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Complementing freshwater ecosystem services assessments with Maatauranga Maaori knowledge in the Lower Waikato region

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Executive summary

Objective 3.8 of the Waikato Regional Policy Statement relates to ecosystem services, benefits people obtain from nature, ecosystems. Under this objective, the Waikato Regional Council (WRC) seeks to '*recognise, maintain and enhance ecosystem services*' to enable their ongoing contribution to regional wellbeing. Taking an ecosystem services approach to resource management involves considering all services provided by ecosystems to all sections of a community. To implement this approach, tools such as maps and databases of ecosystem services are useful at a level of detail at which policy and management decisions are made. The Freshwater Ecosystem Services Project herein is one of WRC research activities being undertaken to implement this approach. This project aims to provide a better understanding of the services being provided by freshwater ecosystems (rivers, streams, lakes, wetlands and ground water bores) in the region. The overarching objectives of this project are to i. identify spatial distribution and characteristics of freshwater ecosystems in terms of mapping and assessing their services and their corresponding values, and ii. examine trends in freshwater ecosystem services in terms of comparing and contrasting the demand and supply of these services in the region.

Initially there was no database of these ecosystems with their associated services and values, especially in the context of the Millennium Ecosystem Assessment (2005) and the Gardiner and Huser (2017) framework of ecosystem services. There is a gap between the values the communities place on natural resources and the ecological monitoring data being collected by the WRC. Monitoring data are collected and used to report on ecological status and health with less emphasis on processing the data to reflect the services being provided to communities. Closing this gap is required to monitor the effectiveness of relevant programmes and policies. For example, monitoring ecosystem services is a holistic way of accounting for all trade-offs and potential multiple uses and or opportunities from natural resources. Local Indigenous Biodiversity Strategy (LIBS) is a WRC's practical example of this approach (Vare, 2016). Also, it is an approach to achieve improved productivity and efficiency of resource use for community wellbeing. In addition, these sets of information would help to facilitate learning processes between scientists, policy makers and freshwater management staff so that relevant programmes and policies can be linked to implementation projects. Specifically, the information and the insights will increase the understanding of the relative values of all the available services in the environment. This ultimately will help with the *"recognise, maintain and enhance ecosystem services"* strategy in the resource management and allocation strategy of the WRC.

In phase 1 (Olubode-Awosola, 2016) of the Freshwater Ecosystem Services project, an assessment of ecosystem services from a sample of freshwater bodies (rivers, streams, lakes and wetlands) in the Waikato region was carried out and is being presented in an online interactive map[1] with underlining database and accompanying technical reports (Baillie and Yao, 2015a, b; Mueller and Dean, 2015; Olubode-Awosola 2016; Wildlands, 2018). These sets of information are being fine-tuned and improved upon as more data are collected, and more rigorous analyses are performed. For example, in Phase 2, we expanded on the list of indicators of ecosystem services and assessments by sampling additional freshwater resources in the Waikato region, including geothermal reservoirs.

In this study, we are complementing, with this project, the internationally recognized framework of ecosystem services (Millennium Ecosystem Assessment, 2005) with a Maatauranga Maaori

[1]https://waikatoregion.maps.arcgis.com/apps/webappviewer/index.html?id=cd512953486b430c8b0a18ee50c5467a

perspective by surveying manawhenua and mainstream community members on the value of cultural ecosystem services, specifically freshwater ecosystems services in their areas. Cultural services are one category of ecosystem services. Cultural ecosystem services include non-material benefits such as spiritual enrichment, cognitive development, reflection, recreation and aesthetic values, including knowledge systems, social relations and aesthetic values (Millennium Ecosystem Assessment, 2005). Specifically, in this study, we explore cultural ecosystem services complemented with a tangata whenua assessment and valuation perspective of those services which includes using aspects of local Maatauranga Maaori values to assess freshwater ecosystem services. The concepts, approach, methodology and results of this study are presented in this report.

In summary, the manawhenua and mainstream community members in the lower Waikato were sampled to share their knowledge of cultural ecosystem services and values of freshwater bodies in Te Roto o Waikare, Whangamarino repo, Te Tupuna Awa and; Opuatia repo. The responses across the four ecosystems reveal that the respondents had vast knowledge of the water bodies in their area and the range of values that were identified. Among the respondents, a value common across all water bodies was hauaanga/mahinga kai (hauaanga kai is the Waikato term for the generic “mahinga kai”). Mahinga kai is one of the significant Maaori values identified within the National Objectives Framework for freshwater management (Ministry for Environment, 2014). Other values compared with and identified in the literature are consistent across the manawhenua and mainstream responses. In terms of policy implications, the results suggest there is increasing demand for a wide range of services potentially available from freshwater resources. However, numerous threats to sustainable use of these resources are emerging. This implies an increasing demand for resources to mitigate and or manage such emerging threats. Therefore, more understanding of the ecological, cultural and economic values is required, including how these values are interrelated so that ways to protect them can be investigated. Not only that, recognising and identifying values and significance of ecosystems, especially through a Maaori kaitiaki is required for a successful biodiversity maintenance under the RMA and the proposed National Policy Statement (NPS) for indigenous biodiversity.

1 Introduction

The Freshwater Ecosystem Services project herein is one of the Waikato Regional Council's research projects being undertaken to implement Objective 3.8 of its regional policy statement which relates to the concept of Ecosystem Services i.e. benefits people obtain from nature, ecosystems. Under this objective, the Council seeks to '*recognise and maintain or enhance ecosystem services*' to enable their ongoing contribution to regional wellbeing. The project aims to provide ongoing understanding of services provided by freshwater bodies (rivers, streams, lakes, wetlands and ground water bores) in the Waikato region. The overarching objectives of this project are to i): identify spatial distribution and characteristics of freshwater ecosystems in terms of mapping and assessing their services and values and ii): examine trends in freshwater ecosystem services in terms of comparing and contrasting the demand and supply of these services in the region.

Initially there was no database of these ecosystems with their associated services and values, especially in the context of the Millennium Ecosystem Assessment (2005) and Gardiner and Huser (2017) framework of ecosystem services. Therefore a gap was identified between the values the communities place on natural resources and the ecological monitoring data being collected by the Waikato Regional Council (the Council). Currently, monitoring data are collected and used to report on ecological status and health with less emphasis on processing the data to reflect the implications of the status and health of ecosystem services being provided to communities. Closing this gap is needed to monitor the effectiveness of the relevant regional policies. For example, monitoring ecosystem services is a holistic way of accounting for all trade-offs and potential multiple uses and or opportunities for further development of a specific nature resource. Local Indigenous Biodiversity Strategy (LIBS) is a WRC's practical example of this approach (Vare, 2016).

Also, it is an approach to harness productivity and efficiency of resource-use for community wellbeing. In addition, these sets of information would help to facilitate learning processes between science, policy and operational freshwater management staff so that relevant programs and policies can be linked to implementation projects and programmes such as LIBS. Specifically, the information and insights will increase the understanding of the relative value for all the available services in the ecosystems. This ultimately will help with the ***"recognise maintain and enhance ecosystem services"*** strategy in resource management and allocation strategy of the Council.

In phase 1 of the Freshwater Ecosystem Services project, an assessment of ecosystem services from a sample of freshwater bodies (rivers, streams, lakes and wetlands) in the North Waikato region was undertaken. The assessments are being presented in an online interactive map[2] containing an underlying database and accompanying reports (Olubode-Awosola, 2016). These sets of data and information are being fine-tuned and improved upon as more and more data are collected, requiring correspondingly more and more rigorous analyses. For example, in Phase 2 (Baillie and Yao, 2018; Wildlands, 2018), we expanded on the list of indicators of ecosystem services and assessed more services by sampling additional freshwater resources including geothermal reservoirs.

[2]https://waikatoregion.maps.arcgis.com/apps/webappviewer/index.html?id=cd512953486b430c8b0a18ee50c5467a

In this study, we are complementing the internationally recognized framework of ecosystem services with a Maatauranga Maaori perspective by surveying manawhenua and mainstream communities on the values they hold for cultural ecosystem services in their communities. Cultural ecosystem services are one category of ecosystem services, the benefits that humans and environments realise from nature. Non-material benefits include spiritual enrichment, cognitive development, reflection, recreation and aesthetic values, including knowledge systems and social relations (Millennium Ecosystem Assessment, 2005). Specifically, in this study the ecosystem services concept is complemented with a manawhenua perspective as part of an assessment and valuation of cultural ecosystem services. This includes using aspects of local Maatauranga Maaori to assess freshwater ecosystem services and values. The concepts, approach, methodology and results of this study are presented in this report.

Some aspects of Maatauranga Maaori were used to assess freshwater ecosystem services and values in a sample of freshwater bodies in lower Waikato. The assessment aims to help understand the values that manawhenua and mainstream communities have for water bodies such that the information from this study would provide some cultural attributes as complementary information to the internationally recognised indicators of ecosystem services and values. This approach aligns with recommendations through which the Council can implement the concept of ecosystem services in regional policy making and implementation (Gardiner and Huser 2017).

