NIWA: Future Coasts Aotearoa

Causal diagrams to help understand wellbeing in Te Puuaha o Waikato | The Lower Waikato River – A Tangata Whenua perspective

December 2023

Report by:

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Disclaimer

He Maimai Aroha

Ka maatakitaki iho au ki te riu o Waikato
Aanoo nei hei kapo kau ake maaku ki te kapu o taku ringa,
Ka whakamiri noa i toona aratau
E tia nei he tupu pua hou.

Kia hiwa ake au i te tihi o pirongia,
Inaa, hei toronga whakaruruhau moona ki tooku tauawhirotanga.

Anaa! Te ngoto o toona ngawhaa i ngoona uma kiihai i aarikarika a Maungatautari, a Maungakawa,
ooku puke maunga, ngaa taonga tuku iho.
Hoki ake nei au ki tooku awa koiora me ngoona pikonga
He kura tangihia o te maataamuri.

E whakawhiti atu ai i te koopuu maania o kirikiriroa,
Me ngoona maara kai, te ngawhaa whakatupu ake o te whenua moomona,
Hei kawe ki ngaaruawaahia, te huinga o te tangata.

Araa, te pae haumako, hei okiokinga moo taku upoko,
Hei tirohanga atu maa raro i ngaa huuhaa o taupiri.

Kei reira raa, kei te oroko hanganga o te tangata,
Waahia te tuungaroa o te whare, te whakaputanga moo te kiingi.

I look down on the valley of Waikato,
as though to hold it in the hollow of my hand
and caress its beauty,
like some tender verdant thing.

I reach out from the top of Pirongia,
as though to cover and protect its substance with my own.

See how it bursts through the full bosoms of Maungatautari and Maungakawa,
hills of my inheritance:
The river of life, each curve more beautiful than the last.

Across the smooth belly of Kirikiriroa,
its gardens bursting with the fullness of good things, towards the meeting place at Ngaaruawaahia.

There on the fertile mound I would rest
my head and look through the thighs of Taupiri.

There at the place of all creation...
let the King come forth.

- Kiingi Taawhiao

Reference: WTTKI, (2013).

ACKNOWLEDGEMENTS

The mahi in this component of the wider project would not have been possible without the background support of Waikato-Tainui Te Whakakitenga Inc (specifically Donna Flavell and Manaaki Nepia), and most importantly, the members of our Tangata Whenua Roopu who provided us with the necessary thinking and discussions to develop the causal map:

- Donna Kerridge
- Tim Manukau
- Makere Rika-Heke
- Braden Te Ao
- Patience Te Ao
- Kahurimu Flavell.

The intellectual property rights to the causal map produced under this component sits solely with our Tangata Whenua Roopu members, with the relevant permissions being granted from them for its publication in this and future reports.

We wish to specifically acknowledge the tautoko and vision of two of our key research colleagues at NIWA – Erica Williams, and Scott Stephens. It was with their support that a Te Puuaha case study research strategy (***Maaku anoo e hanga tooku nei whare***[1]) could be developed, facilitating inclusion of the case study within the broader Future Coasts Aotearoa programme in addition to other projects.

It is also thanks to the ongoing support of our colleagues in the wider Future Coasts Aotearoa programme – namely, Christo Rautenbach, Darcel Rickard, Paula Holland, Paula Blackett, Connon Andrews and Alex Fear - that we can continue to build a robust kete of tools and resources from within the programme for whaanau in Te Puuaha o Waikato, to help them navigate their climate changing future.

And finally, we wish to acknowledge the most important sources of inspiration for this and other projects under the banner of '***Maaku anoo e hanga tooku nei whare***'– our marae and whaanau in Te Puuaha and Te Awa Waikato/ Waikato River itself.

[1] Inspired by the tongi kura of Kiingi Taawhiao.

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Executive summary

It is increasingly recognised that to reconcile the impacts of climate change with the resilience of culture, more meaningful conversations are needed with tangata whenua ‘at place’ to better understand their mitigation options and/or tools. A case study in Te Puuaha o Waikato (approx. 40km stretch and surrounding catchment in the lower Waikato River system), within the Future Coasts Aotearoa research programme, seeks to do this with Te Puuaha whaanau.

This report describes a causal diagram/mapping process to better understand drivers and aspirations of tangata whenua - inclusive of whaanau, hapuu and iwi - affiliated with the lower River. Its main purpose is to provide a way for Te Puuaha communities as well as decision makers, to also understand the many related qualitative factors that are woven into the challenges of responding to climate change.

The diagram is anchored around the maimai aroha of Kiingi Taawhiao. This paints a clear mental picture about the state of the river catchment, providing a baseline about a point in time when colonial settlement-related activities had not yet had an impact on the land. He maimai aroha is a key driver for Waikato-Tainui social-environmental decision-making and strategic planning (WTTKI, 2013), and guides Te Puuaha aspirations within this project.

