APPENDIX SIX

Upper Waikato Project

Assessments

Contents

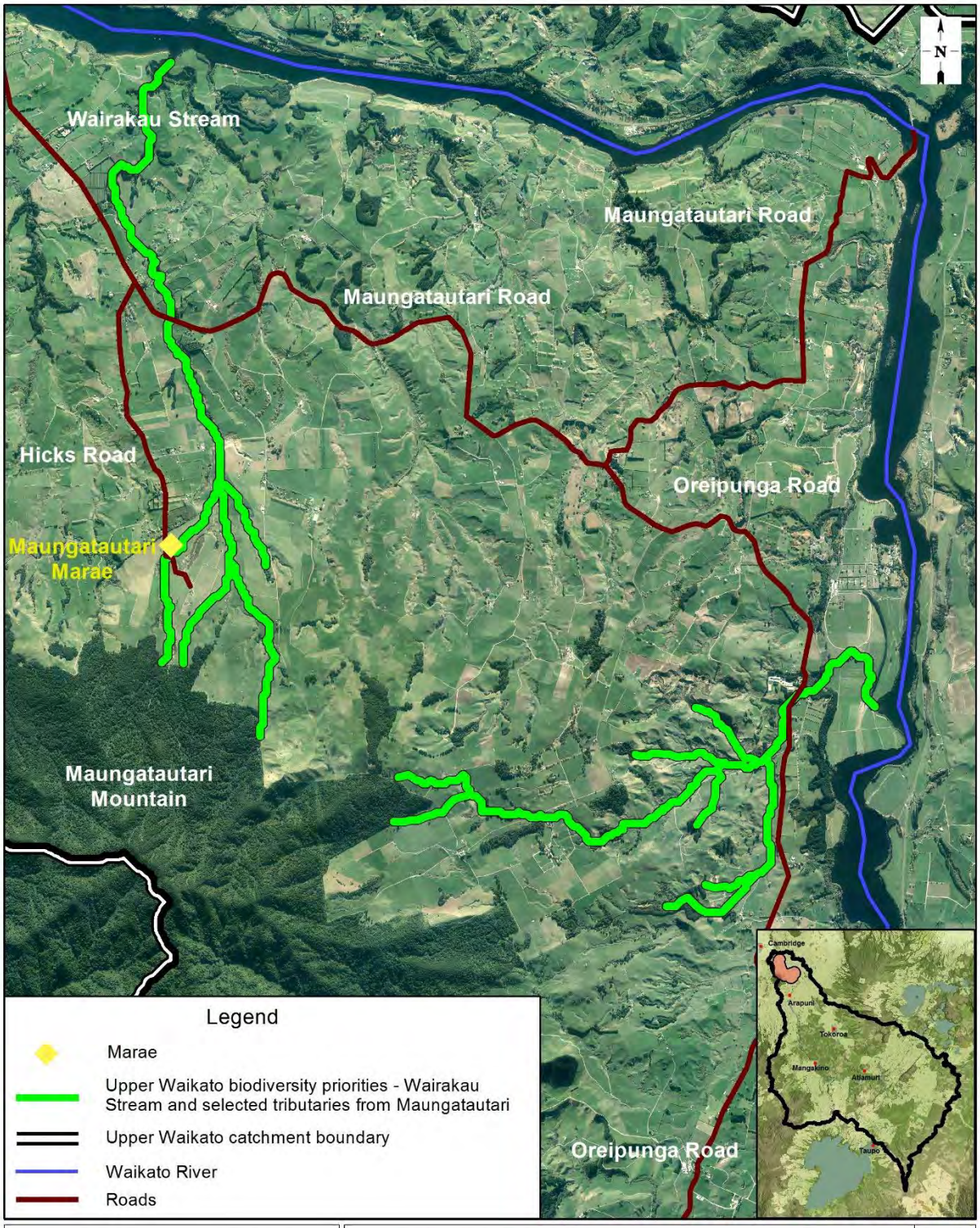
UW 1 Priority: medium	Riparian management along selected tributaries flowing from Maungatautari into Lake Karāpiro	BCR value
Relevant unit goal(s)	Ecological networks include the full range of fresh water and terrestrial ecosystem types found throughout the Upper Waikato catchment. They are in a healthy 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.

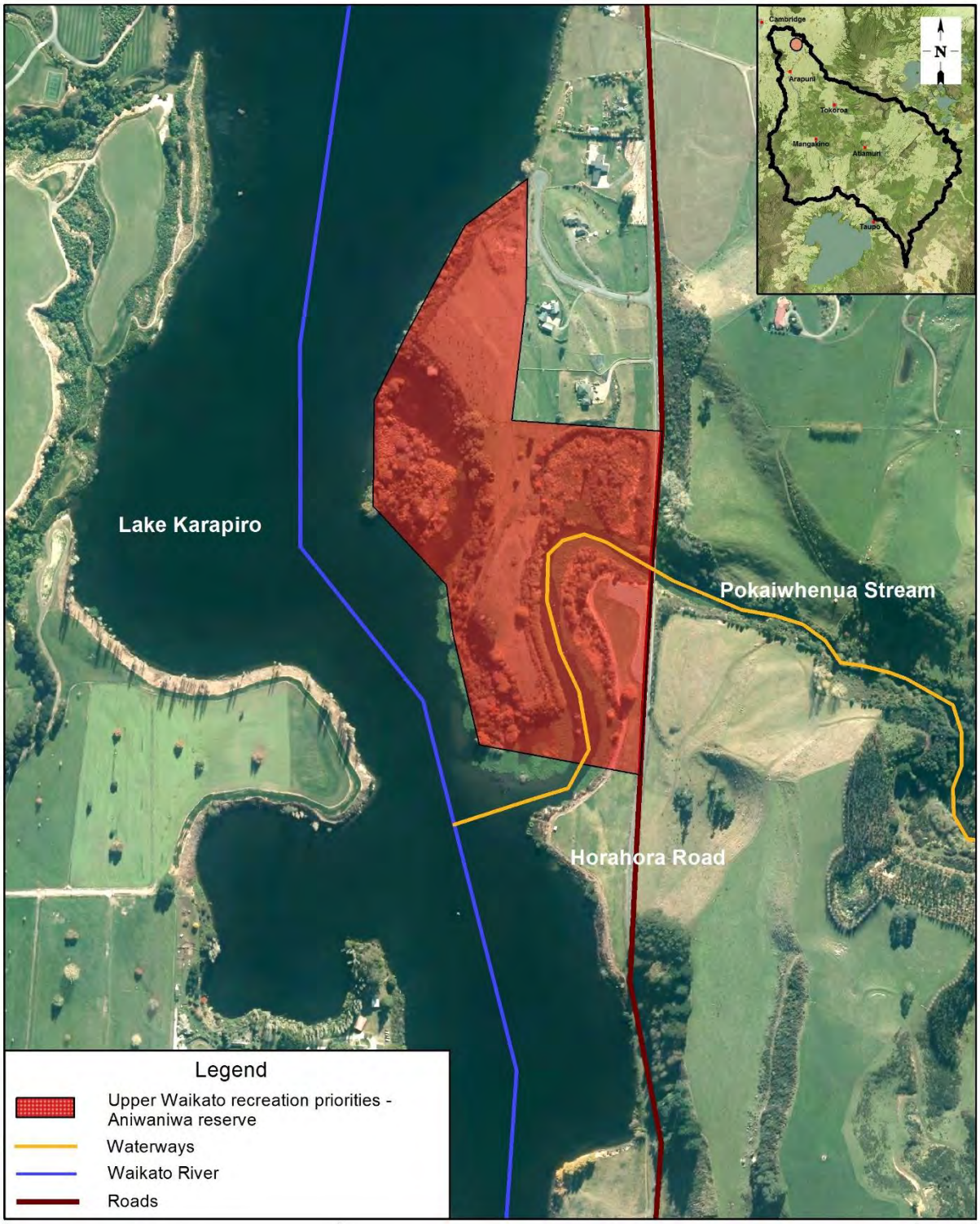
Karāpiro is very important to local iwi. It is from the Battle of Taumatawiwi that Karāpiro gets its name. Kara means rocks, and piro means smell, or odour. After the battle Te Waharoa was worried about a counterattack from the Ngāti Marutuahu, so that night he burnt the bodies of his dead warriors “lest 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

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

Scale1:6,500@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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	

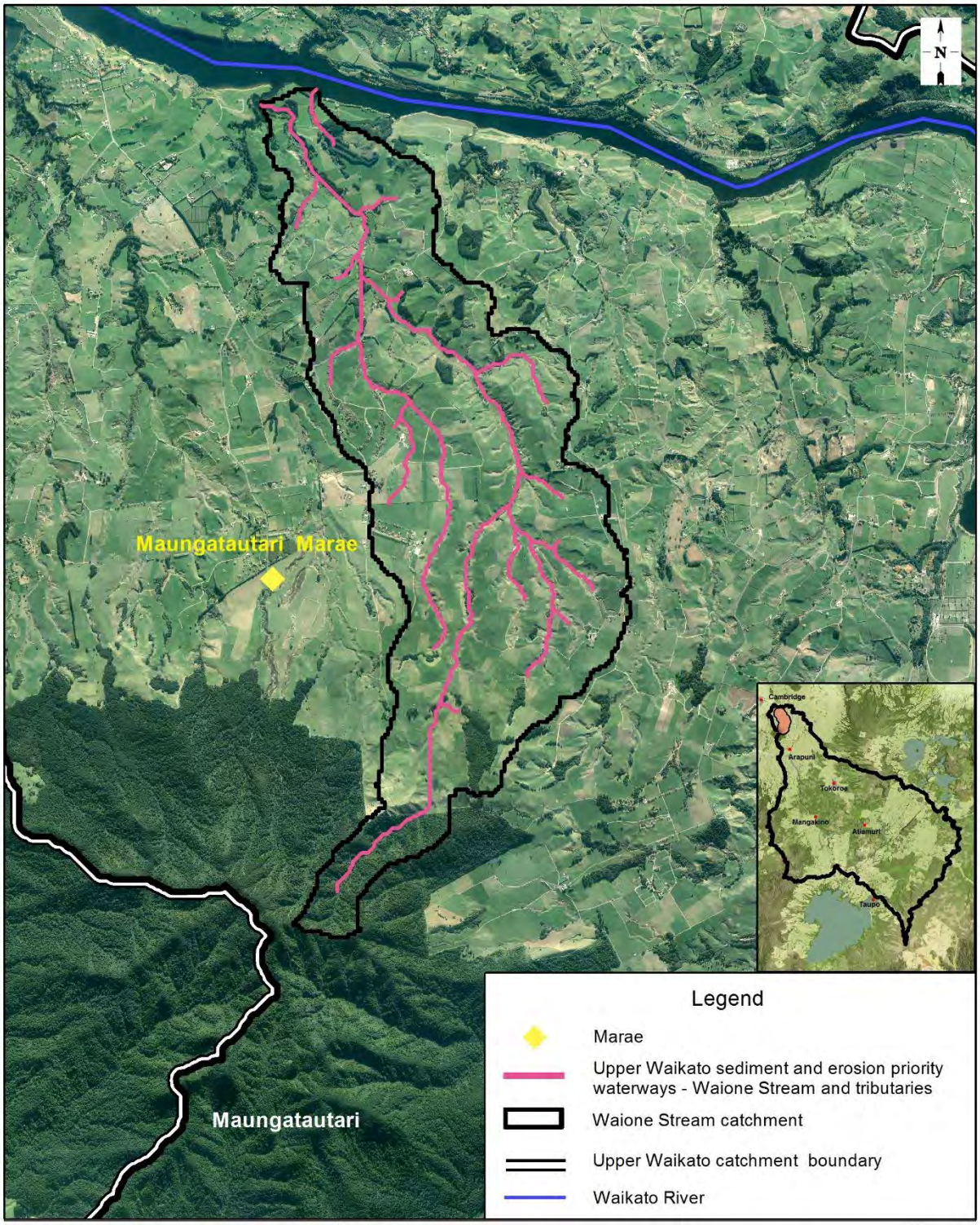
<table>
<tr><td></td><td>edge of the river (now just below the water ski club). http://www.maungatautarimarae.co.nz/hitori/1800-2</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- A stream network with stable, vegetated banks and where major erosion events are limited.
- 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

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

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.

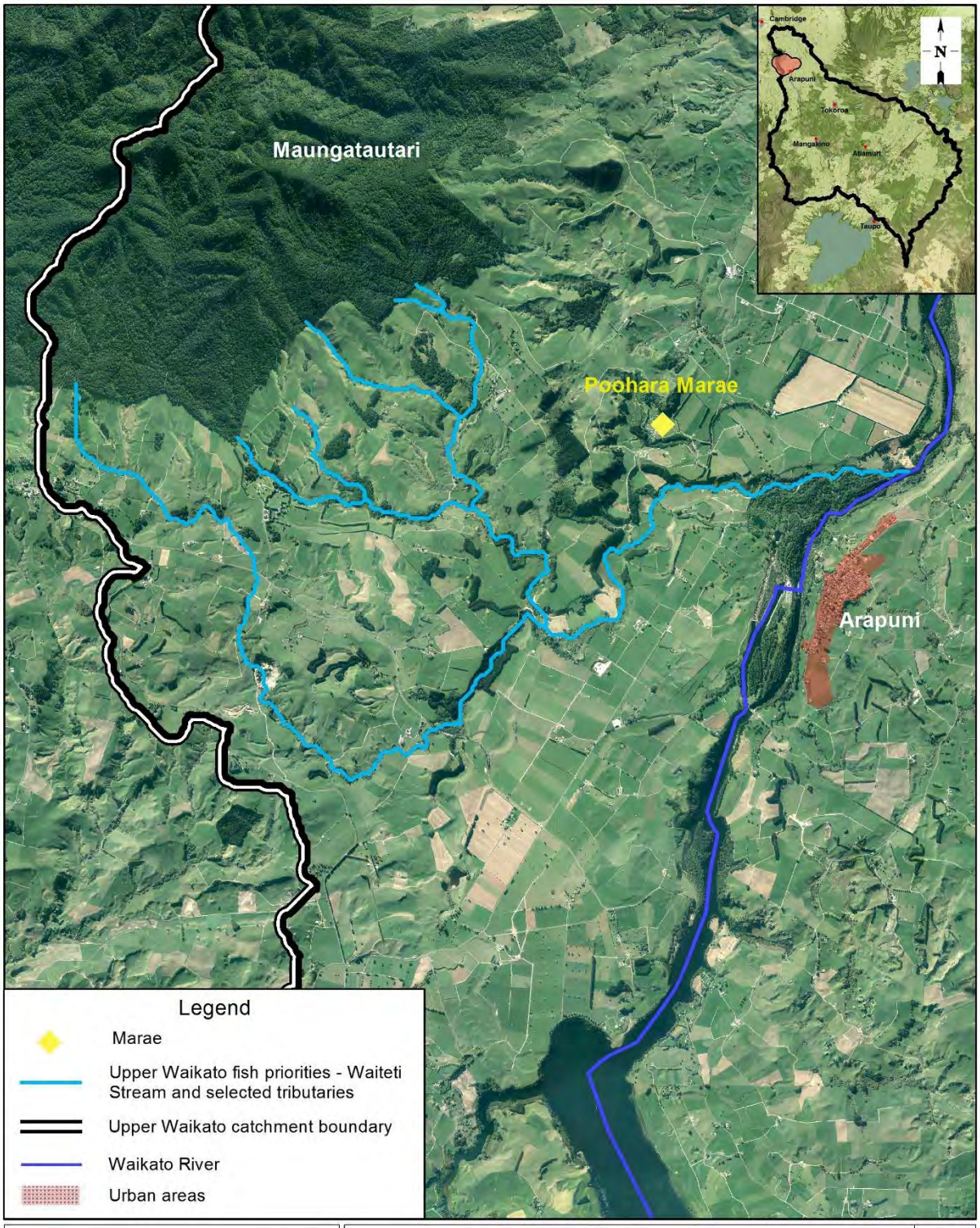
Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence with 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 50% (26km of streambank) requires fencing or fence upgrade at a cost of $8 per metre ($208,000).

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>

<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 at project completion.</td><td>L = 10</td></tr>
<tr><td>Effectiveness of works</td><td>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.</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.</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 = 0.50</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>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 (26km of streambank)</td><td>208,000</td></tr><tr><td>Planting (13ha)</td><td>514,176</td></tr><tr><td>Project management/staffing/incidentals (25% of project cost)</td><td>180,544</td></tr><tr><td>Total</td><td>902,720</td></tr></table></td><td>C = 0.9</td></tr>
</table>



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><td>UW 5
Priority: high</td><td>Water quality improvement in the lower Pōkaiwhenua 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.