In this study, manawhenua and other community members in the Lower Waikato were sampled to share their knowledge of cultural ecosystem services and values of freshwater bodies Te Roto o Waikare, Whangamarino repo, Te Tupuna Awa, and Opuatia repo (Figure 1). The value of the knowledge of cultural ecosystem services and values derived from this study can be hinged on the claim that enhancing the culture of the local community has potential to enhance the local economy (Kraus, 2013). Despite that, this study was not necessarily designed for a particular policy, rather the information gleaned from this study can complement other research contributions to support the Councils strategic direction and approach. For example, the Councils Strategic Direction 2016-2019, states that “the full range of ecosystem types, including land, water and coastal and marine ecosystems is in a healthy and functional state” and “economic growth ensures natural capital and ecosystem services are maintained”. Also, the Policy Statement Objective 3.8 states that “a range of ecosystem services associated with natural resources are recognised and maintained or enhanced to enable their ongoing contribution to regional wellbeing”.

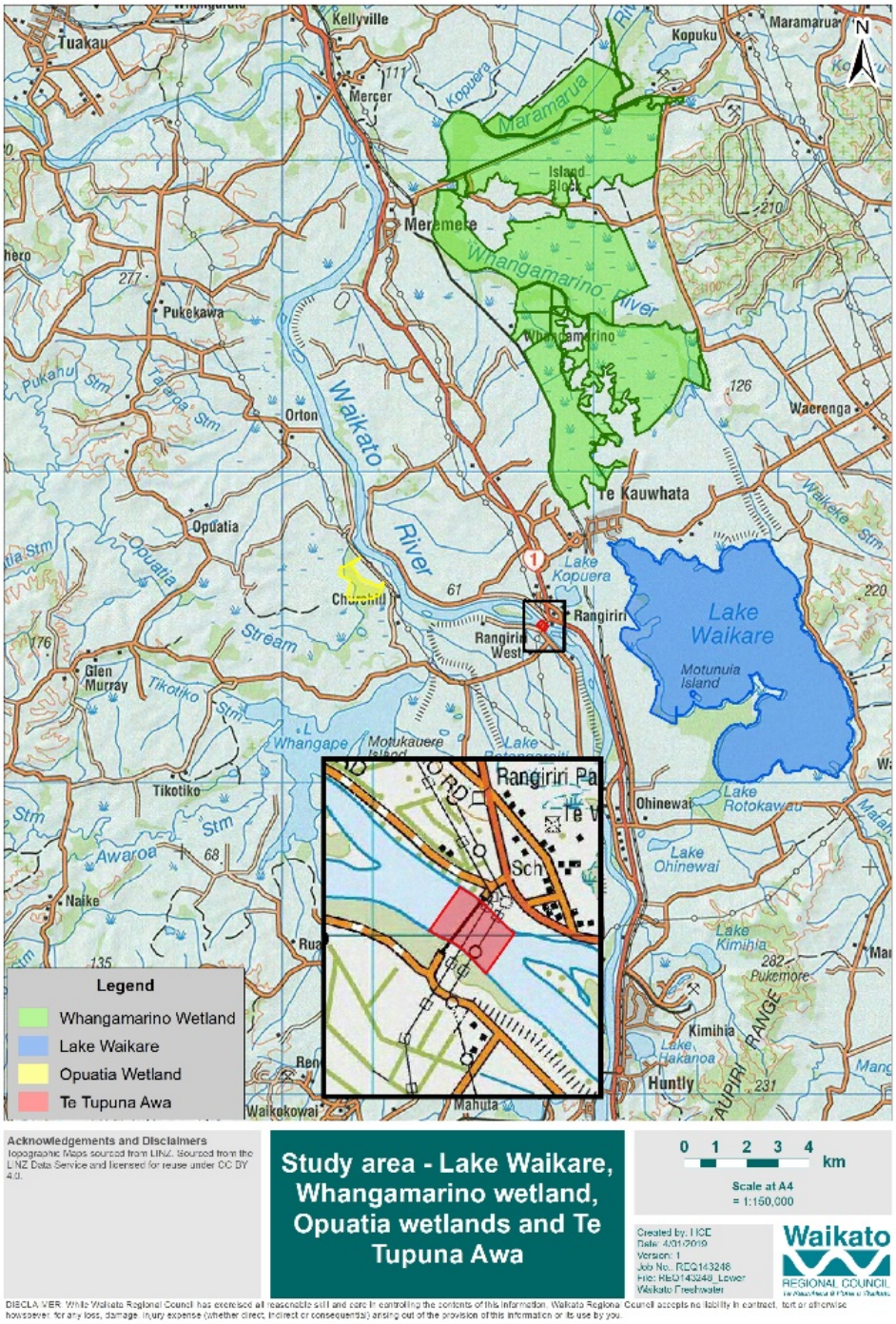

Figure 1: The Study Area

2 Ecosystem services concept and framework

The knowledge gleaned from the literature in terms of the concept of ecosystem services, specifically cultural values of those services are summarised and presented in this section. Te Mana o Te Wai represents the innate relationship between Te Hauora o Te Wai, Te Hauora o Te Taiao and their ability to support each other while sustaining Te Hauora o Tangata. Valuing ecosystems and/or the services they provide commonly includes an evaluation of the use and non-use values of those ecosystems or services (Chan *at al.*, 2012). An interpretation of this theory of indigenous cultures including Maaori requires a commentary on the way of life mai raano due to the importance of ecosystems, i.e. taaonga tuku iho for substance and shelter following the arrival of the Tainui waka. Valuing cultural values such as non-direct use for Maaori apply from knowing taaonga exists. The practice of raahui or temporary prohibition by hapuu ensures taaonga exists for future use.

Lyver *et al.* (2017) defines Cultural Ecosystem Services (CES) as "contributions by ecosystems to non-material benefits such as capabilities and experiences that arise from complex and dynamic relationships between ecosystems and humans". The concept of Cultural Ecosystem Services is rich and has complex meaning and values that emerge from contexts over time. These contexts can be articulated in ways that will contribute to a better understanding of cultural dynamics (Cooper *et al.,* 2016). Key benefits of CES are cultural diversity and identity, spiritual and religious values, aesthetic and cultural heritage values, recreation and ecotourism, knowledge systems and inspiration (Lyver *et. al.*, 2017).

Cultural Ecosystem Services have "non-material or intangible dimensions that matter more to people than do the affiliated sustenance, shelter, material or financial benefits" (Chan *et al.,* 2012). Cultural heritage such as visible and material representations of cultural activities and species on the landscape are linked to myths, legends and religious practices that have "concrete" locations and ecosystem features relevant to ecosystem services. According to Daniel *et. al.* (2012), cultural integrity and continuity for indigenous peoples and genealogy are examples of values whose importance is determined at the group level rather than an individual level. Indigenous cultures believe people are an integral part of nature (Lyver *et al.,* 2017).

Any working definition of ecosystem services should be specific to the culture of the people whose valuations are being sought because ecosystem-based cultural benefits are valuable to people (Cooper *et al.,* 2016). Most cultural services are best understood as benefits produced as cultural and provisioning services that have value and importance in motivating the public to protect ecosystems (Daniel *et al.,* 2012). But according to Stalhammar and Pedersen (2017) CES is difficult to operate, it is difficult to measure (Cooper *et al.,* 2016) it is challenging to classify (Chan *et. al*., 2012) which tends to conflate or fuse services, benefits and values (Satz *et al.,* 2013).

World views have a role to play in the understanding of the CES concept. World views create differences in how societies relate to, value and understand the environment (Lyver *et al.,* 2017) so the focus of decision-making and research should be on what people care about (Chan *et al.,* 2012). Indigenous cultures have identified values such as genealogy and cultural heritage, association with the spiritual realm and ancestors that can provide support for language and culture, a sense of place and kinship, having strong governance and regimes of joint

management and stewardship (Lyver *et al.,* 2017). Harmsworth and Awatere (2014) outline in detail the Maaori world view from the beginning of time. They recount environmental concepts to illustrate and portray ecosystems that make up taaonga tuku iho in te taiao, mauri, cultural health, wetlands, well-being, aspirations, ecosystem services and their frameworks, decision making in ecosystem management, and settlement of the Treaty of Waitangi.

In the international framework, the standard classifications of ecosystem services include provisioning services, cultural services, regulating services and supporting services (MEA, 2005). Dymond et al. (2012) added more sub-categories that included option values, existence values, and bequest values to form a comprehensive ecosystem classification framework. Harmsworth and Awatere (2014) use common Maaori concepts of whakapapa, kaitiakitanga, mana, ki uta ki tai, taaonga tuku iho, te ao turoa, mauri, ritenga and wairuatanga.

Lyver *et. al.* (2017) found that different value-belief systems such as CES influence the importance of ecosystem services and their benefits. Lyver *et al* (2017) mapped forest value services for Ngaati Porou and used four "bio-cultural" themes deemed relevant including importance of place, capacity to provide, connectivity with communities and future aspirations. The values identified most were mahinga kai, oranga, oohanga whai rawa and ahikaaroa. They examined the possible application of the concept of ecosystem services to provide an effective framework to map indigenous people's values by considering how the loss of key ecosystem services influences the viability of indigenous cultures to deliver and express CES.

