Mackays to Peka Peka (M2PP) Kaitiaki Monitoring Programme Report 2023

Prepared by Te Kōnae Limited for

Ātiawa ki Whakarongotai Charitable Trust

1 Table of Contents

2 Mihimihi

Whakarongo atu ki ngā tai o Raukawa moana e pāpaki mai ra, ia rā, ia rā.
Mutunga kore, pāpaki tū ana ngā tai ki uta.
I tēnei rā kua pāpaki mai ngā tai o te ao ki a Te Ātiawa.
Pī kē pea te piki atu, rere haere ai ki runga i te kaha o te ao hurihuri;
Me kore pea te kitea he maramatanga ki ngā whakaritenga o te wā e tika ai tātou te iwi.
Nō reira, whakarongotai o te moana, whakarongotai o te wā.

Wi Te Kākākura Parata

The above pepehā from noted Ātiawa ki Whakarongotai rangatira Wi Te Kākākura Parata, tells us to listen to the tides of the time as we listen to the tides of ocean. In the changing world we live in both tides will always bring new challenges and new opportunities. It is in our ability to observe and understand these changes that we secure ourselves as an iwi.

This wisdom informs the work presented in this report. For five years Ātiawa ki Whakarongotai undertook a kaitiaki monitoring programme to observe and understand the ongoing effects of a large expressway constructed through our rohe. It presents an informed direction for how these effects should be responded to, in order to secure the well-being of our people and their rohe.

We wish to acknowledge the time and expertise of the following kaitiaki who provided invaluable input into this project: Les Mullens, Aaria Dobson-Waitere, Luke Barnsley, Rawiri Barnsley, Mohi Edwin, Manaaki Barrett, and Sharlene Maoate-Davis. We also acknowledge those iwi members who participated through the iwi surveys and oral interviews, sharing their insights, and often vulnerable kōrero. Ānei te mihi aroha ki a koutou.

Report Author: Jordan Housiaux

Reviewed by: Dr. Mahina-a-rangi Baker

3 Executive Summary

Between 2018 and 2022, Ātiawa ki Whakarongotai Kaitiaki undertook cultural and ecological monitoring to examine the effects of the M2PP Expressway on mana whenua and wāhi taiao in relation to our values of mahinga kai.

Kaitiaki measured impacts to Hauora mana whenua, in addition to water quality, watercress presence and health, and tuna relative abundance and health.

The results demonstrate impacts to the wellbeing of mana whenua, and the contamination and loss of mahinga kai species across a number of arawai.

The key findings are summarised below:

- ‘Extremely severe’ impacts of environmental change to whānau and individual Hauora.
- Exceedances of acceptable aqueous E. coli levels at the Kiwi Road site, and Wharemauku, Mazengarb, Waimeha, and Kākāriki Streams.
- Exceedances of acceptable watercress E. coli levels at the Whareroa Test, Kiwi Road, Wharemauku Control, Wharemauku Test, Mazengarb, and Kākāriki Test sites.
- Exceedances of acceptable watercress lead levels at the Kiwi Road site.
- A value of arsenic approximately nine times greater than the prescribed health objective at the Kiwi Road site in 2018.
- An inconsistent presence of watercress over the five-year sampling period at the Kiwi Road site and in the Waimeha and Kākāriki Streams, with an ultimate absence of watercress at these locations in 2022.

The following report examines the M2PP Kaitiaki Monitoring Programme and proposes the following three areas of restorative action in mitigation to adverse effects:

1. Support restoration of Hauora through Indigenous healing practices.
2. Support restoration of Mahinga Kai Values across the Wharemauku Catchment.
3. Support restoration of mahinga kai through watercress reseeding.

4 Introduction

4.1 Mahinga Kai And Kaitiaki Monitoring

New Zealand government policy has for some time identified ‘mahinga kai’ as a key national value to be managed and protected, particularly in the context of natural resource management. This is reemphasised through local government natural resource planning, which identifies mahinga kai as a compulsory value for protection.

In response, mahinga kai monitoring and management have developed as a key field of modern Māori resource management, where transdisciplinary approaches are being applied to deliver both the environmental and social values included within ‘mahinga kai’.

It should be understood that research, science, and technology related to ‘mahinga kai’ is grounded in mātauranga Māori - the Māori knowledge paradigm - and kaupapa Māori – a research approach and methodology requiring participants to engage in Māori ways of knowing. This requires practitioners to have a familiarity and competency with Māori language, theory, and concepts. For those scientists or managers coming from outside the Māori knowledge paradigm wishing to work with mahinga kai or mahinga kai practitioners, it can often require a significant degree of learning or interpretation to become familiar with new concepts or terminology.

4.1.1 The Whakarongotai Framework

In 2015, Ātiawa ki Whakarongotai Charitable Trust was commissioned by the national ‘Wai Ora’ fund to develop a ‘freshwater mahinga kai health index’. This involved identifying: a definition of the key values associated with mahinga kai; practices required to manage and restore mahinga kai and uphold those values, and finally; measures of mahinga kai health that can be observed and monitored.

The project method was largely informed by the ‘Hua Parakore’ theoretical framework[1]. Hua Parakore is a kaupapa Māori framework for planning and evaluating management practices in natural systems, particularly where mahinga kai is a key feature of that system. The Hua Parakore framework sets out that food production systems can be conceptualised through the function of the following six key values:

- Mauri: the health and energy of natural processes and systems
- Te Ao Tūroa: the natural order, balance and patterns of systems
- Māramatanga: the quality of information and knowledge in a system

[1] Hutchings et al., Hua Parakore: An indigenous food sovereignty initiative and hallmark of excellence for food and product production, 2012.

- Mana: the social security and influence of humans in a system
- Wairua: the peace and safety of a system
- Whakapapa: connectivity within the system

The project delivered 'Whakarongotai o te moana, Whakarongotai o te wā'[2], a framework which identified:

a) How the six key Hua Parakore values related to mahinga kai in the rohe (tribal area) of Ātiawa ki Whakarongotai.
b) An index of 73 different measures of mahinga kai health, and;
c) Associated practices that could be implemented to manage and restore mahinga kai.

The 'Whakarongotai Framework' has been successfully recognised as providing a method of mahinga kai management at the local, regional and international level. The framework has been presented at international conferences to support the development of similar frameworks in other (post) colonial nations. In 2016, the Trust were selected by Greater Wellington Regional Council to pilot a project for the region which identified how the Framework could be utilised to prioritise and monitor mahinga kai attributes of health for ongoing regional 'kaitiaki monitoring' regimes. Critically, the Framework provides the key method for necessary environmental assessments and management projects carried out by the Trust.

Figure 1 Ātiawa ki Whakarongotai Kaitiaki Monitors.

[2] Whakarongotai o te moana Whakarongotai o te wā, Kaitiakitanga Plan for Te Ātiawa ki Whakarongotai.

4.1.2 The Whakarongotai Framework & M2PP

The application of the Whakarongotai Framework to the M2PP Project requires that priority attributes of system well-being, specific to the context of the M2PP Project, are identified across the six key values of the Framework to inform and guide monitoring, management and restoration. The identification of priority attributes is carried out by applying an 'influence matrix', which non-Māori scientists may recognise from fields such as system dynamics modelling.

An influence matrix uses expert opinion to evaluate the influence that the various aggregated attributes within the system have on each other, to identify the functional role those attributes play in the system. This categorisation is then used to prioritise what driver and critical values and highly impacted values should be focused on for monitoring, management and restoration.

The figure below shows part of the influence matrix that has been applied from the Framework for the purpose of the M2PP Project.

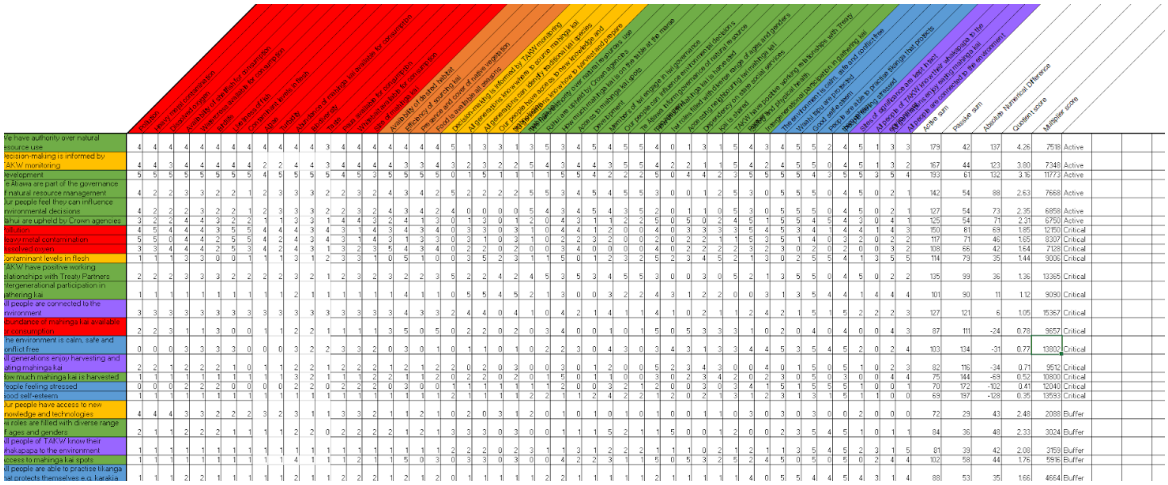


Figure 2 Influence Matrix applied for the M2PP Project.

Several algorithms are applied to the matrix to identify those values most critically influential and most influenced in the system. The application of the matrix and algorithms for the purpose of the M2PP Project have identified the following across the six key priority attributes of the mahinga kai system for monitoring, management, and restoration:

1. Mauri: degree of heavy metal and microbiological contaminants in mahinga kai food and in water where mahinga kai is gathered.
2. Te Ao Tūroa: the efficiency of sourcing mahinga kai
3. Māramatanga: the influence of Ātiawa knowledge on management and restoration
4. Mana: the strength of the relationship between Ātiawa and the M2PP Project.

5. Wairua: the degree of environmental distress experienced by mana whenua
6. Whakapapa: the ability for mana whenua to maintain a relationship with the environment through mahinga kai

Based on these priorities, the Trust proposed the following programme to ensure that mahinga kai is adequately monitored, managed, and restored, and that monitoring involves Ātiawa input to an appropriate extent. Monitoring is critical to informing effective management and restoration, therefore, the Kaitiaki Monitoring Programme aimed to address both matters of monitoring, and, mahinga kai site management and restoration together in one programme.

5 Kaitiaki Monitoring Programme

5.1 Part A. Māramatanga and Mana; ensuring appropriate knowledge and relationship management.

As indicated above, two of the key priorities identified by the Trust were:

- ensuring the influence of Ātiawa knowledge on management and restoration, and;
- the strength of the relationship between Ātiawa and the M2PP Project.

The Trust and M2PP agreed to the following deliverables to achieve these priorities:

5.1.1 A1: Developing agreed post-construction relationship protocols between the Trust and the M2PP Alliance.

These protocols will set out:

- How environmental issues will be communicated and discussed between both parties and externally if necessary.
- How environmental and other monitoring is to be conducted, utilised and communicated.
- Expectations both parties hold of one another.

5.1.2 A2: Identification of mahinga kai sites of significance.

Prior to the development of this monitoring programme there has been no survey conducted to identify mahinga kai sites of significance, which is a fundamental requirement for the M2PP Project to meet their condition to ensure the management and restoration of those sites. This will involve creating a GIS or Google Earth layer identifying those sites of significance.

5.1.3 A3: Approximating baselines and identifying trigger levels for mahinga kai health attribute levels.

Due to the M2PP Project failing to appropriately address mahinga kai values and monitoring in the pre-construction and construction phase of the project, the implementation of appropriate post-construction monitoring requires an approximation of a baseline. Trigger levels that indicate the need for a management response are also required to ensure that Ātiawa knowledge can inform post-construction management.

5.1.4 A4: Reviewing post-construction monitoring data to identify mahinga kai restoration mitigation.

Once post-construction monitoring is completed all data should be reviewed to assess potential effects to mahinga kai that have resulted from the M2PP Project. This will enable the identification of the need for mahinga kai restoration where this is apparent. If a need for mahinga kai restoration is identified, the Trust and NZTA will enter into good faith discussions regarding the costs for mahinga kai restoration.

5.2 Part B: Mauri and Te Ao Tūroa; managing the environmental value of mahinga kai

Two key priorities for mahinga kai identified by the Trust were:

- the management of heavy metal and microbiological contamination of mahinga kai and water where mahinga kai is found, and;
- the management of efficiency of sourcing mahinga kai

The Trust and M2PP agreed to the following deliverables to achieve these priorities:

5.2.1 B1: Monitoring of heavy metals and microbiological contaminants at mahinga kai sites of significance using watercress as an indicator species.

Monitoring the effects of contaminants on mahinga kai as a whole, would require a significant amount of time and resource, therefore, a survey on mahinga kai was used to identify the most widely accessed and valued species to use as an indicator to monitor the effects of contaminants

on mahinga kai. Watercress is the second most widely consumed mahinga kai by Ātiawa[3] and occurs across the district. Standard microbiological and heavy metal testing will be applied to samples taken from mahinga kai sites of significance to provide data on any potential contamination of mahinga kai.

5.2.2 B2: Monitoring of efficiency of sourcing mahinga kai at mahinga kai sites of significance

Efficiency of sourcing mahinga kai will be surveyed by using kaitiaki monitoring protocols as developed through Greater Wellington Regional Council Kaitiaki and Information Monitoring Strategy. This is determined by surveying relative abundance and condition of mahinga kai species at mahinga kai significant sites of interest. Both watercress and tuna will be used as indicator species for this monitoring, in response to the significant value attributed to these two species through the Mahinga Kai Survey[3].

5.3 Part C: Wairua and Whakapapa; managing the cultural value of mahinga kai

Two key priorities for mahinga kai identified by the Trust were:

- managing any potential environmental distress to mahinga kai created by outcomes of the Project
- the ability for mana whenua to maintain their connection to the environment through mahinga kai

5.3.1 C1: Monitoring cultural effects to mahinga kai.

As per the kaitiaki monitoring protocols developed through Greater Wellington Regional Council, the Trust will survey cultural effects to mahinga kai using the Environmental Distress Scale[4] (EDS) and questions on connectedness to nature, to determine any potential environmental distress to mahinga kai and to ensure that the ability for mana whenua to maintain their connection to the environment through mahinga kai is being protected. Furthermore, kōrero captured in mana whenua surveys, will undergo values based thematic analysis to identify further cultural effects.

[3] Ātiawa ki Whakarongotai Mahinga Kai Survey, 2017.
[4] Higginbotham et al., Validation of an environmental distress scale, 2006.