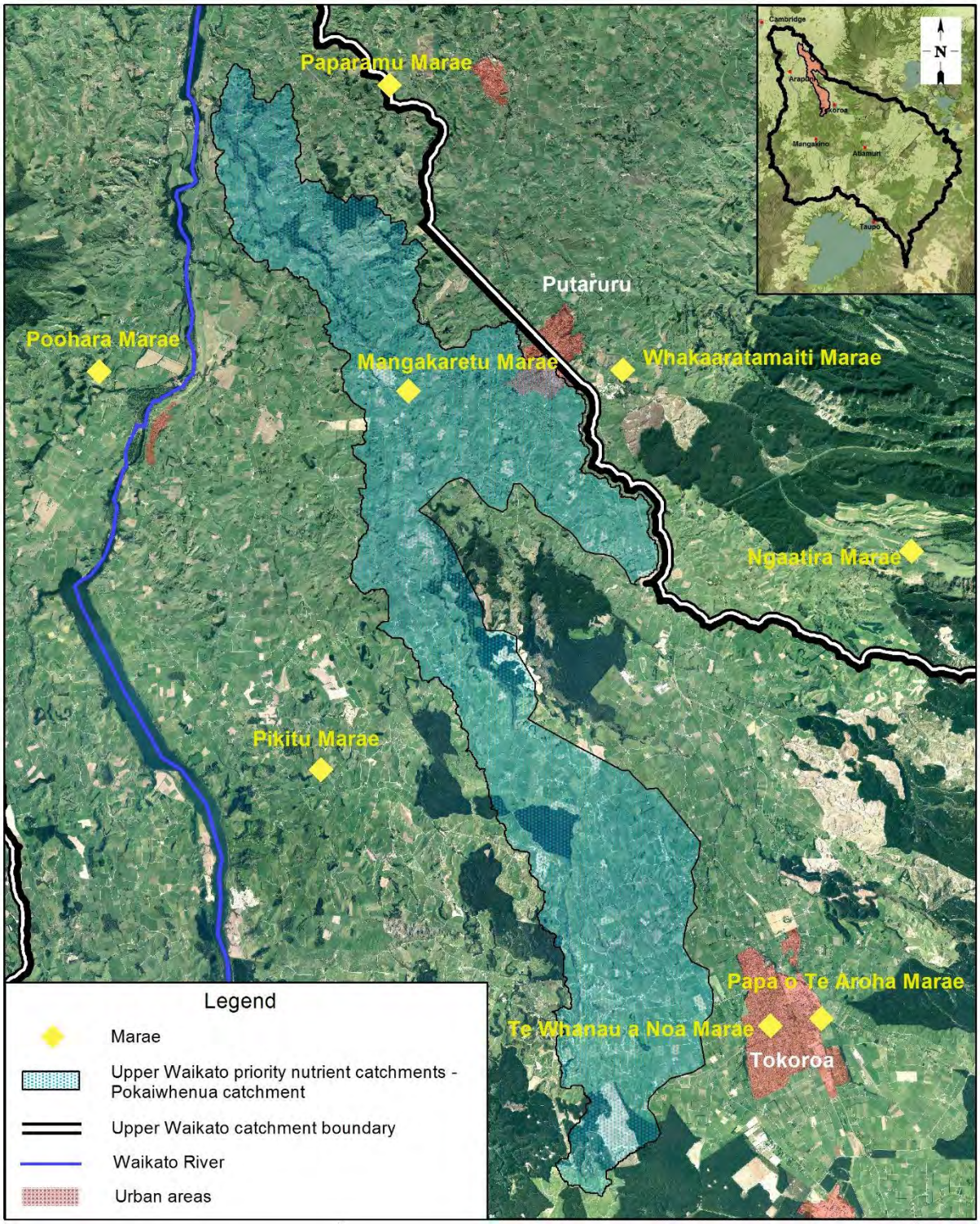
Fresh water quality enables habitats for plants and animals to thrive.</td><td></td></tr>
<tr><td>Name of feature</td><td>Pōkaiwhenua sub-catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The lower Pōkaiwhenua catchment (below Arapuni Road) consists of 13,558ha of moderately steep 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>
</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** - 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

<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>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>



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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of wetland seeps that would benefit from fencing to exclude cattle.

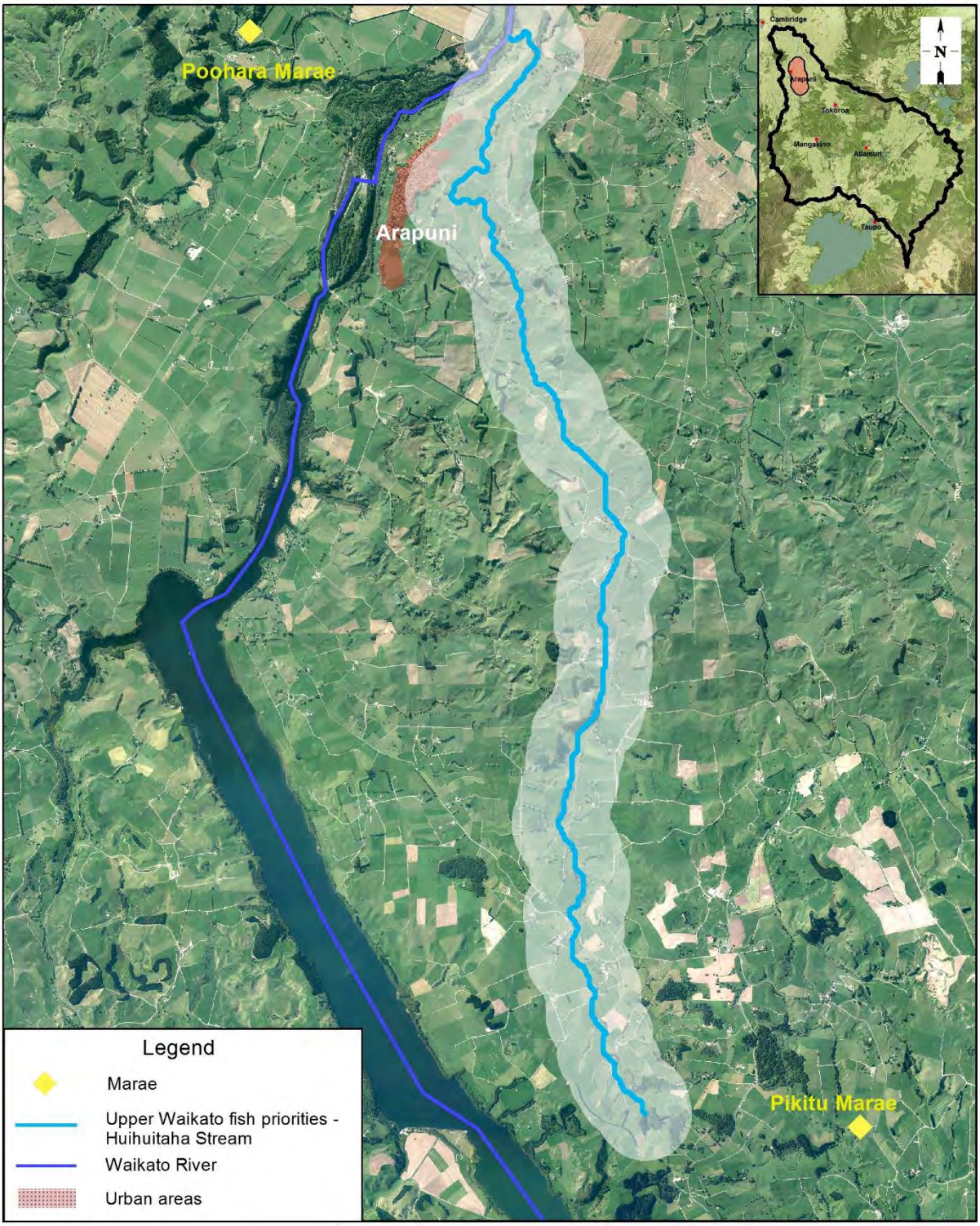
<table>
<tr><td>UW 6
Priority: medium</td><td>Fish habitat rehabilitation in Huihuitaha Stream</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The fisheries of the Upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.</td><td></td></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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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.

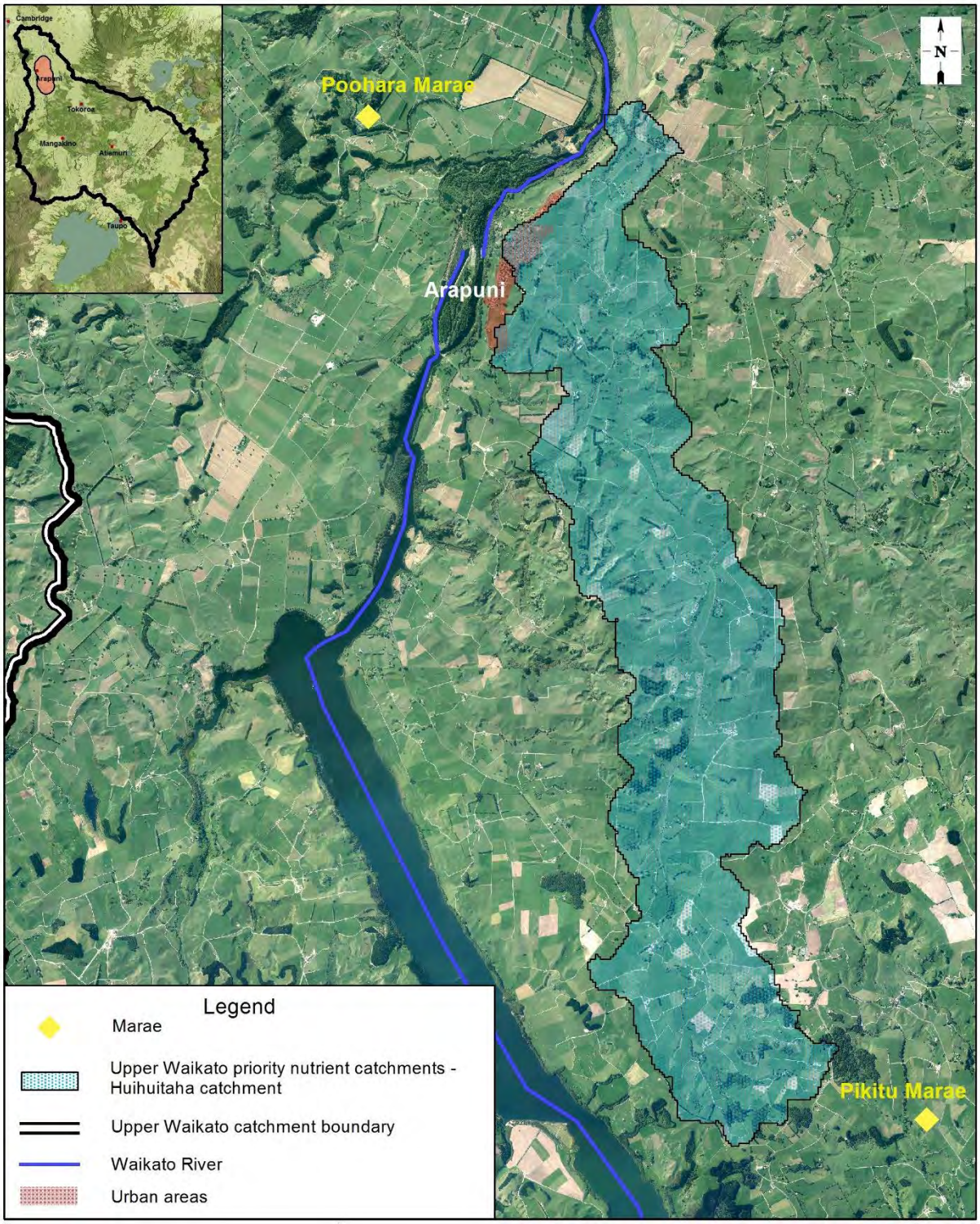
Fresh water quality enables habitats for plants and animals to thrive.</td><td></td></tr>
<tr><td>Name of feature</td><td>Huihuitaha sub-catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Huihuitaha Stream lies within a 2007ha catchment, 95% of which is pastoral and mostly 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>

	Weed species: Compete with native plant communities and are a threat to agriculture.	
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** - 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.	
Time lag for benefits to be realised	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.	L = 3.5
Effectiveness of works	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.	W = 0.005
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.	

<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>
</table>



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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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.

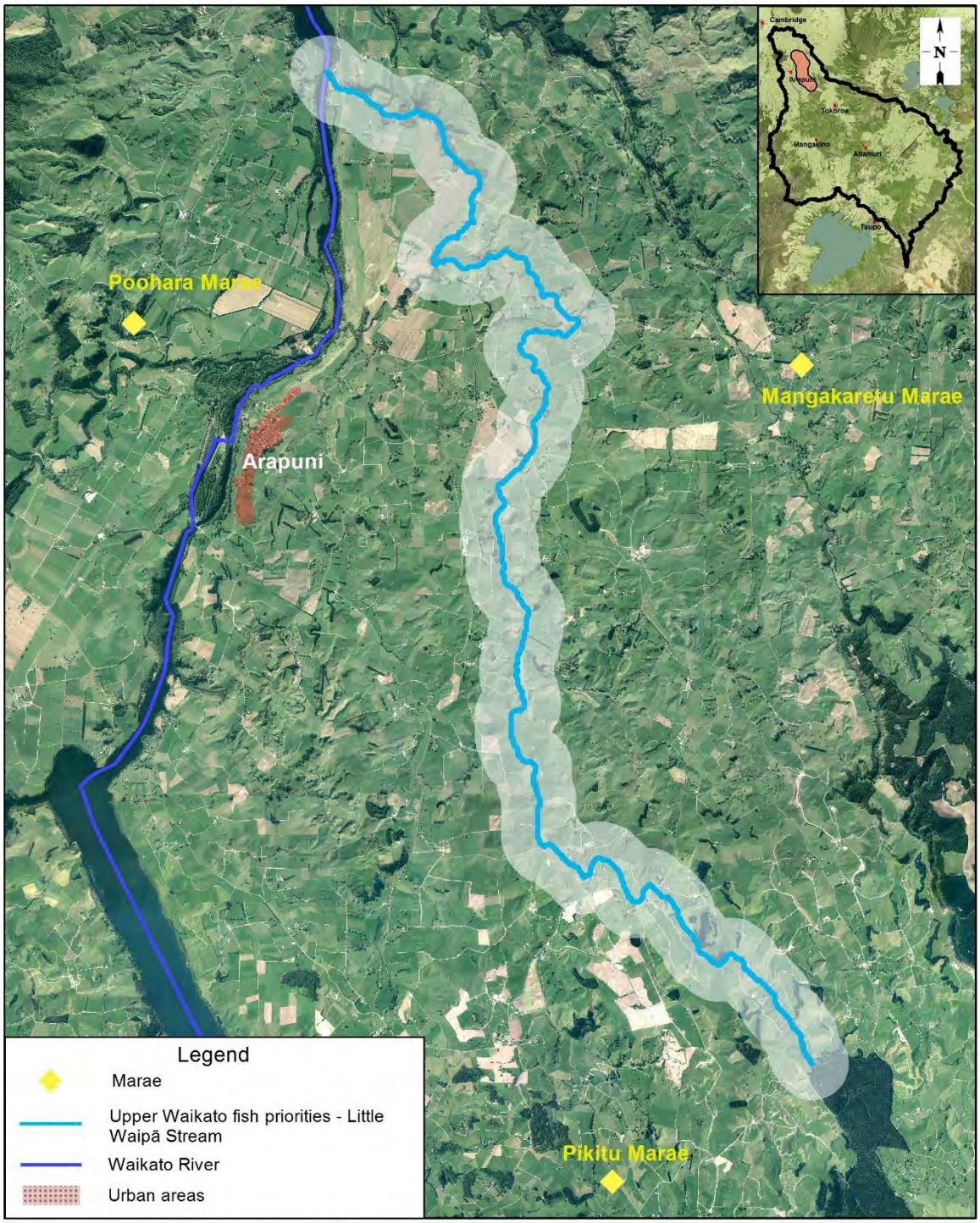
Riparian management
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas within the riparian fencing.
- Assume 25% (11.5km of streambank) requires fencing or fence upgrade ($92,000).

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>



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

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale1:70,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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.	

