	Specific areas for fencing and planting will need to be identified during project planning.
Project duration (years)	5 years

Costs	<table><tr><th>Work description</th><th>Cost ($)</th></tr><tr><td>Project management (25%)</td><td>77,118</td></tr><tr><td>Fencing (2km)</td><td>40,000</td></tr><tr><td>Site preparation (willow control)</td><td>30,000</td></tr><tr><td>Riparian planting (paa harakeke)</td><td>134643</td></tr><tr><td>Animal pest control</td><td>1950</td></tr><tr><td>Raupo planting plus support resources</td><td>46,881</td></tr><tr><td>Watercress seeding</td><td>50,000</td></tr><tr><td>Wananga</td><td>5000</td></tr><tr><td>Total</td><td>385,592</td></tr></table>

Shallow Lakes 8 Priority: Very high	Lake Waikare paa harakeke and other native plant restoration and enhancement project.
Project summary	This project was identified as a very high priority by local tangata whenua. This project will enable paa harakeke to be re-established around the margin (and associated wetlands) of Lake Waikare; additionally, other suitable trees, shrubs, rushes and sedges will be planted to restore riparian plant communities in key areas identified by mana whenua, and if appropriate watercress will be seeded into appropriate sites surrounding both lakes.
Vision for the project	Mana whenua are able to further fulfil their role as kaitiaki, utilise paa harakeke and other plant based resources as appropriate. Thus continuing with their cultural practices and intergenerational transfer of indigenous knowledge.
Location	Lake Waikare, Te Kauwhata
Brief description of site	**Lake Waikare** Lake Waikare is the largest lake in the Lower Waikato catchment, with 3442ha of open water. It has an average depth of 1.5m and a maximum depth of 1.8m. Lake Waikare has very poor water quality and is hypertrophic. There are no large submerged aquatic plants growing in the lake. In 1965 the lake level was lowered by 1m. This was in accordance with the Lower Waikato Waipā Flood Control Scheme and followed the construction of an outlet gate. Lake Waikare discharges to the Whangamarino Wetland from the artificial Pungarehu Canal. The lake is managed under a strict seasonal fluctuation regime of approximately 0.3 metres.
Key threats/impacts	• Loss of the ability to practice kaitiakitanga. • Weed species. • Loss of knowledge.
Project goal/s (SMART)	• Areas of up to 10ha (identified as important by tangata whenua) around the lake margins and associated wetlands are cleared of exotic weeds and planted in native plants (including paa harakeke) within 3 years of the project commencing. • 10 protected sites have been re-seeded with watercress (if appropriate) within 3 years of the project commencing.
Works required	Works could be completed at whanau, marae, hapū or iwi level. We welcome co-funding opportunities/partnerships. **Project management:** Manage the project, engage with marae, hapū, iwi, land owners, arborists, planting crews, nurseries and pest control, liaise with land care groups, land care trust and DOC and complete reporting at $121,759.60. 20% of project costs. **Fencing:** The lake margin shall be fenced primarily to exclude stock. Most of the lake is fenced but assume 4km requires fencing, i.e. around wetlands, at $80,000.

	Site preparation: Willow control and other pest weeds should be undertaken using ground based methods to minimise off-target damage. Willows are densely populated. Assume $100,000. **Riparian planting:** Assumes 8ha of planting including paa harakeke around the lake margins/or associated wetlands. $44,881 x 8 = $359,048. **Animal pest control** (for plant establishment): Over 3 years. Assume $9750. **Watercress seeding:** 10 sites per lake x $5000 per site = $50,000. **Restoration wananga**: Marae or hapū based restoration wananga x 2 at $5000 per wananga = $10,000.
Risks to project success	Land ownership (although with previous projects around Lake Waahi this has not been a problem).
Land tenure – likelihood of adoption and adoption circumstances	Private and public land.
Knowledge gaps and response	These lakes are of very high cultural significance and have archaeological remains, investigation of preservation methods would be beneficial.
Project duration (years)	5 years
Costs	

Work description	Cost ($)
Project management (20%)	121,759.60
Fencing	80,000
Site preparation (willow control)	100,000
Riparian planting (paa harakeke)	359,048
Animal pest control	9750
Watercress seeding	50,000
Wananga	10,000
Total	**730,557.60**