6 Kaitiaki Monitoring Methods

6.1 Mahinga Kai Monitoring

Figure 3 Kaitiaki Monitors, Mazengarb Stream, 2022.

Between 2018 and 2022, Ātiawa ki Whakarongotai Kaitiaki Monitors carried out sampling of mahinga kai sites within the Ātiawa rohe. Most sites were sampled during summer months, though some discretion was allowed due to adverse weather and Covid-19 restrictions.

Mahinga kai sites of significance were identified during early sampling periods and a sub-set were sampled through subsequent years. Where appropriate, control and test sites, upstream and downstream of the Expressway respectively, were sampled for each waterway to identify effects of changes in conditions due to the construction and presence of the M2PP Expressway.

Kaitiaki monitors carried out a standard method of sampling at each site, in order to best capture the state of the arawai and mahinga kai. Appropriate tikanga ensured the cultural safety of kaitiaki and sample sites during monitoring events.

6.1.1 Assessments and Measures

Water quality and clarity was assessed at each site by means of kaitiaki observation, and a 100 mL sample submitted for analysis. Specifically, lab analysis assessed levels of Escherichia coli (E. coli, MPN / 100mL) and Total Coliforms (MPN / 100mL)[*].

Watercress abundance and health was assessed through both kaitiaki observation, and laboratory analysis submitted to measure the following variables:

- Campylobacter per 10g
- Total Coliforms MPN / g
- Faecal Coliforms MPN / g
- Escherichia coli MPN / g
- Arsenic mg/kg
- Cadmium mg/kg
- Chromium mg/kg
- Copper mg/kg
- Lead mg/kg
- Mercury mg/kg
- Nickel mg/kg
- Zinc mg/kg

Tuna abundance and health was measured by setting two baited fyke nets at each site overnight. The next morning, the following data was recorded:

- Number of Tuna
- Species
- Sex
- Length (cm)
- Girth (cm)
- Weight (g)
- Condition (observation scale 1-5)

6.2 Monitoring Cultural Effects

To capture how impacts of changes in environment due to the M2PP Expressway have affected the hauora/wellbeing of Ātiawa ki Whakarongotai, iwi members completed two online surveys (Appendix B). The survey collected both open answer and likert scale responses. In addition, ten key informants participated in semi-structured oral interviews.

[*] Samples were sent via M2PP to Hill Laboratories, Hamilton, New Zealand

MPN – Most Probable Number

7 Deliverables

7.1 Māramatanga & Mana

7.1.1 Developing agreed post-construction relationship protocols between the Trust and M2PP Alliance.

Post-construction relationship protocols between the Trust and M2PP Alliance were intended to be formalised during this project, however, these proved challenging to develop cooperatively, and were not completed.

7.1.2 Identification of Mahinga Kai Sites of Significance.

Mahinga Kai Sites of Significance were identified in the early stages of the project by Tohunga (experts) who are active in their kaitiakitanga with mahinga kai, and their engagement with the arawai of Ātiawa ki Whakarongotai. These sites were identified as historically and currently significant, contributing to the wellbeing of Ātiawa ki Whakarongotai through tikanga Mahinga Kai.

Sites of Significance were logged as active GIS map layers, held by Ātiawa ki Whakarongotai, with ongoing contribution by knowledge holders. A subset of these sites were identified to be used for the M2PP Kaitiaki Monitoring Programme (Figure 4).

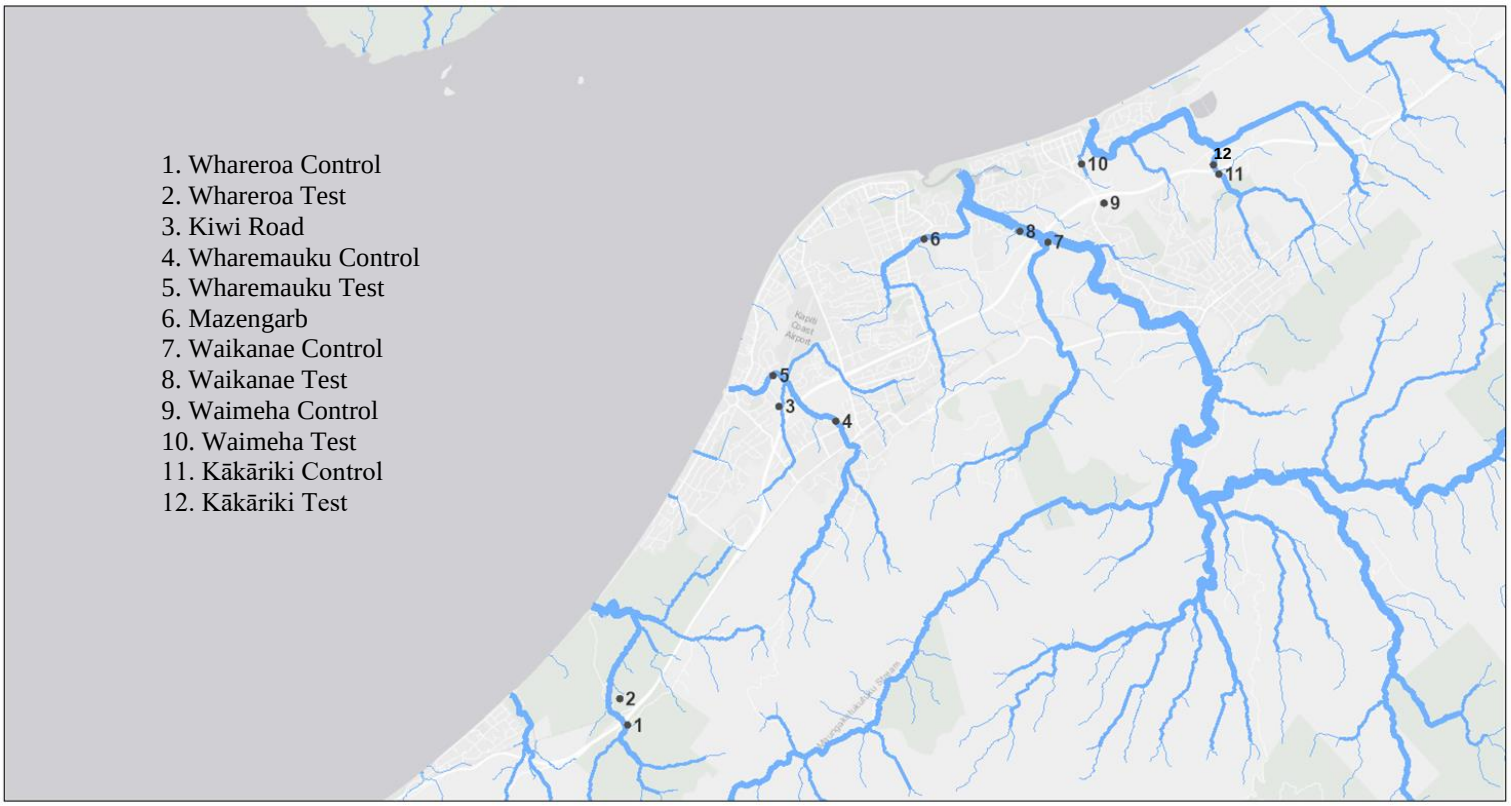


Figure 4 Kaitiaki Monitoring Mahinga Kai Sites across the rohe of Ātiawa ki Whakarongotai.

7.1.3 Approximating baselines and identifying trigger levels for mahinga kai health attribute levels.

As construction of the M2PP Expressway had already begun, 'baseline' levels could not be appropriately measured. Therefore, Health Objectives were identified to operate as the trigger levels necessary for the agreed approach between M2PP and the Trust. These objectives were formulated to identify the state at which mahinga kai values were at an acceptable health range, according to Ātiawa ki Whakarongotai kaitiaki assessment. These objectives were identified on the basis of expert opinion and advice of tohunga, and where available, existing New Zealand environmental and human health standards.

These objectives are detailed in Table 1.

Table 1 Mahinga Kai Health Objectives for the M2PP Kaitiaki Monitoring Programme.

Kaupapa **Values**	**Tohu** **Attribute**	**Measurement Unit**	**Monitoring Method**	**Huanga** **Health Objective**
Mauri **-** **Wai**	E. coli levels	MPN/100 mL	Sample submitted for lab assessment	National Policy Statement for Freshwater Management (NPS-FM)[5] National Bottom-line <540 MPN /100mL
Mauri & Te Ao Turoa **-** **Watercress**	Presence/Absence of Watercress	Presence/Absence	Kaitiaki observation	Watercress is consistently present at sample sites (> 90% of summer sampling occasions).
	Watercress Abundance & Health	Abundance	Kaitiaki observation & collection	One standard 30 x 35cm bag of dark green, fresh watercress is consistently available.
	Heavy Metal Loads	mg contaminant/kg plant material	Sample submitted for lab assessment	Safe for human consumption[#]. Heavy metal levels do not exceed any of the following limits: Arsenic mg/kg 1 Cadmium mg/kg 0.1 Chromium mg/kg None Copper mg/kg 30

[5]NPS-FM National Policy Statement for Freshwater Management 2020.

[#]As of Schedule 19 of the Australia New Zealand Food Standards Code (2022)[6] and where no limit is given, from Edmonds & Hawke, 2004[7].

				Lead mg/kg 0.3 Mercury mg/kg 0.03 Nickel mg/kg None Zinc mg/kg 40
	E. coli Levels	MPN/g plant material	Sample submitted for lab assessment	Safe for human consumption* in accordance with Australia New Zealand Food Standards[8]. < 100 CFU/g or MPN/g¤.
	Detection of Campylobacter	Detected/Not Detected	Sample submitted for lab assessment	No campylobacter detected on any occasion in accordance with Australia New Zealand Food Standards[8].
Mauri & Te Ao Turoa - **Tuna**	Shortfin/Longfin Total Catch	Total (n) catch	Standard eel survey monitoring	Presence of both shortfin and longfin tuna across rohe.
	Average number of tuna caught per sample event	Average number caught per sample event at each site	Standard eel survey monitoring	An average of 4 eating size (≥ 35 cm) tuna caught per sampling event over summer sampling months.
	Tuna Length	Length cm	Total length measured	Arawai display consistent diversity of tuna size <75 and >75 cm.
Maramatanga - **Wairua** - **Whakapapa**	Intergenerational knowledge transfer	Likert scale	Social survey	Achieve an average score ≥ 4 ‘Te Rea: I am learning and practising this knowledge’ across all knowledge types.
	Connection to te taiao through mahinga kai	Likert scale	Social survey	Achieve an average score ≥ 4 ‘Participating in activities in contact with nature’.
	Experiences of environmental distress	Likert scale	Social survey	Achieve an average score < 2 of severity of environmental impacts and effects on Hauora.

*Guided by the Food Standards Australia New Zealand Compendium of Microbiological Criteria for Food, 2022[8] and Edmonds & Hawke, 2004[7].
¤CFU/g – Colony Forming Units per gram, MPN – Most Probable Number per gram.

7.2 Wairua and Whakapapa

7.2.1 Monitoring cultural effects to mahinga kai: Environmental Distress Scale

To capture the effects of environmental disruption to mana whenua and their connection to te taiao and mahinga kai, an adaptation of the Environmental Distress Scale (EDS) was applied. The EDS is a tool used to appraise solastalgia: the distress produced by environmental change impacting on people's connectivity with home and environment[9]. The EDS algorithm comprises six elements that address the relationship between environmental distress and family heritage within an area[4].

"Environmental change can create distressed environments inhabited by distressed people."[9]

Ātiawa ki Whakarongotai iwi members (n = 43) responded to two online surveys derived from the Environmental Distress Scale (EDS), to assess the impacts of environmental change on mana whenua connection to te taiao and mahinga kai.

Table 2 displays a shift over time of iwi members participating less in activities in contact with nature. This is reflected in the 2022 average score for "Frequency of participating in activities in contact with nature" of 2.6, compared to 3.9 in 2020.

Table 2 Frequency of participating in activities in contact with nature (%).

	Survey Date	
Response Scale	2020	2022
1 Hardly Ever	0	27
2	3	18
3	34	18
4	28	37
5 Every Day	34	0
Average Score:	**2020**: 3.9	**2022**: 2.6

[4]Higginbotham et al., Validation of an environmental distress scale, 2006.
[9]Albrecht, et al., Solastalgia: The distress caused by environmental change, 2007.

In 2020, 38% of survey respondents rated the environmental change as a result of the M2PP Expressway as “Severe”. This number reduced to 9% in 2022, however, a large proportion of respondents reported a 3-4 severity on the likert scale. The average severity score in 2020 was 4, and 3.2 in 2022.

Table 3 Severity of environmental change experienced as a result of the Expressway.

	Survey Date	
Response Scale	2020	2022
1 Not at All Severe	0	18
2	6	0
3	19	36
4	38	36
5 Extremely Severe	38	9
Average Score:	**2020**: 4	**2022**: 3.2

Respondents rated the impacts of the above environmental changes on their Hauora; the physical, mental, spiritual, social, and economic well-being of individuals and whānau. 53% of survey respondents described the impacts of environmental changes to Whānau and Individual Hauora as “Extremely Severe”, with an average score of 4.3. This value was only documented for the year 2022.

Table 4 Severity of impacts of these changes on Whānau and Individual Hauora.

Response Scale	% Response
1 Not at All Severe	3
2	0
3	19
4	25
5 Extremely Severe	53
Average Score:	4.3

44% of respondents noted an “Extremely Strong” reaction or action in response to imposed environmental change.

Table 5 Strength of reaction/action to environmental change.

Response Scale	% Response
1 Not at All Strong	3
2	3
3	22
4	28
5 Extremely Strong	44
Average Score:	4

Table 6 below, displays the self-assigned score of Ātiawa ki Whakarongotai iwi members along a mātauranga continuum. Darker cell colours reflect the highest number of respondents in each knowledge category. The average score for each category is then reported in Table 7.

Across all knowledge categories, the average score of self-assigned knowledge was below 4. The average score of mahinga kai harvest and preparation was 3.4 - *Te Aka: 'I know how to access this knowledge if I need or decide to'.*

Table 6 Self-Identified Positioning on the Knowledge Continuum of Ātiawa ki Whakarongotai Respondents (%).