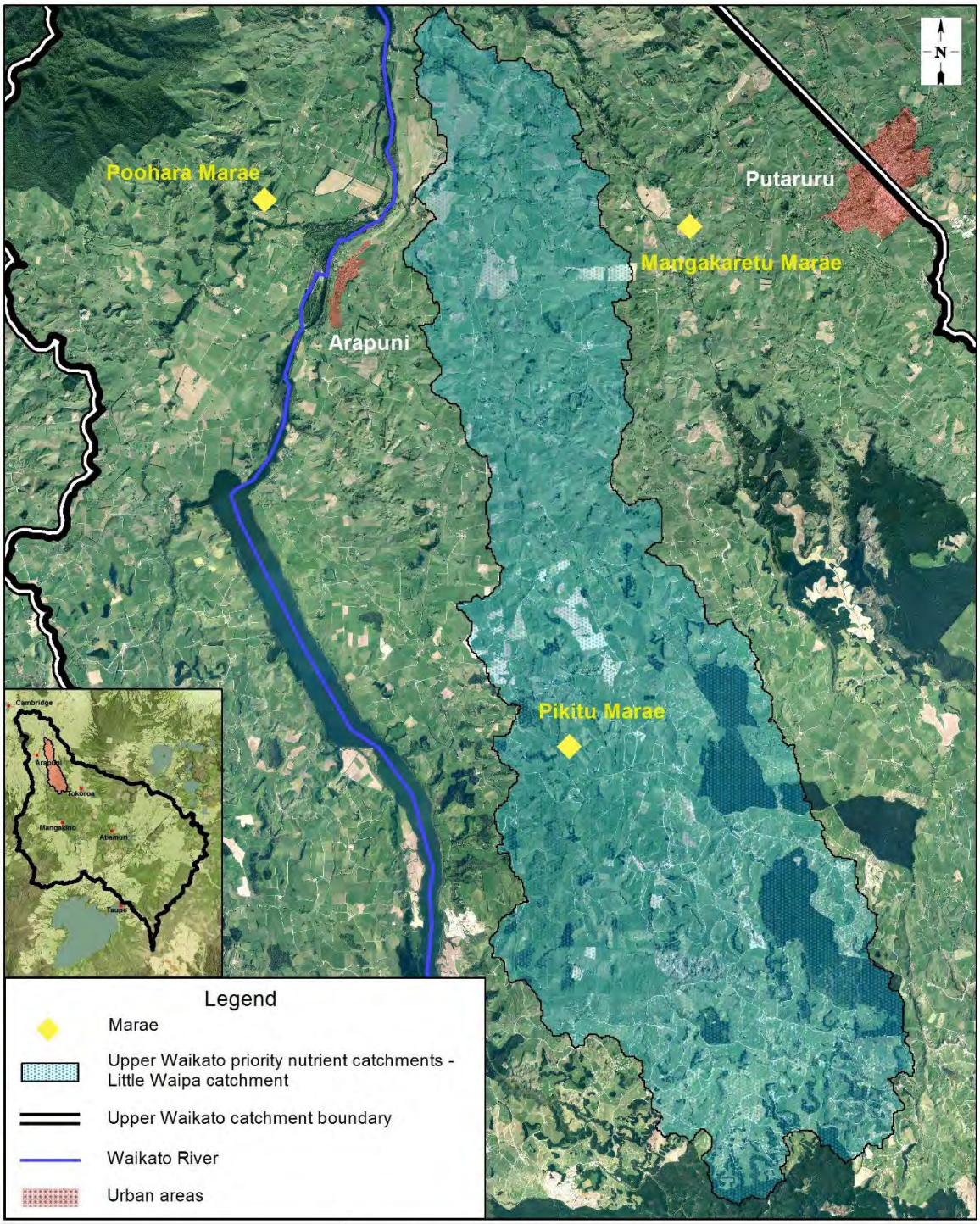
<table>
<tr><td></td><td>- There are no manmade barriers to native migratory fish. Native fish are abundant and there is a wide diversity of species present.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</td><td>VS = 80</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>
<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
- 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.</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>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</td><td>W = 0.075</td></tr>
</table>

<table>
<tr><td></td><td>Restoration Strategy, and a fuller range of initiatives over the long term.</td><td></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 = 0.315</td></tr>
<tr><td>Information quality</td><td>Average – estimates are 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. 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>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 (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></td><td>C = 0.88</td></tr>
</table>



Water quality improvement in the Little Waipa 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

Scale1:110,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of wetland seeps that would benefit from fencing to exclude cattle.

UW 10 Priority: medium	Longfin eel habitat rehabilitation in Mangare Stream catchment	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	Mangare Stream sub-catchment	
Brief description of feature	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.)	

<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:

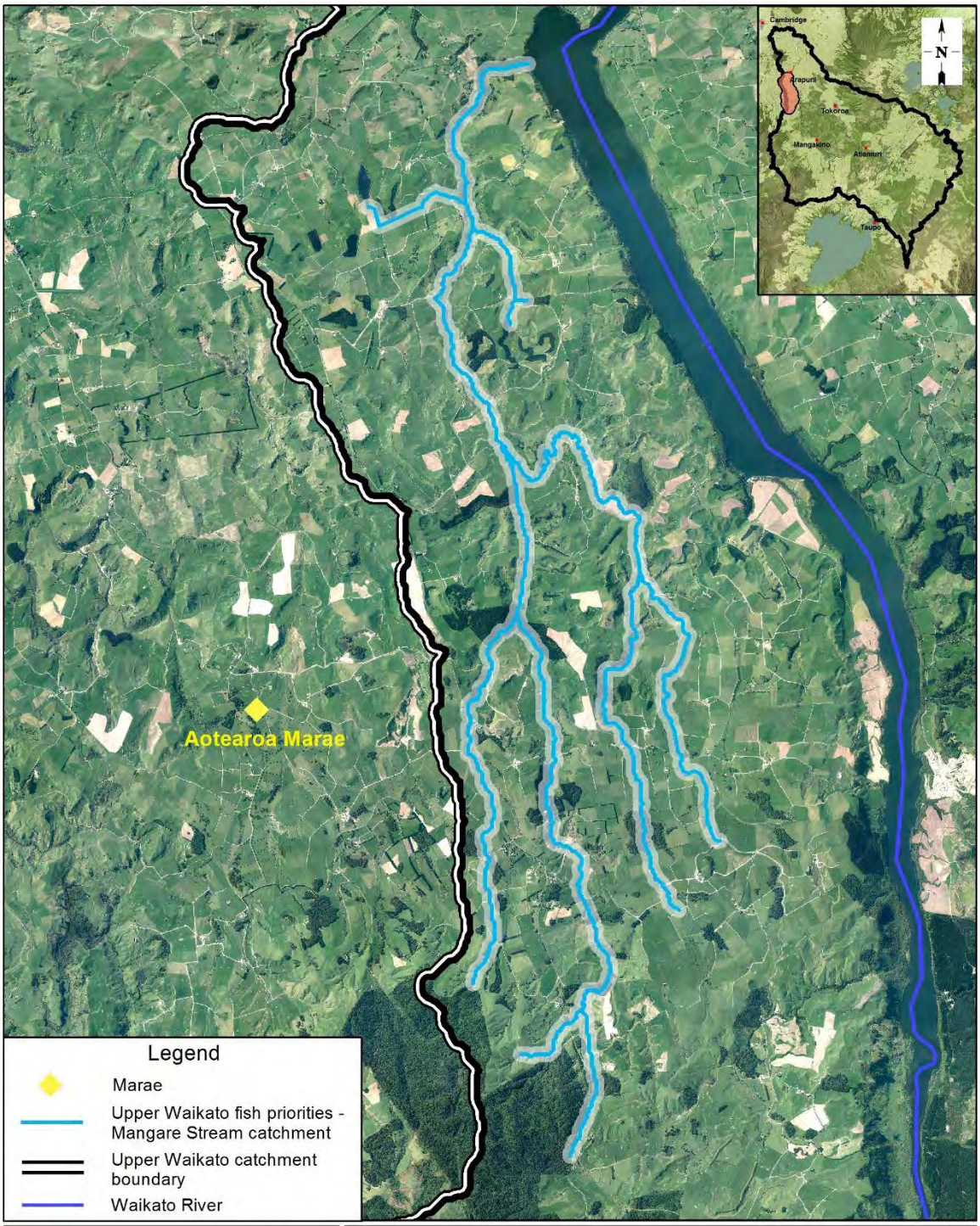
Year 1
- Site visits – 2 people for 6 days plus travel and accommodation ($10,000)
- Construction materials ($5000)
- Construction - 5 days, 2 people ($6000)
- Operation of trap – 10 days, 2 people plus vehicle ($15,000)

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>



Longfin eel habitat rehabilitation in Mangare Stream catchment

WWRRS Project Map

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

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

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale1:65,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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:

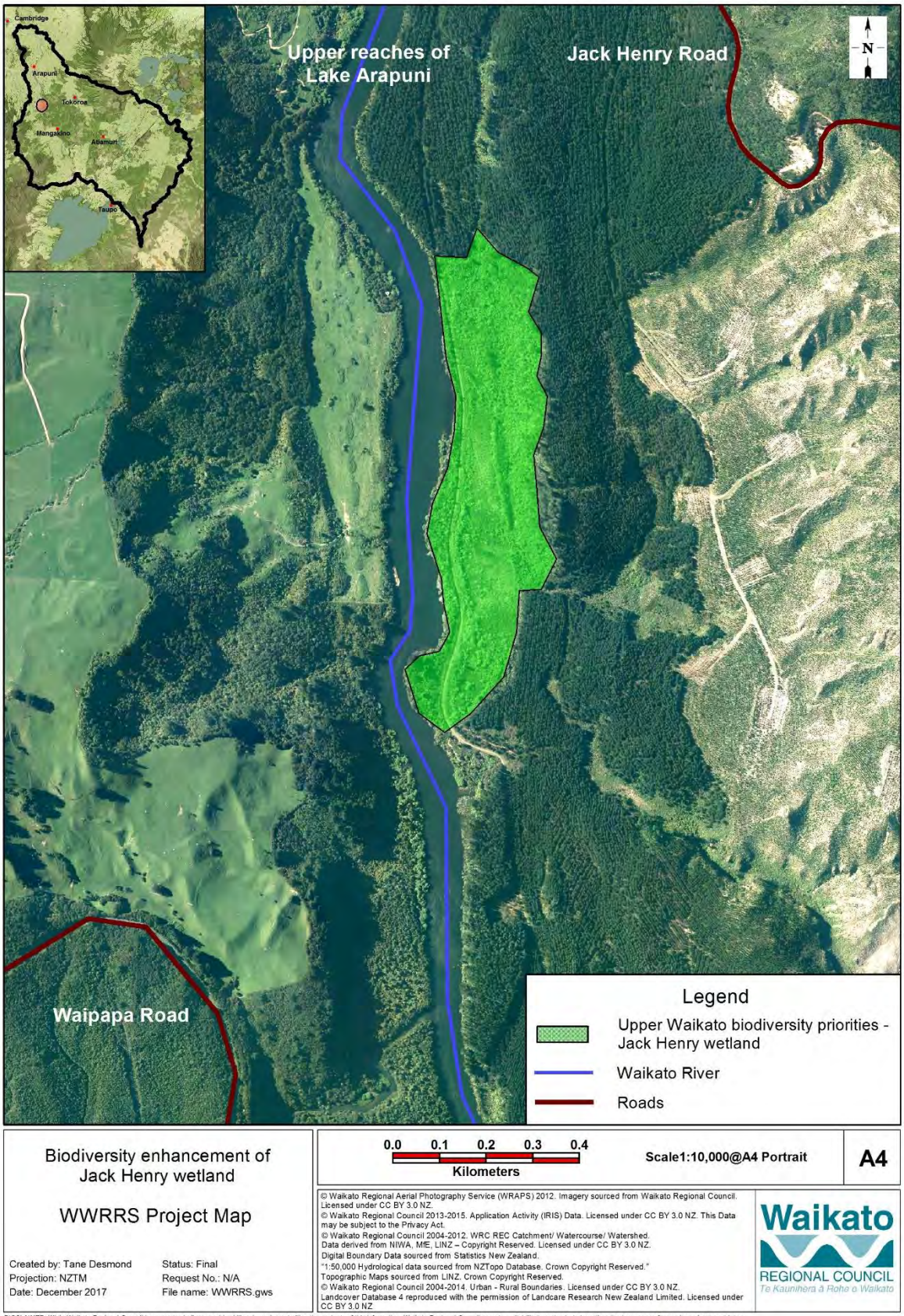
Weed control
Most of the wetland and bush ecosystems identified have a range of weed species present that will require ground based control. The estimate cost of this is $42,000 (16ha at $2800 per ha).

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></table></td><td>C = 0.06</td></tr>
</table>



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.	

<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 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 Stream 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>Bank erosion</td><td>Contributes significant sediment load to the Pōkaiwhenua 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>- 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.</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 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).</td><td></td></tr>
</table>

	- 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>
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<td>C = 2.83</td>
</tr>
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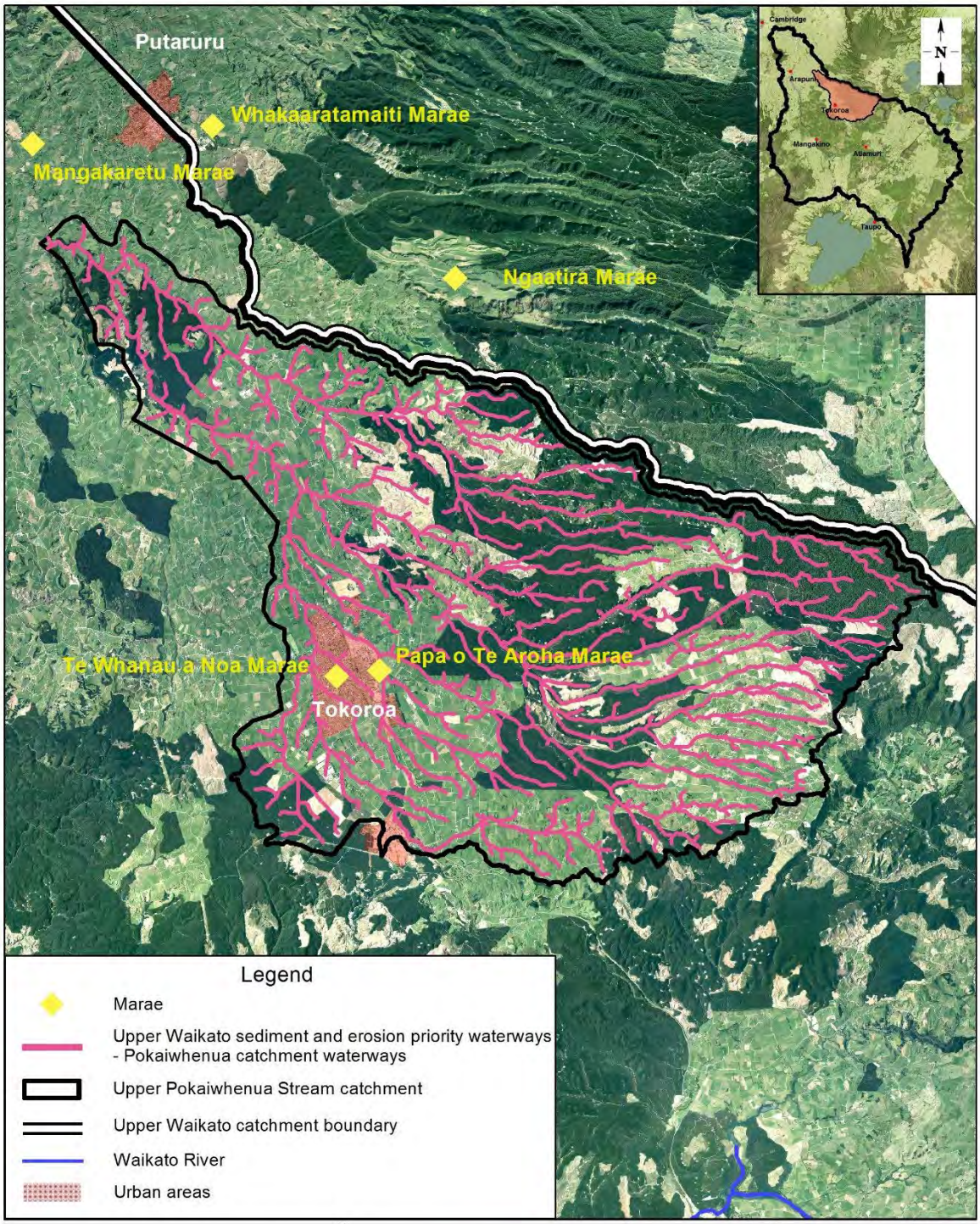