Shallow Lakes 9 Priority: Very high	Kaitiakitanga in action through reducing koi carp (and other pest fish) in the Lower Waikato Lakes
Project summary	This project was identified as a very high priority (second highest priority) by tangata whenua in the lower Waikato River catchment. Koi carp (and other pest fish) were identified as a major source of harm to our tupuna awa (which by definition includes the shallow lakes) and also as a major threat to future restoration efforts, including lake bed plant restoration, water quality improvement projects and/or mahinga kai restoration projects. The concerted effort to remove koi carp (and other pest fish species) is a modern version of kaitiakitanga in action. As kaitiaki we have an inherent responsibility to restore, protect and enhance not only our shallow lakes but our taonga species. The project would see a team of kaitiaki actively fish down and dispose of primarily koi carp, but also other pest fish species such as perch, cat fish, etc. All year round. These fish have a detrimental effect on te mana o te awa and compete with mahinga kai (eg tuna) for food and habitat.
Vision for the project	Koi carp and other pest fish are significantly reduced in three Lower Waikato shallow lakes (Waahi/Whangape/Waikare) resulting in better outcomes for mahinga kai species, water quality and plant reestablishment efforts.
Location	Lake Waahi, Lake Whangape and Lake Waikare
Brief description of site	The lower Waikato shallow lakes are highly significant to Waikato-Tainui. All of the shallow lakes have significant pre-European history and were major food baskets for our tupuna. The three lakes identified for this project all have high pest fish populations, all have poor water quality and little to no significant macrophyte beds. They have also been identified for other parallel restoration works to occur in their catchments. The project will involve rotating between the lakes and fishing down pest fish populations. Daily catches will be recorded. Changes in catch rates and water quality as identified by lake buoys will be monitored. Depending on the results of the project, following the five year period, this project could get extended into the other shallow lakes.
Key threats/impacts	Loss of the ability to practice kaitiakitanga on the ground has led to a disconnection of the whanau and the lakes.
Project goal/s (SMART)	• Koi carp populations have been significantly reduced in the three shallow lakes (by at least half or more). • The methods have been refined and can be applied across other koi hot spots.
Works required	**Project management:**

	• Manage project, engage with landowners, mana whenua, coordinate fishers, design and installation of gates, monitoring and reporting over 5 year period at $335,000. **Project plan:** • Detailed project plan at $20,000. **Koi gates:** • Design and consents at $40,000. • Install one way koi gates at the outlets of the three lakes at $300,000. **Fishing gear, training and vehicle:** • Purchase boat, nets, safety equipment at $50,000. • Purchase or lease truck at $30,000. • Fuel, etc, for boat at $500pw x 52 x 5 = $130,000. • Health and safety training, etc, at $10,000. **Kaitiaki fishers:** • 3 x fishers x $45,000 each per year = $135,000 annually. • 5 years x $135,000 = $675,000. **Monitoring:** • Engagement with WRC, review of buoy data, plus baseline and final fisheries survey at $80,000. **Pest fish wananga:** • Wananga to learn about pest fish at $5000.
Risks to project success	• Flooding. • Vandalising.
Land tenure – likelihood of adoption and adoption circumstances	Crown land. Iwi owned land (Lake Waikare and some margins). Maaori owned land.
Project duration (years)	5 years
Costs	

Work description	Cost ($)
Project management (25%)	335,000
Project plan	20,000
Koi gates	340,000
Fishing gear, training and vehicle	220,000
Kaitiaki fishers (x 3) over 5 years	675,000
Monitoring	80,000
Wananga	5000
Total	**1,675,000**