	Whakapapa	Tāhuhu Kōrero - Iwi History	Te Reo Māori	Tikanga o te Marae – Whaikōrero /Karanga	Karakia	Waiata	Mahinga Kai - Harvest, Preparation	Toi Māori	Rongoā Māori
1. Te Pū: 'I know this knowledge exists within iwi members or records'	**6**	**6**	**6**	**9**	**6**	**6**	**3**	**9**	**9**
2. Te Weu: 'I know that this knowledge is being shared within the iwi'	**6**	**9**	**9**	**3**	**6**	**6**	**16**	**19**	**19**
3. Te Aka: 'I know how to access this knowledge if I need or decide to'	**22**	**28**	**16**	**19**	**16**	**13**	**34**	**41**	**44**
4. Te Rea: 'I am learning and practicing this knowledge'	**41**	**34**	**44**	**47**	**53**	**66**	**34**	**25**	**22**
5. Te Wao-nui: 'I have taught or created this type of knowledge'	**25**	**22**	**25**	**22**	**19**	**9**	**13**	**6**	**6**

Table 7 Average Knowledge Continuum scores of Ātiawa ki Whakarongotai Respondents.

Knowledge Category	Average Score
Whakapapa	3.7
Tāhuhu Kōrero - Iwi History	3.6
Te Reo Māori	3.7
Tikanga o te Marae - Whaikōrero/Karanga	3.7
Karakia	3.7
Waiata	3.7
Mahinga kai - Harvest, Preparation	3.4
Toi Māori	3.0
Rongoā Māori	3.0

7.2.2 Monitoring cultural effects to mahinga kai: Thematic Analysis

7.2.2.1 Wairua Impacts

People described stressors to the environment as a result of construction of the Expressway. These were things such as land and awa disruption, fish, bird, and mahinga kai physical disturbance or displacement, and social/whānau stressors.

Stressors impacted the wairua of these environments, which caused mental stress to mana whenua who are active in their engagement with these sites. Figure 5 captures the themes that emerged from mana whenua online surveys and oral interviews pertaining to wairua.

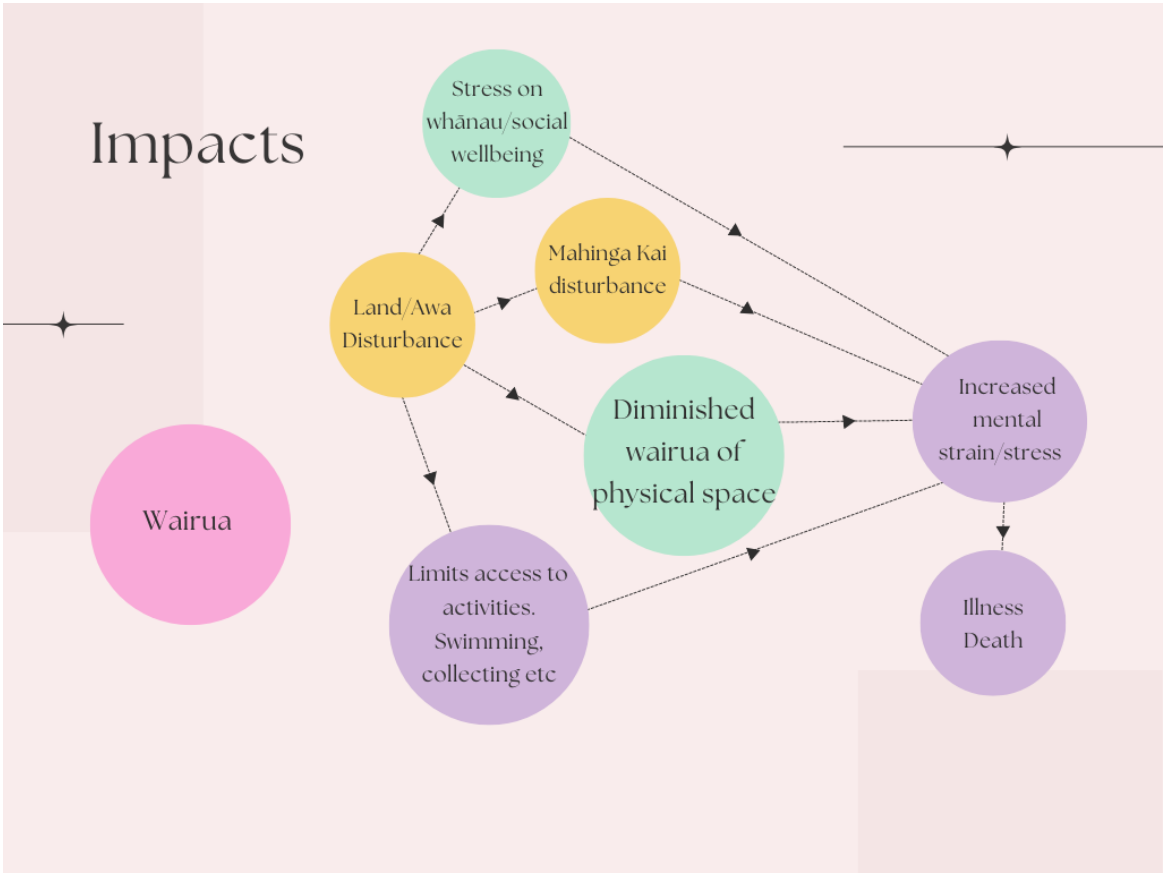


Figure 5 Wairua Impacts to Mana Whenua as a result of M2PP construction.

Respondents described the how environmental disturbance as a result of the expressway impacted their experiences in engaging with physical spaces.

"The expressway has damaged our whenua, removed families from their homes, interfered with the wairua of the awa and whenua."

"There's less peace, less space to swim and enjoy the natural awa without noise pollution."

"It troubles me that I have to travel through this area and know how much damage and destruction was caused and there is really no way to mitigate that. Extensive impact."

"Every single peka of that awa is important as it is a part of a whole ecology, and if you start to tamper with that, you change ecology forever."

Respondents also described consequences to their hauora/over-all wellbeing as a result of experiencing stressors. Some spoke of the mental and physical toll of decisions pertaining to housing and wāhi tapu.

"When things progressed, I couldn't breathe and was diagnosed with asthma but was actually anxiety and ended up on antidepressants. That was my first experience of anything like that."

"It's been very unsettling because we never wanted the road in the first place. Some of the things that people are having to go through…court cases to protect our land and to fight to have our land not taken as part of the building of the road was quite unsettling."

"It was massive - something I wasn't ready for. During the process because we're involved with land taken as well, it was definitely hard on whānau. There were arguments in our home that affected all of us."

7.2.2.2 Whakapapa & Te Ao Tūroa Impacts

Figure 6 captures the themes that emerged from mana whenua online surveys and oral interviews pertaining to Whakapapa and Te Ao Tūroa. Respondents shared how as a result of mahinga kai disturbance and removal, there was less healthy kai to gather, share, and care for. These valuable indigenous practices are steeped in mātauranga and are fundamental to the health and wellbeing of whanau Māori.

"I know it looks all fancy with those rocks and things now, I still feel the basic things are the signs of the watercress, the food plants that should be along both sides of the banks. We have to improve road runoff stuff which ends up in the streams as well."

"The taha whanau, wairua and tinana have all taken a hit as a result of our mentalities changing around kai, preferring easy access unhealthy kai and less need for whanau bonding kohikohi kai sessions. Losing connection with our atua maaori along the way."

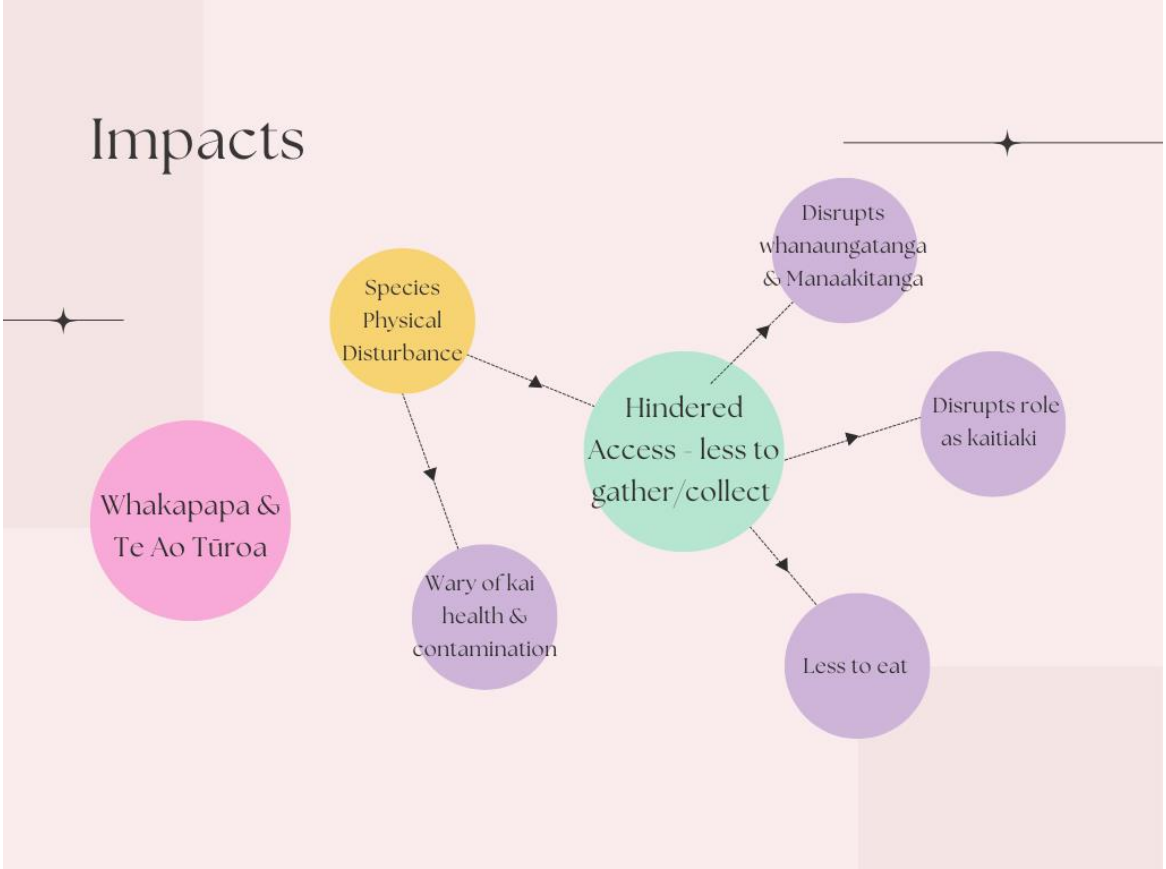


Figure 6 Whakapapa & Te Ao Tūroa Impacts to Mana Whenua as a result of M2PP construction.

"We can't fish, gather, collect like we used to. it's disappointing, frustrating, and quite sad how much our traditional food gathering practises have had to change."

"It's hard to be a kaitiaki if you don't have an intimate relationship with it."

"The loss of species has impacted our physical health post construction, not being able to still gather kai. We should be able to fish the Waimeha for fish and whitebaits."

"It starts to impact upon our social wellbeing and kai as being an economic vehicle for us. That was our currency and how we would interact. Go grab some whitebait and you share it around and then someone else will have some kai that they will share around so it is the social and economic wellbeing being impacted upon if we are not able to function like that, it is quite foreign for us."

7.2.2.3 Maramatanga Responses

Figure 7 captures the themes that emerged from mana whenua online surveys and oral interviews pertaining to Maramatanga. Respondents shared how their experiences with the Expressway construction have positioned them to prepare and consider for similar events in the future. They shared ways in which the "new environment" could be replenished, and identify ways in which kaitiaki should be educated and armed with tools to respond in their role.

"We need to be active in our kaitiaki role. We owe this to our future generations."

"I think you have to be down the river to actually listen to it."

"Are there contaminants in the awa? Of course there is, it doesn't take a rocket scientist to know that's happening, but every time I hear I say now what? What are we gonna do? I'm looking for the solutions."

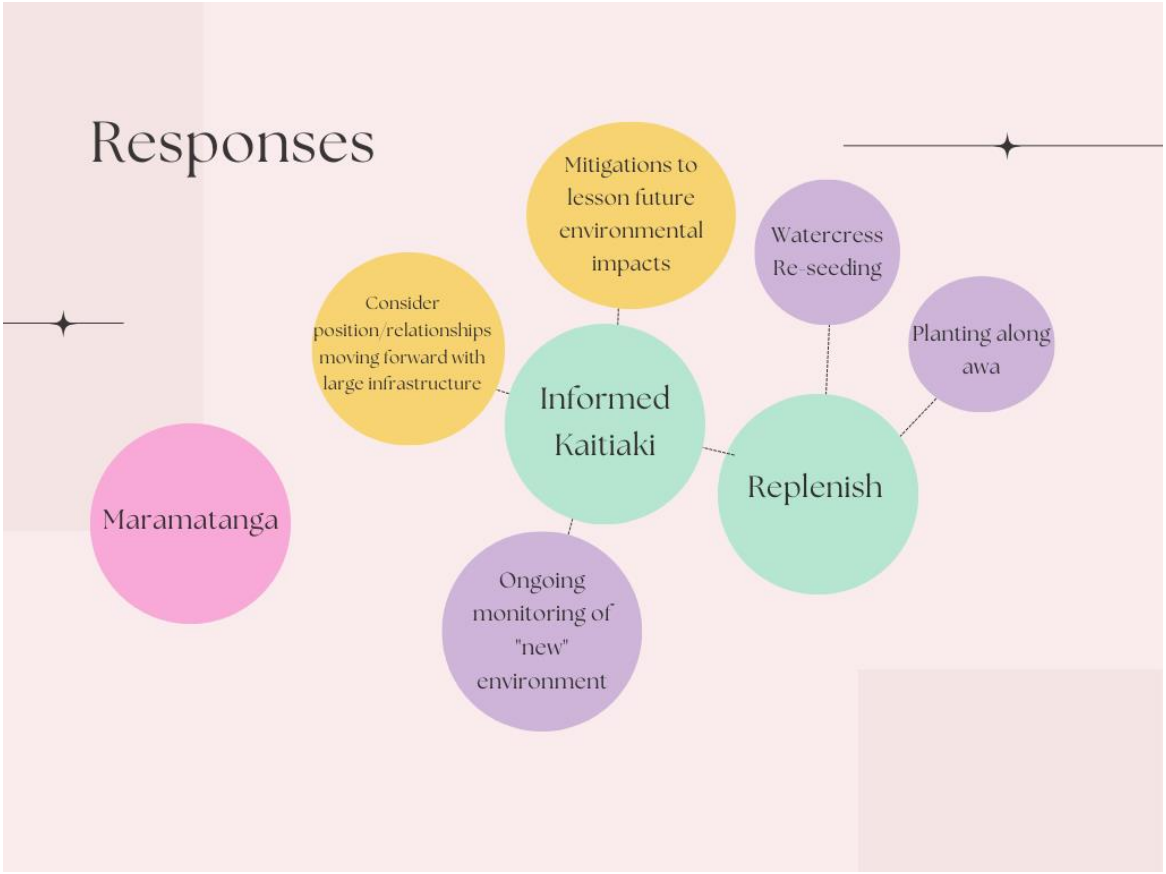


Figure 7 Maramatanga Responses of Mana Whenua.