Upper Pokaiwhenua stream bank erosion protection and riparian enhancement

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>
<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>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 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>
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</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></table></td><td>C = 0.04</td></tr>
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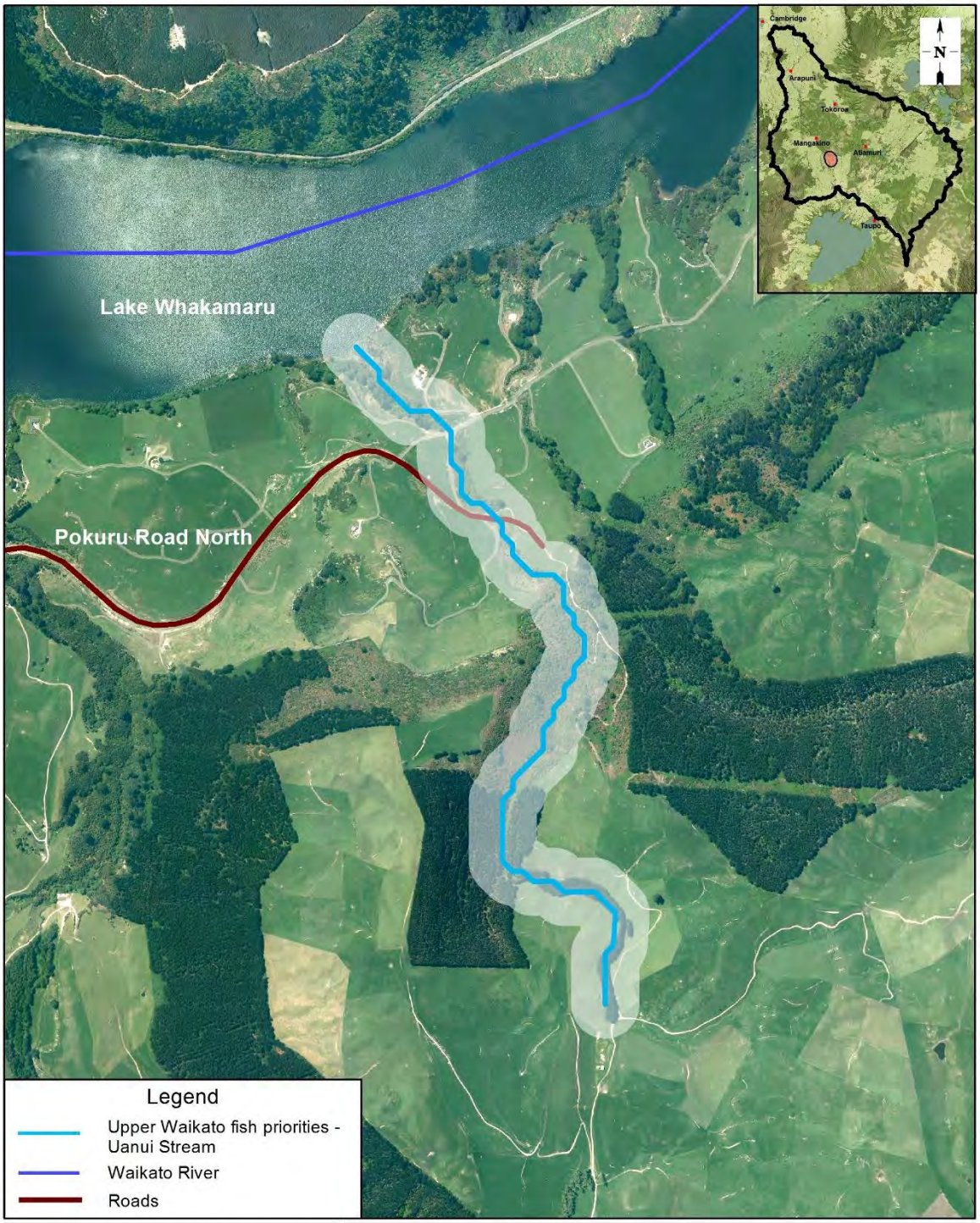

Koura habitat rehabilitation on Uanui Stream

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
Kilometers

Scale1:15,000@A4 Portrait

A4

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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.	

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- 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.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</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></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 retired from heavy stock grazing.
- There is a 30% reduction in suspended sediment across the three streams within 10 years.</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
- 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)</td><td></td></tr>
</table>

	- 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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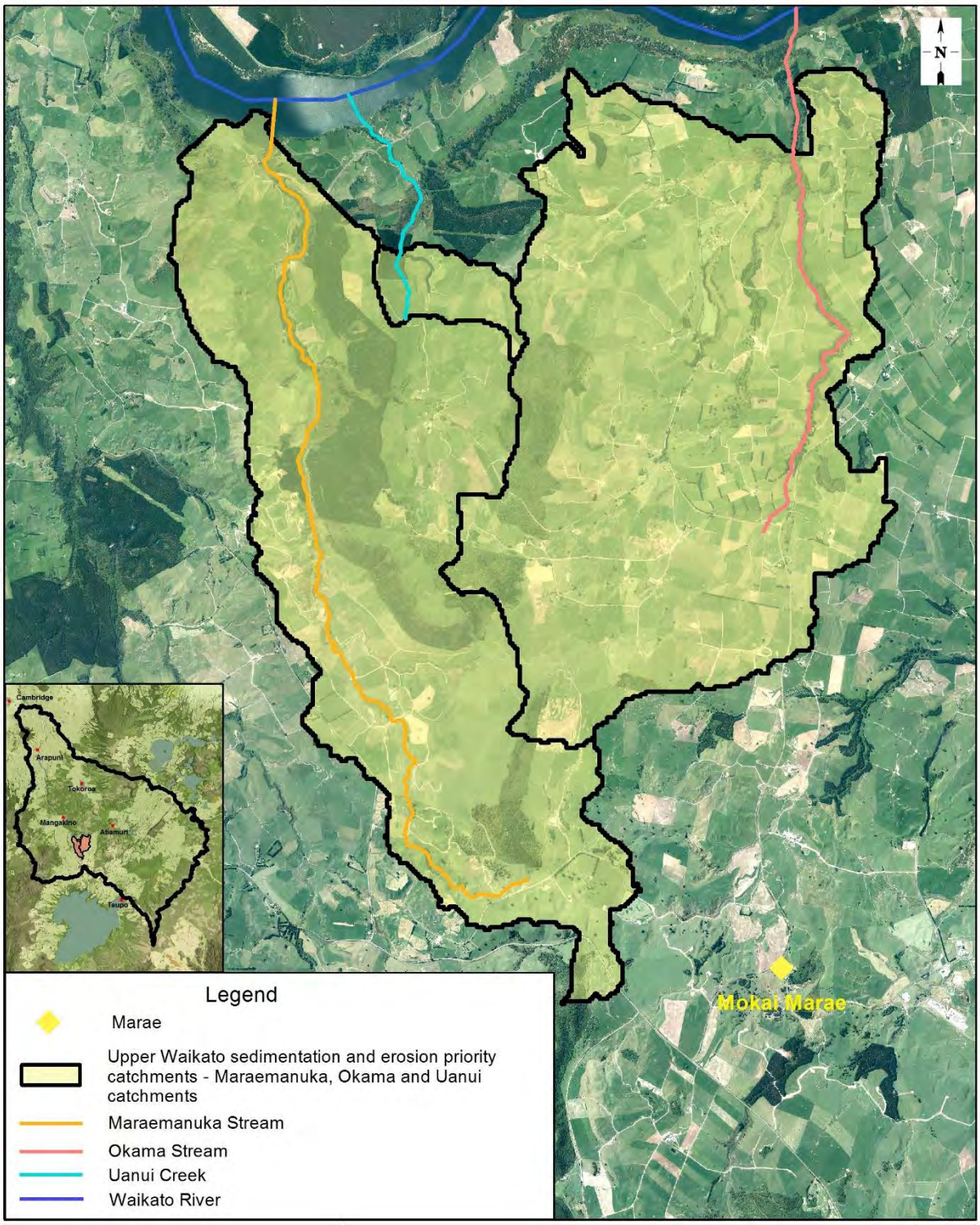

Hill country erosion protection and remediation in the Maraemanuka, Okama and Uanui catchments

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

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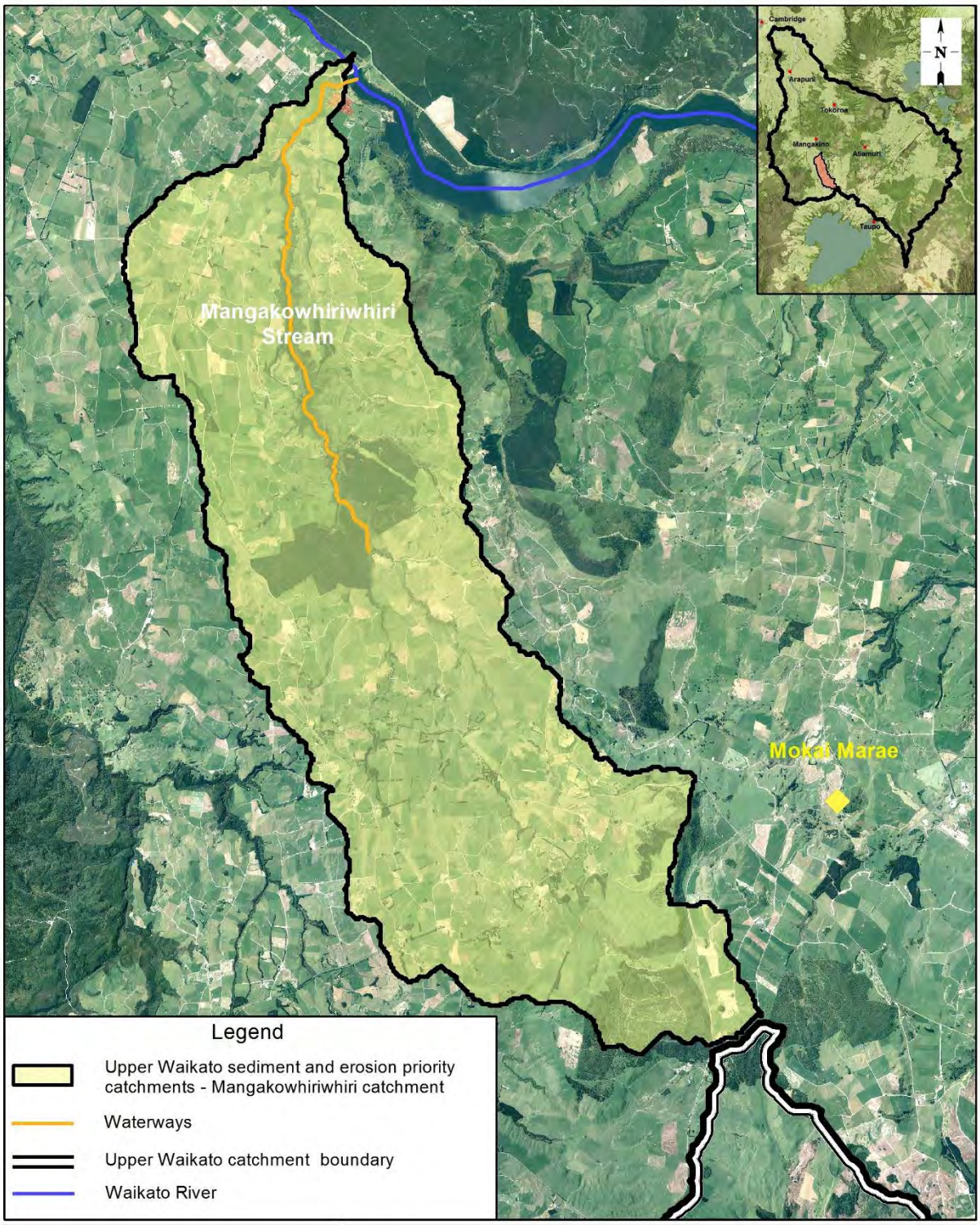

Mangakowhiriwhiri catchment hill country erosion protection and remediation

WWRRS Project Map

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

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

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale1:85,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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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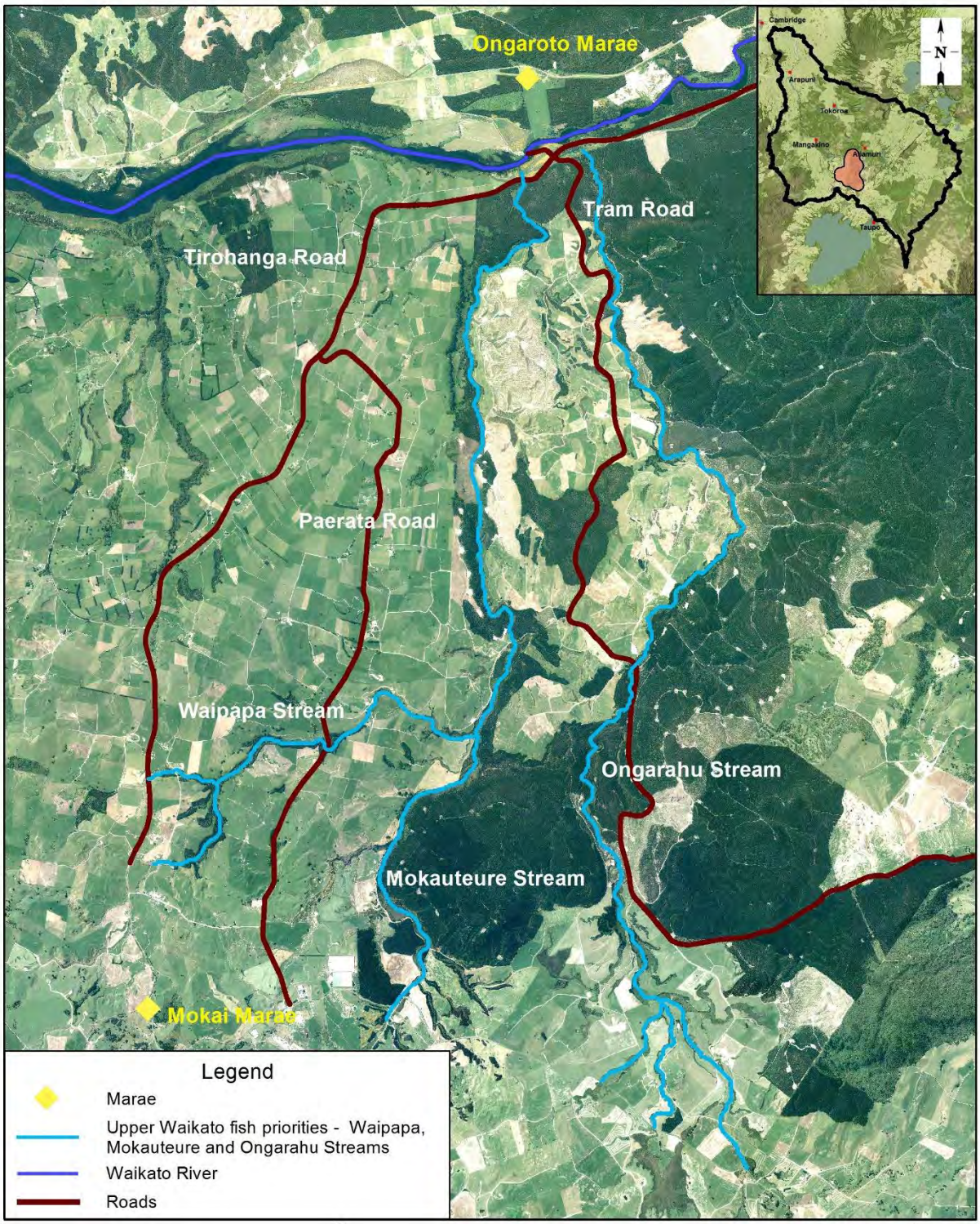