Shallow Lakes 10 Priority: High	Recognising and honouring our sites of significance – Lower Waikato lakes iPOU project
Project summary	This project was identified as a high priority by iwi. It provides a means of sharing our knowledge, connection, history and relationship with the significant shallow lakes in the Lower Waikato River catchment, which otherwise could be lost. The project will create a physical network of interactive pou (iPou) connected to a database that delivers cultural, historical, spiritual and ecological layers to smart phones and devices. The pou will also act as a physical presence to acknowledge the sites.
Vision for the project	Sites of significance are acknowledged through iPou (or some other appropriate tohu for the place, eg kohatu, or carved pou) and the korero that is able to be shared with whanau.
Location	The project location is the significant shallow lakes in the Waikato River catchment.
Brief description of the site	The specific iPou sites will be determined by iwi, but could include waahi tapu sites such as Lake Kopuera, traditional fishing sites like Lake Whangape, and/or traditional paa sites like Lake Kimihia or any other significant sites. Twenty iPou sites may be selected due to historical, cultural, spiritual or ecological significance as determined by iwi. 10 carved pou sites selected by iwi. This project is significant because it enables iwi to tell their story as kaitiaki to acknowledge and share knowledge of the shallow lakes around the Waikato River and its tributaries.
Key threats/impacts	• Connections and important history will be lost. • Sites won't be appropriately recognised and acknowledged. • Cultural safety.
Project goal/s (SMART)	Within 3 years of the project commencing, up to 20 iPou and 10 carved pou will be standing at lakes of significance in the Waikato River catchment.
Works required	Works could be implemented at iwi, hapū, marae, or whanau level. Co-funding contributions from other interested partners to assist with completing this project would be welcomed. **Project management ($222,000):** Manage the project; engage with iwi, hapū, marae to identify sites of significance; landowner liaison; negotiate agreements and engage with iPou developer and iPou fabricator; source wood, source carvers, inspect completed works; organise hui to unveil iPou (catering, venue); provide monitoring and milestone reports over a 3 year period.

	Collate information for iPou ($20,000): Collate information for the sites. Assume: • $1000 per site to undertake this task. **Fabricate and install up to 20 iPou onto the designated shallow lakes sites ($200,000) and up to 10 carved pou at $32,000 per pou ($320,000)** **Wood $150,000** Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design e.g. carved pou, or kohatu). Assume: • $10,000 per iPou (fabrication and installation costs) per site = $200,000 • $32,000 per carved pou (carving) • $6000-$15,000 per pou for wood, depending if pine or native. For the purpose of this costing, native wood has been used at $15,000. **Technology/information loaded and installed into iPou ($40,000):** Engage iPou developer to install information collated into the fabricated pou. Upload/install the technology. Assume: • $2000 per pou x 20 = $40,000. **Cultural Safety ($10,000):** Cultural advisors and practices to ensure cultural safety of this project.
Risks to project success	Access to sites. Access to knowledge, although if the project regarding collection of traditional knowledge is completed then this is no longer an issue.
Land tenure – likelihood of adoption and adoption circumstances	Mix of public, private and iwi owned. Very high likelihood of adoption.
Knowledge gaps and response	Permit requirements for iPou installation.
Project duration (years)	3 years

Costs	

Work description	Cost ($)
Project management (30%)	222,000
Collate information for iPou	20,000
Fabricate and install up to 20 iPou onto the designated shallow lakes sites	200,000
Up to 10 carved pou (approx. 6m by 0.6m)	320,000
Materials (wood for pou)	150,000
Technology/information loaded and installed into iPou	40,000
Hui costs	10,000
Total	**962,000**

Shallow Lakes 11 Priority: High	Nga tapu wae o te wherowhero project
Project summary	This project was identified as a high priority by representatives from Waahi Paa. The project will involve the construction of a gravel walkway connecting Waahi Paa, Lake Waahi and Lake Puketirini. The walkway will contain iPou, picnic tables and some sections will be planted out in native vegetation.
Vision for the project	Whanau are re-establishing their relationship with Lake Waahi and Lake Puketirini by using the walkway and enjoying hauora benefits. Intergenerational knowledge and practices are recorded, shared and transferred.
Location	Lake Waahi, Huntly.  
Brief description of site	Lake Waahi is very significant culturally and has been a food bowl for Ngaati Mahuta and the Kiingitanga for generations. Waahi Marae functions as the focus of much of the community life of Ngaati Mahuta. As the home of the Kaahui Ariki since the 1890s, it also functions as a focus for all the tribes of the Waikato-King Country and beyond who are affiliated to the King Movement. The long association with Kiingitanga gives this marae special significance in the Māori world.