7.2.2.4 Whakapapa Responses

Figure 8 captures the themes that emerged from mana whenua online surveys and oral interviews pertaining to Whakapapa Responses. Respondents shared their aspirations for kaitiakitanga through re-connection to the environment, customary knowledge, and knowledge sharing.

"What I've tended to do is find one of the younger members of the iwi and take them for a walk along the Wharemauku and talk about what its role is, what its history is and the fact that it is now regarded by the Council as more of a drain than a water course. As you know we have twice imposed a rāhui because of the watercress. Now my concern is we have a number of points of contamination that lead into it."

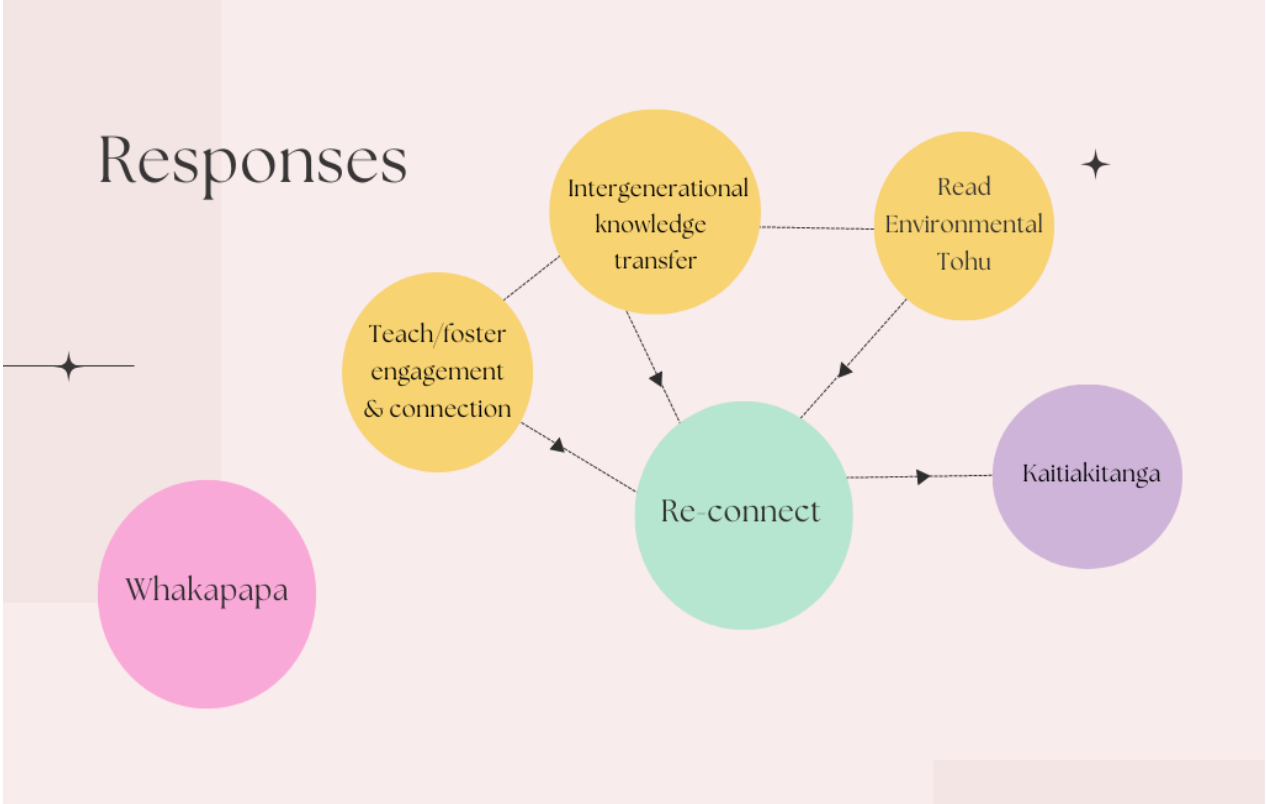


Figure 8 Whakapapa Responses of Mana Whenua.

7.3 Mauri and Te Ao Tūroa

The findings below, display the results of the kaitiaki monitoring between 2018 – 2022, including monitoring of heavy metals, microbiological contaminants, relative abundance, and condition of mahinga kai. Site specific results can be found in Appendix A. Results of monitoring have been assessed against the Huanga/Health Objectives outlined in Table 1.

7.3.1 Wai Health

Figure 9 displays total coliform bacteria found at samples sites between 2018 and 2022. Coliforms are made up of a number of bacteria and can indicate contamination pathways between sources of bacteria and water supply.

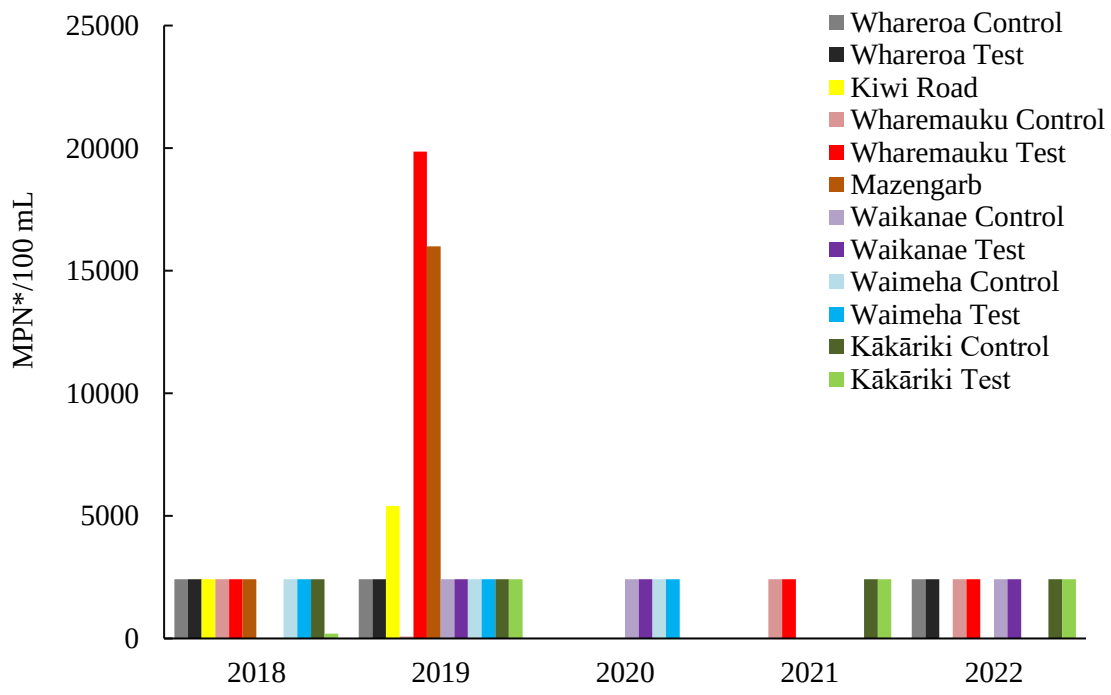


Figure 9 Water sample Total Coliforms at Ātiawa ki Whakarongotai Sites 2018-2022.
*MPN – Most Probable Number

Figure 10 displays aqueous E. coli levels at sample sites between 2018 and 2022. A number of arawai E. coli levels continue to exceed the NPS-FM National Bottom-line[5] (< 540 MPN/100 mL) in 2022, indicating faecal contamination at these sites. Of additional note is the Wharemauku Test and Mazengarb sites in 2019, that returned E. coli levels of over 26 and 29 times greater than the National Bottom-line.

Table 8 below, displays the sites returning E. coli levels in exceedance of the NPS-FM National Bottom-line between 2018 and 2022.

	2018	2019	2020	2021	2022
Whareroa Test	2420				
Kiwi Road	2420	920			
Wharemauku Control	2420			727	1414
Wharemauku Test	2420	14140			1553
Mazengarb	2420	16000			
Waimeha Test			579		
Kākāriki Control	2420	1414		2420	1733
Kākāriki Test	2420	1553		1986	2420

[5]NPS-FM National Policy Statement for Freshwater Management 2020.

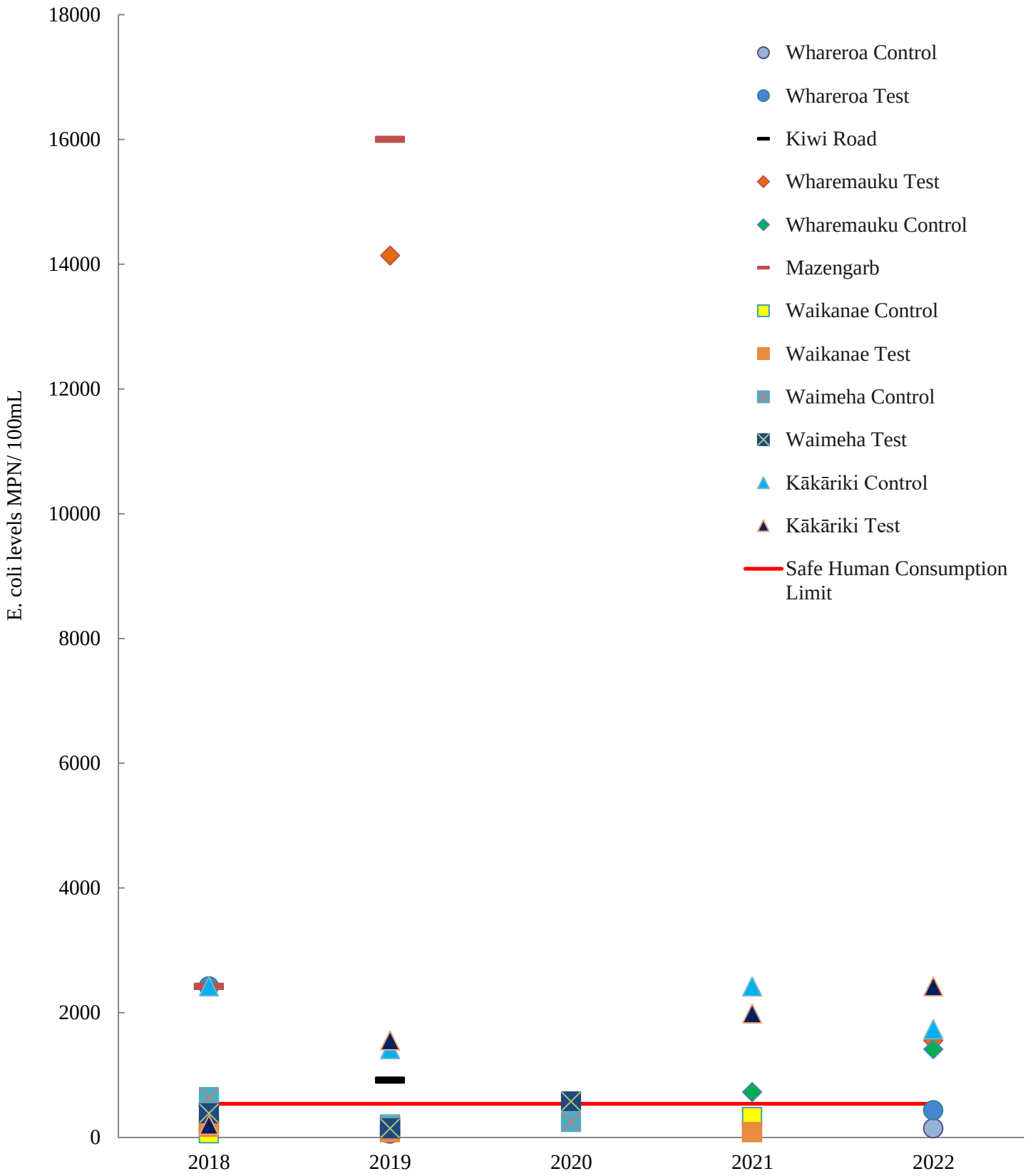


Figure 10 Water Sample E. coli Levels at Mahinga Kai Sites 2018 – 2022.

7.3.2 Watercress Health

Table 9 displays the presence or absence of watercress at sampling sites between 2018 and 2022. Blank cells indicate no sampling at this site occurred during that year.

Kiwi Road, Wharemauku Control, Waikanae Control and Test, Waimeha Control and Test, and Kākāriki Control and Test sites all display a presence, followed by an absence of watercress in subsequent year/s between 2018 and 2022.

Table 9 Presence/Absence of Watercress found at Mahinga Kai Sites

	2018	2019	2020	2021	2022
Whareroa Control	Present	Present			Present
Whareroa Test	Present	Present			Present
Kiwi Road	Present	Present			Absent
Wharemauku Control	Present	Present		Absent	
Wharemauku Test	Present	Present		Present	
Mazengarb	Present	Present			Present
Waikanae Control		Present	Absent		Absent
Waikanae Test		Present	Absent		Absent
Waimeha Control	Present	Present	Absent		Absent
Waimeha Test	Absent	Present	Absent		Absent
Kākāriki Control	Present	Absent		Absent	Absent
Kākāriki Test	Absent	Absent		Present	Absent

Table 10 displays the detection/lack of detection of Campylobacter in watercress, found at sampling sites between 2018 and 2022. Campylobacter is primarily associated with gastrointestinal disease in humans, and is shed by animals in their faeces, leading to contamination of waterways and kai.

Campylobacter was detected in both 2018 and 2019 at the Wharemauku Test site, and in 2019 at both the Whareoa Control and Test sites. Blank cells indicate no watercress was found, or no sampling took place at the site in that year.

Table 10 Detection of Campylobacter in Watercress at Mahinga Kai Sites 2018 - 2022.

	2018	2019	2021	2022
Whareroa Control	Not Detected	Detected		Not Detected
Whareroa Test	Not Detected	Detected		Not Detected
Kiwi Road	Not Detected	Not Detected		
Wharemauku Control	Not Detected	Not Detected		
Wharemauku Test	Detected	Detected	Not Detected	
Mazengarb	Not Detected	Not Detected		
Waikanae Control		Not Detected		
Waikanae Test		Not Detected		
Waimeha Control	Not Detected	Not Detected		
Waimeha Test		Not Detected		
Kākāriki Control	Not Detected			
Kākāriki Test			Not Detected	

Figure 11, displays E. coli levels from watercress sampled at Mahinga Kai Sites between 2018 and 2022. In 2018, the Mazengarb and Wharemauku Control sites displayed watercress E. coli levels over twice the prescribed Health Objective trigger level (<100 MPN/g, Table 1). Watercress sampled from the Whareroa Test, Kiwi Road, and Wharemauku Test sites in 2018 were over 20 times the limit safe for human consumption. In 2021, watercress from the Kākāriki Test Site was found to have E. coli levels over 10 times higher, and the Wharemauku Test site; over two times higher, than the limit safe for human consumption. Of the small number of samples obtained in 2022, the Whareroa Test site returned a value over two times the prescribed level safe for human consumption.