He maimai aroha calls to the restoration of both environmental and community health and wellbeing to a state like that observed by Kiingi Taawhiao when he composed it. Placed within the causal diagram, it provides an ‘anchor’ for movement in that direction and is seen as a driver in what will be a multi-generational journey for whaanau and their River. He maimai aroha may be viewed as a key indicator framework for assessing and monitoring how successful we are as a society in moving towards that ‘anchor” (‘the difference between the maimai aroha and reality’) as captured under the ‘efforts’.

Four important interaction points are identified within the diagram:

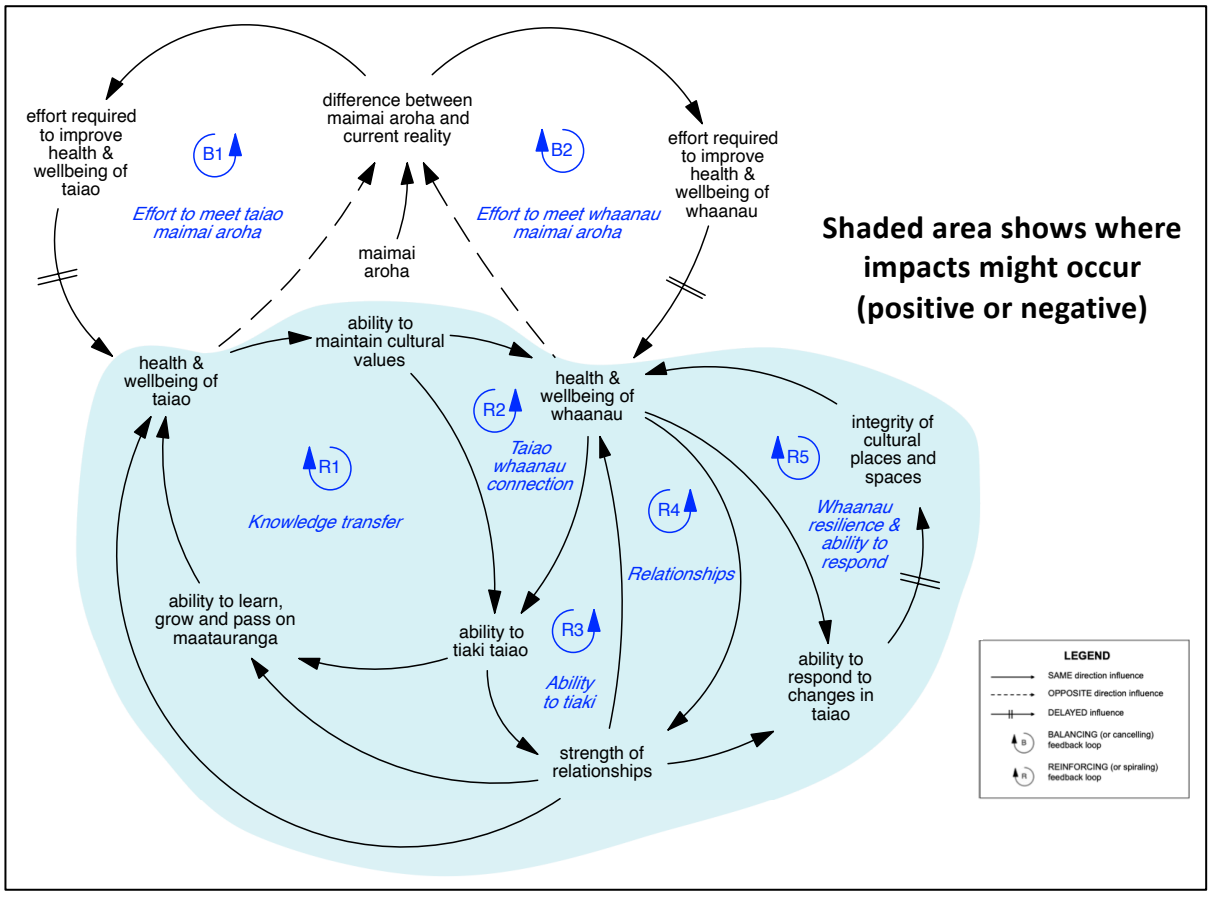
The Health & wellbeing of Te Taiao:	The general state, condition or health of the natural environment.
Ability to maintain cultural values:	The tangible and intangible cultural values are central to how Maaori view the world.
Health & wellbeing of whaanau:	The general state, condition or health of tangata whenua, including physical, mental and spiritual health and wellbeing.
Integrity of cultural places and spaces:	The integrity of places and spaces important to the cultural identity of whaanau.