	Located on the bank of the Waikato River in Rahui Pokeka (Huntly) and adjacent to the Huntly power station, Waahi is the principal marae of Ngaati Mahuta of Waikato and home of the Kaahui Ariki, the paramount family in the King Movement. The marae is strategically located next to the Waahi Stream which connects Lake Waahi to the Waikato River.
Key threats/impacts	• Flooding
Project goal/s (SMART)	Within 2 years of the project commencing, the gravel loop walkway is completed, including the installation of 4 iPou or other signage as appropriate. Within 3 years of the project commencing, the Waahi Stream will be planted.
Works required	Works could be implemented at iwi, hapū, marae or whanau level. Co-funding contributions from other interested partners to iwi, hapū, or whanau to complete this project would be welcomed. This project could be undertaken in parts or as a whole. Prior to any works taking place, a full concept plan and costings should be developed for the project. The costs provided below are estimates only. **Project management:** Project manager would be required to manage the project, including, landowner liaison, providing information, negotiating agreements, inspecting works and project managing parts of the work as required. Project management/staffing is estimated to be 25% of the project cost. **Project plan:** Detailed project plan at $20,000. **Walkway:** Installation of a 4.5km walking track reconnecting whanau to both Lake Waahi and Lake Puketirini. Estimate of $600,000 based on Ohinewai Walkway PAF. Installation of 4 picnic tables and viewing areas along the walkway at $28,000. **iPou:** Installation of 4 iPou (or other signage as appropriate) x $15,000 per iPou = $60,000. **Waahi Stream planting:**

	Site preparation at $10,000. Assume 1 hectare of planting at $44,881. Animal pest control (to allow plants to establish) at $750.
Risks to project success	Funding. Vandalism. Private landowners not allowing a public accessway.
Land tenure – likelihood of adoption and adoption circumstances	Mix of public and privately owned.
Knowledge gaps and response	If consents or authorisations are required.
Project duration (years)	3 years
Costs	

Work description	**Cost ($)**
Project management (25%)	190,908
Project plan	20,000
Walkway plus picnic tables	628,000
iPou x 4	60,000
Waahi Stream planting	55,631
Total	**954,539**

Shallow Lakes 12 Priority: Very high	Nga rauwiri o te riu o Waikato-Tainui
Project summary	The project was a very high priority for iwi and will involve the construction of a paa tuna in the Waahi Stream and Whangape Stream.
Vision for the project	Whanau are able to express mana whakahaere and reconnect with traditional fishing practices along Waahi Stream, at Lake Waahi, and the Whangape Stream, Lake Whangape. Intergenerational knowledge and practices are recorded, shared and transferred. The ability to act as kaitiaki is enhanced, and the learnings/methodology can be extended to other whanau and other lakes.
Location	Lake Waahi, Waahi Stream Huntly. Lake Whangape. Whangape Stream.
Brief description of site	Waahi Stream links Lake Waahi and the Waikato River. Waahi Marae is located adjacent to Waahi Stream and is well known throughout Māoridom for providing puhi eel. Fishing for puhi has occurred at Waahi over many generations. Historically there were several paa tuna along Waahi Stream, the remnants of which still remain. These were used to fish the downstream migration of tuna leaving Lake Waahi and heading to the Waikato River. Lake Whangape is very significant for tangata whenua. It was once a rich source of tuna, and had many paa tuna located along the lake edge and Whangape stream. The paa tuna were so productive that several battles were fought over access. One such battle was in March 1843 when "Te Ahiwera" displayed his diplomatic skill and his fearlessness. A quarrel respecting the ownership of a paa-tuna called Kororipo threatened to involve the whole of Waikato in a war. This paa (also called Rauwiri) was a great V-shaped structure extending nearly across the lake, near the place where a stream flowed from Whangape to the Waikato River. At the apex of the work, the hinaki or eel-traps, woven of mangémangé creepers, were set. The new paa tuna can be used traditionally to harvest tuna but also for kaitiaki monitoring of fish stocks and educational purposes.
Key threats/issues	Floods.
Project goal/s (SMART)	Within 2 years of the project commencing, the paa tuna is constructed.
Works required	Works could be implemented at iwi, hapū, marae or whanau level. Co-funding contributions from other interested partners to iwi, hapū, or whanau to complete this project would be welcomed. **Project management ($41,750):** Project manager would be required to manage the project, including landowner liaison, providing information, negotiating agreements,