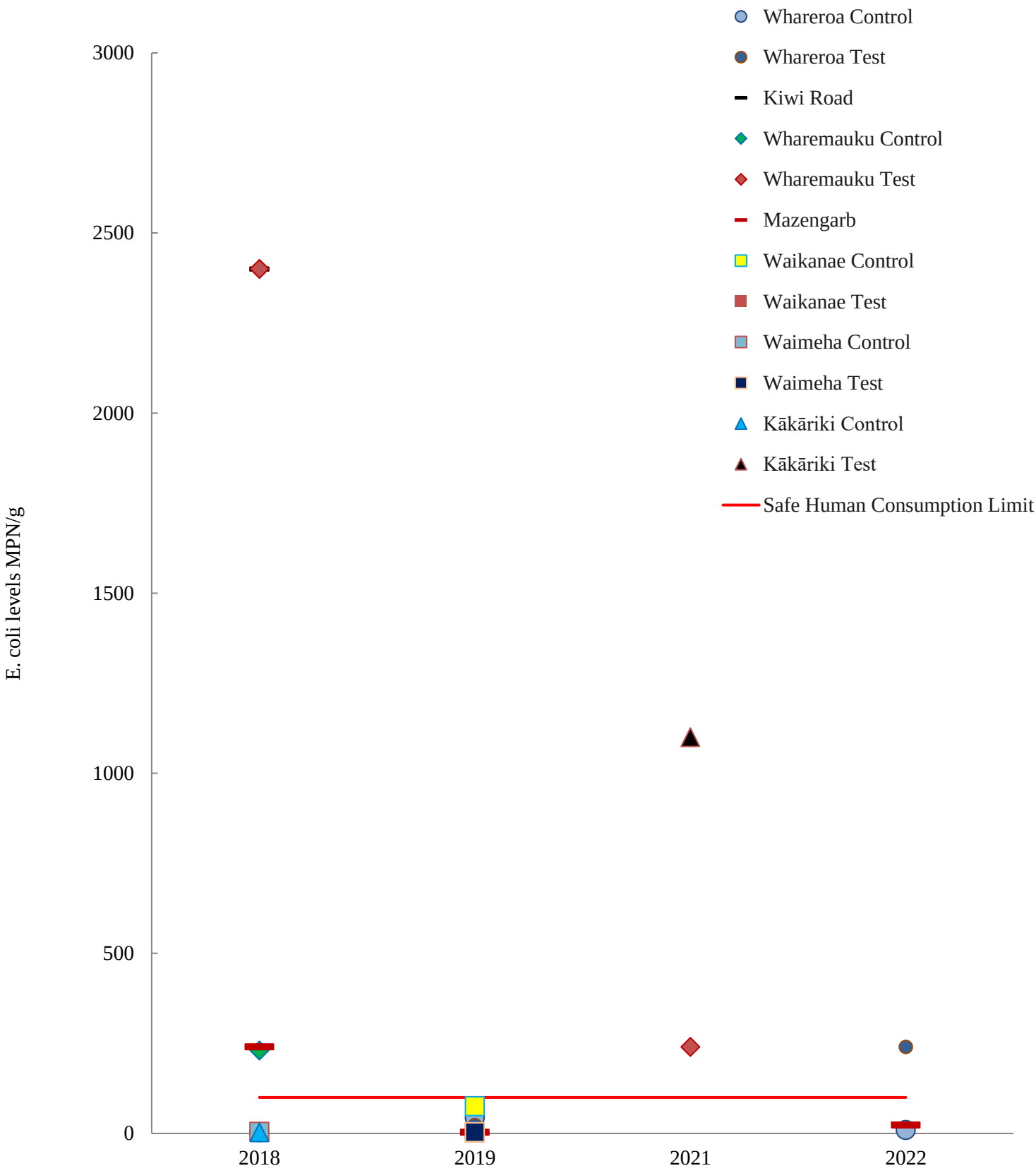


Figure 11 Watercress E. coli Levels at Mahinga Kai Sites 2018 – 2022.

Heavy metal testing of watercress samples at the Kiwi Road site in 2018 revealed levels of Arsenic approximately nine times over the maximum acceptable level of contaminants according to the prescribed Health Objectives (Table 1) and the Australia New Zealand Food Standards Code[6]. In 2019, this level reduced to 0.84 mg/kg (prescribed limit 1 mg/kg). Lead levels at the same Kiwi Road site also exceeded prescribed limits in 2018. Watercress sampled from the Wharemauku Control and Wharemauku Test sites returned lead levels of 0.23 mg/kg and 0.2 mg/kg respectively in 2018 (prescribed limit 0.3 mg/kg).

[6] Schedule 19 of the Australia New Zealand Food Standards Code (2022).

Table 11 below, displays results of heavy metal (mg/kg) testing in watercress samples across sites between 2018 and 2022. Red cells indicate exceedance of safe human consumption limits.

	Arsenic				Cadmium				Chromium				Copper			
	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022
Whareroa Control	0.02	0.04			0.0189	0.0077		0.0069	0.013	0.38		0.012	0.53	0.46		0.3
Whareroa Test	0.03				0.0035			0.0078	0.148			0.04	0.71			0.35
Kiwi Road	9.3	0.84			0.0061	0.0015			0.27	0.29			0.93	0.63		
Wharemauku Control	0.07	0.38		0.06	0.0033	0.002		0.0014	0.23	0.088		0.028	0.84	0.66		0.51
Wharemauku Test	0.23	0.02	0.08	0.27	0.0009	0.0011	0.0008	0.0008	0.22	0.172	0.021	0.029	0.3	0.89	0.45	0.36
Mazengarb	0.03	0.06		0.05	0.0039	0.0045		0.0008	0.32	0.71		0.042	0.59	1.59		0.46
Waikanae Control		0.009				0.0127				0.133				1.36		
Waikanae Test		0.02				0.0103				0.079				0.39		
Waimeha Control	0.02				0.0065	0.0035			0.019	0.013			0.39	0.77		
Waimeha Test		0.07				0.0061				0.041				0.56		
Kākāriki Control	0.02				0.0038				0.027				0.91			
Kākāriki Test			0.04				0.0016				0.049				0.42	

	Lead				Mercury				Zinc				Nickel			
	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022
Whareroa Control	0.004	0.082		0.003	0.002	0.003		0.002	3	3.1		1.9	0.02	0.1		0.02
Whareroa Test	0.044			0.005	0.002			0.002	3.8			2.4	0.06			0.02
Kiwi Road	0.47	0.067			0.002	0.002			13.3	4.2			0.2	0.1		
Wharemauku Control	0.23	0.045		0.028	0.002	0.002		0.002	8.6	9.2		4.6	0.17	0.07		0.03
Wharemauku Test	0.2	0.064	0.029	0.03	0.002	0.002	0.002	0.002	12.4	10	4.2	3	0.16	0.07	0.06	0.06
Mazengarb	0.032	0.097		0.025	0.002	0.003		0.002	7.4	9.6		4.6	0.03	0.14		0.02
Waikanae Control		0.072				0.002				6.6				0.13		
Waikanae Test		0.013				0.002				4				0.05		
Waimeha Control	0.0052	0.005			0.002	0.002			8	8.1			0.02	0.03		
Waimeha Test		0.022				0.002				9.4				0.03		
Kākāriki Control	0.02				0.002				6.7				0.03			
Kākāriki Test			0.029				0.002				2.8				0.03	

7.3.3 Tuna Health

Figure 12 Longfin Tuna, 2022.

The data below describes findings pertaining to tuna sampling between 2019 and 2022. Longfin tuna were overwhelmingly represented in comparison to shortfin tuna. The average number caught per sampling event varied across sites and did not significantly differ between all Control and Test Sites.

Longfin Tuna lengths sat between 30 – 160 cm, with a number of individuals measuring larger than 75 cm, indicating the presence of females[10] within sample populations. The average length of tuna sampled did not significantly differ between most sites.

[10] New Zealand National Institute of Water and Atmospheric Research (NIWA)

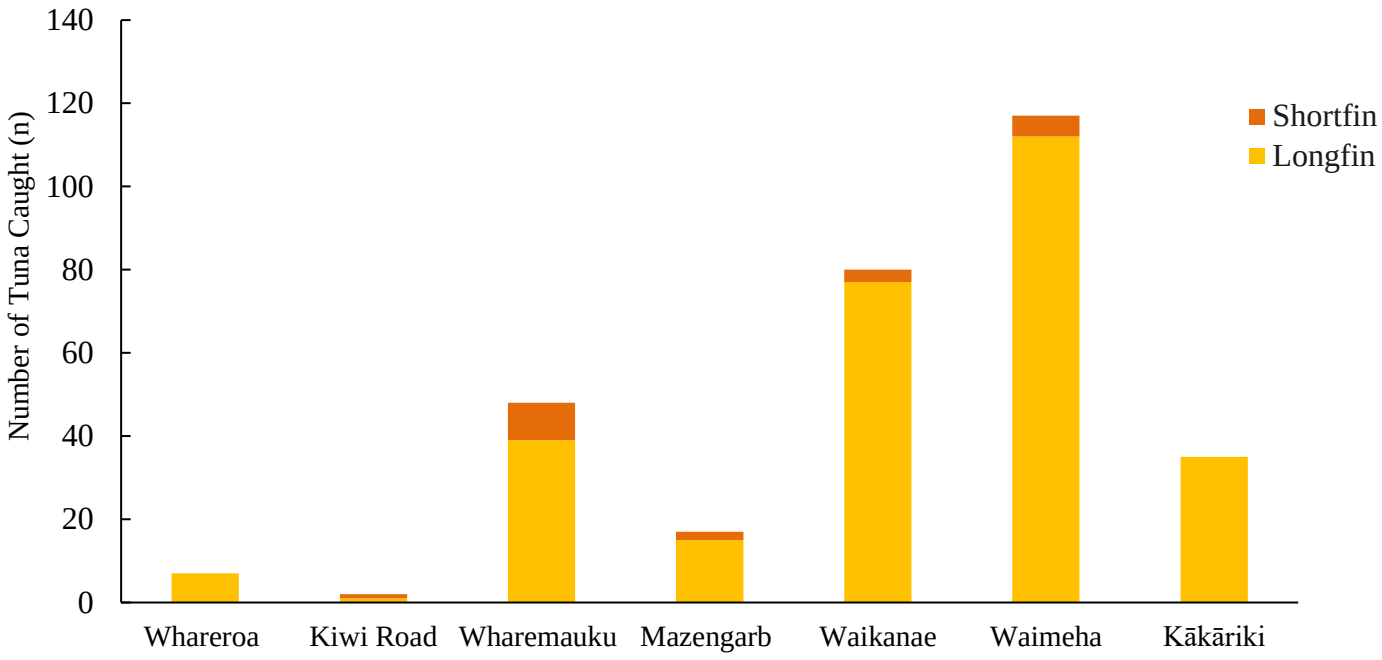


Figure 13 Shortfin-longfin tuna total catch at Mahinga Kai sites 2019 - 2022.

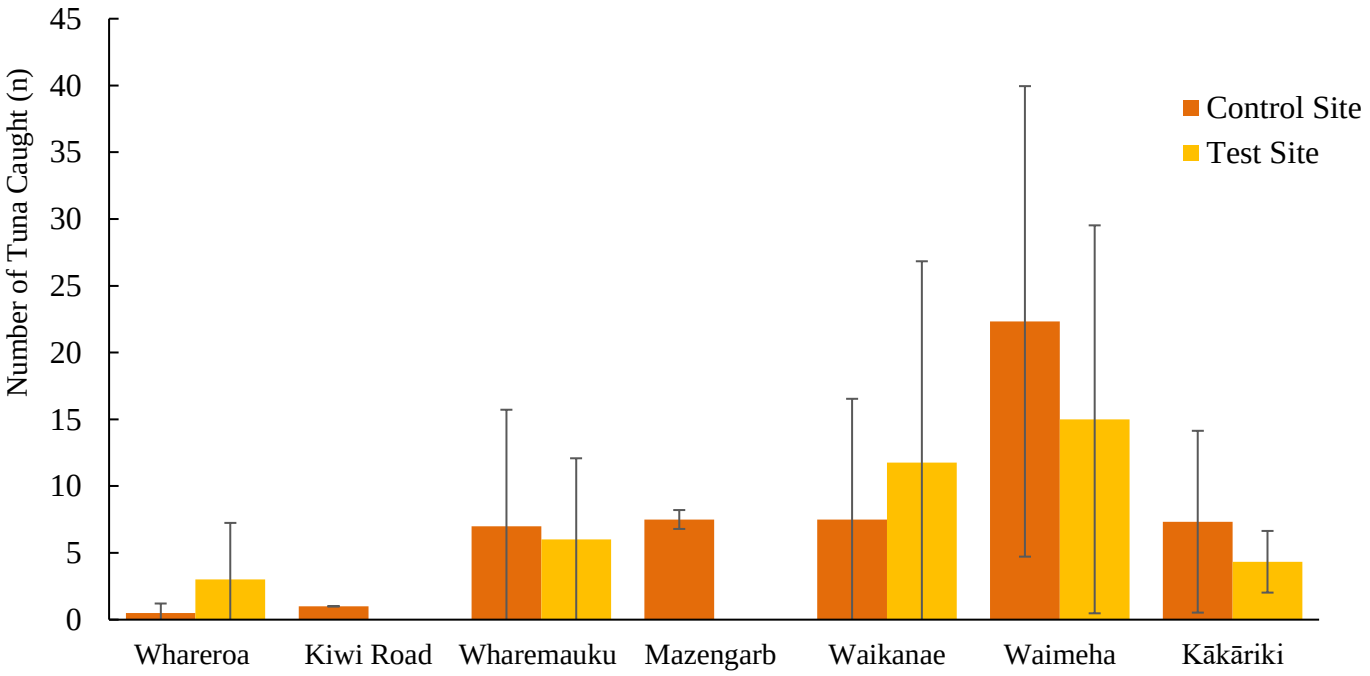


Figure 14 Average number of longfin tuna caught at Mahinga Kai sites 2019 - 2022.