The relationship between indigenous people and nature being included in ecosystem services frameworks was questioned by Walker (2014). Marginalisation of indigenous people means their values become sub-ordinate to those of the dominant culture and less covered in ecosystem services assessments (McMichael *et al*., 2005), so some studies used participatory approaches to such indigenous peoples perceptions of values and benefits (Chan *et. al*., 2012). A counter to the suggestion people can be separated from the environment is that ecosystem services could connect society with nature (Greenhalgh and Hart, 2015). Therefore, the information from this study is useful to provide some cultural attributes in terms of services that water bodies provide as complementary information to the internationally recognised indicators of ecosystem services and values which can be monetary especially in a monetized world we live in today.

3 Methodology

In the context of the overarching objectives of the project, i.e. to characterise and assess the services and values of freshwater ecosystem services, purposive sampling was conducted in the study area. Community and manawhenua members were selected based on their familiarity and values they hold for particular water bodies in their area. The benefit of this approach is the efficiency in gathering rich information from relatively small numbers of people on a subject (Payne and Payne, 2004). This approach provides qualitative data to be collected from respondents such as community leaders, professionals, local residents, those with first-hand knowledge about the community and the target freshwater ecosystems. These respondents can be referred to as community experts who provide insights to the questions being posed.

Ngaati Pou and Ngaati Naho Hapuu whanau were invited to participate and share their knowledge during the data collection exercise. A monthly hui at Horahora Marae was used to present the CES project to Ngaati Pou and Ngaati Naho whanau that began with a whakatau and a karakia to whakanoa the hui. This is a traditional approach to asking for and collecting information from whanau. For this project, taaonga tuku iho, tohu that may or may not affect ecosystem services, as well as the ecosystem services provided currently, and historically was presented in a power point presentation followed by the fielding of questions and distribution of the survey questionnaire. A similar process was attempted with Ngaati Hine Hapuu whanau but for reasons of scheduling and timelines, kanohi ki te kanohi interviews with whanau were conducted. This approach was used to survey known key representatives and stakeholders from the Te Kauwhata and districts community to identify the ecosystem services the community may relate to and identify with water.

Horahora marae hui attendees were invited to provide their feedback to a set of structured questions in a survey questionnaire. As a result, the hui elicited the paku korero of kaumaatua and kuia and other interested marae beneficiaries from Maurea, Horahora and Waikare marae. The korero and whakaaro of kaumaatua and kuia were directed at freshwater ecosystems such as repo, awa, roto, ngaahere, ika and manu specifically that are collectively referred to as taaonga tuku iho. Where korero or whakaaro reverts back to oral traditions and histories that are too sensitive to reveal, such information has been with-held.

Prior to data collection, the reports from previous studies were synthesised to review existing data on community values for freshwater bodies. These studies were considered to determine what additional information was required from the community including manawhenua. As a result, a questionnaire was developed and reviewed before being administered. The questionnaire contained a set of key questions focussing on eliciting the social and cultural values of freshwater ecosystems and the services they potentially provide. The questions draw upon the respondent's knowledge and experience and the benefits associated with the water bodies in the area. Respondents were also prompted to think about the causes of trends in regard to the type of benefits provided. Open-ended questions provided opportunities for respondents to include additional information relating to the level of services, expectations, recommendations and or solutions that may address the declining levels of services and benefits provided by waterbodies into the future.

After analysing the data with discussions and interpretations presented in this report, a draft copy of the report was shared with the respondents (See Appendix II). This was an opportunity for them to provide their feedback on the report. Specifically, if they possibly identify and disapprove of any of the contents they have provided when they filled in the questionnaire such that those contents were removed from this report before being made public.

4 Results and discussion

In this section, the data collected from the questionnaire are summarised and presented with reference to the previously assessed indicators of ecosystem services in the study area. Detailed indicators of ecosystem services are presented in Table A1 in the Appendix I. The discussion of the manawhenua and mainstream surveys are presented and organised by the ecosystems: Opuatia Repo, Te Roto o Waikare, Whangamarino repo and Te Tupuna Awa at Rangiriri Bridge. For each ecosystem, the discussions are organised by themes identified in the responses to the questionnaire after a brief description of the respondents' knowledge of the ecosystem, and lastly, their aspiration for the future of the ecosystem.

4.1 Opuatia Repo

4.1.1 Opuatia Repo and Ecosystem Services

Opuatia repo serves a wetland ecosystem of about 660.95ha in the Lower Waikato. A decade previously, the wetland had a history of good health in terms of water quantity and quality, but the biodiversity and other ecosystem services are currently being threatened by invasive exotic species, including the expansion of agricultural activities in the catchment (Browne et al, 2005). In terms of the MAE (2005) classification of ecosystem services from freshwater bodies, a number of indicators of ecosystem services have been assessed in Opuatia repo. For example, an indicator of provisioning service, the volume of the water take for agricultural use is more than 2,000,000 m^3 $year^1$ from approximately 90 days of 26,400 m^3day^1 of water take from Opuatia stream, as well as from groundwater from the wetland for portable and irrigation water use. Details and other indicators are presented in Table A1 in the Appendix I. Some indicators of cultural services include education and recreation services, i.e. number of scientific projects/studies and number of public access points. This information is complemented by the data from the survey as presented in the next few paragraphs.

4.1.2 The Respondents' Knowledge of Opuatia Repo

Two manawhenua respondents completed the questionnaire on Opuatia Repo. Both respondents were unaware of the concept of CES, but they were aware of where Opuatia Repo was located, and one of them was aware of how the repo was formed. Ten mainstream community respondents completed the questionnaire on Opuatia Repo. Three were aware of the concept of CES and five had visited the wetland previously. About half of the respondents were aware their parents or grandparents had visited the wetland, and more than half were aware the wetland had historical significance and value. They also mentioned that the wetland was not as popular as it should be. It can be inferred that the respondents have a good knowledge of the wetland. Their first visits dated back at least five years with some level of frequency in summer, autumn, and in some instances, all year round. The reasons for visiting included sightseeing by boat or otherwise, duck shooting, farming, and work-related activities. Other benefits mentioned were catching mullet and possum shooting.

4.1.3 What Tuupuna and Whaanau used Opuatia Repo for

The manawhenua respondents were aware of how tuupuna and whaanau used Opuatia Repo, i ngaa waa o mua, which include puna kai (tuna), puna wai (drinking water)~~,~~ parking the waka and washing. Tuupuna and whaanau also grew kumara, and participated in recreational activities with waka on the margins of Opuatia Repo i ngaa waa o mua.

4.1.4 Species of importance in Opuatia Repo

The Ika species gathered from Opuatia Repo include carp, tuna, inanga, kanae – mullet. Manu species gathered from Opuatia Repo include pukeko and duck. Other species included Kaeo - fresh water mussel and koura. Likewise, the aquatic tipu species gathered from Opuatia Repo i ngaa waa o mua were harakeke, pingao and watercress. The important aquatic pepeke species living in Opuatia Repo i ngaa waa o mua is dragonfly. The raakau species growing on the margins of Opuatia Repo i ngaa waa o mua used as building materials include nikau, manuka, kanuka, ponga while the ngahere species used as hauaanga kai include mauku, pikopiko, and puha. The maara kai grown on the margins of Opuatia Repo i ngaa waa o mua were kumara, maize, corn and watercress.

4.1.5 Values tuupuna and whaanau place on Opuatia Repo

The values tuupuna and whaanau place on Opuatia Repo are presented in Table 1. The manawhenua respondents mentioned it is a cultural practice to say karakia before harvesting some of the services. This may be in the form of asking for permission, waiting for blessing and even saying thank you for the services. Also, they believe it is culturally important to know how to harvest, especially to sustain the availability of the services in the future.

Table 1: Values tuupuna and whaanau place on Opuatia Report

Resources	Values
Aquatic and terrestrial tipu	Wairuatanga, puutaiao, respect - karakia to ask before taking, protect plants, know how to harvest, take only what's needed, leave roots so it continues to grow
Raakau	Whakairo, Karakia - get permission, wait for sign to get blessing, mahia te mahi - say thank you, leave koha.
Ika species	Manaaki tangata, Kanae - mullet, catfish, tuna
Terrestrial and aquatic pepeke	Tohu, puutaiao, watercress
Maara kai	Manaaki whaanau, manaaki tangata
Ngaahere species	Rongoa, ponga, kawakawa, willow, koromiko
Recreation	Wairuatanga, set hinaki
Whenua	Whakapapa

4.1.6 The Respondents' Aspirations for Opuatia Repo

When the respondents were asked what they would pay for these services, the common response was that it should be free or charged through rates. However, the respondents believed the wetland should be maintained, protected and conserved for future generations.

4.2 Te Roto o Waikare

4.2.1 Lake Waikare and Ecosystem Services

Lake Waikare is one of the main freshwater sources in the Lower Waikato catchment with 3,442 hectares of open water. It is a shallow lake with an average depth of 1.5 metres and a maximum depth of 1.8 metres, which partly explains the poor water quality in the Lake. Yet, quite a number of ecosystem services have been assessed on this Lake. See details in the Table A1 in the Appendix. For example, about 17 anglers were observed in Lake Waikare and the Pungarehu Canal area during a study in April 2012 (Hicks et al., 2013). Evidence of recent boat usage was observed during a site visit in May 2017. Much research work has been conducted using Lake Waikare as the focus (Olubode-Awosola, 2016).