	inspecting works and project managing parts of the work as required. Project management/staffing is estimated to be 25% of the project cost. **Project plan ($20,000):** Prior to any works taking place a full concept plan and costings should be developed for the project. The costs provided below are estimates only. **Consents ($35,000)** Prepare consents and authorisations as necessary. **Cultural safety ($20,000)** Project cultural advisors at $10,000 per lake. **Installation of paa tuna ($80,000)** Based on historical designs, reinstall paa tuna at$40,000 per paa tuna. **Tuna wananga ($12,000)** Two tuna wananga and tuna tool kits. Use the paa tuna for monitoring purposes.
Knowledge gaps and response	If consents or authorisations are required.
Project duration (years)	2 years
Costs	

Work description	Cost ($)
Project management (25%)	41,750
Project plan	20,000
Consents	35,000
Cultural safety	20,000
Installation of paa tuna	80,000
Tuna wananga	12,000
Total	**208,750**

Shallow Lakes 13 Priority: High	Waikato-Tainui – Te Wharekura o Rakaumangamanga and kura – tuna ponds project
Project summary	The aim for this project is to restore tuna abundance through the construction of up to four dividable tuna ponds to increase, support and promote quality tuna habitat. This project will see the creation of four tuna habitat ponds adjacent to an area that was traditionally known by whanau, hapū and marae as being historically, culturally, ecologically or spiritually significant to them. The project is of high priority.
Vision for the project	Tuna (freshwater eels) are plentiful at the sites. Whanau are able to exercise their mana whakahaere through restoring, protecting, enhancing and harvesting tuna. Customary practices and knowledge is transferred on to future generations.
Location	 The project site is located directly west of Te Wharekura o Rakaumangamanga, immediately south of Waahi Stream.
Brief description of site	Exact locations of the four dividable tuna ponds will be identified between Lake Waahi and the rear of Rakaumangamanga. The land is currently wetland type area prone to flooding and known to be whanau, hapū and marae traditional paa tuna sites. This project is significant because tuna are a very significant mahinga kai taonga species for Waikato-Tainui, Waahi Whaanui Trust and Ngaa Muka Development Trust. Whanau, hapū and marae have witnessed a steady decline in the tuna abundance over time. The restoration of taonga species and the ability to again provide these taonga as food for manuwhiri (visitors) is a critical marker of the whanau, hapū and marae's mana and status. It also confirms the whanau, hapū and marae proficiency in manaaki tangata or the practice of generosity and reciprocity. The abundance of food and

	other resources that were traditionally available to Waikato-Tainui within its tribal rohe are well known by other tribes throughout the motu.
Key threats/issues	• Tuna population will continue to decline and become less abundant. • Whanau, hapū and marae will become less engaged with the practises of kaitiakitanga and mahinga kai.
Project goal/s (SMART)	Within 5 years, four tuna habitat ponds have been created. Tuna wananga have been held with iwi members at (or near) the ponds, transferring knowledge and tools to the kura. Tuna from the ponds are being monitored on a regular basis with the future inclusion of the monitoring into the kura's learning curriculum using matauranga Māori and available science where required. Tuna for the ponds may be served at Poukai, thus contributing to restoring the relationship of the marae with the awa.
Works required	Works could be implemented at iwi, hapū, marae, whanau and kura level. Co-funding contributions from other interested partners to iwi, hapū or whanau to complete this project would be welcomed. This project could be undertaken in parts or as a whole. **Earthworks:** Excavate marginal low lying pasture areas to create shallow ponds/wetlands. • Construct ponds up to a maximum of 5000m^2 and approximately 2m deep. Ponds should be no deeper than 3m deep to avoid deoxygenation of bottom layers and associated fish deaths. • Ponds are lined with suitable soils so they are capable of holding water with minimum leakage. • Good quality water is maintained in the constructed ponds.