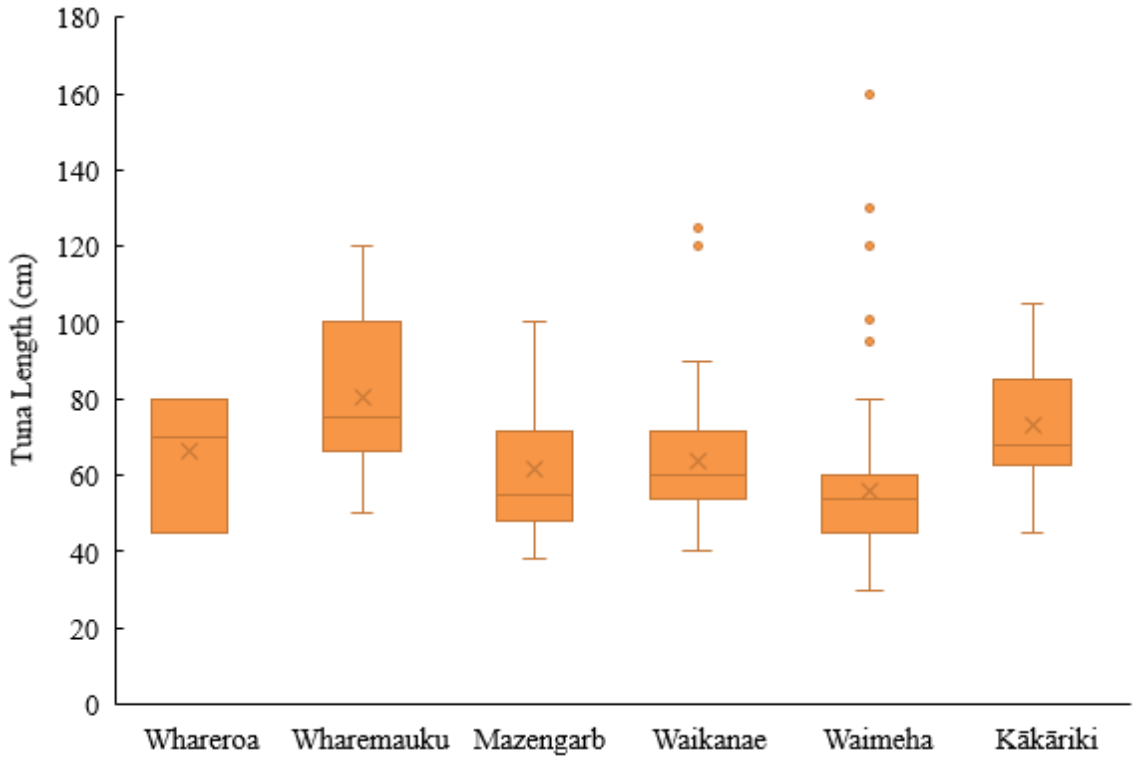


Figure 15 Actual lengths of longfin tuna at Mahinga Kai sites 2019 – 2022.

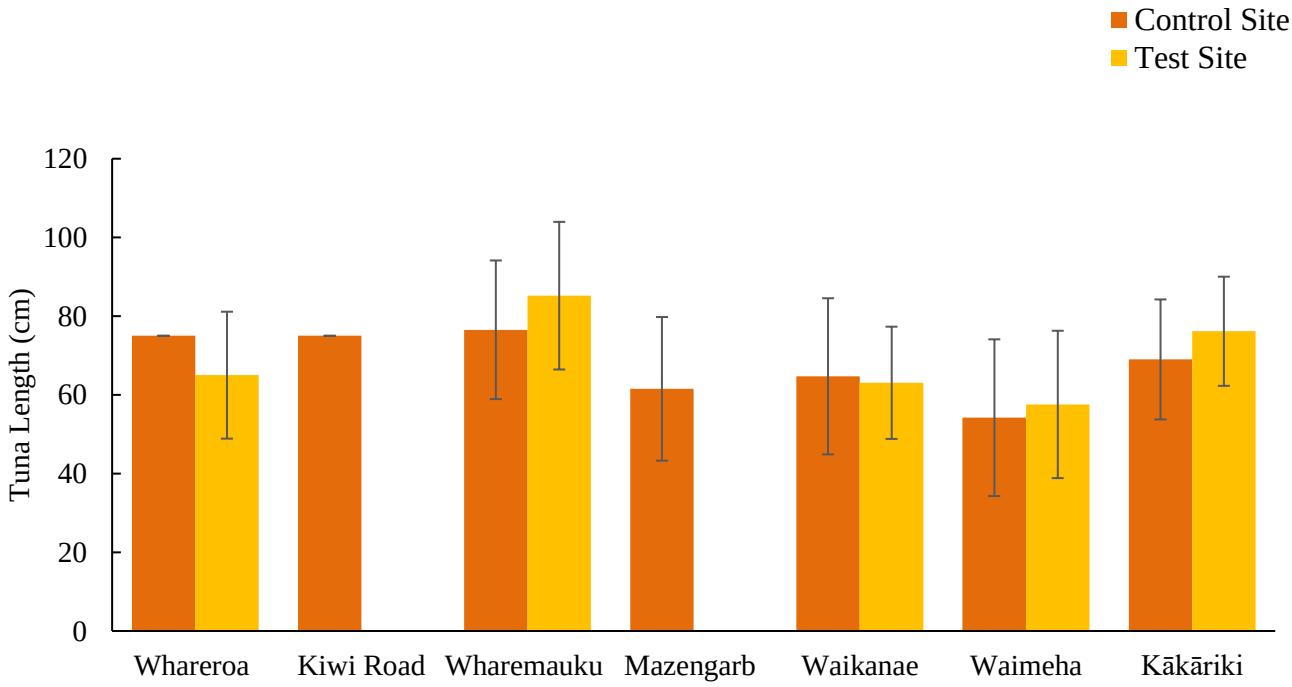


Figure 16 Average lengths of longfin tuna at Mahinga Kai sites 2019 – 2022.

8 Recommendations

8.1 Arotake: Key Issues

In evaluating the evidence collected across the M2PP Kaitiaki Monitoring Programme, we identify the following key areas that have failed to meet the standards of the Mahinga Kai Health Objectives as outlined in Table 1.

Recommendations for mitigation are then detailed in Section 7.2.

a) Impacts on Whānau and Individual Hauora

More than 50% of iwi members surveyed, rated the impacts of environmental change due to construction of the M2PP Expressway as “Extremely Severe” to their Hauora. Hauora includes the physical, mental, spiritual, social, and economic well-being of individuals and their whānau.

b) Wharemauku Stream

The Wharemauku catchment continues to fail to meet the Health Objectives set for the values of Mauri and Te Ao Turoa; in particular, the Wharemauku Test site, downstream of the M2PP Expressway.

Aqueous E. coli levels consistently exceed the minimum standards set by the NPS-FM, including an extreme value of 14140 MPN/100 mL at the Wharemauku Test site in 2019. In addition, campylobacter was detected in watercress samples from the Wharemauku Test site in 2018 and 2019. E. coli levels in watercress samples at the Wharemauku Test site were more than twenty times higher than the prescribed safe human consumption limit in 2018. In 2021, this number was over twice the value of the safe human consumption limit.

c) Kiwi Road Site

The Kiwi Road site fails to meet a number of the Health Objectives set for the values of Mauri and Te Ao Turoa. Aqueous E. coli samples in 2018 and 2019 exceeded the minimum NPS-FM standard. In 2018, watercress samples were taken from a contaminated site that the M2PP project developed into a flood offset storage area. These samples exceeded levels for safe human consumption in regards to E. coli (a level of over twenty times the prescribed safe human consumption limit), lead, and arsenic. The arsenic value was approximately nine times greater than the safe human

consumption limit. Watercress was present in both 2018 and 2019, but was absent at re-sampling in 2022.

d) Mazengarb Stream

The Mazengarb site fails to meet the objectives for the value of Mauri, with aqueous levels of E. coli in exceedance of the NPS-FM limits (<540 MPN/mL) in 2018 and 2019. The 2019 value was 16000 MPN/mL. In 2018, watercress E. coli levels were more than double the prescribed limit safe for human consumption.

e) Kākāriki Stream

The Kākāriki catchment continues to fail to meet the Health Objectives set for the values of Mauri and Te Ao Turoa. Aqueous E. coli levels at both the Control and Test sites consistently exceed the minimum standards set by the NPS-FM between 2018 and 2022. In addition, watercress presence was inconsistent over the sampling period, and ultimately was found to absent in both sites in 2022. In 2021, watercress E. coli levels at the Kākāriki Test site were over ten times higher than the prescribed limits for safe human consumption.

f) Waimeha Stream

The Waimeha Test site failed to meet the minimum standards set by the NPS-FM for aqueous E. coli in 2020. Despite the presence of watercress at both Control and Test sites in 2019, upon re-sampling in 2020 and 2022, no watercress was found for both sites. We note the realignment of this stream during construction of the M2PP Expressway.

8.2 Recommendations for Mitigation

We propose the following steps toward mitigation of the effects of the construction of the M2PP Expressway to the wāhi taiao and mana whenua of Ātiawa ki Whakarongotai, as evidenced in this report.

These initial recommendations provide a basis for further development and discussion between Ātiawa ki Whakarongotai and NZTA/M2PP Alliance.

1. **Support restoration of Hauora through Māori healing practices**

To begin to address hauora impacts to individuals and their whānau, in partnership with Ātiawa ki Whakarongotai, we propose a pathway of mana whenua to access rongoā māori. This could look like the provision of rongoā training, or access to rongoā services as treatment. This approach would foster reconnection of relationships to te taiao, and indigenous knowledge and healing practice, thus strengthening the values of maramatanga, wairua, and whakapapa.

2. **Support restoration of mahinga kai values across the Wharemauku Catchment**

To support the restoration of the values of Mauri and Te Ao Turoa to the Wharemauku stream, we recommend the introduction of mechanisms to reduce the pressure of contamination loads in the catchment.

We propose the M2PP Project commit to preparing and implementing a proposal for remedial works in the affected catchment areas.

3. **Support restoration of mahinga kai through watercress reseeding**

To restore mahinga kai and the associated values encompassed in the practice of mahinga kai, we propose the reseeding of watercress at arawai where a loss across the monitoring years has been identified (including the Wharemauku, Waikanae, Waimeha, and Kākāriki catchments).

9 Conclusions

The Ātiawa ki Whakarongotai-M2PP Kaitiaki Monitoring Programme was established to ensure that mahinga kai was adequately monitored, managed, and restored within the rohe in response to effects of the M2PP Expressway. The ecological and cultural effects identified in this report expose the key issues to be addressed in order to facilitate adequate management and restoration moving forward.

In collaboration with Ātiawa ki Whakarongotai, NZTA/M2PP Alliance should engage with the findings of this report and work with mana whenua to address the proposed mitigations.

10 References Cited

1. Hutchings, J. et al. (2012). Hua Parakore: An indigenous food sovereignty initiative and hallmark of excellence for food and product production. *MAI Journal* 1.
2. Te Ātiawa ki Whakarongotai Charitable Trust. (2019). *Whakarongotai o te moana Whakarongotai o te wa Kaitiakitanga Plan for Te Ātiawa ki Whakarongotai*.
3. *Te Ātiawa ki Whakarongotai Mahinga Kai Survey* (2017).
4. Higginbotham, N., Connor, L., Albrecht, G., Freeman, S. & Agho, K. (2006). Validation of an environmental distress scale. *Ecohealth* 3, 245–254.
5. Manatū Mō Te Taiao Ministry for the Environment. (2022). *National Policy Statement for Freshwater Management 2020*.
6. Te Mana Kounga Kai – Ahitereiria me Aotearoa Food Standards Australia New Zealand. *Food Standards Code, Schedule 19 Maximum levels of contaminants and natural toxicants* (2022).
7. Edmonds, C. & Hawke, R. (2004). Microbiological and metal contamination of watercress in the Wellington region, New Zealand-2000 survey. *Environmental Health*.
8. Te Mana Kounga Kai – Ahitereiria me Aotearoa Food Standards Australia New Zealand. *Compendium of Microbiological Criteria for Food* (2022).
9. Albrecht, G. et al. (2007). Solastalgia: The distress caused by environmental change. *Australasian Psychiatry* 15.
10. New Zealand National Institute of Water and Atmospheric Research (NIWA), *https://niwa.co.nz/te-kūwaha/tuna-information-resource/biology-and-ecology/maturation-and-identifying-sex*.

11 Appendix A: Arawai Reports

11.1 Whareroa

Watercress Presence/Absence

	2018	2019	2022
Whareroa Control	Present	Present	Present
Whareroa Test	Present	Present	Present

Watercress Campylobacter (/10g)

	2018	2019	2022
Whareroa Control	Not Detected	Detected	Not Detected
Whareroa Test	Not Detected	Detected	Not Detected

Watercress E. coli (MPN/g)

	2018	2019	2022
Whareroa Control	3	43	9
Whareroa Test	2400	23	240
Human Health Limit (CFU)	100	100	100

Water Sample E. coli (MPN/100 mL)

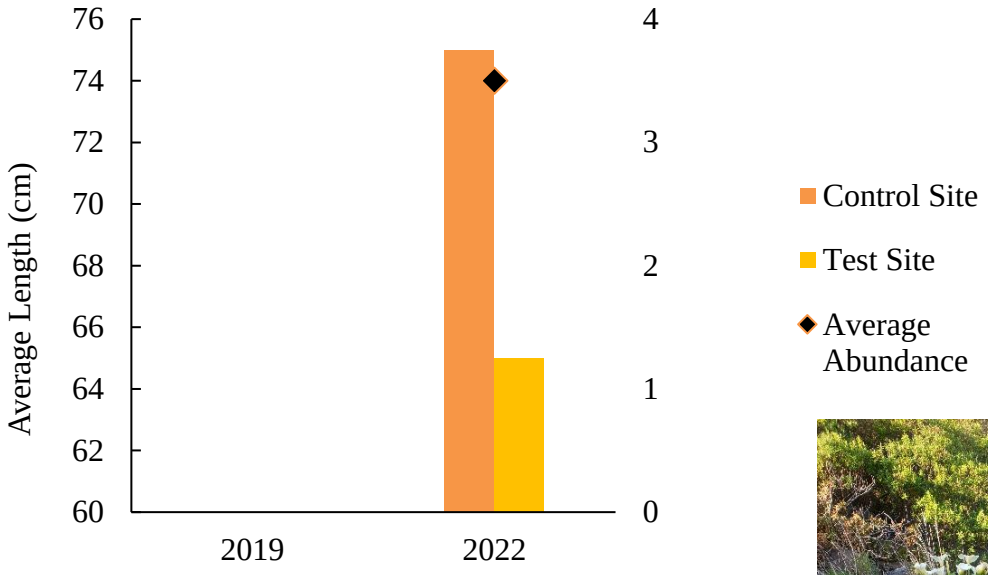
	2018	2019	2020
Whareroa Control	517	61	147
Whareroa Test	2420	80	345
Human Health Limit	540	540	540

CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg)