These are influenced by important interacting feedback loops:

R1: Knowledge transfer:	Active engagement with the environment provides the opportunity for creating platforms for intergenerational exchanges of knowledge, language and practices.
R2: Taiao-Whaanau Connection:	The health and wellbeing of one is linked to and supported by that of the other.
R3: Ability to Tiaki:	The application of the best available tools and information (maatauranga and science) to support protection and enhancement of the health and wellbeing of the environment.
R4: Relationships:	The strength of whaanau, hapuu, iwi and inter-iwi relationships. Whanaungatanga (relationships) and reciprocity between and within whaanau is a critical component of identity, and therefore community and environmental health and wellbeing.
R5: Ability to respond to changes in Te Taiao:	The term 'respond' as used here is intended to have a wider framing than 'adaptation' with focus on opportunities as well as challenges.

The causal diagram is shown below. He maimai aroha remains the anchor or driver at the top of the diagram, while the blue shaded area highlights the areas where impact may occur and flow through the other influences to have impact in different areas.

The causal diagram:



1 Introduction

- **C. van Schravendijk-Goodman, R. Mahuta & J. Connolly**

In 1863, the colonial forces under the direction of Governor Grey marched into the Waikato region and initiated an invasion on the peoples of Waikato and supporters of the Kiingitanga which resulted in the confiscation of 1.2 million acres across Waikato and parts of Auckland (WTTKI, 2013). A pivotal moment in history, these actions are recognised colloquially as the 'crossing of the Aukati line' near Mangataawhiri (northern Waikato). Associated colonial propaganda of the time announced this as a rebellion of Waikato peoples and their kin towards the Crown and a justification to invade. But amongst the drivers for invasion, it is now recognised that a key objective was to undermine Waikato leadership and Maaori control over their lands and resources, leading to Raupatu (confiscation). Thus, assuring economic development for the settlers at the expense of Waikato Maaori community wellbeing (Mahuta, 2008).

When considering the impacts of Raupatu to the peoples of Waikato in the context of climate change, it is important to recognise that modern whaanau, hapuu and iwi must attempt to adapt to a rapidly shifting landscape within the constraints imposed upon them by government-supported decisions and activities since European settlement. Such constraints include the conversion of thousands of hectares of coastal and freshwater wetlands and swamp forests to pasture for farming, in addition to the fragmentation and reduction of Maaori-owned lands. Specifically, drainage of wetlands in the river deltas and estuaries has removed an important ecological buffering system to the potential risks of sea-level rise, particularly on freshwater ecology further upstream, but also on current and future human habitation and associated infrastructure. And declines in Maaori land ownership limits the ability for whaanau to: (1) maintain and uphold important cultural practices and, (2) limits the available options for movement away from natural patterns of flooding and inundation as once practiced by their tuupuna as part of their seasonal interactions with lowland coastal areas.

Raupatu was also the catalyst for major impacts to the ancestral river of Waikato hapuu and iwi – Te Awa Waikato/ Waikato River. The river is deemed to be of national significance economically, due to the important role it plays within the national hydro power scheme network, and as a key water supply to the country's largest municipality of Auckland (amongst other uses and activities). The resilience and protection ('defence') of such infrastructure to climate change impacts, therefore, play a major role in the decision-making processes by central and local government. But this has usually been at the expense of the things that are important to tangata whenua; primarily, the ability of the river to naturally respond and cope with the onset of climate change impacts. Whilst at the same time, ensuring the maintenance of Waikato cultural heritage associated with the relationship of the people with their river and coastline.

To reconcile the impacts of climate change with the resilience of culture, it is increasingly recognised that more meaningful conversations are needed with tangata whenua 'at place' to better identify the full gambit of mitigation options and/or tools that could be adopted. Taking this into consideration, researchers from NIWA and community-based environmental

researchers from Swamp Frog Environmental & Tree Consultants Ltd ("Swamp Frog[2]") collaborated to identify appropriate research processes to compile key information and support aspirations for better engagement with tangata whenua within the climate change space. This culminated in a partnership as a case study on Te Puuaha o Waikato (approx. 40km stretch and surrounding catchment in the lower Waikato River system), under the Future Coasts Aotearoa research programme.

Future Coasts Aotearoa is a 5-year research programme funded under the MBIE Endeavour fund and led by NIWA. The programme seeks to understand the impacts of climate change on coastal lowlands in Aotearoa New Zealand[3]. Within that programme are case study areas that were identified in collaboration with key community, research and/or council partners. As noted above, one of those case study sites is Te Puuaha o Waikato ("Te Puuaha"). This is a landscape of significance to the peoples of Waikato and noted as a key research priority area for tangata whenua due to the potential cultural, ecological and social impacts of sea-level rise in the lower River delta.

To fully appreciate the impacts of climate change, and more specifically sea-level rise on the indigenous communities of Te Puuaha, the case study team invited Deliberate (Justin Connolly[4], also a co-author to this report) to assist in the development of a causal diagram/mapping process as a tool for better understanding the drivers and aspirations of Te Puuaha whaanau (see **section 4** later for further description about this tool). Tangata whenua representatives affiliated with Te Puuaha were then invited to firstly explore with the research team the cultural values underpinning the key decision-making processes for their people and introduce them to the casual diagram process. Follow up hui were then conducted to build the diagram. In total, three hui were held. Roopu members involved in this process can whakapapa to hapuu and marae in Te Puuaha, and also come with a range of technical skills and expertise related to health, finance, archaeology, social development, rongoaa Maaori, environmental policy and planning, as well as having an intimate and practical understanding of their ancestral River and its natural resources.