Koura habitat rehabilitation in Waipapa, Mokauteure and Ongarahu Streams

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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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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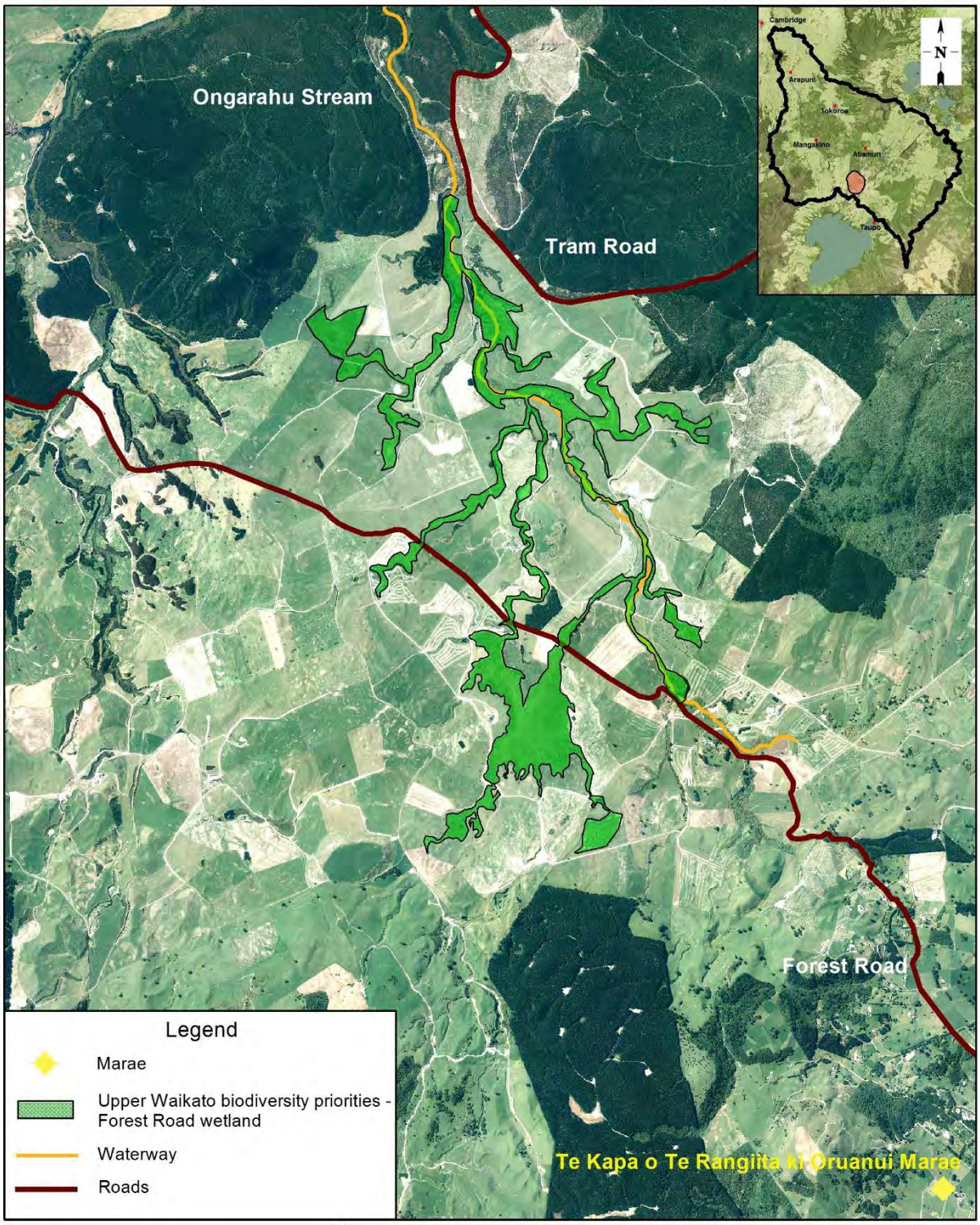


Biodiversity enhancement at Forest Road wetland

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
Te Kaunihera ā Rohe o Waikato

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	

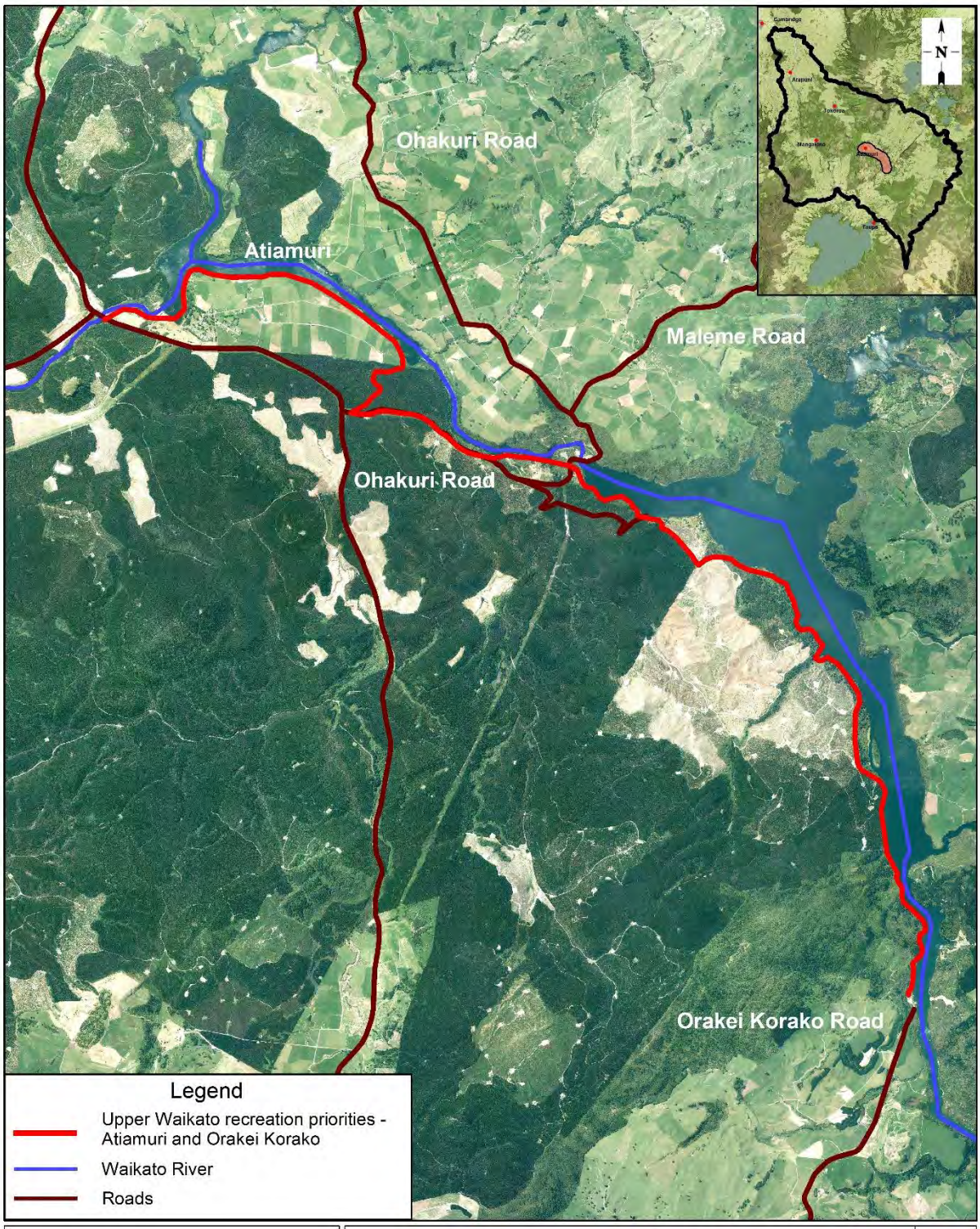
<table>
<tr><td></td><td>excessive growth of the aquatic weed hornwort. In particular, the Whirinaki Arm which feeds into Lake Ohakuri has ongoing water quality issues.

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.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy of feature</td><td>- 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.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</td><td>VS = 175</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 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></td><td></td></tr>
<tr><td>Project goal/s</td><td>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.</td><td></td></tr>
</table>

	- 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.	

<table>
<tr><td></td><td>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 approximately 1 year after project completion.</td><td>L = 3</td></tr>
<tr><td>Effectiveness of works</td><td>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.</td><td>W = 0.05</td></tr>
<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 track is well designed and safe.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>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.</td><td>A = 0.8</td></tr>
<tr><td>Information quality</td><td>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.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Costs provided are indicative. To establish more accurate costs, detailed scoping of specific trail route needs to be completed.</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>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>Project planning</td><td>50,000</td></tr><tr><td>Legal requirements and procurement</td><td>13,500</td></tr><tr><td>Track construction (22km) and planting (85,000 plants)</td><td>1,930,000</td></tr><tr><td>Project management/staffing/incidentals (30%)</td><td>598,050</td></tr><tr><td>TOTAL</td><td>2,591,550</td></tr></table></td><td>C = 2.6</td></tr>
</table>



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,	

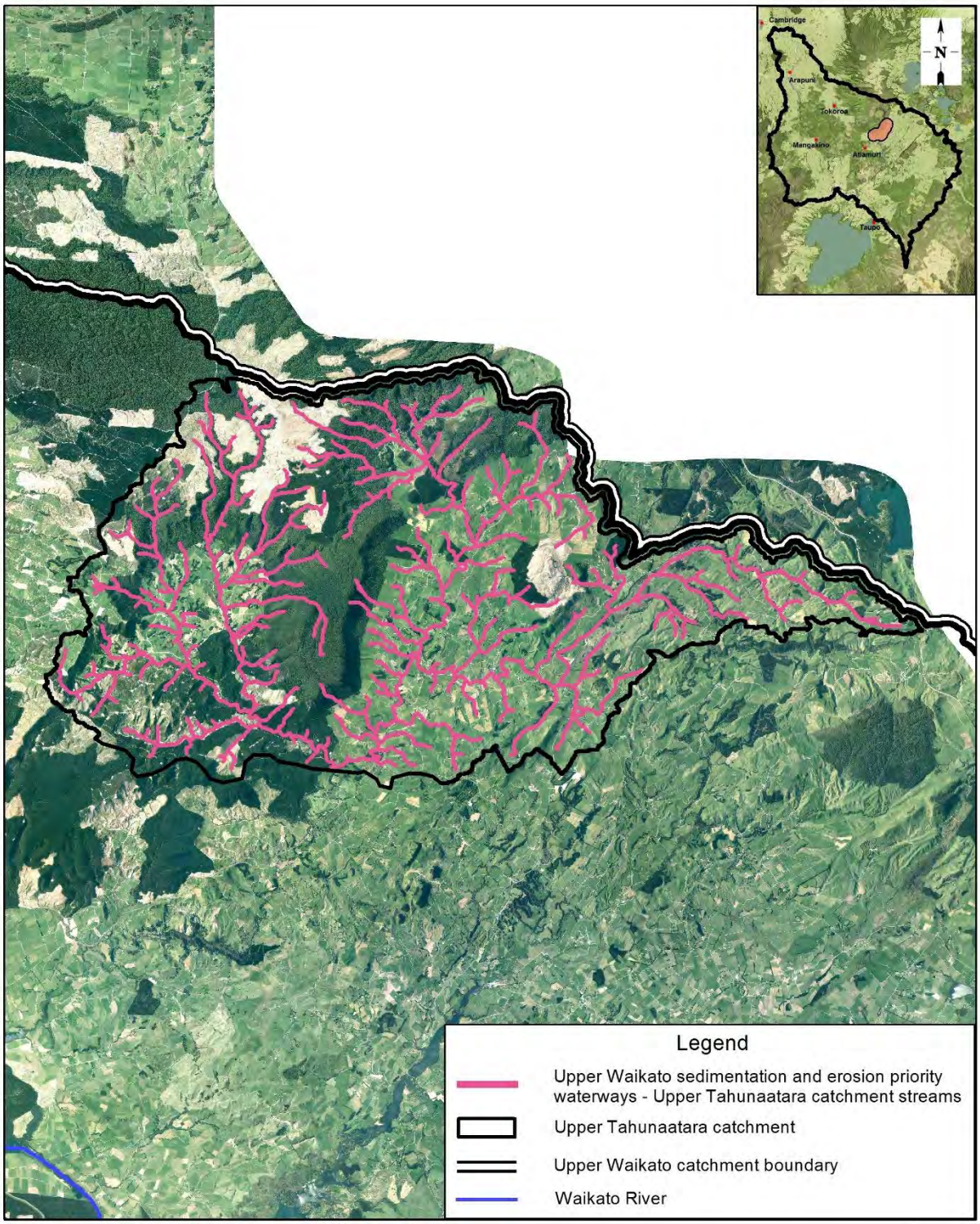
<table>
<tr><td></td><td>kumara and other crops were also grown and the first willow trees in the area were planted there.
http://www.tahu-whaoa.iwi.nz/lands/wahitapu

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>
</table>
</td>
<td>C = 1.26</td>
</tr>
</table>



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.	

<table>
<tr><td></td><td>Modelling undertaken in 2016 indicates that the Ātiamuri catchment is a high priority for hill country erosion. 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).
- 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 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).</td><td></td></tr>
</table>

	- 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.	
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 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.	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 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.	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)	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>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>C = 0.84</td>
</tr>
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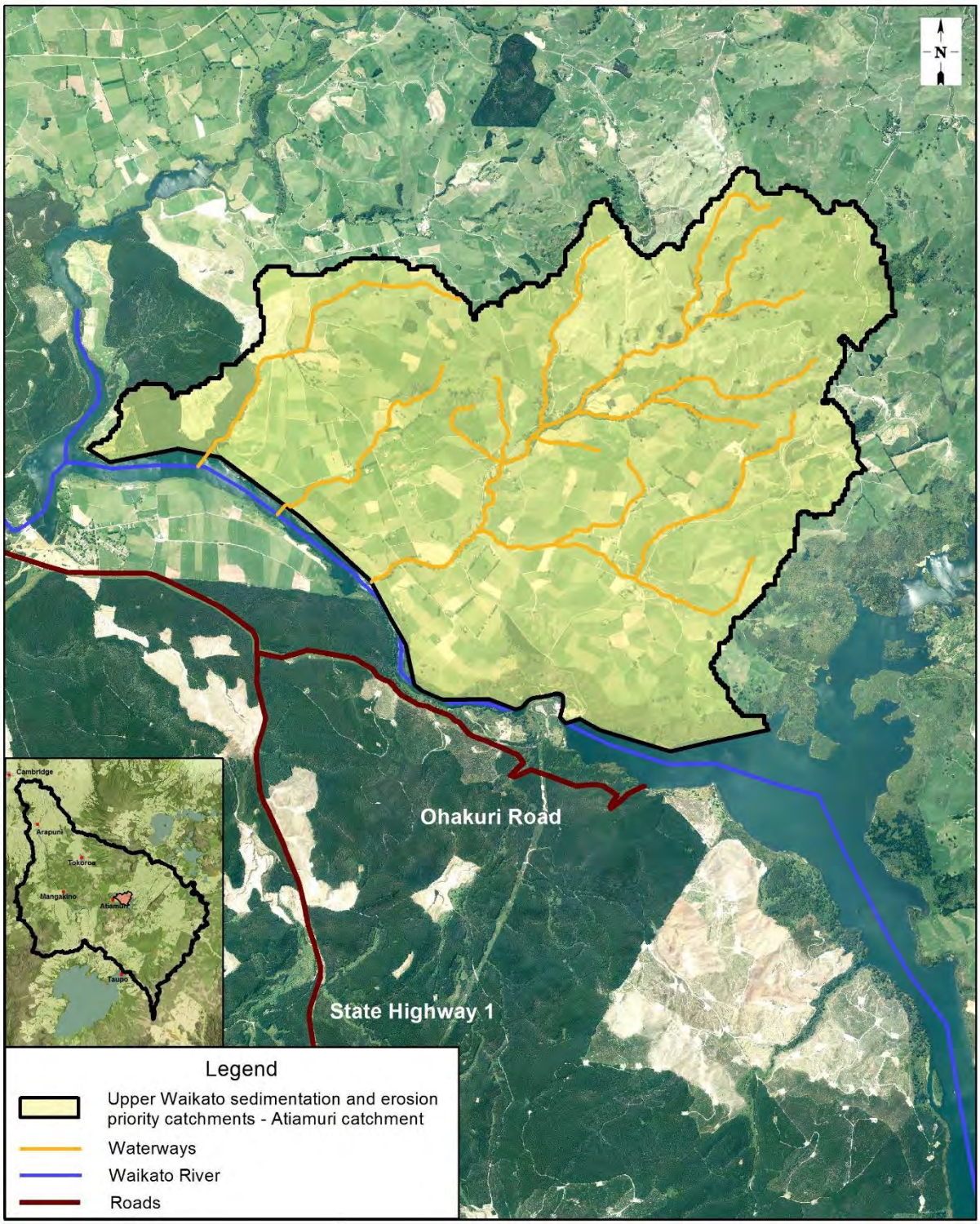

Atiamuri catchment hill country erosion protection and remediation

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.	

<table>
<tr><td>Impact on Vision & Strategy</td><td>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.</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>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.