4.2.2 The respondents' knowledge of Lake Waikare

Eleven manawhenua respondents returned completed questionnaires on Lake Waikare. Three were aware of the concept of CES. However, seven were aware of pollution going into the Lake and the effects that would have on the use and values they have for the lake. Four respondents were concerned about the possible impacts of climate change on the Lake. Seven respondents were aware of pest ika or manu species in or around Lake Waikare. The pests included Koi Carp and Canadian Geese. Fish species include matamata, puhi ringo, mouku, catfish, piharau and tuna. Plant species include mauku. Ten mainstream respondents returned fully completed questionnaires and nine respondents had visited Lake Waikare, with the first visit 13 years previously and some up to 50 years previously. The frequency of visit varied: daily, for some, others weekly or less frequent. A few of the respondents live near or have property at the lake edge. The reasons for visiting included yachting, eeling, sailing, walking and biking. Other benefits included walking around the lake with friends and family.

4.2.3 What tuupuna and whaanau used Lake Waikare for

The respondents mentioned tuupuna and whaanau using the lake for duck shooting, black/bat-fish, mullet, tuna, freshwater pipi/mussel, swimming, "i etahi wa e pupuhi ana manu (duck shooting), e kaukau ana (swimming), canoeing from one part of the lake to the other side, gathering water for cooking and washing clothes, hii ika". Some activities were undertaken all year round. However, most respondents claimed they could not do many of these activities currently due to pollution in the lake.

In terms of what tuupuna and whanau did with their whenua on the edge of Te Roto o Waikare i ngaa waa o mua, some whanau had urupaa where their tuupuna are buried, "miraka kau (dairy farming), whakato mara kai, wahi kau kau, "wind breakers" at one time or another during the year". Maara kai included strawberries, kumara, kaanga, riwai, kamokamo, puha taratara, wai mereni, peach, quince, apples, plums, paukena, black berries. Some of these crops were available all year round and some during raumati.

4.2.4 Species of importance in Lake Waikare

Some important manu species living in or on the margins of Te Roto o Waikare i ngaa waa oo mua were pukeko, rakiraki, swan, kotuku (weather forecaster), and kereru for kai. Some of these were collected as kai all year round. Some of the ngaahere species that were used by tuupuna and whanau included kahikatea bush, whiro, raupo, harakeke, manuka, pikopiko, karore, nikau, tirea with some grown all year round. The manu species living in the ngaahere were kereru, tui, waana, rakiraki, pukeko, and herons on the lake. The tipu used by tuupuna and whanau that grew in or on the margins of Te Roto o Waikare i ngaa waa o mua were raupo (Bull rushes), harakeke, manuka, and toetoe. These are all seasonal activities. Some important pepeke species living on the margins of Te Roto o Waikare i ngaa waa o mua were small lizards (but no more now), huhu grubs, weta, and praying mantis.

4.2.5 Values Tuupuna and whanau place on Lake Waikare

Table 2 shows the values whanau have for different services from Lake Waikare. To some the value are priceless. Whanau depended on the ecosystem for harvesting of building materials, food for whanau, medicinal plants, etc. and they recognise the lake help the community to mitigate climate change impacts.

Table 2: Values tuupuna and whaanau place on Te Roto o Waikare

Resources	Values
Water and land tipu	means of survival, priceless, food bowl, swimming, kai
Raakau	Whiro - patching up whare, teraire - building
Hauaanga kai	Kumara pit, kaanga pirau, tuna (boiled, pawhara, smoked, fried and dried), tame raina
Ika species	Tuna, mullet, mairire (catfish), iinanga,
Water and land insects	Poroka, ngaro (blowfly), moth, moui (gecko). Individual tohu species were moth (death)and moui (death)
Maara kai	Kamokamo, kumara, dried little kumara for snax, riwai, kaanga, riwai Maaori, riwai kōtero
Recreation	kaukau, waka pekepeke, waka races, waka whai puhi, picnic's, baptisms
Whenua	Come under Tainui waka, Oko kai, wai Maaori, waiora, urupa, wai
Climate change	Karakia, manaakitanga tetahi ki tetahi. Ma te wa, ka kite katoa tatou, o te ao, tenei ahuatanga, Hihiko te wairua, Hihiko te wairua

4.2.6 The Respondents' Aspirations for Lake Waikare

Similar stories emerged from both mana whenua and mainstream respondents. Mention was made of how the community should have better public access: 'it is a matter of 'pride of place' - "Te Kauwhata is our village, Waikare is our lake." However, it was noted that the lake was 'dirty and polluted', the perceived causes were from the presence of koi carp, Canadian geese and 'Te Kauwhata sewage discharging into the lake'. When asked what respondents would pay to have the lake restored, the responses were that it should be free as it has been in the past but if there were to be charges, then it could be through rates. One respondent mentioned that if there was a walkway along the edge, they would be willing to pay perhaps $5 a time. The majority of respondents believed that the lake should be maintained, protected and conserved for future generations. Half of respondents were aware of elders or ancestors visiting the lake and the significant historical value of the lake. Duck shooting, swimming, and fishing were popular activities. Respondents believed the lake was not as popular as it used to be due to lack of access and degraded water quality. However, duck shooters did use the lake seasonally.

A number of changes have occurred that potentially impact the lake such as land use, removal of land cover, land management practices, water storage, diversion and extraction, industrial development, residential development, climate change, changes in plant/animal communities, presence of pest species. These changes have caused issues such as increasing numbers of carp, treatment pond runoff, farm runoff, animals wading in the lake, the lake being lowered and controlled, and use of fertilisers "causing nitrogen run off".

These changes are believed to have affected community values "pollution has destroyed the aesthetic value of the lake." The water quality and fish life as well as plant life have all been compromised. The area, however, is still valued as 'pride of place'. Respondents expect a number of changes in the future that could restore the lake, such as:

- access preservation;
- controls on land use around the lake/wetlands;
- allowing the lake level to rise more than water being let in;
- creating man made islands in Lake Waikare to allow nature/plant life to exist plus contribute to better water quality;
- building a canal into the south west corner of Waikare from the Waikato River to reduce nutrient loads into Waikare;
- removal of Koi carp and Canada geese;

- halting the discharge of sewage into the lake;
- preservation and beautification of the area;
- better water flow through the lake ideally from the southern end so as to keep the lake clean.

4.3 Whangamarino Repo

4.3.1 Whangamarino Repo and Ecosystem Services

Whangamarino repo is another important freshwater ecosystem in the study area. The wetland has an approximate size of 6137.67 ha[1]. Estimates extrapolated from findings for Whangamarino peat dome, assume that due to its size and additional access points, this wetland will become more popular and will be more frequently used. Of the 7290 ha[1] current extent of the Whangamarino wetland, around 730 ha are owned and managed by the Auckland/Waikato Fish & Game Council with an equivalent area privately owned in which game-bird hunting opportunities are the management focus. A handful of ecosystem services indicators have been assessed and details presented in Table A1 in the Appendix I. For example, the wetland was traditionally a source for eels and flax for tangata whenua. Also, there is approximately three tonne of Carbon ha[1] year[1] and 67575.7 tonnes of Carbon Dioxide equivalents produced by the wetland, based on the atomic weight of Carbon and Oxygen calculations, with one tonne of Carbon equivalent to 6.67 tonnes of Carbon Dioxide (Bernal and Mitsch, 2012). According to Landcare Research, peat bogs may absorb up to 0.5 tonnes of Carbon Dioxide equivalent per hectare per year as part of the process of peat formation during the peat bog growth phase.

4.3.2 The Respondents' Knowledge of Whangamarino repo

Manawhenua respondents were aware of pollution, and some were concerned with the threat of climate change on the wetland. They were also aware of pest species, including Canadian Geese, Koi Carp, matamata, puhi ringo, mouku/mauku, catfish.

4.3.3 What tuupuna and whanau used Whangamarino repo for

Respondents mentioned how tuupuna and whanau used Whangamarino wetland; i ngaa waa o mua duck shooting, gum digging, kapia, where flax was cut and milled to make rope and other items. Other uses included medicinal purposes, mud for dye, te rito o te harakeke for women's menstrual/detox uses plus other benefits. There was also a flax mill nearby. These services were available all year round or during raumati. When asked if they could still experience these services, most answered no, "he waahi tapu". Respondents were also asked what tuupuna and whanau did with their whenua on the edge of the wetland i nga waa o mua and the responses were whakato kai and flax.

4.3.4 Species of importance in Whangamarino repo

Ngaahere species used as rauemi include swamp kauri, manuka, harakeke, and raupo which could be gathered during raumati and all year round. The Ika species gathered by tuupuna and whaanau from Whangamarino wetland i ngaa waa o mua included small eels (puhi), mullet, catfish, tuna, carp, batfish, kokopu, and poroaka collected all year round. The manu species collected by tuupuna and whaanau i ngaa waa o mua were pukeko, rakiraki, matuku, weka, swan, and ducks all year round and raumati. The repo plants collected by tuupuna and whaanau i ngaa waa o mua included raupo and harakeke all year round. The important pepeke species in Whangamarino wetland i ngaa waa o mua were huhu grubs, mosquito (naeroa) and namu.

4.3.5 Values tuupuna and whenua place on Whangamarino repo

The values that tuupuna and whaanau placed on Whangamarino repo are presented in Table 3.