The purpose of this report is to present the causal diagram developed with the Tangata Whenua Roopu[5] and the associated narratives for its development, in addition to explanatory text about the key features of the tool.

1.1 A note on kupu Maaori and their context

As te reo Maaori derives from a predominantly oral language (as opposed to written), several interpretations or meanings can be drawn for a single kupu Maaori (word). Whilst speakers of te reo do not struggle with how these words are woven and interact within the context of a kaupapa, issues can and do arise when those words are being translated into a singular and

[2] Swamp Frog Environmental & Tree Consultants Ltd; refer to website: https://www.swampfrog.co.nz/key-projects/

[3] Refer to programme website for further information: https://niwa.co.nz/natural-hazards/research-projects/future-coasts-aotearoa

[4] http://www.deliberate.co.nz/

[5] At the request of Swamp Frog, a second group made up of representatives from the wider Port Waikato and Akaaka community was also engaged to capture their thinking and voices in the climate change story. The resultant causal map from that process will be described in another technical report (Connolly *et al.*, 2023).

fixed English-translated narrative. Given a history over decades of Maaori knowledge and language being appropriated and then (generally) homogenised into one singular definition, this became an underlying concern for the Tangata Whenua Roopu during the development of the causal diagram. Specifically, that kupu Maaori **should not** be translated to English in order to provide the freedom for indigenous users of the tool to be able to define for themselves what those values, and/or concepts mean to them as/when applied within their geographical and cultural contexts.

If there is ever a need for more specific context relating to the inter-relationships described in this report, then Te Puuaha whaanau should be approached for greater detail as it may relate to any future context.

1.2 A report for multiple audiences

This report is intended for multiple audiences. The primary audience is the Future Coasts Aotearoa project. Yet it also intended for both Paakeha and Maaori decision makers and communities - inclusive of whaanau, hapuu, iwi, as a useful tool for understanding many related qualitative factors that are woven into the challenges of responding to climate change. We have kept the lay reader in mind when writing this report and hope that such an audience finds it useful.

1.3 Structure of this report

This report is structured as follows:

- What are causal diagrams? (section 2);
- How to read a causal diagram (section 3);
- Description of the tangata whenua group causal diagram (section 4);
- Using the causal diagram to explore impacts and insights (section 5)

2 What are causal diagrams?

- **J. Connolly, C. van Schravendijk-Goodman & R. Mahuta**

The world that we live in is a highly interconnected place of causality and effect. The work of policy development often seeks to respond to undesirable behaviour or patterns being experienced in our natural environment and therefore seeks to influence these causes, to alter or improve the desired behaviour.

'Systems Thinking' is a name often applied to a range of approaches to thinking about issues holistically. One of these approaches is academic discipline of 'System Dynamics'. System Dynamics originated from the Sloan School of Management at the Massachusetts Institute of Technology, Cambridge, Massachusetts in the late 1960's.

Systems thinking, as described by the discipline of System Dynamics, is a conceptual framework and set of tools that have been developed to help make these patterns of interconnectedness clearer (Senge, 2006)[6]. They help us understand the structure of a set of various interacting causal factors that influence a behaviour that we are trying to understand. Once these interconnections are articulated in a system map (or causal loop map as described in this report), we can better understand which parts of a system are having the most influence on the behaviour, allowing us to identify (usually a combination of) areas of leverage where action could be expected to influence this.

Where the term causal loop mapping has been used in this report, it refers to the qualitative tool of that name (causal loop diagram or causal loop map) articulated by the discipline of System Dynamics (Sterman, 2000). The term causal loop map is used throughout this report for ease of reference and because the term 'system' was a source of confusion or frustration for some participants (see section 6.1 for a discussion of this from the first workshop).

2.1 Understanding The Jargon – Building A Common Language Dictionary

The following are some of the terminologies you will see used in this report. To counter misunderstandings, we have defined them here as they are used in the context of the causal diagram explored further in s.4.

Table 1: Common language dictionary for this report

Term	Description in the context of this report
Indicators	These are used to help measure changes in something that we wish to monitor. Within Te Ao Maaori, these may also be interpreted as 'tohu' or observable signs of change.
Health & Wellbeing (HWB)	This refers to the state, or integrity of our communities and environment in relation to the types of interactions – positive or compromised – between them. Features explored within health and

[6] For a detailed introduction to the concepts of Systems Thinking, the reader is referred to The Fifth Discipline – the art and practice of the learning organisation (2nd ed) by Peter Senge (2006) as an accessible introduction.