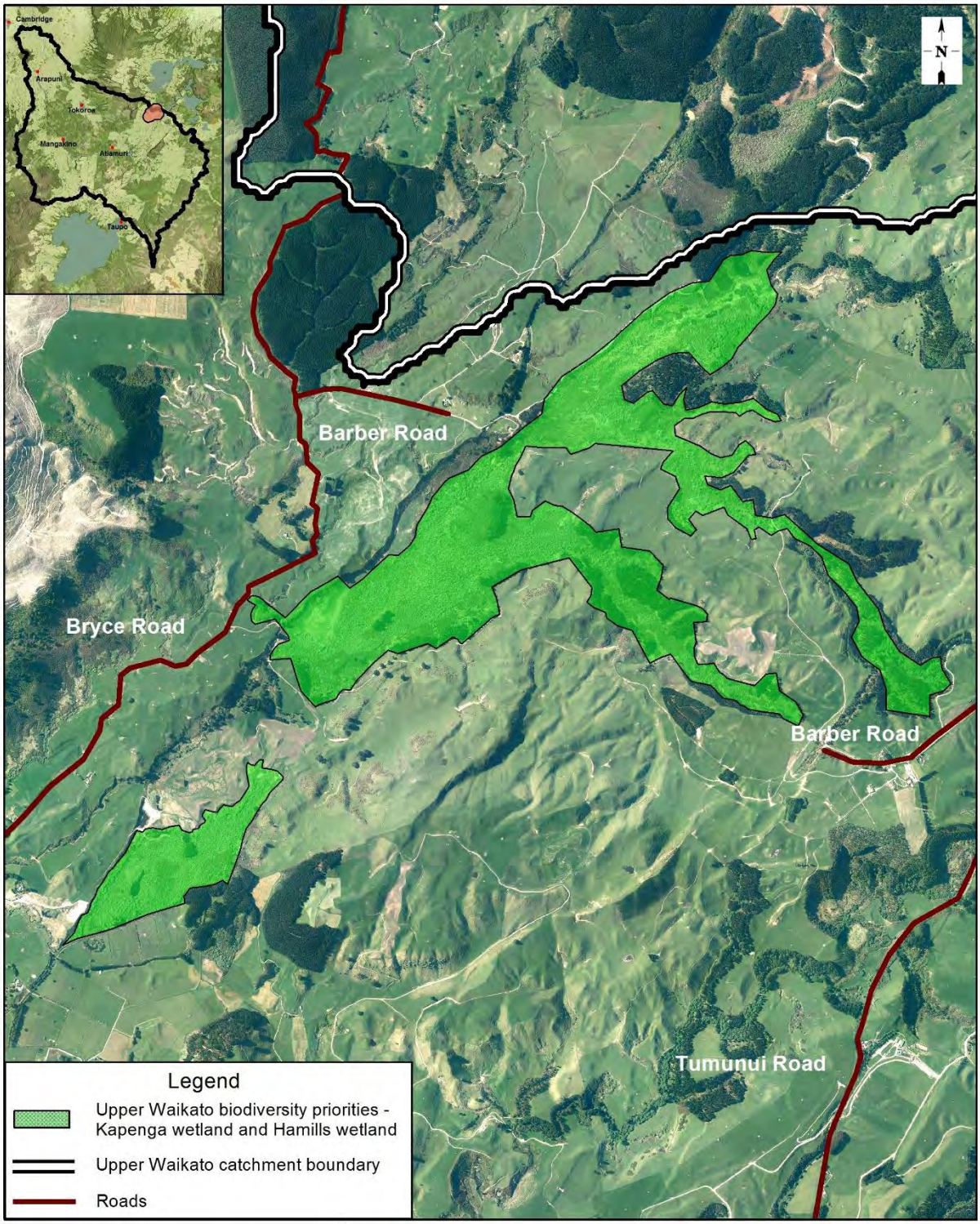
Fencing
Unfenced areas of the wetland should be fenced to exclude stock with an 8 wire post and batten fence. Ideally this would be followed immediately by native planting and associated weed control.
- Project costs assume that fencing is only required at the unmanaged wetland site next to Hamills wetland – 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</td><td></td></tr>
</table>

	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). **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

<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 weed control – to minimise this the work should be carried out by experienced practitioners to ensure it is effective.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>Landowners are supportive of the project and full adoption would be anticipated if the works were fully incentivised.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Good – advice of local expert/s with a history of association to selected sites.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>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.</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 (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>



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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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	

<table>
<tr><td></td><td>wetland. Within the Otamakokere Stream reach there is also a riparian section of Māori reservation (on Rotomahana Parerarangi 6A2No2b2B).

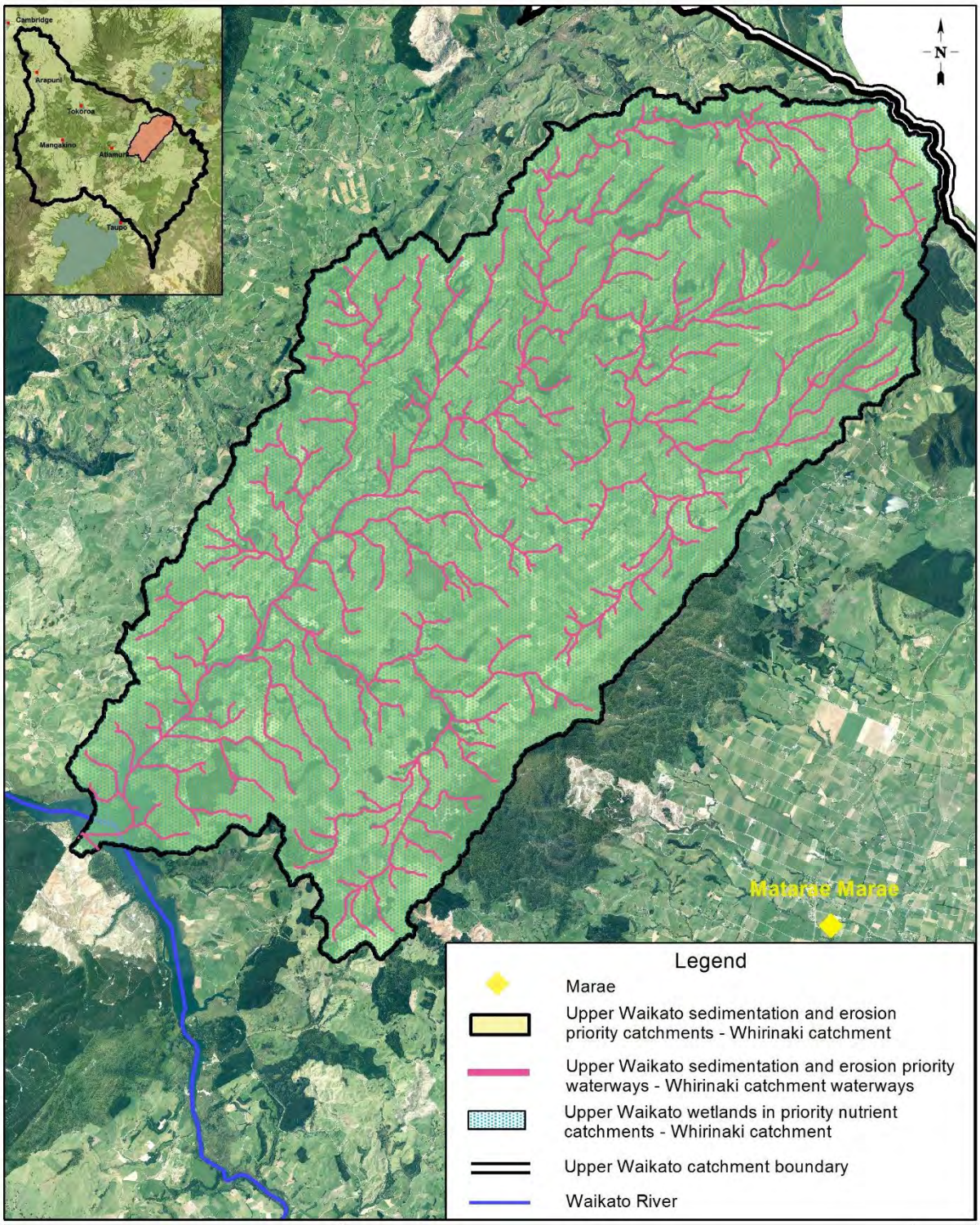
Extensive historical erosion control works and a number of riparian protection sites are established throughout the northern and eastern sections of the catchment, and around the lake itself. There is high risk of erosion in the northeastern and southeastern parts of the catchment, reflecting the prevalence of steep elevated terrain and deeply incised gullies in these areas, and there is 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>
</table>

Project goal/s	- 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.	
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** - 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). - 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
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 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.	A = 0.6
Information quality	Average – estimates are based on modelled information and input from local experts who are familiar with the sub-catchment.	
Knowledge gaps	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.	
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>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>
</table>
</td><td>C = 14.05</td></tr>
</table>



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	

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- 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.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</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>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></td><td></td></tr>
<tr><td>Project goal/s</td><td>- 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.</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
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.</td><td></td></tr>
</table>

	- 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.	

<table>
<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 10-11 years after project commencement.</td><td>L = 10.5</td></tr>
<tr><td>Effectiveness of works</td><td>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.</td><td>W = 0.2</td></tr>
<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 establishment of plantings or inability to stay on top of weed control. Weed management should be undertaken by an experienced practitioner to reduce this risk.</td><td>F = 0.82</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>
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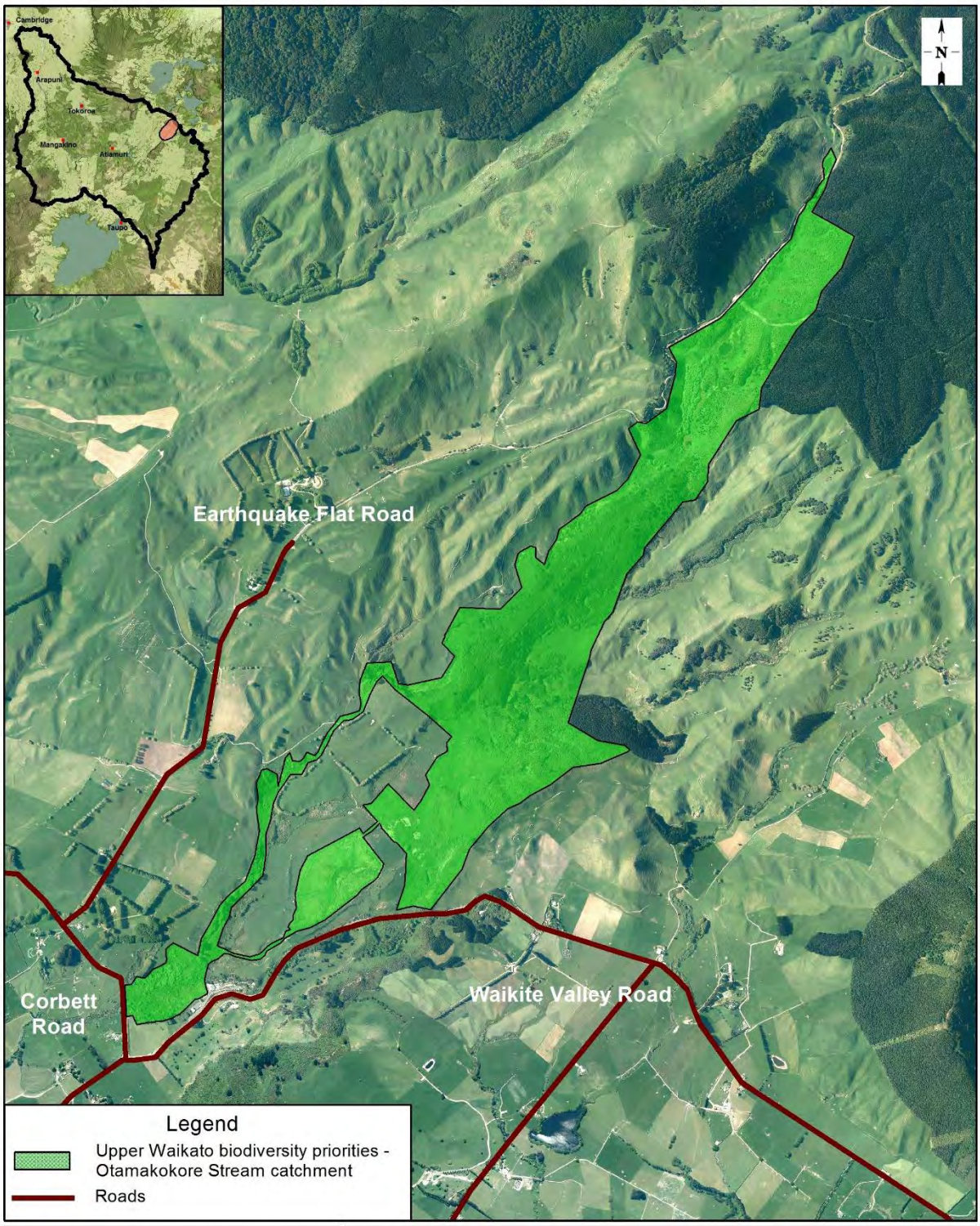

Biodiversity enhancement in the upper Otamakokore Stream catchment (above Corbett Road in the Waikite Valley)

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>

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>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.</td><td>F = 0.97</td></tr>
<tr><td>Adoptability</td><td>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.</td><td>A = 0.585</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</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>7500</td></tr>
<tr><td>Construction of walkway</td><td>157,500</td></tr>
<tr><td>Construction of 160m of boardwalk</td><td>104,000</td></tr>
<tr><td>Wooden walking bridges x 2 at2m length</td><td>4500</td></tr>
<tr><td>Interpretation signage</td><td>5000</td></tr>
<tr><td>Picnic table</td><td>750</td></tr>
<tr><td>Re-fencing</td><td>350</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>55,920</td></tr>
<tr><td>Total</td><td>335,520</td></tr>
</table></td><td>C = 0.3</td></tr>
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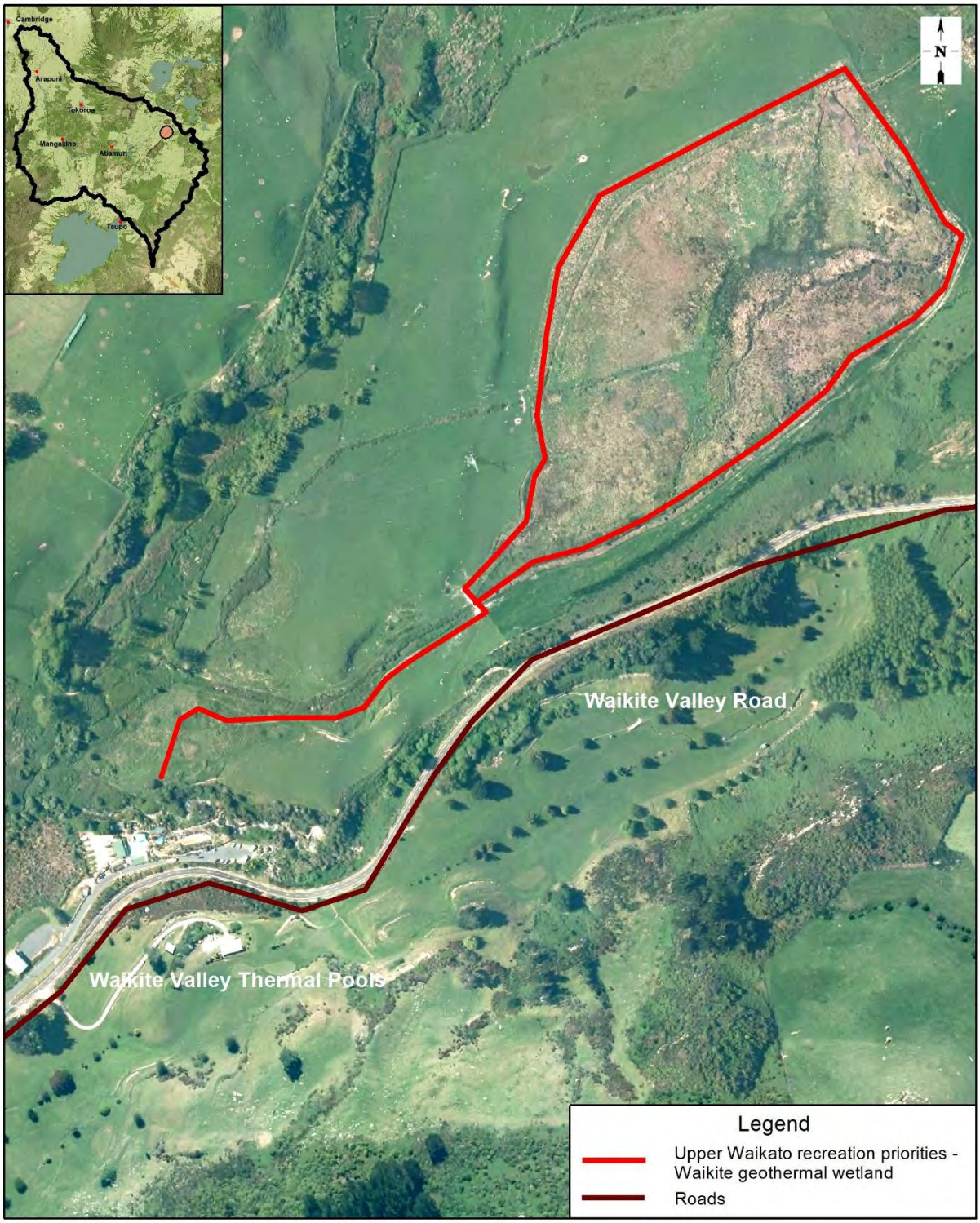


Walkway around Waikite geothermal wetland

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 REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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