	 **Note: Resource consent may be required.** Costs include excavator transport and are based on ponds being 5000m^2 x 2m deep and a 12 tonne excavator moving 150m^3 per hour ($10,000), returning for one day to reshape the site once excavations have settled ($1800). 4 ponds = $47,200. **Fencing:** Ponds should be fenced to exclude cattle with a 7-wire post and baton fence. • Per pond: 400m x $20/m = $8000. Estimated total fencing cost: 4 ponds x $8000 = $32,000 **Planting** Dense native planting should be carried out around the pond to create overhanging habitat for eels. Species should consist of hardy native species that would have naturally existed within the wetland environment (e.g. carex secta, cabbage tree, flax). • Native planting 0.3ha per pond at $11,865. • Additional weed control for 3 years at each pond at $2520. Estimated planting cost of 4 ponds = $57,540. **Resource consent** It is anticipated that most ponds will require resource consent. Costs will vary depending on whether one consent application is lodged for multiple ponds or whether resource consents are applied for separately. A generous cost estimate of $5000 per pond has been used. Estimated resource consent cost across 4 ponds = $20,000.

	 **Capacity development** • Tuna wananga Provide training for tribal members to learn about tuna restoration. Tuna wananga (4) plus tuna took kits. Estimated cost at $24,000. **Project management** Project manager to carryout knowledge holder interviews, work with whanau, marae, hapū or iwi (as appropriate), landowner liaison, provide information, negotiate agreements, inspect works and project manage parts of the work as required. Project management/staffing is estimated to be up to 30% of the project cost. Estimated cost across 4 ponds at $47,022.
Risks to project success	Access to sites. Resource consents not granted. Inexperienced practitioners or in-completed works.
Land tenure – likelihood of adoption and adoption circumstances	Mixed land ownership public and private (by agreement) but predominantly land owned by whanau, hapū, ngaa marae and iwi. Very high likelihood of adoption.
Knowledge gaps and response	Whether consents or authorisations are required.
Project duration (years)	3 years per pond per site includes construction, planting and weeding programme. 5 year project in total.

<table>
<tr>
<td>Costs</td>
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<table>
<tr><th>Work description</th><th>Cost ($)</th></tr>
<tr><td>Earthworks</td><td>47,200</td></tr>
<tr><td>Fencing</td><td>32,000</td></tr>
<tr><td>Planting</td><td>57,540</td></tr>
<tr><td>Resource consents</td><td>20,000</td></tr>
<tr><td>Capacity building</td><td>24,000</td></tr>
<tr><td>Project management (30%)</td><td>47,022</td></tr>
<tr><td>Total</td><td>227,762</td></tr>
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Shallow Lakes 14 Priority: High	Waipā peat lakes project – collection, storing and sharing of traditional korero regarding our lakes.
Project summary	This project was identified as a high priority by iwi at the iwi priorities wananga. It will contribute towards reconnecting whanau and the history and knowledge of our significant lakes. It involves recording our traditional mātauranga regarding the Waipā peat lakes and making it available for iwi in digital and print media format.
Vision for the project	Intergenerational knowledge and practices of Waipā peat lakes are recorded, stored, shared and transferred.
Location	This project is located within the rohe of the Waipā peat lakes and includes but is not limited to Lake Ngaroto and Lake Mangakaware.
Brief description of site	The Waipā peat lakes are included in this project. They are very culturally significant. The creation of mātauranga resources that record and share our history and knowledge of the lakes will be a valuable resource now and for generations to come.
Key threats/impacts	• Loss of knowledge. • No transfer of customs and practices between generations.
Project goal/s (SMART)	Within 2 years of the project commencing, the interviews, literature review will be completed. Within 3 years of the project commencing, the resources will be developed (digital platform and print media).
Works required	Works could be implemented at iwi, hapū, marae or whanau level. Co-funding contributions from other interested partners to iwi, hapū, or whanau to complete this project would be welcomed. **Project management ($33,000):** Project manager would be required to manage the project, including coordinating up to 30 interviews, engaging researchers/writers, publishing documents, monitoring and milestone reporting. Project management/staffing is estimated to be 25% of the project cost. **Mātauranga interviews ($59,400):** Interview knowledge holders, i.e. kaumatua/kuia (as appropriate) and collate relevant information from literature sources. Assume: • 20 kaumatua/kuia interviews x $500 per interview = $10,000 • Film and editing of interviews at $800 per day x 28 days = $22,400. • Interviewer at $800 per day x 20 days = $16,000. • Transcribe interviews at $200 per interview x 20 = $4000. **Mapping and photographing lake sites (digital platform) ($37,600):** Map and photograph all significant lake sites. Enter information (and