Term	Description in the context of this report
	wellbeing assessments include cultural, physical, spiritual, and metaphysical.
Qualitative tools	Qualitative tools are developed by capturing the experiences, language and values of the intended audiences/users. These may be underpinned with narratives to guide how the tools are most appropriately used. This contrasts with ***quan****titative tools* which are (generally) based on numbers and/or counts, e.g., freshwater monitoring tools like the MCI (Macroinvertebrate Community Index).
Conceptual frameworks	These are visual representations of relationships that might be expected between the different variables or characteristics that are being studied. In the example in this report, this includes relationships between communities and the environment in a climate changing future, but as understood through a tangata whenua lens.
Cultural	In the context of this report, this refers to taonga tuku iho, practices and traditions of tangata whenua, i.e., the whaanau, hapuu and iwi of Te Puuaha o Waikato.
Desired level or state	The point of achievement of a goal or strategy as defined by whaanau of Te Puuaha o Waikato. It is useful to acknowledge the factors that facilitate, change or limit the necessary conditions towards achieving that state, rather than on the outcome alone. These points of influence – no matter how subtle - are often where the most important learnings for responding to climate change (for example) can be observed.

3 How to read the causal diagram outlined in this report.

- **J. Connolly**

At the core of causal diagrams is the visualisation of the relationships between different features to better understand their interactions and influences on each other. This resultant relationship is depicted as a 'causal structure'.

This section outlines important fundamental elements of causal structure. These are: feedback loops; how they are annotated; and the use of the 'goal/gap' structure (as this can explain how different loops dominant at different times).

3.1 Feedback loops – the basic building blocks of a causal diagram

Causal diagrams are especially interested in systems where loops of causality are identified – these are called feedback loops. There are two types of feedback loops, reinforcing and balancing (Senge, 2006).

Reinforcing loops tend to drive growth or decline. A simple example of a reinforcing loop is money in a bank account earning interest. Assuming no withdrawals, the *more* money in the bank then the *more* interest earned, thus resulting in even *more* money in the bank. This influences back on itself in the same direction and has the effect of compounding on itself.

Balancing loops tend to create control, restraint or resistance. A simple example of a balancing loop is thermostat-controlled heating. Let's say that the room temperature *drops* so the thermostat clicks on and *generates heating*, this *increases* the room temperature, so the thermostat clicks off, *stopping the heating*. This has the effect of cancelling itself out.

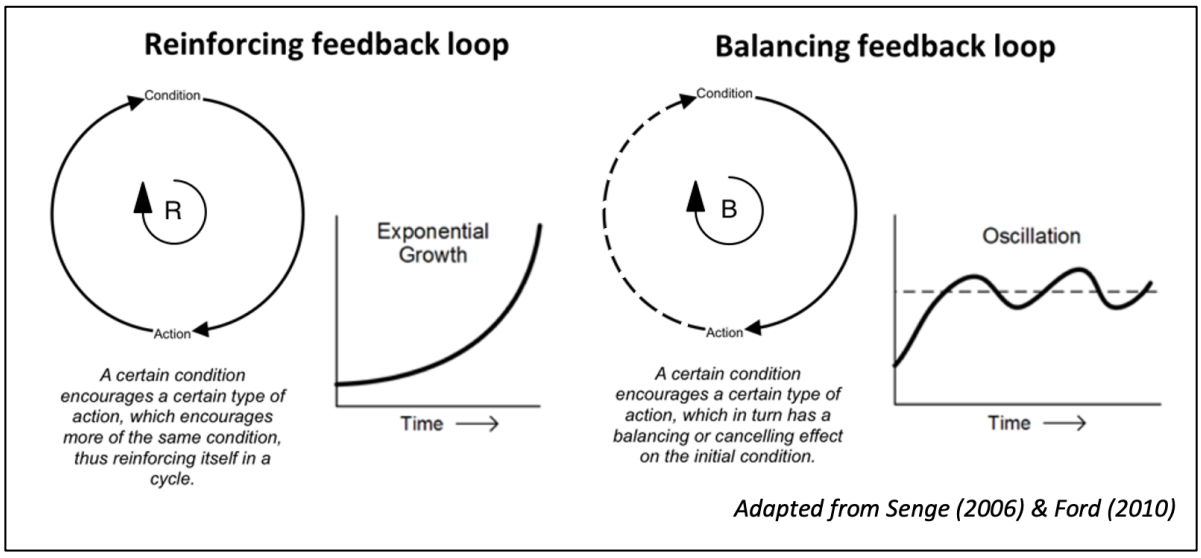


Figure 1. **The two types of feedback loops.**

Feedback loops can be made up of more than two variables and can be linked together to form a causal diagram. How these interact in a wider network of loops provides insight into the influences that may be causing a change.

3.2 Labelling variables

An important concept within causal loop maps is the process of build-up (accumulation) or decrease (decumulation) between the connected variables. The simple analogy of a bathtub is often used to describe this. In causal diagrams, accumulation is captured by describing variables in such a way that their name implies they can increase or decrease. This means that they should be described as nouns; have a clear sense of direction; and/or have a normal sense of direction that is positive. Examples to demonstrate this are shown in Figure 2.