Waikite geothermal wetland. Photo: Department of Conservation

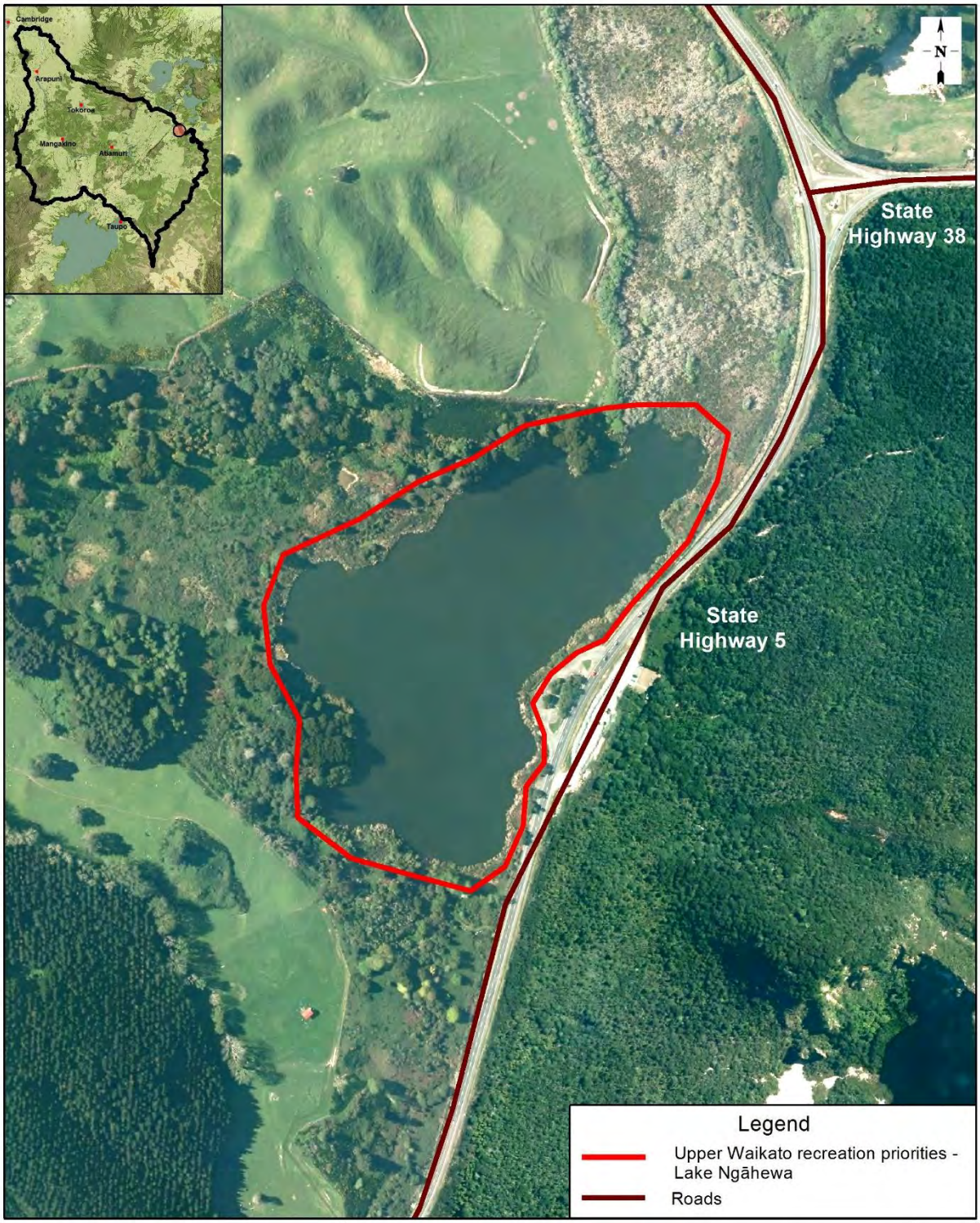
UW 25 Priority: medium	Lake Ngāhewa Walkway	BCR value
Relevant unit goal(s)	Rivers and waterways are widely used by the community and are a place to relax, play, exercise, recreate and gather kai. River restoration activities enhance the economic wellbeing of the Upper Waikato.	
Name of feature	Lake 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

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 REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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 Priority: very high	Restoration of Wai-O-Tapu South Geothermal Area	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.	

	 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.	
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 the final year.	L = 20
Effectiveness of works	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.	W = 0.05

<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>
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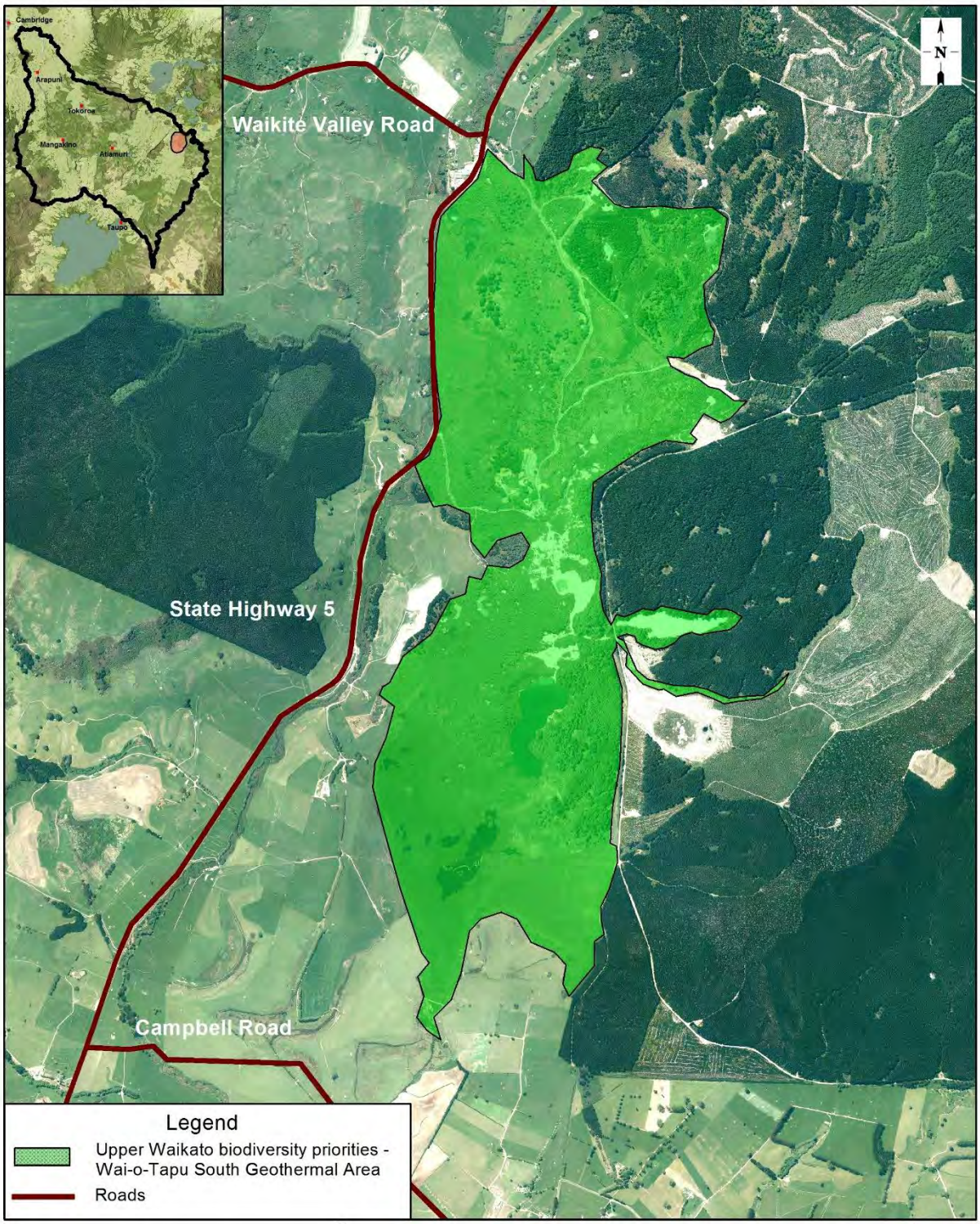


Restoration of Wai-o-Tapu South Geothermal Area

WWRRS Project Map

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

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

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale1:25,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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.

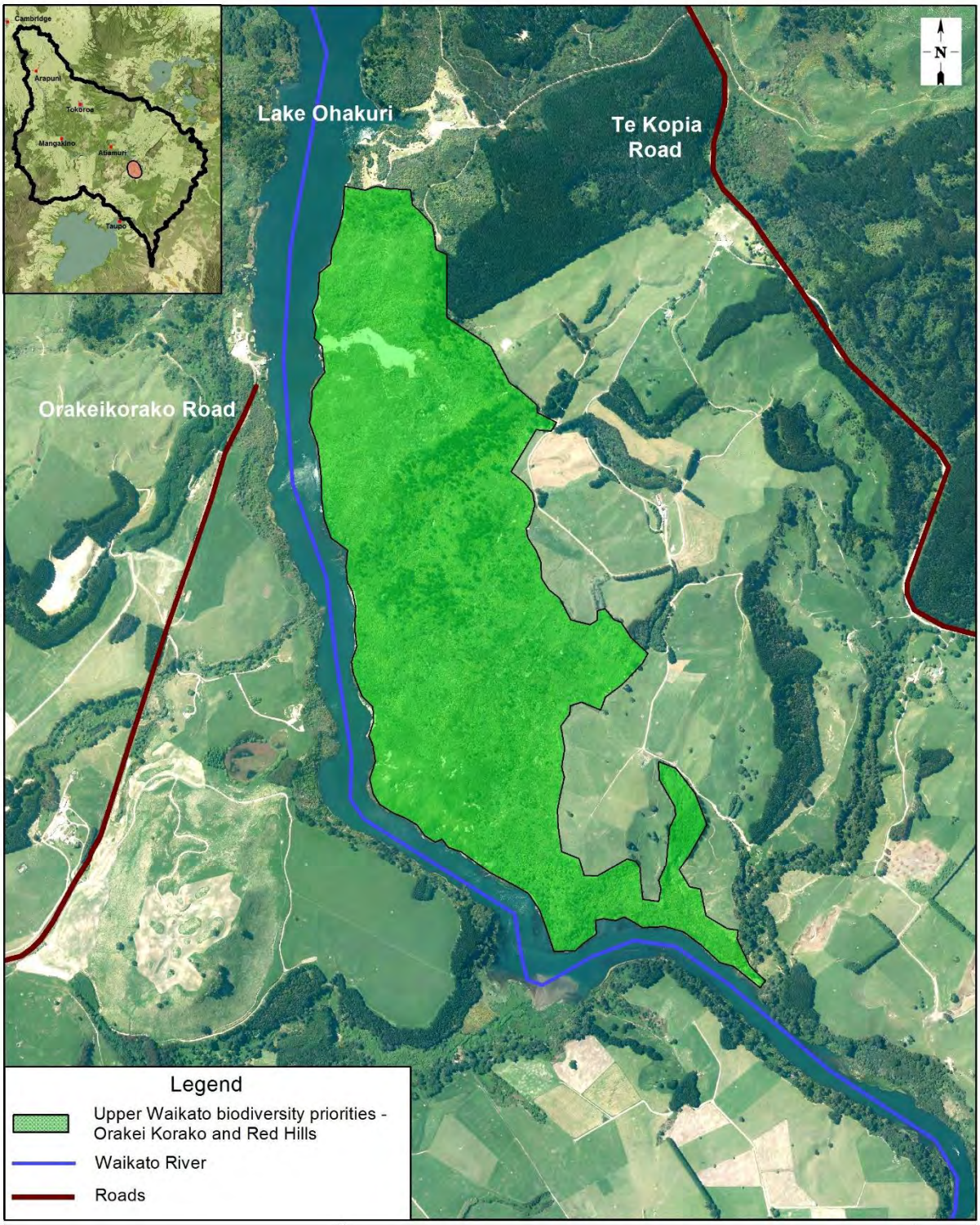
Wilding conifer control
- Felling of large mature wilding pines in northern section of block (owned by Tutukau East/tourist operator). Estimated cost: 5 days labour at $500 per day is $2500
- Hand removal of pine seedlings within northern section of block every 3 to 4 years (3-4 days at $500 per day 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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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).	

<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.
- 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.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</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></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- 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.</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.

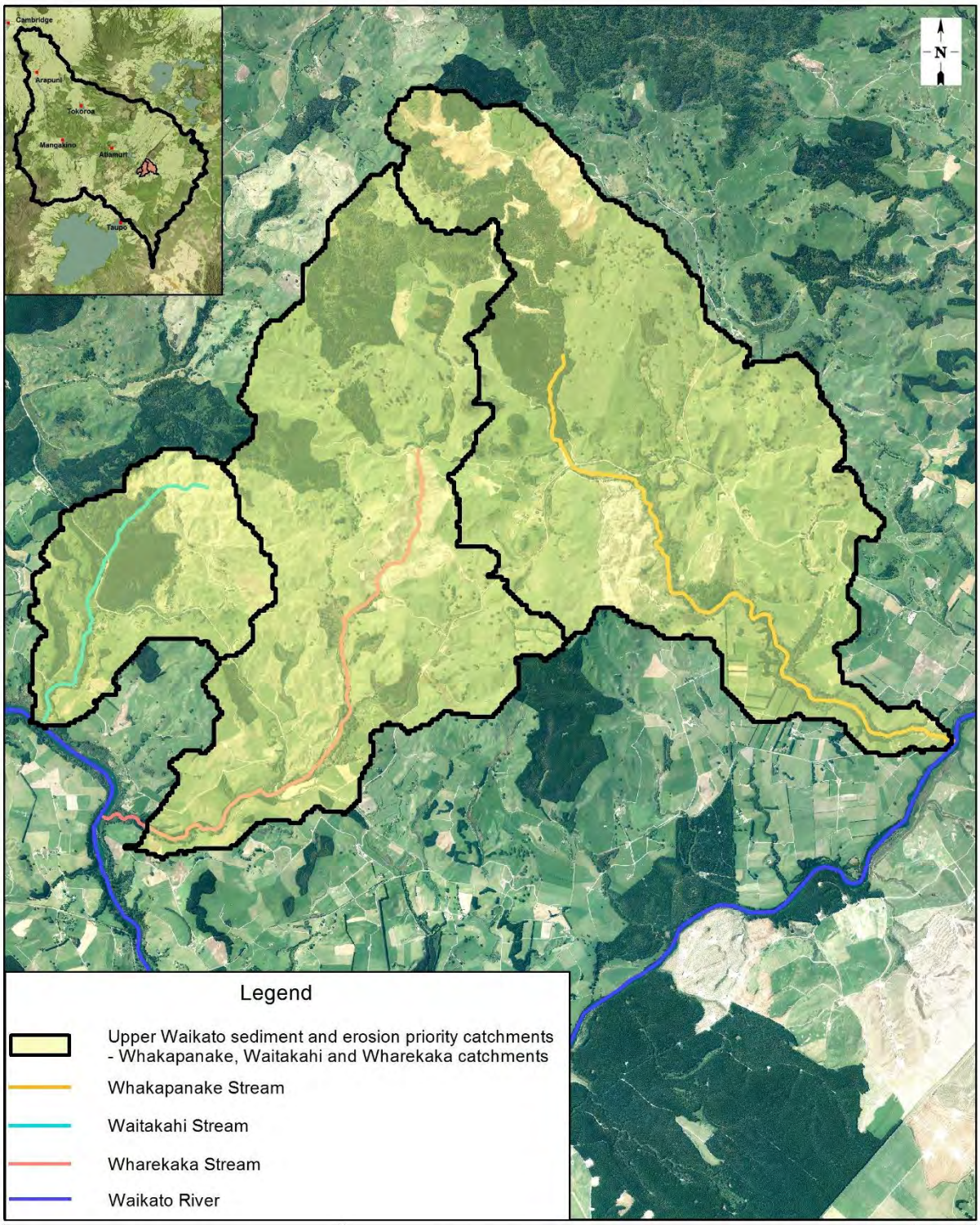
Hill country soil conservation
- 5 erosion control structures on LUC 6e land at $15,000 per structure (e.g. bunds, flumes, debris dams, drop structures etc.) ($75,000).
- 134ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $2500 per hectare including fencing ($335,000).
- 336ha LUC 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</td><td></td></tr>
</table>

<table>
<tr><td></td><td>transport, office overheads, consumables and miscellaneous professional fees.