Table 3: Values tuupuna and whaanau place on Whangamarino repo

Resources	Values
Water and land tipu	If they were here today it will still be as it was, used as an ecosystem and kai
Raakau	Manuka
Hauaanga kai	Riwai, kumara, kamokamo, kaanga, Kokopu
Ika species	Tuna, puhi, inanga, aotearoa carp, kokopu, mairire, catfish, mullet
Water and land insects	Ngaro, namu, moths, gecko
Repo species	Harakeke, raupo, manga
Recreation	Picnics
Whenua	Yes
Climate change	There are changes in our four seasons. Some days, the four in one. With the ngaahere were chopped down and repo drained to become farms and crop growing may have some effect, change of climate causes the imbalance of nature

4.3.6 The Respondents' Aspirations for Whangamarino repo

Responses from the wider, mainstream community were complementary to those of manawhenua. All respondents had visited Whangamarino repo with the earliest first visit dating back eight years. Some visited all year round, others in winter or spring, and others at any time of the year. The reasons for visiting included hunting, eeling and duck shooting. The benefits included having fun and relaxing, enjoying nature - flora and fauna. When asked what respondents would be willing to pay for these benefits, the common response was it should be free as it has been in the past, but if there were a need to charge a fee that it could be applied through rates. Some respondents were aware of elders visiting the Whangamarino wetland as well as its historical and cultural significance. They also viewed the wetland as popular in the community.

4.4 Te Tupuna Awa at Rangiriri Bridge

4.4.1 Te Tupuna Awa at Rangiriri Bridge and Ecosystem Services

For example, as a provisioning service from the Waikato River at Rangiriri Bridge, a resource consent is held to temporarily take up to 600m³/day from the Waikato River for construction activities and dust suppression purposes at Glen Murray Road, Rangiriri. In terms of fish species richness, native is rated 10; exotic pest fish 6 (potential negative ecosystem services indicator). Also, native fish rarity (threatened or at risk), is rated 5. There were no records on the NIWA FBIS database for this site but records further downstream indicate indigenous fish biodiversity. The presence of exotic pest fish species in this section of the Waikato River compromises the intrinsic ecosystem services for this site. Cost of pest fish removal is a potential negative ecosystem services indicator for this site (Goodman et al., 2013). A number of research and educational activities have been conducted on the Waikato River. There are also a number of cultural and historical sites. During the New Zealand land wars, the Battle of Rangiriri on 20–21 November 1863 was a major event in the invasion of Waikato. The battle cost both sides more than any other event of the land wars. The Royal Navy was significantly involved in the land wars forming the Waikato Flotilla against the Maaori Kiingitanga forces during 1863–64.

Historically, the Waikato River provided a critical communications and transport link for Maaori and European communities with Hamilton as a busy centre of economic activity. As an inland river, the Waikato provided an easier transport route, it was navigable from Port Waikato to Cambridge, the Waipa, and Alexandra (now Pirongia). Paddle steamers and barges plied both rivers carrying freight, passengers, livestock and mail. The Waikato River system was used for freight until after the Second World War, however, shifting sandbars at Port Waikato, willow infestation and sediment build-up began to impede navigation. Port Waikato closed in 1955 heralding the end of most Waikato river transport.

The Rangiriri site is a recreational fishing location for eel, coarse fish (koi carp, goldfish, perch, tench, rudd) and trout (Hicks et al. 2013). The $69 per fishing visit (in 2015 NZ$) was derived from McBeth (1997) and was multiplied by 4,950 visits in 2007/2008 from Unwin (2009). Estimated annual angler days for the Waikato River below Karapiro was 4950 days (SEM ± 980) (Unwin, 2009). Close to home, ease of access, and area of fishable water are key attributes attracting fishermen and women to this section of the river. The mean enjoyment score was 1.77 (range 1.24 - 4.08) (Unwin, 2016).

4.4.2 The respondents' knowledge Te Tupuna Awa at Rangiriri Bridge

Two mana whenua respondents completed their questionnaire on Te Tupuna Awa and neither were aware of the concept of CES, but both were aware of how Te Tupuna Awa was formed. Ten mainstream community respondents completed their questionnaires and likewise, only three were aware of the concept of CES. Eight had visited Te Tupuna Aware previously, the first visit being 40 years previously with a frequency of monthly visits. The reasons for visiting include boating, water skiing, fishing for mullet, work, sighting water levels, and marvel at the huge resource of fresh water. For some, it was just about passing by, shifting stock.

4.4.3 What Tuupuna and Whaanau Used Te Tupuna Awa at Rangiriri Bridge for

Respondents were aware of how tuupuna and whaanau used Te Tupuna Awa i ngaa waa o mua. Responses were, as a means of transport, survival (ko au te awa, ko te awa ko au), drinking, cooking kai (boil up) and blessings. In terms of how tuupuna and whaanau used the whenua on the margins of Te Tupuna Awa i ngaa waa o mua, whare were built, catch kai (fish, eel and carp), and picking berries. Maara kai prospered, harvesting kumara, corn, potatoes, squash, riwai and mushrooms.

4.4.4 Species of importance in Te Tupuna Awa at Rangiriri Bridge

Raakau species that grew on the margins of Te Tupuna Awa were suitable as building materials such as manuka, ponga, kanuka, and willow. The aquatic tipu species used by tuupuna and whaanau i ngaa waa o mua were harakeke, manuka, willow: important ika species were kaeo (fresh water mussels), koura, catfish, carp, and tuna; important manu species on the margins of the awa i ngaa waa o mua were duck, pukeko, swan, ruru and piwaiwaka/tirairaka (fantail).

4.4.5 Values tuupuna and whenua place on Te Tupuna Awa at Rangiriri Bridge

The values tuupuna and whanau place on Te Tupuna Awa are presented in the table 4 below. The range of values tuupuna and whenau place on this waterbody can be interpreted as a source of wellbeing and sustenance, ko au te awa, ko te awa ko au, I am the river and the river is me.

Table 4: Values tuupuna and whaanau place on – Te Tupuna Awa at Rangiriri Bridge

Resources	Values
Aquatic and terrestrial tipu	Wairuatanga, rongoa, maatauranga, ko au te awa
Raakau	Ponga
Hauaanga kai	Manaaki tangata, kaanga wai (rotten corn), tuna, carp, catfish
Ika species	Manaaki tangata, carp (not Koi carp), koki
Terrestrial and aquatic pepeke	Manaaki wai, frogs, dragon flys, cicadas, crickets
Maara kai	Manaaki tangata, manaaki whanau, corn, riwai, kumara, pumpkin (squash) - used at Poukai, tangihanga by Hau kainga
Ngahere species	Rongoa, whakairo
Recreation	Regatta, waka ama, kopapa
Whenua	Papakainga, whakapapa

4.4.6 The Respondents' Aspirations for Te Tupuna Awa at Rangiriri Bridge

Most respondents had a long history of visiting, dating back at least 40 years. Two visited daily, one monthly, three visited yearly, and one every other year, with the others less frequently. Depending on frequency of visits, some were all year round or just in summer, autumn or winter. Eight had visited the site for recreational activities including boating, skiing, fishing for mullet, possum shooting, duck shooting, and canoeing from the bridge to Meremere. Other reasons were for spiritual purposes, work, shifting stock, sighting water levels, marvelling at the huge resource of fresh water, relaxation - peace and quiet, enjoying nature and bird life, collecting rubbish along the stop bank area and planting along the bank. Mention was also made of using the river to bless a neck decoration belonging to a granddaughter.

When asked what respondents would pay for these services, the response was that it should be free for all to visit. However, if there was a charge that it should be through rates, "I believe in access to water for all; have enjoyed this area as is for over 40 years." It was also mentioned that it would take a lot of money to bring the area up to "tourist" standard due to health and safety issues and consideration of amenities which would need to be funded.

The majority commented that freshwater should be maintained, protected and conserved for future generations. Some respondents claimed their parents and/or grandparents visited the river for various purposes, including boating, hunting, swimming, fishing, duck shooting, eeling, netting carp for bait, sightseeing, and use historically as an important highway. Family days were held, stop banks and river levels were inspected. Respondents were aware of the historical/cultural significance of the river, including the value of Rangiriri in the early days when river traffic was busy. Respondents recalled the Battle of Rangiriri and how the river was used for transportation and protection. The area is now somewhat popular as a food source, for recreation, marae water use and irrigation of crops.

There have been some changes in the area, including land use and land cover change, water diversion/extraction, residential development, pollution, presence/absence of species, pest species, land management practices, climate change, water storage, plant and animal communities. These changes were explained in various ways: willows/weed banks being sprayed; Koi carp being introduced which has degraded and polluted the river, and; old river beds being filled in with stop banks. The number of wildlife is reducing, and irrigation water is being extracted. The Lower Waikato Flood Control Scheme has controlled flooding in Rangiriri

and has provided valuable land development options. The river is being fenced off and planted with ti-tree, cabbage trees, flax and other aquatic plant species. Another response referred to "the state highway is currently closer to the river, there have been more intensive bursts of rain in the area and upstream which has increased river levels and therefore allowing farmland to be more prone to flooding in the area".

The changes have affected some values, including roading development over the last few years, which has hindered access to the river. "I highly value the area, the rivers natural flow has been affected by man in many ways, none of which has helped the life of the river or the quality of the water; be good to see more people enjoying the river, the waterways etc." Others commented on the impact of pest fish. "Koi carp has totally ruined the Waikato River and the river will never be restored until the Koi carp is removed." Mention was also made of aesthetic changes, pollution and discoloration and lack of sports such as yachting.