	interviews) into digital database and maps. Assume: • Access and photograph sites at \$800 per day x 7 days = \$5600. • GIS mapping services at \$200 per hour to input maps and develop digital platform x 20 days = \$32,000. **Publish printed resource regarding traditional knowledge/mātauranga of Waipā peat lakes (\$35,000):** • Literature review (archives, Māori text, early explorers etc) at \$10,000. • Use literature review and interview content as basis to write Waipā peat lakes booklet at \$10,000. • Publish book at \$15,000. **Book and digital platform launch (\$5000)**
Risks to project success	May be difficult to find 20 knowledge holders.
Knowledge gaps and response	Knowledge holders will need to identified during project planning.
Project duration (years)	3 Years
Costs	

Work description	Cost ($)
Project management (25%)	33,000
Mātauranga interviews	52,400
Photographing and mapping sites (digital platform)	37,600
Publish printed resource	35,000
Launch book/digital platform	5000
Total	**163,000**

Shallow Lakes 15 Priority: Very high	Lake Whangape weir project
Project summary	This project was identified as a very high priority by iwi. The level of the lake and its effect on taonga species and water quality is concerning for iwi. Historically the lake was at much higher levels than it is now. This project is to restore the lake to more historical levels by repairing or replacing the rock rubble weir at the outlet.
Vision for the project	The water level for the lake is at a level that is considered beneficial for the mauri of the lake, water quality and also taonga species habitat.
Location	Lake Whangape is located northwest of Huntly and is the second largest lake in the Lower Waikato catchment.
Brief description of site	Lake Whangape has a surface area of 1450ha, an average depth of 1.5m and a maximum depth of 3.5m. Lake Whangape catchment is mostly pastoral and the lake drains to the Waikato River via the Whangape Stream. In 1999 a rock rubble weir was consented by the Waikato Regional Council and had been constructed on the outlet of the lake – the maximum weir height at the weir crest should not exceed 4.91m (Motoriki Datum). The weir is need of repair/replacement. Lake Whangape is very significant for tangata whenua. It was once a rich source of tuna, and had many paa tuna located along the lake edge and Whangape stream. The paa tuna were so productive that several battles were fought over access. One such battle was in March 1843 when "Te Ahiwera" displayed his diplomatic skill and his fearlessness. A quarrel respecting the ownership of a paa-tuna called Kororipo threatened to involve the whole of Waikato in a war. This pa (also called Rauwiri) was a great V-shaped structure extending nearly across the lake, near the place where a stream flowed from Whangape to the Waikato River. At the apex of the work, the hinaki or eel-traps, woven of mangémangé creepers, were set.
Key threats/issues	Flooding. Weir damaged. Taonga species affected by low water levels.
Project goal/s (SMART)	Within 2 years of the project commencing, the old weir has been replaced with a new more effective weir.

Works required	Works could be implemented by iwi, hapū, marae, whanau or in partnership with an organisation. Co-funding contributions from other interested partners to complete this project would be welcomed. Prior to any works taking place, a full concept plan and costings should be developed for the project. The costs provided below are estimates only. **Project plan and design specifications for weir ($30,000):** Detailed project plan including more detailed costings. **Site investigation, survey of ground levels ($10,000):** This project will require investigation to determine the most feasible method to repair/install the weir. This is likely to require some initial site investigation to determine ground levels. **Consents preparation. Consent fees and stakeholder consultation ($35,000):** Consent will be required to undertake earthworks associated with repair/replacing the weir. **Cultural safety ($10,000):** Cultural safety advisors. **Installation/repair of weir ($100,000):** Rock rubble weir. **Project management ($46,250):** Project manager would be required to manage the project, including, landowner liaison, providing information, negotiating agreements, inspecting works and project managing parts of the work as required. Project management/staffing is estimated to be 25% of the project cost.
Knowledge gaps and response	Tangata whenua also want the possibility of dredging the lake to restore depth explore.
Project duration (years)	2 years
Costs	(see table below)