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></table></td><td>C = 2.08</td></tr>
</table>

	Fencing existing indigenous vegetation (3km)	75,000	
	Project management/staffing/incidentals (30%)	480,000	
	Total	**$2,080,000**	



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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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-	

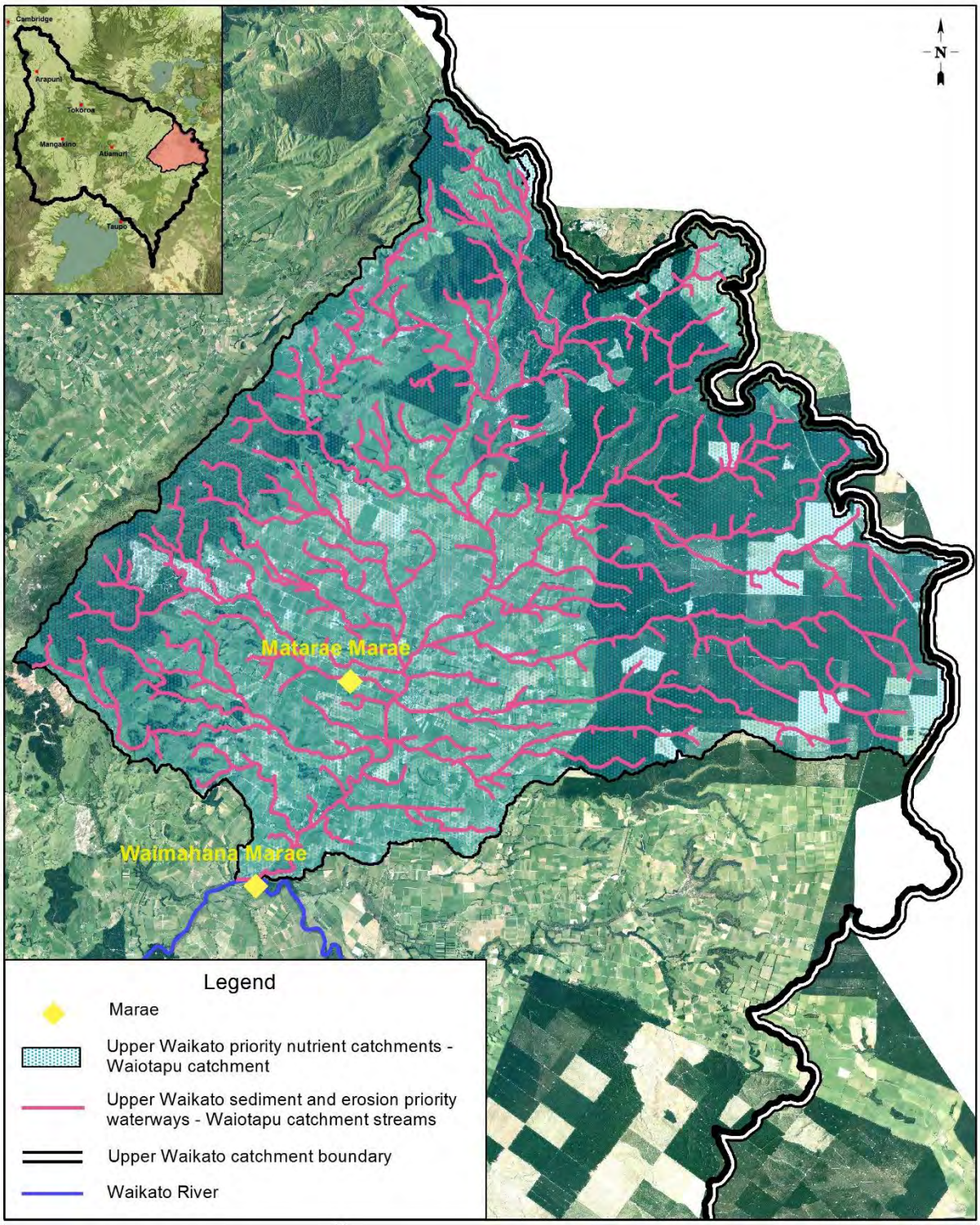
<table>
<tr><td></td><td>4km of the lower reaches of the Mangahoanga Stream – a tributary of the Wai-O-Tapu.

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

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and catchment wide surveys of riparian fencing.</td><td></td></tr>
<tr><td>Knowledge gaps</td><td>Estimates of 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>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>Riparian fencing (120km)</td><td>960,000</td></tr>
<tr><td>Riparian willow/poplar pole planting (3010 poles)</td><td>42,140</td></tr>
<tr><td>Native riparian planting (30ha)</td><td>1,126,560</td></tr>
<tr><td>Wetland fencing (135km)</td><td>1,080,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>962,610</td></tr>
<tr><td>Total</td><td>4,171,310</td></tr>
</table>
</td><td>C = 4.171</td></tr>
</table>



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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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	

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Desired state to achieve Vision & Strategy</td><td>- 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 Carex 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.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>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.</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>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 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.</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.

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</td><td></td></tr>
</table>

	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>C = 0.4</td>
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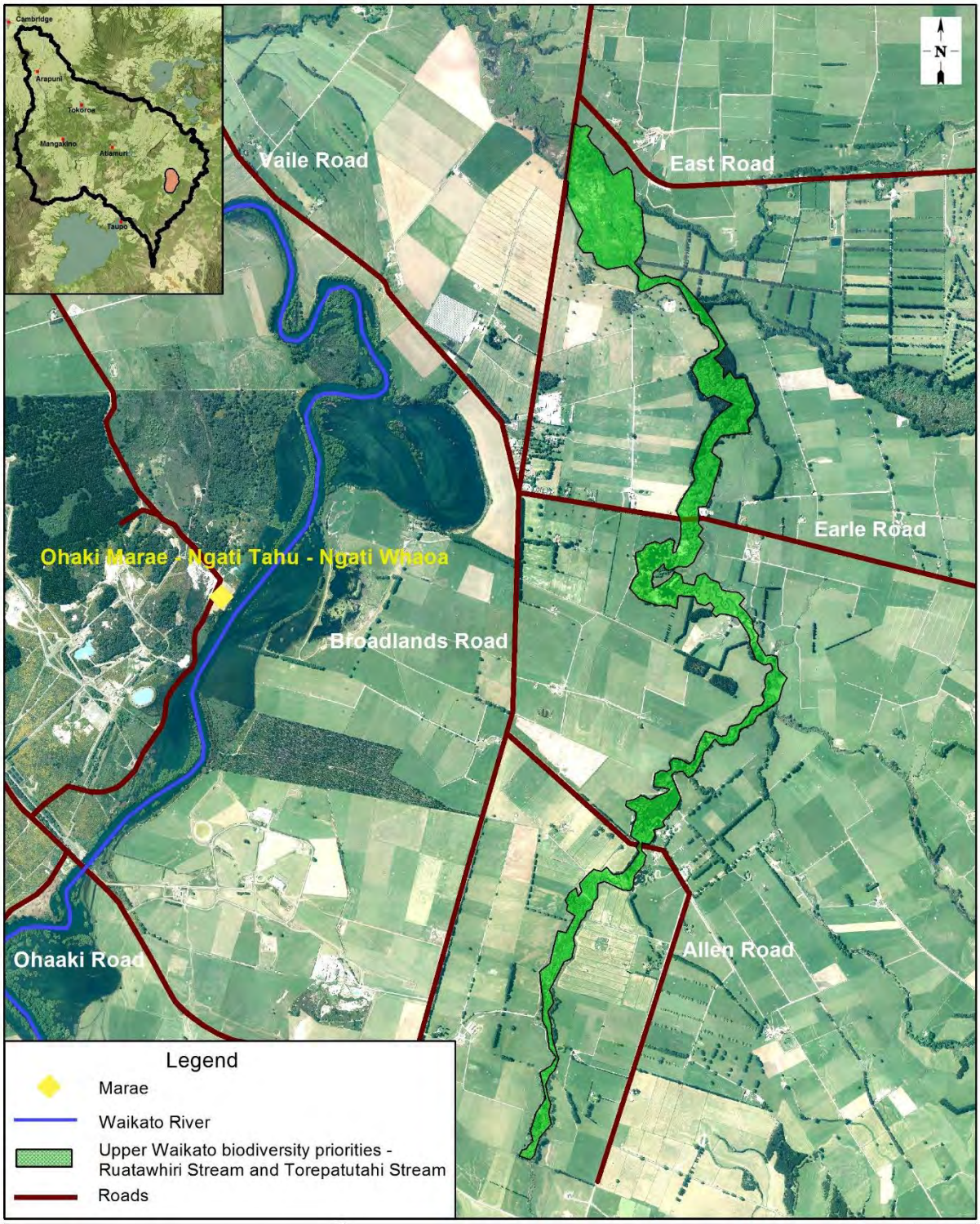

Biodiversity enhancement on the lower reach of Ruatawhiri Stream and part of Torepatutahi Stream

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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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>
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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>
<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 (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>C = 0.357</td>
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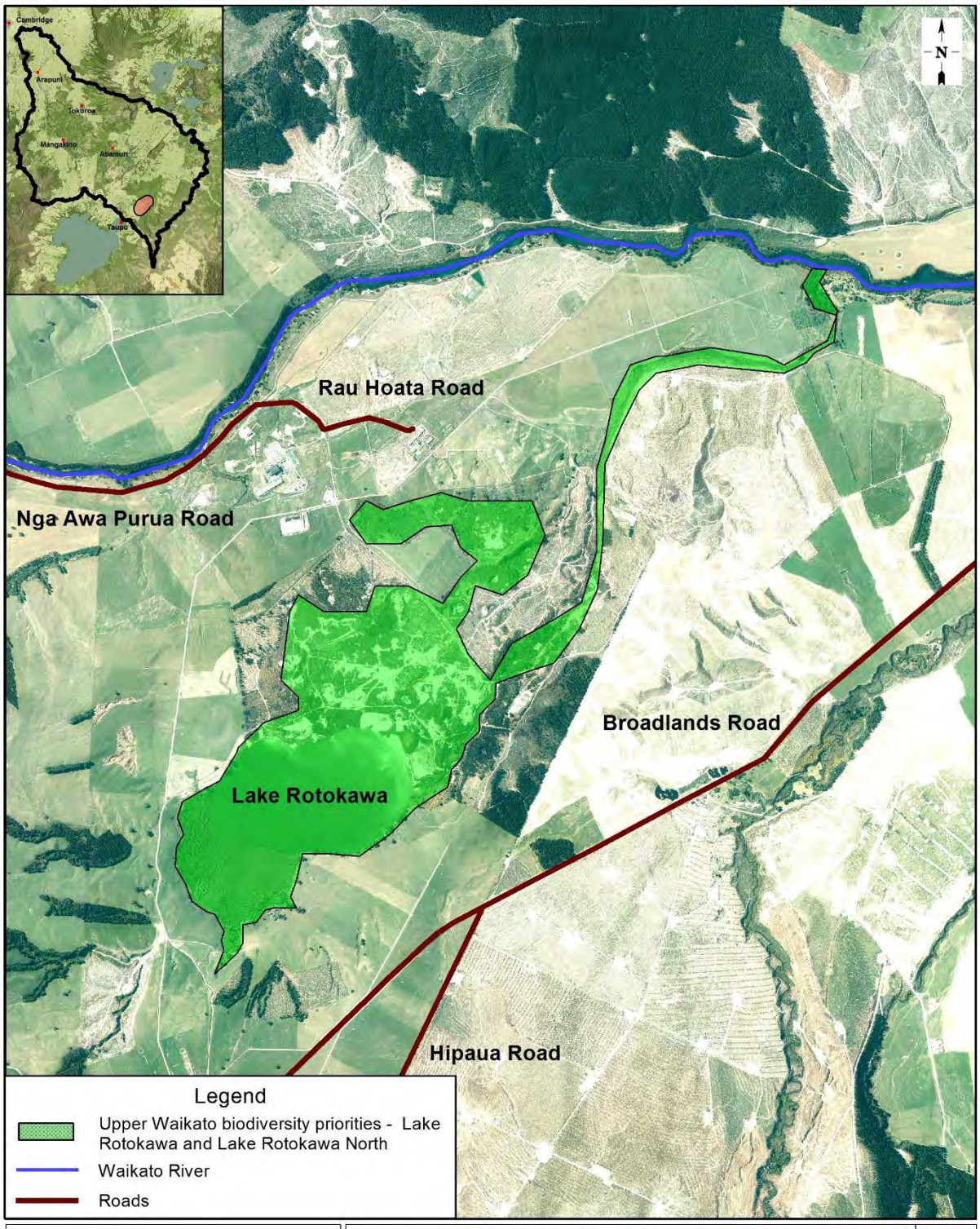

Biodiversity enhancement at Lake Rotokawa and Lake Rotokawa North

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

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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. Water quality monitoring information on the Waikato Regional Council website indicates that phosphorus levels are	

<table>
<tr><td></td><td>”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).
- 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).</td><td></td></tr>
</table>

	- 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 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.	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	F = 0.82

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>Adoptability</td><td>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.</td><td>A = 0.9</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and catchment wide surveys of riparian fencing.</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>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.</td><td>P = 0.62</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>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><td>C = 4.56</td></tr>
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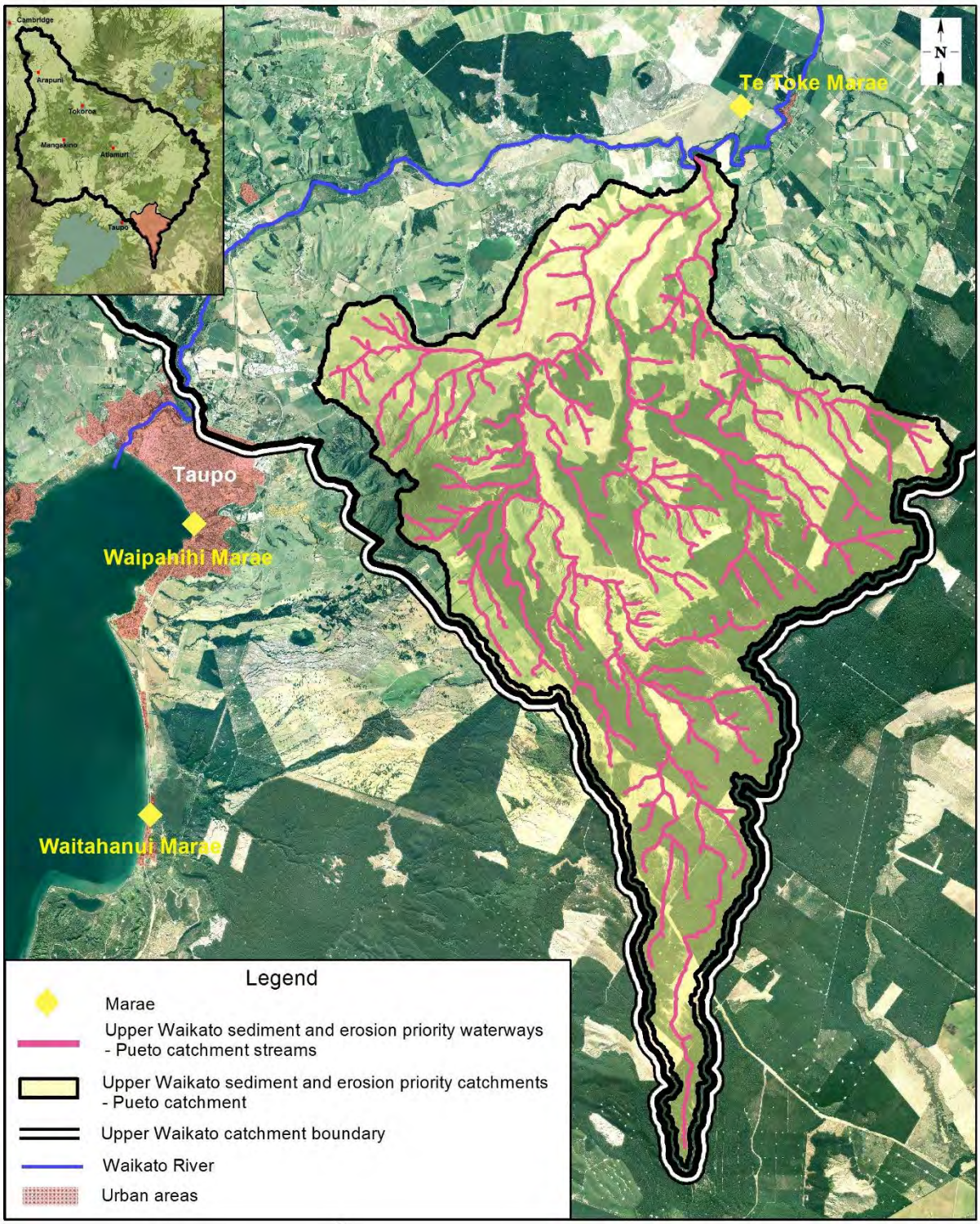

Pueto catchment hill country and streambank erosion protection and remediation

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
Te Kaunihera ā Rohe o Waikato