Respondents expected some changes in the future, such as better access, less or no spraying of toxic chemicals into or on the banks of the river, less willow removal, close monitoring on water takes and restrictions, eradication of pest fish (e.g. Koi carp), recreational activities for youth, scope for further irrigation, preservation of water and improved water quality.

5 Summary and conclusion

Having analysed the data collected, we've uncovered considerable depth and insight in terms of the values that the freshwater ecosystems in the study area have had, and also currently have on communities. Common across the four ecosystems in the study area is the wealth of knowledge amongst respondents who affiliate with each of the waterbodies. Together with the indicated values summarised in the literature, these values have a high level of consistency as complemented by the knowledge from mana whenua and mainstream communities.

Various values were identified by respondents. For manawhenua, a value common across all water bodies in the study area was hauaanga/mahinga kai. Mahinga kai is one of the significant Māori values identified within the National Objectives Framework for freshwater management (Ministry for Environment, 2014). A consistent expectation is to restore, maintain, protect and enhance waterbodies in the study area, meaning sustainable use and management of nature resources. This is in line with Allen et. al (2013) that Maori aspirations include sustainable use of indigenous forests and scrub lands.

The value of this information can be hinged on the claim that enhancing the culture of the local community has potential to enhance the culture of the local economy as well (Kraus, 2013). The importance of these values cannot be over emphasised as studies also indicate they impact on the behaviour of the community (Harmsworth and Awatere, 2013). Details on ways to manage freshwater in the wider Waikato, Waipa River Catchment have been reported in Henry (2017) where the values Waikato and Waipa river iwi have for freshwater in the catchment have been well reviewed and reported in Henry. However, most of the values that this study reveals are consistent with the broader values reported in Henry (2017). More importantly, the values are specific to the waterbodies in the study area which could help tailor restoration programmes and other activities according to particular needs and aspirations in particular areas.

While this study was not necessarily targeted at a particular policy, the richness of the information was of sufficient value to implement the Council's ecosystem services approach to identify, value, quantify and describe ecosystem services in the Waikato Region. Particularly, the information contributed to the Councils Strategic Direction 2016-2019. "The full range of ecosystem types, including land, water and coastal and marine ecosystems, is in a healthy and functional state" and 'economic growth ensures natural capital and ecosystem services are maintained" as well as the Policy Statement Objective 3.8 which states that "a range of ecosystem services associated with natural resources are recognised, maintained and/or enhanced to enable their ongoing contribution to regional wellbeing" (Gardiner and Huser, 2017).

In terms of policy implications for the kaitiaki of the resources, the results suggest there is increasing demand for a wide range of services possible from freshwater resources. However, many threats and/or competing uses to the availability and sustainability of these services are emerging. This implies increased competition for financial resources required to mitigate the threats and/or manage the competing uses. Therefore, more understanding of the ecological, cultural and economic values is required, including how these values are interrelated so that ways to protect them can be investigated. Not only that, recognising and identifying values and

significance of ecosystems, especially though a Māori kaitiaki is required for a successful biodiversity maintenance under the RMA and the proposed NPS for indigenous biodiversity.

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7 Appendix

7.1 Appendix I: Feedback and Content Approval from Survey Respondents

18 March 2019

Re Cultural Ecosystems Services Questionnaire

Dear _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Greetings!

A few months ago, you agreed to and participated in a survey and filled in a questionnaire. A copy of the questionnaire is presented as the appendix to this report. Your response together with other respondents' and other information from other related studies have been analysed and reported anonymously in this report. This is to give you an indication of how the survey responses have been and will be used.
We are now giving you the opportunity to provide your feedback on this report. Specifically, if you possibly identify and disapprove of any of the contents you provided when you filled in the questionnaire, please contact us immediately with details and such contents will be removed from this report before being made public.

Please provide your feedback prior to 19th April 2019 to the authors below.

Ngaa mihinui

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7.2 Appendix II: Assessed Ecosystem Services for Selected Waterbodies in Lower Waikato

Table 5: Selected Ecosystem Services in Lower Waikato

MAE Service Category	Ecosystem Service Indicator	Assessment			
		Opuatia Stream/ Wetland	Lake Waikare	Whangamarino repo	Waikato River at Rangiriri Bridge
Provisioning	volume of water take for agricultural/irrigation/industrial use (m^3/year)	2,376,000			219,000
	amount of eel/whitebait/grey mullet catch (ton/year)				58.6
Regulation and Maintenance	amount of carbon (C) sequestrated (ton/year)	1,983		18,413	
	number of threatened or at risk species (Number)	18	1	19	21
	volume of flood storage (m^3/year)	3,066,808	94,800,000	94,800,000	
	volume of consented waste water discharge (m^3/day)		1,100		
	amount of sediment export from catchment (m^3/ha/year)				0.59
	amount of Nitrogen export (N yield) from catchment (ton/ha/year)				0.02
	amount of nitrate (NO3) removal (ton/year)	603		5,601	
Cultural services	number of scientific projects/articles/studies (number)	40	523	361	20
	number of public access (number)	2	3	21	
	number of Pa sites (number)		1	9	
	number of recreational/cultural/historical/heritage buildings/sites (Number)				1
	number of angling/fishing/boating days/visits/passengers (number/year)		100	10	4,950

7.3 Appendix III: Questionnaire

Applied Lake & Wetland Restorations

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AM^2& Associates

Agreement to Participate:

"What cultural ecosystem services or benefits do Te Tupuna Awa and Opuatia Repo provide to hapuu and whanau in North Waikato in the past and now?"

Whakataki

Cultural ecosystems services is defined as "non-material benefits iwi obtain from ecosystems such as lakes repo and awa through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic values, including knowledge systems and social relations". This survey will inform the Waikato Regional Councils desire to identify cultural indicators that measure the status of target freshwater ecosystems in the Lower Waikato including their magnitude. The lead researcher is Aareka Hopkins assisted by Baylee Kelepamu. If you have concerns regarding this survey you can contact Femi Olubode at Femi.Olubode@waikatoregion.govt.nz or free phone 0800 800401

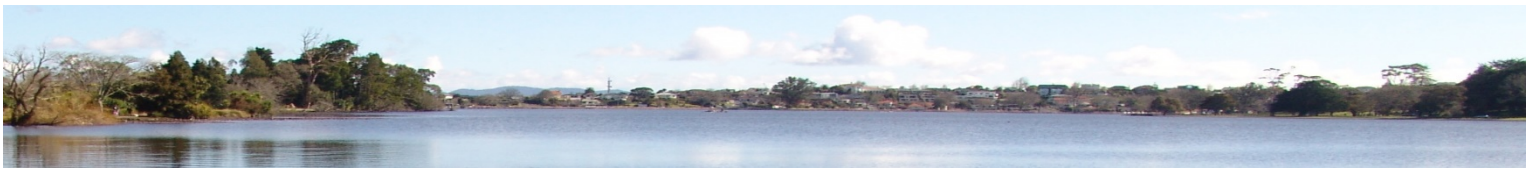
Participant Understanding:
I understand my participation in this survey is voluntary and no coercion has been used to influence my participation. I can withdraw from the survey at anytime and can decline to answer any questions I choose. I understand my answers will remain confidential and no material will identify me or my responses. I understand all responses will be stored securely and will be incinerated at the completion of the project by the researchers.

Participant commitment:
I have read and understand the purpose of the survey.
I understand my participation in the survey is voluntary.
I understand my identity and the contribution I make will remain confidential.

I ……hereby consent to participate in this survey

Signature……Date……2018

Ngaa mihi ki a koe mo tou whakaurunga atu i tenei rangahau



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AM^2& Associates

Agreement to Participate:

"What cultural ecosystem services or benefits do Te Roto o Waikare and Whangamarino Repo provide to hapuu and whanau in North Waikato in the past and now?"

Whakataki

Cultural ecosystems services is defined as "non-material benefits iwi obtain from ecosystems such as lakes repo and awa through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic values, including knowledge systems and social relations". Waikato Regional Council seeks to identify maintain and where possible enhance ecosystem services to enable their on-going contribution to the well-being of the Waikato region. The lead researcher is Aareka Hopkins assisted by Baylee Kelepamu. If you have concerns regarding this survey you can contact Femi Olubode at Femi.Olubode@waikatoregion.govt.nz or free phone 0800 800401

Participant Understanding:
I understand my participation in this survey is voluntary and no coercion has been used to influence my participation. I can withdraw from the survey at anytime and can decline to answer any questions I choose. I understand my answers will remain confidential and no material will identify me or my responses. I understand all responses will be stored securely and will be incinerated at the completion of the project by the researchers.

Participant commitment:

I have read and understand the purpose of the survey.

I understand my participation in the survey is voluntary.

I understand my identity and the contribution I make will remain confidential.

I ……hereby consent to participate in this survey

Signature……Date……2018

Ngaa mihi ki a koe mo tou whakaurunga atu i tenei rangahau

Applied Lake & Wetland Restorations

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Signature……Date……2018

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Cultural Ecosystems Services Questionnaire

"What cultural services or benefits do Te Tuupuna Awa at Horahora Marae and Opuatia Repo provide to hapuu and whanau in North Waikato in the past and now?"