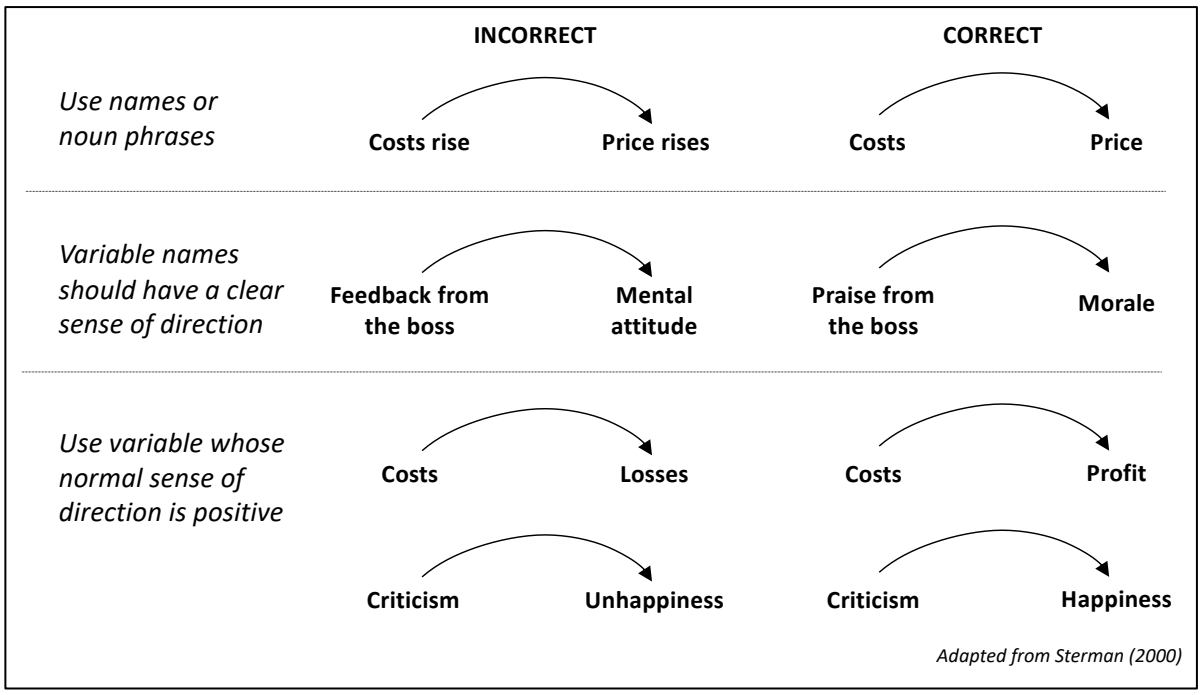


Figure 2. **Labelling variables**

3.3 Annotating loops

Variables within causal loop maps are connected (and made into feedback loops) by arrows, indicating that one factor has a causal relationship with the next. These arrows are **solid or dashed lines**, because they work in either the **'same' or 'opposite' direction**. These terms correspond to the direction of change caused by one variable on another.

For example, if change in one variable leads to change in the next variable in the *same direction*, it is a *same relationship*. Likewise, if the second variable changes in the *opposite direction*, it is an *opposite relationship*. See Figure 3 for a visual description.

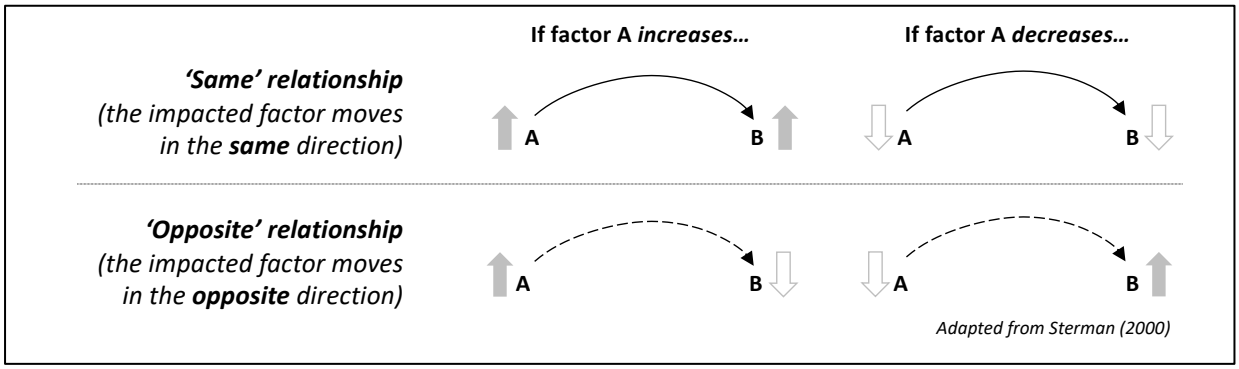


Figure 3. **How arrows are labelled in system maps**

Delays in influence between two variables, when compared to other influences outlined in the casual diagram, is annotated as a *double line crossing the arrow*. An example of this is shown in **figure 4**.