	Arsenic			Cadmium			Chromium			Copper		
	2018	2019	2022	2018	2019	2022	2018	2019	2022	2018	2019	2022
Control	0.02	0.04		0.0189	0.0077	0.0069	0.013	0.38	0.012	0.53	0.46	0.3
Test	0.03			0.0035		0.0078	0.148		0.04	0.71		0.35
	Lead			Mercury			Zinc			Nickel		
	2018	2019	2022	2018	2019	2022	2018	2019	2022	2018	2019	2022
Control	0.004	0.082	0.03	0.002	0.003	0.002	3	3.1	1.9	0.02	0.1	0.02
Test	0.044		0.005	0.002		0.002	3.8		2.4	0.06		0.02

Tuna Average Length and Abundance



11.2 Kiwi Road

Watercress Presence/Absence

	2018	2019	2022
Kiwi Road Control	Present	Present	Absent

Watercress Campylobacter (/10g)

	2018	2019
Kiwi Road Control	Not Detected	Not Detected

Watercress E. coli (MPN/g)

	2018	2019
Kiwi Road Control	2400	3
Human Health Limit (CFU)	100	100

Water Sample E. coli (MPN/100 mL)

	2018	2019
Kiwi Road Control	2420	920
Human Health Limit	540	540

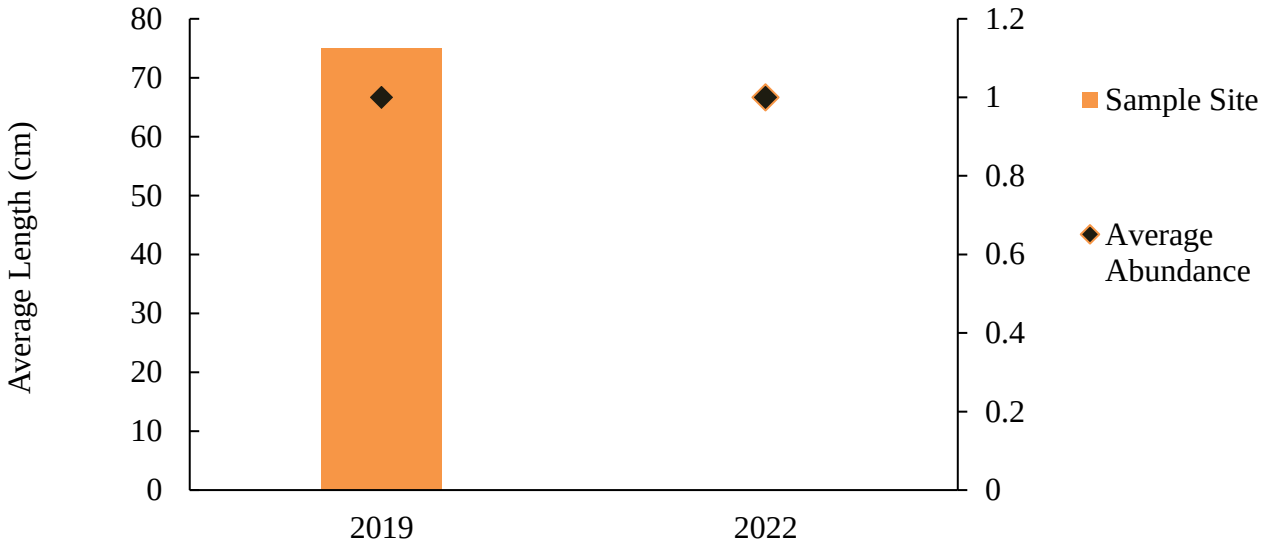
CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg)

	Arsenic		Cadmium		Chromium		Copper	
	2018	2019	2018	2019	2018	2019	2018	2019
Kiwi Road	9.3	0.84	0.0061	0.0015	0.27	0.29	0.93	0.63

	Lead		Mercury		Zinc		Nickel	
	2018	2019	2018	2019	2018	2019	2018	2019
Kiwi Road	0.47	0.067	0.002	0.002	13.3	4.2	0.2	0.1

Tuna Average Length and Abundance



11.3 Wharemauku

Watercress Presence/Absence

	2018	2019	2021	2022
Wharemauku Control	Present	Present	Absent	Present
Wharemauku Test	Present	Present	Present	Present

Watercress Campylobacter (/10g)

	2018	2019	2021
Wharemauku Control	Not Detected	Not Detected	-
Wharemauku Test	Detected	Detected	Not Detected

Watercress E. coli (MPN/g)

	2018	2019	2021
Wharemauku Control	230	9	-
Wharemauku Test	2400	4	240
Human Health Limit (CFU)	100	100	100

Water Sample E. coli (MPN/100 mL)

	2018	2019	2021	2022
Wharemauku Control	2420	173	727	1414
Wharemauku Test	2420	14140	249	1553
Human Health Limit	540	540	540	540

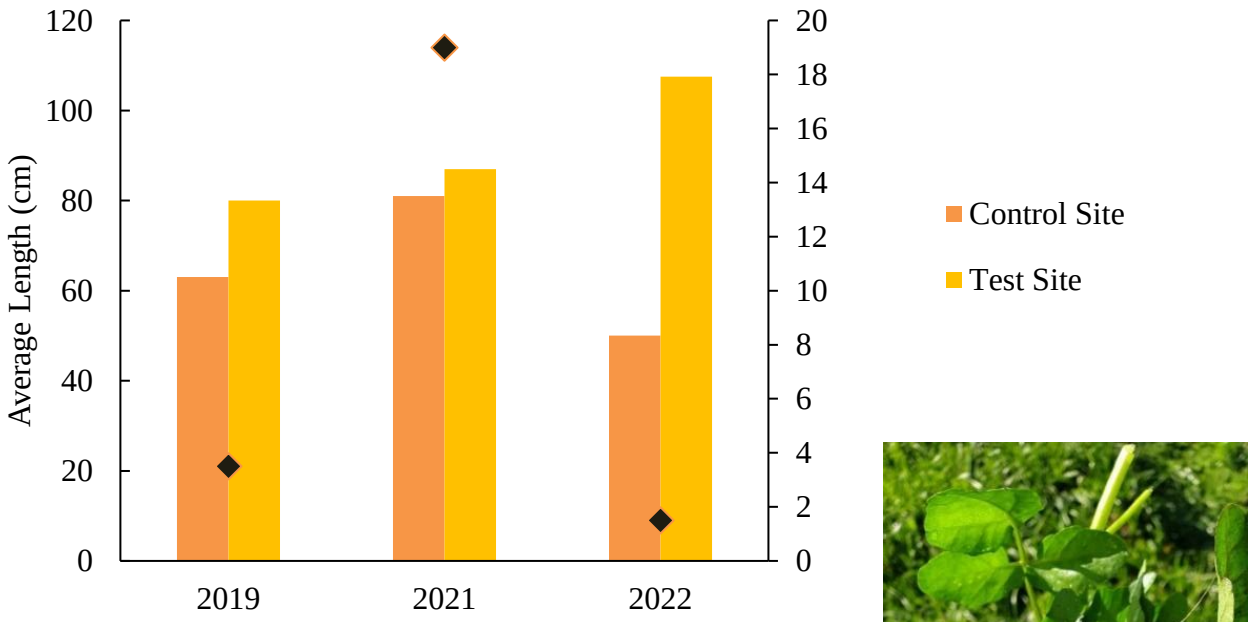
CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg)

	Lead				Mercury				Zinc				Nickel			
	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022
Wharemauku Control	0.23	0.045		0.028	0.002	0.002		0.002	8.6	9.2		4.6	0.17	0.07		0.03
Wharemauku Test	0.2	0.064	0.029	0.03	0.002	0.002	0.002	0.002	12.4	10	4.2	3	0.16	0.07	0.06	0.06

	Arsenic				Cadmium				Chromium				Copper			
	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022	2018	2019	2021	2022
Wharemauku Control	0.07	0.38		0.06	0.0033	0.002		0.0014	0.23	0.088		0.028	0.84	0.66		0.51
Wharemauku Test	0.23	0.02	0.08	0.27	0.0009	0.0011	0.0008	0.0008	0.22	0.172	0.021	0.029	0.3	0.89	0.45	0.36

Tuna Average Length and Abundance



11.4 Mazengarb

Watercress Presence/Absence

	2018	2019	2022
Mazengarb	Present	Present	Present

Watercress Campylobacter (/10g)

	2018	2019
Mazengarb	Not Detected	Not Detected

Watercress E. coli (MPN/g)

	2018	2019	2022
Mazengarb	240	3	23
Human Health Limit (CFU)	100	100	100

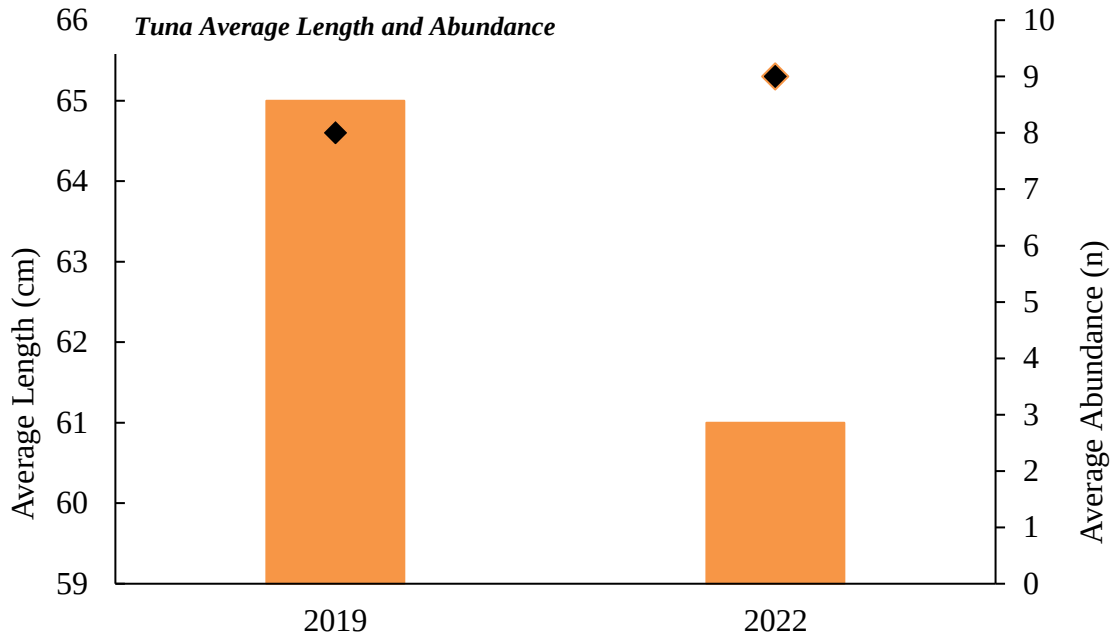
Water Sample E. coli (MPN/100 mL)

	2018	2019
Mazengarb	2420	16000
Human Health Limit	540	540

CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg)

Arsenic			Cadmium			Chromium			Copper		
2018	2019	2022	2018	2019	2022	2018	2019	2022	2018	2019	2022
0.03	0.06	0.05	0.0039	0.0045	0.0008	0.32	0.71	0.042	0.59	1.59	0.46
Lead			Mercury			Zinc			Nickel		
2018	2019	2022	2018	2019	2022	2018	2019	2022	2018	2019	2022
0.032	0.097	0.025	0.002	0.003	0.002	7.4	9.6	4.6	0.03	0.14	0.02


Tuna Average Length and Abundance
Average Length (cm)
66
65
64
63
62
61
60
59
Average Abundance (n)
10
9
8
7
6
5
4
3
2
1
0
2019
2022

11.5 Waikanae

Watercress Presence/Absence

	2019	2020	2022
Waikanae Control	Present	Absent	Absent
Waikanae Test	Present	Absent	Absent

Watercress Campylobacter (/10g)

	2019
Waikanae Control	Not Detected
Waikanae Test	Not Detected

Watercress E. coli (MPN/g)

	2019
Waikanae Control	75
Waikanae Test	3
Human Health Limit (CFU)	100

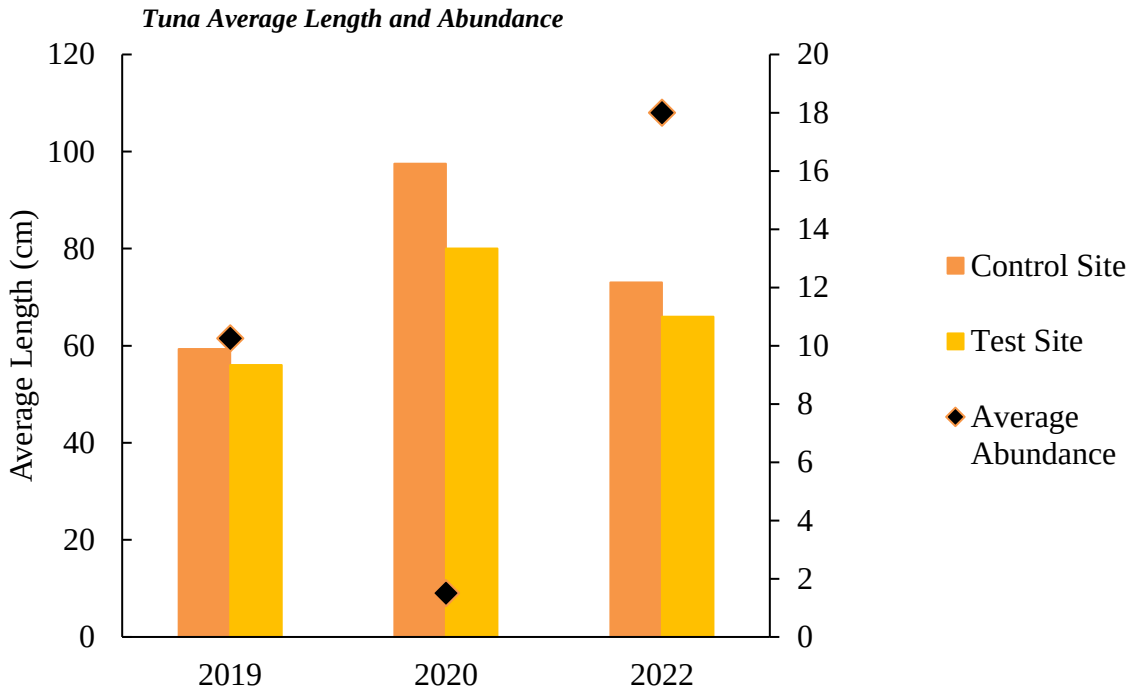
Water Sample E. coli (MPN/100 mL)

	2019	2020	2022
Waikanae Control	66	206	326
Waikanae Test	172	84	84
Human Health Limit	540	540	540

CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg)