Whakataki

Cultural ecosystems services simply means "cultural services or benefits such as whakapapa, wairuatanga, manaakitanga, tuurangawaewae etc that whanau and hapuu receives from Te Tuupuna Awa and Opuatia Repo".

Survey Instructions

All questions relate to ecosystems in Te Tupuna Awa at Horahora marae and Opuatia Repo,
All responses will remain confidential and anonymous;
Answer all questions koa.

Q.1: Were you aware of the term 'cultural ecosystems services" before today?

Circle/mark your answer…….Yes……No

Questions Q.2 to Q.12 relate to Te Tuupuna Awa

Q.2: With regards to te tupuna awa, do you know how the awa was formed?

Circle/mark your answer…… Yes……..No

Q.3: I ngaa wa o mua, what did tuupuna and whanau use Te Tupuna Awa for? List them here.

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Q.4: The topography of the whenua on the margins of Te Tuupuna Awa is mainly flat. What did tuupuna and whanau use that whenua for I ngaa wa o mua? List them here.

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Q.5: With regards to question Q.4 above, what maara kai was grown and harvested by tuupuna and whanau on the whenua I ngaa o mua? List them here.

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Q.6. Ngaahere covered the whenua on the margins of the awa i ngaa wa o mua. If you know what rakau species grew that were suitable as a building material, list them here:

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Q.7: With regards to question Q.6 above, if you know what ngaahere species tuupuna used to collect as hauaanga kai list them here. If not go to Q.8

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Q.8: With regards to the question Q.6 above, if you know what manu species used the ngaahere as habitat, list them here. If not go to Q.9

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Q.9: If you know what aquatic tipu species that grew on the margins of Te Tuupuna Awa that was used by tuupuna and whanau I ngaa wa o mua, list them here. If not go to Q.10.

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Q.10: If you know what aquatic and other pepeke species on the margin of Te Tuupuna Awa that were important to tuupuna and whanau I ngaa wa o mua, list them here. If not go to Q.11

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Q.11: If you know what manu species on the margins of Te Tuupuna Awa were important to tuupuna and whanau I ngaa wa o mua, list them here. If not, go to Q.12:

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Question 12 relates to Valuing Te Tuupuna Awa at Horahora Marae

Q.12: What value do tuupuna and whanau place on Te Tuupuna Awa in terms of:
Aquatic and terrestrial tipu for example maatauranga, wairuatanga, rongoa

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Rakau for example hanga whare, whakairo, hanga marae

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Hauaanga kai for example manaaki tangata, manaaki whanau

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Ika species for example manaaki tangata, manaaki whanau

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Terrestrial and aquatic pepeke for example, tohu, manaaki wai

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Maara kai for example manaaki tangata, manaaki whanau

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Ngaahere species for example rakau, whakairo, rongoa

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Recreation for example waka ama, regatta

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Whenua for example whakapapa, papakainga.

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Questions Q.13 to Q.24 relate to Opuatia Repo

Q.13: Do you know where Opuatia Repo is?

Circle/mark your answer…….Yes……No

Q.14: Do you know how Opuatia Repo was formed?

Circle/mark your answer…….Yes……No

Q.15: If you know what Opuatia Repo was used for by tuupuna and whanau I ngaa wa o mua, list those uses here. If not, go to Q.16

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Q.16: The topography of the whenua on the margins of the Opuatia Repo is mainly flat. If you know what tuupuna and whanau used that whenua for I ngaa wa o mua, list those uses here. If not, go to Q.17

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Q.17: If you know what ika species tuupuna and whanau gathered from Opuatia Repo I ngaa wa o mua, list them here. If not go to Q.18

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Q.18: If you know what manu species tuupuna and whanau gathered from Opuatia Repo I ngaa wa o mua, list them here. If not, go to Q.19

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Q.19: If you know what aquatic tipu species tuupuna and whanau gathered from Opuatia Repo I ngaa wa o mua, list them here. If not, go to Q.20

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Q.20. If you know what aquatic pepeke species were living in Opuatia Repo that were important to tuupuna and whanau I ngaa wa o mua, list them here. If not, go to Q.21

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Q.21: Ngaahere covered the whenua on the margins of Opuatia Repo I ngaa wa o mua. If you know what rakau species that tuupuna and whanau used as a building material, list them here. If not, go to
Q22

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Q.22: With regards to question Q.21 above, if you know what ngaahere species were used as hauaanga kai by tuupuna and whanau I ngaa wa o mua, list them here. If not, go to Q.23

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Q.23: If you know what maara kai was grown and harvested on the margins of Te Tuupuna Awa by tuupuna and whanau I ngaa o mua, list them here. If not, go to Q.24

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Question 24 relates to Valuing Opuatia Report

Q.24: What values do tuupuna and whanau place on Opuatia Repo in terms of:
Aquatic and terrestrial tipu for example maatauranga, wairuatanga puutaiao

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Rakau for example hanga whare, whakairo, hanga marae

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Hauaanga kai for example manaaki tangata, manaaki whanau

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Ika species for example manaaki tangata, manaaki whanau

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Terrestrial and aquatic pepeke for example, tohu, manaaki wai, puutaiao

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Maara kai for example manaaki tangata, manaaki whanau

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Ngaahere species for example rakau, whakairo, rongoa

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Recreation for example wairuatanga

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Whenua for example whakapapa, papakainga, tuurangawaewae

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<u>Ngaa mihi ki a koe mo tou whakaurunga atu I tenei rangahau</u>

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"What cultural ecosystem services do communities in Te Kauwhata and Districts value?"

Introduction

Cultural ecosystem services simply means "the cultural services or benefit/s such as recreation, aesthetics, spiritual etc. that communities receive from ecosystems."

Survey Instructions

All questions relate to ecosystems near Te Kauwhata including Waikato River, Opuatia Wetland, Lake Waikare and Whangamarino Wetland.

All responses will remain confidential and anonymous

Q.1: Were you aware of the term 'ecosystem services" before today?

Circle/mark your answer Yes No

Questions 2 to 17 relate to the Waikato River at Rangiriri and Opuatia Wetland
If you have not visited either of these places, please go to Q.10

Q.2: Have you ever visited the Waikato River at Rangiriri?

Circle/mark your answer Yes No

Q.3: Have you ever visited Opuatia Wetland?

Circle/mark your answer Yes No

Q.4: When was your first visit to (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland?

(a)

(b)

Q.5: How frequently do you visit (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland? (Circle/mark your answer)

(a) Rarely Daily Weekly Monthly Yearly
Other:

(b) Rarely Daily Weekly Monthly Yearly
Other:

Q.6: What time of the year do you visit (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland?

(a) All Year Winter Spring Autumn Summer
Other:

(a) All Year Winter Spring Autumn Summer
Other:

Q.7: Why do/did you visit (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland? e.g. recreation, historical, ethical, spiritual, sense of place

(a)

(b)

Q.8: What other benefits or values do/did you receive from your visit to (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland? e.g. educational, heritage, cultural, entertainment, aesthetic, symbolic, sacred, religious, flora and fauna

(a)

(b)

Q.9: What would you pay to visit (a) the Waikato River at Rangiriri and/or (b) Opuatia Wetland? Please explain your reasoning.

(a)

(b)

Q.10: Should the Waikato River at Rangiriri and Opuatia Wetland be maintained and protected?

(Circle/mark your answer) Yes No

Q.11: Should the Waikato River at Rangiriri and Opuatia Wetland be available for future generations?

(Circle/mark your answer) Yes No

Q.12: Are you aware of your parents and/or grandparents ever visiting the Waikato River at Rangiriri and Opuatia Wetland? If yes, when and why did they visit? If no, go to Q. 13.

Q.13: Are you aware of any historical and/or cultural significance associated with the area? If yes, please explain? If no, go to Q. 14.

Q.14: In your opinion, how popular is the area? i.e. how many others do you see and/or know of that visit the area? Why do they visit? What age group and ethnicity do they belong to?

Q.15: What changes have you seen and/or are aware of in the area? Please explain.

Land Cover	Residential development
Land management practices	Pollution
Land use	Climate change
Water storage	Plant/animal community
Diversion/extraction	Presence/absence of species
Industrial development	Pest species

Q.16: How have these changes affected your value of the area? i.e. frequency of visits, reason for visiting, changes in aesthetic, existence and bequest values

Q.17: What changes would you like to see in the area? i.e. future aspirations
e.g. access, ecological diversity, preservation

Questions 18 to 33 relate to Lake Waikare and Whangamarino Wetland
If you have not visited either of these places, please go to Q.26.

Q.18: Have you ever visited Lake Waikare?

Circle/mark your answer Yes No

Q.19: Have you ever visited Whangamarino Wetland?

Circle/mark your answer Yes No

Q.20: When was your first visit to (a) Lake Waikare and/or (b) Whangamarino Wetland?

(a)
(b)

Q.21: How frequently do you visit (a) Lake Waikare and/or (b) Whangamarino Wetland? (Circle/mark your answer)

(a) Rarely Daily Weekly Monthly Yearly
Other:

(b) Rarely Daily Weekly Monthly Yearly
Other:

Q.22: What time of the year do you visit (a) Lake Waikare and/or (b) Whangamarino Wetland?