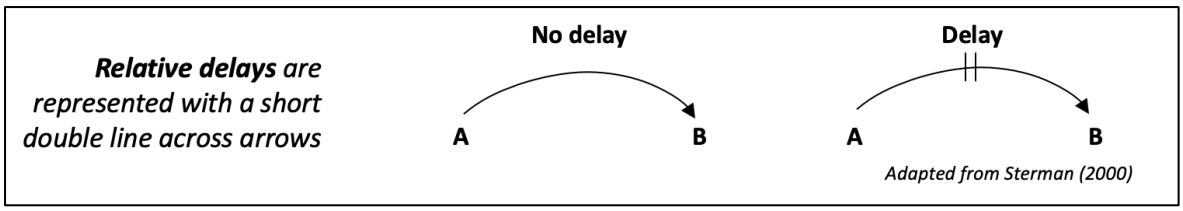


Figure 4. **How delays are annotated on arrows**

3.4 Goals and gaps – driving individual loop dominance.

Realising that multiple loops are operating together to generate the behaviour you are trying to understand is the first useful insight of causal loop mapping. A further useful insight is understanding that not all loops operate at the same strength all the time. Different loops can dominate at different times. For example, the behaviour generated by your causal diagram might be dominated by a period of growth, but when a physical limit is approached (e.g., the available space in a pond for algae to grow) a balancing loop will start to dominate, therefore slowing the rate of growth.

One useful mechanism for gaining insight into the strength of a balancing loop is *'goal/gap' structure*. This is a feature on the casual diagram that combines both the *desired or aspirational level* for something (a 'goal'), with its *actual* level. The difference between these – aspiration versus actual - is the 'gap'. The higher the desired level and the lower the actual level, **the greater the 'gap'**. The result is movement towards activities/decisions that narrow the gap between desired and actual. The lower the desired level and the higher the actual level, **the lower the 'gap'**. This usually leads to decreases in activity because it is nearer to its goal.

An example is shown in Figure 5, which shows an example of filling a glass of water. Initially, while the gap/difference between the desired and actual water level is high, the tap will be opened more. As the desired level of water is approached the gap/difference reduces, so the tap is closed further, until it is fully closed when the water level reaches the desired amount.

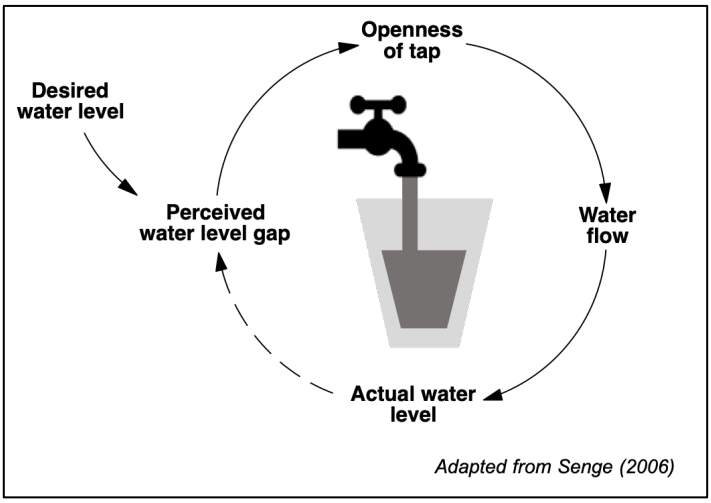


Figure 5. **Example of a 'goal/gap' structure in a system map – pouring a glass of water**

The 'goal/gap' mechanism – represented through He Maimai Aroha - can be seen in the causal diagram described in this report, where it plays an important role.

4 Exploring tangata whenua perspectives of change and response.

- **R. Mahuta, C. van Schravendijk-Goodman & J. Connolly.**

'Look at it as opportunity as opposed to a negative push. Let us look at those adaptive things as an opportunity rather than a loss.' - Braden Te Ao.