Work description	Cost ($)
Project management (25%)	46,250
Project plan and design	30,000
Site investigation, survey	10,000
Consents	35,000
Cultural safety	10,000
Installation of weir	100,000
Total	**231,250**

Shallow Lakes 16 Priority: High	Recognising and honouring our sites of significance – Waipā peat lakes iPou project
Project summary	This project was identified as a high priority by iwi. It provides a means of sharing our knowledge, connection, history and relationship with the significant Waipā peat lakes which otherwise could be lost. The project will create a physical network of interactive pou (iPou) connected to a database that delivers cultural, historical, spiritual and ecological layers to smart phones and devices. The pou will also act as a physical presence to acknowledge the sites.
Vision for the project	Sites of significance are acknowledged through iPou (or some other appropriate tohu for the place, e.g. kohatu, or carved pou) and the korero that is able to be shared with whanau.
Location	The project location is the significant Waipā peat lakes in the Waipā and Waikato River catchments.
Brief description of the site	The specific iPou sites will be determined by iwi, but could include traditional paa sites (eg Lake Mangakaware), traditional fishing sites, traditional battle sites (eg Lake Ngaroto), or any other significant sites. Twenty iPou sites may be selected due to historical, cultural, spiritual or ecological significance as determined by iwi. 2 carved pou sites selected by iwi. This project is significant because it enables iwi to tell its story as kaitiaki to acknowledge and share knowledge of the Waipā peat lakes around the Waipā catchment.
Key threats/impacts	• Connections and important history will be lost. • Sites won't be appropriately recognised and acknowledged. • Cultural safety.
Project goal/s (SMART)	Within 3 years of the project commencing, up to 20 iPou and 2 carved pou will be standing at Waipā peat lakes of significance in the Waikato River catchment.
Works required	Works could be implemented at iwi, hapū, marae, or whanau level. Co-funding contributions from other interested partners to assist with completing this project would be welcomed. **Project management ($109,200):** Manage the project; engage with iwi, hapū and marae to identify sites of significance; landowner liaison; negotiate agreements and engage with iPou developer and iPou fabricator; source wood, source carvers, inspect completed works; organise hui to unveil iPou (catering, venue); and provide monitoring and milestone reports over a 3 year period.

	Collate information for iPou ($20,000): Collate information for the sites. If a collection of knowledge project has been completed, this step will be less arduous. Assume: • $1000 per site to undertake this task. **Fabricate and install up to 20 iPou onto the designated Waipā peat lakes sites ($200,000) and up to 2 carved pou at $32,000 per pou ($64,000)** **Wood $30,000** Engage appropriate whakairo expert (or other design artist as appropriate) to fabricate and install iPou (or other design, e.g. carved pou, or kohatu). Assume: • $10,000 per iPou (fabrication and installation costs) per site = $200,000. • $32,000 per carved pou (carving). • $6000-$15,000 per pou for wood, depending if pine or native. For the purpose of this costing, native wood has been used at $15,000 **Technology/information loaded and installed into iPou ($20,000):** Engage iPou developer to install information collated into the fabricated pou. Upload/install the technology. Assume: • $2000 per pou = $40,000. **Cultural safety ($10,000)** Cultural advisors and practices to ensure cultural safety of this project.
Risks to project success	Access to sites. Access to knowledge.
Land tenure – likelihood of adoption and adoption circumstances	Mix of public, private owned. Very high likelihood of adoption.
Knowledge gaps and response	Permit requirements for iPou installation. Ongoing maintenance.
Project duration (years)	3 years

Costs	

Work description	Cost ($)
Project management (30%)	109,200
Collate information for iPou	20,000
Fabricate and install up to 10 iPou onto the designated shallow lakes sites	200,000
Up to 2 carved pou (approx. 6m by 0.6 m)	64,000
Materials (wood for pou)	30,000
Technology/information loaded and installed into iPou	40,000
Cultural safety costs	10,000
Total	**473,200**