(a) All Year Winter Spring Autumn Summer
Other:

(b) All Year Winter Spring Autumn Summer

Other:

Q.23: Why do/did you visit (a) Lake Waikare and/or (b) Whangamarino Wetland? e.g. recreation, historical, ethical, spiritual, sense of place

(a)

(b)

Q.24: What other benefits or values do/did you receive from your visit to (a) Lake Waikare and/or (b) Whangamarino Wetland? e.g. educational, heritage, cultural, entertainment, aesthetics, symbolic, sacred, religious, flora and fauna

(a)

(b)

Q.25: What would you pay to visit (a) Lake Waikare and/or (b) Whangamarino Wetland? Please explain your reasoning.

(a)

(b)

Q.26: Should the Waikato River at Rangiriri and Opuatia Wetland be maintained and protected?

(Circle/mark your answer) Yes No

Q.27: Should the Waikato River at Rangiriri and Opuatia Wetland be available for future generations?

(Circle/mark your answer) Yes No

Q.28: Are you aware of your parents and/or grandparents ever visiting the Waikato River at Rangiriri and Opuatia Wetland? If yes, when and why did they visit? If no, go to Q. 13.

Q.29: Are you aware of any historical and/or cultural significance associated with the area? If yes, please explain?

Q.30: In your opinion, how popular is the area? i.e. how many others do you see and/or know of that visit the area? Why do they visit? What age group and ethnicity do they belong to?

Q.31: What changes have you seen and/or are aware of in the area? Please explain.

Land Cover	Residential development
Land management practices	Pollution
Land use	Climate change
Water storage	Plant/animal community
Diversion/extraction	Presence/absence of species
Industrial development	Pest species

Q.32: How have these changes affected your value of the area? i.e. frequency of visits, reason for visiting, changes in aesthetic, existence and bequest values

Q.33: What changes would you like to see in the area? i.e. future aspirations
e.g. access, ecological diversity, preservation

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"What cultural services or benefits did Te Roto o Waikare and Whangamarino repo provide to hapuu and whanau in North Waikato in the past and now?"

Whakataki:
Cultural ecosystems services simply means "cultural services or benefits such as wairuatanga that whanau and hapuu receives from ecosystems such as Te Roto o Waikare and Whangamarino Repo". But water pollution, pest species and climate change can impact on those services.

I understand:
My participation in the survey is voluntary and no coercion has been used;
I can withdraw from the survey at any time and can decline to answer any question I choose;
My identity will remain confidential and no material will identify me or my survey responses;
All responses will be stored securely and will be destroyed by incineration at the completion of the project by the researchers.

Survey Instructions:
All questions relate to Te Roto o Waikare and Whangamarino repo;
All participants are of kaumaatua and kuia status;
All participants whakapapa to Waikare, Okaerea, Taniwha and Maurea Marae and Horahora marae;
Whenua referred to herein is "Maaori land".

Q.1: Had you heard the term 'Cultural Ecosystems Services" before today?
Circle/mark your answer……Yes……No

Q.2: Are you aware of any pollution going into Te Roto o Waikare or Whangamarino repo?
Circle/mark your answer……Yes……No

Q.3: There is concern among some iwi world-wide e.g. American Indians about climate change. Do you think Te Roto o Waikare or Whangamarino repo are threatened by climate change? If you don't know, go to Q.4
Circle/mark your answer……Yes……No

Q.4: Are you aware of any pest ika or manu species in or around Te Roto o Waikare and/or Whangamarino? If you don't know, go to Q.5
Circle/mark your answer……Yes……No

If you mark yes, list the species here

Questions Q.5 to Q.12 relate to Te Roto o Waikare

Q.5: If you know what tuupuna and whanau used Te Roto for i ngaa wa o mua, list those uses here. If you don't know of any, go to Q.7

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Circle/mark the season it was used and mark in the box below what was used during that season

Hotoke	Tokerau	Wa katoa	Raumati	Koanga

Q.6: Can you still do the things that tuupuna did at Te Roto o Waikare i ngaa wa o mua?

Circle/mark your answer…….Yes……No

Circle/mark the season it was used and in the box below, what was used during that season

Koanga	Wa katoa	Tokerau	Raumati	Hotoke

Q.7: If you know what tuupuna and whanau did with their whenua on the edge of Te Roto o Waikare i ngaa wa o mua, list them here. If you don't know, go to Q.8

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Circle/mark the season it was used and in the box below, what was used during that season

Wa katoa	Tokerau	Hotoke	Raumati	Tokorau

Q.8: With regards to question Q.7 above, what maara kai was grown on that whenua i ngaa o mua? List them here. If you don't know of any, go to Q.9

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Circle/mark the season mara kai was grown and what was grown at that time

Koanga	Hotoke	Raumati	Wa katoa	Tokerau

Q.9. Ngaahere grew on the margins of Te Roto o Waikare i ngaa wa o mua. Do you know if any species from the ngaahere was used by tupuna and whanau. List them here. If you don't know, go to Q.10

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Q.10: With regards to question Q.9 above, if you know any ngaahere species was used as kai, list them here. If you don't know, go to Q.11

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Circle/mark the season they were collected:

Hotoke	Koanga	Tokerau	Raumati	Wa katoa

Q.11: With regards to the question Q.9 above, if you know of any manu species living in the ngaahere, list them here. If you don't know any, go to Q.12

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Q.12: If you know of any tipu that grew in, or on the margins of Te Roto o Waikare that were used by tuupuna and whanau i ngaa wa o mua, list them here. If you don't know any, go to Q.13

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Circle/mark the season they were collected:

Raumati	Koanga	Wa katoa	Hotoke	Tokerau

Q.13: If you know any pepeke (insect) species living on the margins of Te Roto o Waikare that were important to tuupuna and whanau i ngaa wa o mua, list them here. If you don't know of any, go to Q.14

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Q.14: If you know any manu species living in or on the margins of Te Roto o Waikare that were important to tuupuna and whanau i ngaa wa o mua, list them here. If you don't know of any, go to Q.15:

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Circle/mark the season they were collected if they were used as kai:

Koanga	Hotoke	Raumati	Wa katoa	Tokerau

Question 15 relates to Valuing Te Roto o Waikare

Q.15: What values if any, do tuupuna and whanau place on Te Roto o Waikare in terms of:
Water and land tipu, for example hauaanga kai

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Rakau, for example whakairo

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Hauaanga kai, for example manaaki manuwhiri

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Ika species, for example manaaki whanau

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Water and land insects, for example tohu

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Maara kai, for example manaaki whanau

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Ngaahere species, for example whakairo

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Recreation, for example kaukau

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Whenua, for example whakapapa

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Climate change, for example wairuatanga

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Questions Q.16 to Q.23 relate to Whangamarino Repo

Q.16: If you know what tuupuna and whanau used Whangamarino Repo for i ngaa wa o mua, list those uses here. If you don't know, go to Q.18.

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Circle/mark the season the repo was used:

Hotoke	Tokerau	Raumati	Wa katoa	Koanga

Q.17: Can you still do the things tuupuna did at Whangamarino Repo i ngaa wa o mua?

Circle/mark your answer…….Yes……No

Circle/mark the season you do it:

Raumati	Koanga	Tokerau	Hotoke	Wa katoa

Q.18: If you know what tuupuna and whanau did with their whenua on the edge of Whangamarino Repo i ngaa wa o mua, list them here. If you don't know, go to Q.19

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Circle/mark the season the whenua was used:

Koanga	Wa katoa	Hotoke	Raumati	Tokerau

Q.19: Ngaahere grew on the margins of Whangamarino Repo i ngaa wa o mua. Do you know any ngaahere species tupuna and whanau used as rauemi? List them here. If you don't know of any, go to Q.20

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Circle/mark the season the rauemi was gathered:

Wa katoa	Koanga	Hotoke	Raumati	Tokerau

Q.20: If you know any ika species tuupuna and whanau gathered from Whangamarino Repo i ngaa wa o mua, list them here. If you don't know any, go to Q.21

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Circle/mark the season ika were collected:

Tokerau	Koanga	Wa katoa	Raumati	Hotoke

Q.21: If you know any manu species tuupuna and whanau collected from Whangamarino Repo i ngaa wa, list them here. If you don't know any, go to Q.22

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Circle/mark the season manu were collected from the repo:

Hotoke	Wa katoa	Koanga	Raumati	Tokerau

Q.22: If you know any repo plants tuupuna and whanau collected from Whangamarino Repo i ngaa wa o mua, list them here. If you don't know of any, go to Q.23

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Circle/mark the season they were collected:

Wa katoa	Koanga	Hotoke	Raumati	Tokerau

Q.23. If you know any pepeke (insect) species in Whangamarino Repo that were important to tuupuna and whanau i ngaa wa o mua, list them here. If you don't know of any, go to Q.24

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Question 24 relates to Valuing Whangamarino Repo

Q.24: What values if any, did tuupuna and whanau place on Whangamarino Repo in terms of: Water and land tipu, for example hauaanga kai

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Rakau, for example whakairo

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Hauaanga kai, for example manaaki manuwhiri

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Ika species, for example manaaki whanau

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Water and land insects for example tohu

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Repo species, for example raupo

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Recreation, for example hauaanga kai

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Whenua, for example, tuurangawaewae

……..

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……

Climate change, for example wairuatanga

……..

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……

Ngaa mihi ki a koe mo tou whakaurunga atu i tenei rangahau