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	Nickel
	2019	2019	2019	2019	2019	2019	2019	2019
Waikanae Control	0.009	0.0127	0.133	1.36	0.072	0.002	6.6	0.13
Waikanae Test	0.02	0.0103	0.079	0.39	0.013	0.002	4	0.05


Tuna Average Length and Abundance
Average Length (cm)
120
100
80
60
40
20
0
20
18
16
14
12
10
8
6
4
2
0
2019
2020
2022
Control Site
Test Site
Average Abundance

11.6 Waimeha

Watercress Presence/Absence

	2018	2019	2020	2022
Waimeha Control	Present	Present	Absent	Absent
Waimeha Test	Absent	Present	Absent	Absent

Watercress Campylobacter (/10g)

	2018	2019
Waimeha Control	Not Detected	Not Detected
Waimeha Test		Not Detected

Watercress E. coli (MPN/g)

	2018	2019
Waimeha Control	4	3
Waimeha Test	-	3
Human Health Limit (CFU)	100	100

Water Sample E. coli (MPN/100 mL)

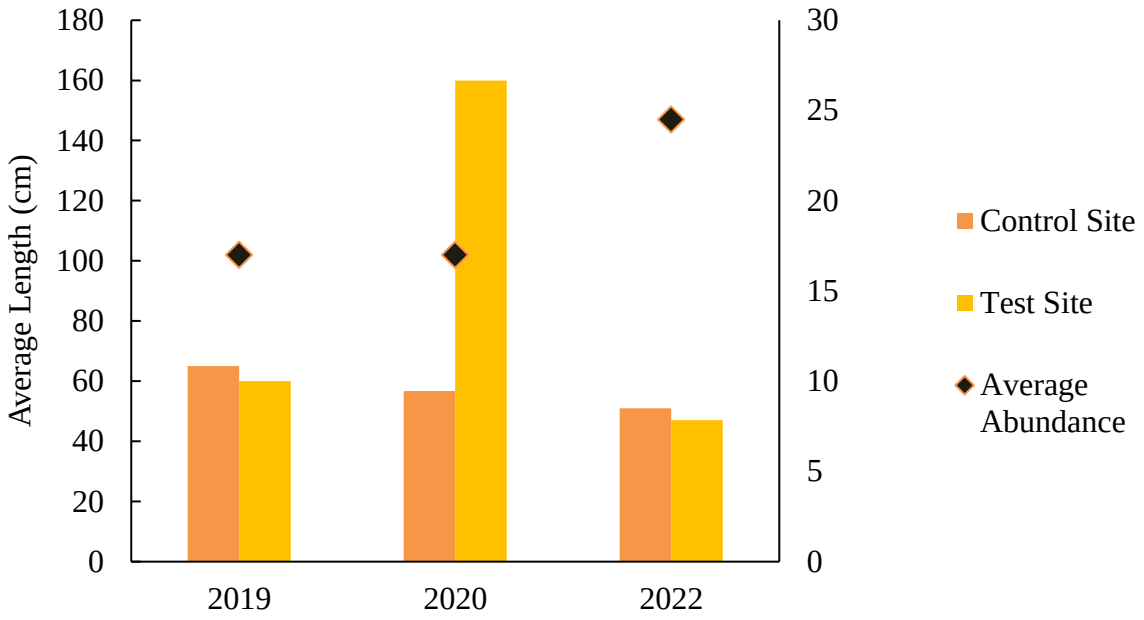
	2018	2019	2020
Waimeha Control	649	184	249
Waimeha Test	387	148	579
Human Health Limit	540	540	540

CFU – Colony Forming Units
MPN - Most Probable Number.

Watercress Heavy Metals (mg/kg

	Arsenic		Cadmium		Chromium		Copper	
	2018	2019	2018	2019	2018	2019	2018	2019
Waimeha Control	0.02		0.0065	0.0035	0.019	0.013	0.39	0.77
Waimeha Test		0.07		0.0061		0.041		0.56
	Lead		Mercury		Zinc		Nickel	
	2018	2019	2018	2019	2018	2019	2018	2019
Waimeha Control	0.0052	0.005	0.002	0.002	8	8.1	0.02	0.03
Waimeha Test		0.022		0.002		9.4		0.03

Tuna Average Length and Abundance



11.7 Kākāriki

Watercress Presence/Absence

	2018	2019	2021	2022
Kākāriki Control	Present	Absent	Absent	Absent
Kākāriki Test	Absent	Absent	Present	Absent

Watercress Campylobacter (/10g)

	2018	2021
Kākāriki Control	Not Detected	Not Detected

Watercress E. coli (MPN/g)

	2018	2021
Kākāriki Control	3	-
Kākāriki Test	-	1100
Human Health Limit (CFU)	100	100

Water Sample E. coli (MPN/100 mL)

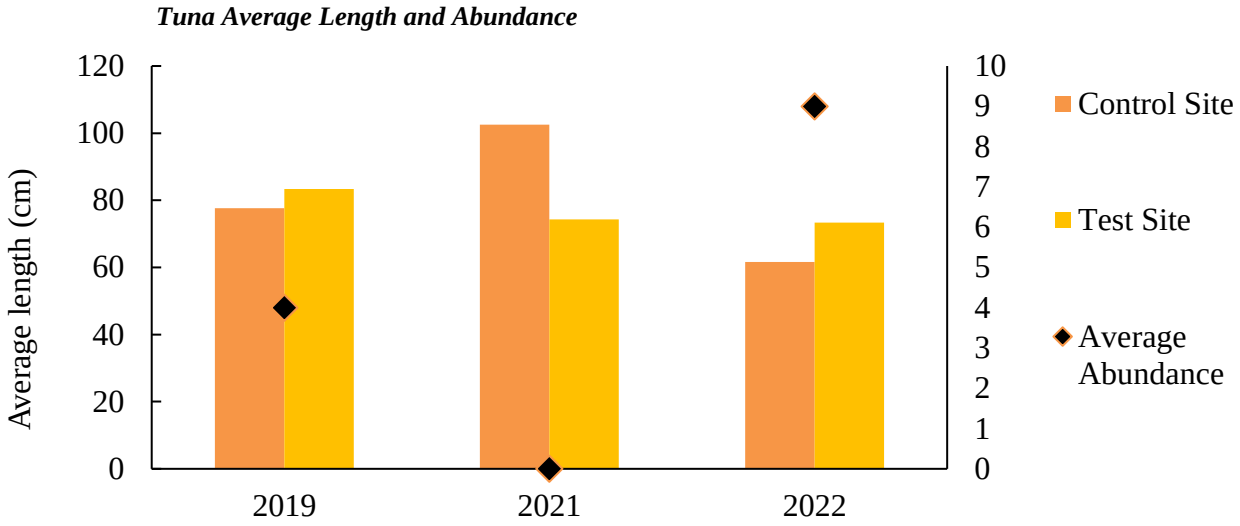
	2018	2019	2021	2022
Kākāriki Control	2420	1414	2420	1733
Kākāriki Test	200	1553	1986	2420
Human Health Limit	540	540	540	540

CFU – Colony Forming Units
MPN - Most Probable Number.

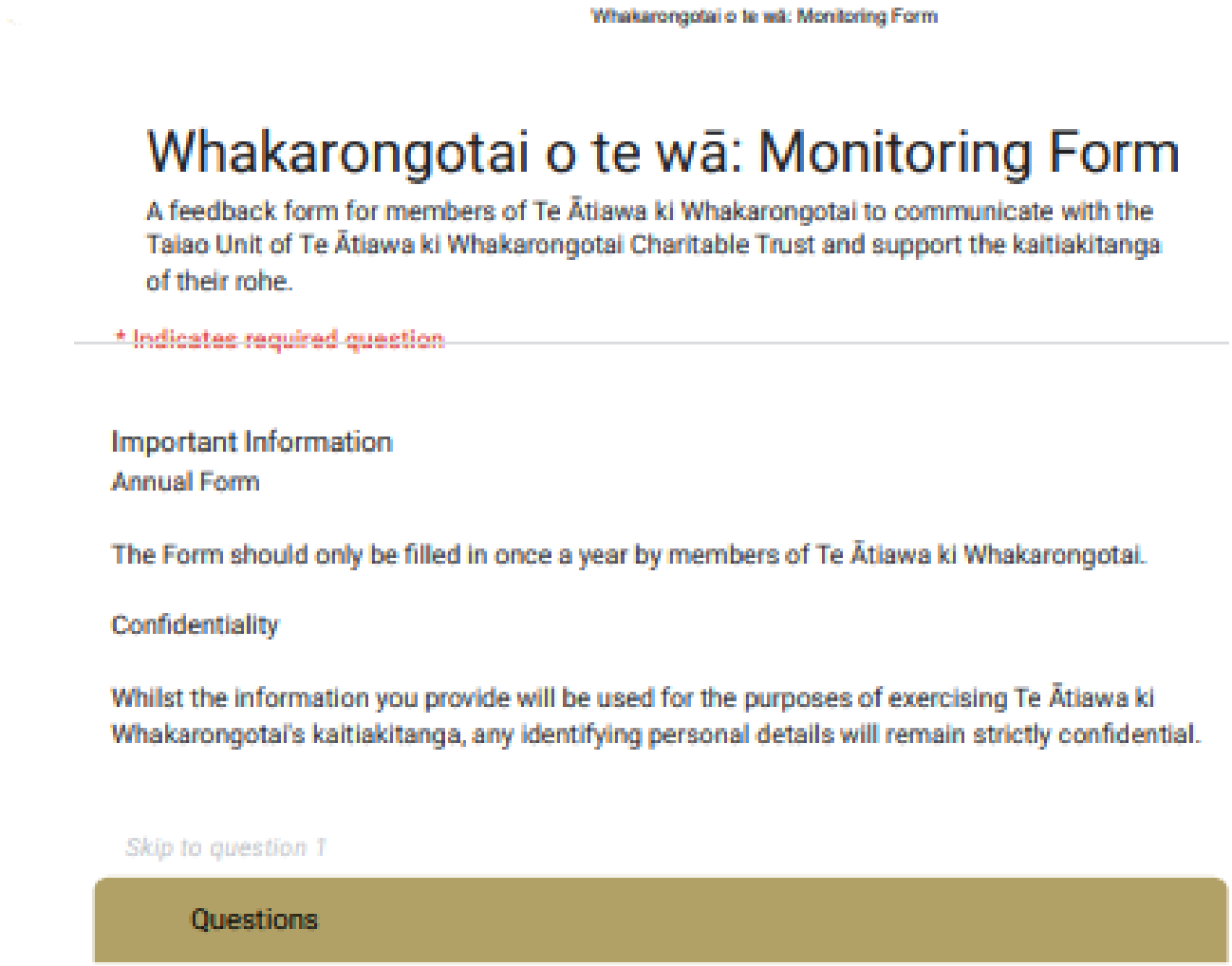
Watercress Heavy Metals (mg/kg)

	Arsenic		Cadmium		Chromium		Copper	
	2018	2021	2018	2021	2018	2021	2018	2021
Kākāriki Control	0.02		0.0038		0.027		0.91	
Kākāriki Test		0.04		0.0016		0.049		0.42

	Lead		Mercury		Zinc		Nickel	
	2018	2021	2018	2021	2018	2021	2018	2021
Kākāriki Control	0.02		0.002		6.7		0.03	
Kākāriki Test		0.029		0.002		2.8		0.03


Tuna Average Length and Abundance
Average length (cm)
120
100
80
60
40
20
0
10
9
8
7
6
5
4
3
2
1
0
2019
2021
2022
Control Site
Test Site
Average Abundance

12 Appendix B: Whakarongotai o te Wā Iwi Survey*



Whakarongotai o te wā: Monitoring Form

Whakarongotai o te wā: Monitoring Form

A feedback form for members of Te Ātiawa ki Whakarongotai to communicate with the Taiao Unit of Te Ātiawa ki Whakarongotai Charitable Trust and support the kaitiakitanga of their rohe.

* Indicates required question

Important Information

Annual Form

The Form should only be filled in once a year by members of Te Ātiawa ki Whakarongotai.

Confidentiality

Whilst the information you provide will be used for the purposes of exercising Te Ātiawa ki Whakarongotai's kaitiakitanga, any identifying personal details will remain strictly confidential.

Skip to question 1

Questions

*2020 version

1. Intergenerational transfer of mātauranga Māori me ōna tikanga: For each type of knowledge, tick the box of how far along the knowledge continuum you are *

Mark only one oval per row.

	Te Pū: 'I know this knowledge exists within iwi members or records'	Te Weu: 'I know that this knowledge is being shared within the iwi'	Te Aka: 'I know how to access this knowledge if I need or decide to'	Te Rea: 'I am learning and practicing this knowledge'	Te Wao-nui: 'I have taught or created this type of knowledge'
Whakapapa	◯	◯	◯	◯	◯
Tāhuhu Kōrero - Iwi History	◯	◯	◯	◯	◯
Te Reo Māori	◯	◯	◯	◯	◯
Tikanga o te Marae - Whaikōrero/Karanga	◯	◯	◯	◯	◯
Karakia	◯	◯	◯	◯	◯
Waiata	◯	◯	◯	◯	◯
Mahinga kai - Harvest, preparation	◯	◯	◯	◯	◯
Toi Māori	◯	◯	◯	◯	◯
Rongoā Māori	◯	◯	◯	◯	◯

2. How frequently do you participate in activities in contact with nature?

Mark only one oval.

Hardly ever

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Every day

3. Can you describe in a few sentences what key changes to the environment, or loss of ecosystem health, you've observed in your life time? *

4. How severe have the changes been... *

Mark only one oval per row.

	1 Not at all	2	3	4	5 Severe
across the whole rohe?	◯	◯	◯	◯	◯
as a result of the Expressway?	◯	◯	◯	◯	◯
to the Waikanae River?	◯	◯	◯	◯	◯

5. Describe the impact these changes had on your hauora? On the physical, mental, spiritual, social and economic well-being of you and your whānau? It is fine to summarise this in a few sentences if you like. *

6. How severe have these impacts been? *

Mark only one oval.

1 ⬭
2 ⬭
3 ⬭
4 ⬭
5 ⬭

7. Describe any reactions or actions taken or responses you and your whānau have had as a result of the impacts you describe? These actions may be positive (e.g. met with those responsible for the impacts) or negative (withdrawal from engagement, stress reactions) *

8. How strong a reaction have you had to these changes? *

Mark only one oval.

Not at all

1
2
3
4
5

Extreme

9. In light of recent events, and as always, we would like to hear if we could assist you or your whānau at this time?

10. If you would like to be contacted to address these impacts further, please provide your contact information (Name, Address, Telephone, Email) below. Any identifying information will be kept strictly confidential.

11. If you would like to be in the draw to win one of the three prizes up for grabs, leave your name and phone number here. Any identifying information will be kept strictly confidential and used just for the purpose of drawing a winner!