The causal diagram process with tangata whenua representatives from Te Puuaha (tangata whenua roopu) involved three key hui with the following kaupapa during each:

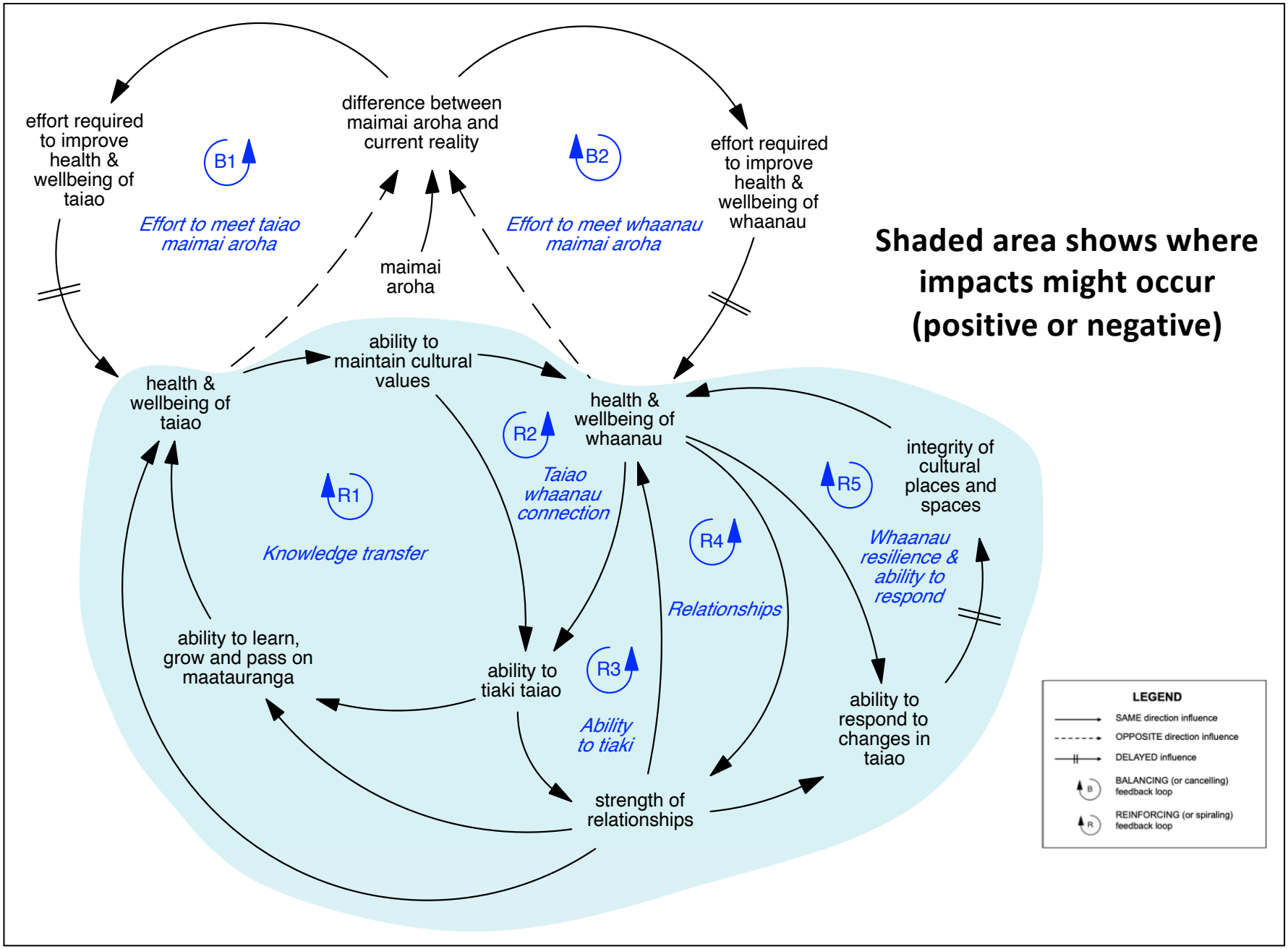
> ***Hui 1*** – an introduction to the concept of causal diagrams, followed by an exploratory discussion with the roopu about their values, and how decisions or actions might be prioritised within their worldview.
>
> ***Hui 2*** – presentation back to the roopu of how their information in hui 1 was interpreted by the research team in the form of a schematic outlining their values, and how these might interact as drivers, ends and means within decision making related to climate change as an example. The roopu were also given an opportunity to begin compiling ideas with Justin for a causal diagram using the example of opportunities from climate change to guide the discussion.
>
> ***Hui 3*** – Presentation back to the roopu of the final causal diagram and a process of confirmation with them about its appropriate use and publication.

This section of the report further explores the final causal diagram and summarises its key features:

- The progression towards He Maimai Aroha as a key anchor for the causal diagram
- The key points of interaction
- Key loops.

Whilst climate change was the driver behind this research output, the overarching mission of the team was to generate a tool that could be utilised by our roopu members and wider Te Puuaha communities across a broader range of spaces. It is for this reason that we do not use language directly pointing to climate change, although there are connections alluded to this within the diagram and its underlying narratives.

The next page presents the causal diagram in its entirety. The narrative that follows will explore the casual diagram. Note that numbering of feedback loops (i.e., 'B1', 'R1', 'R2' etc) is used simply to differentiate loops. These numbers do not indicate any greater priority or influence.


effort required to improve health & wellbeing of taiao
difference between maimai aroha and current reality
effort required to improve health & wellbeing of whaanau
B1
B2
Effort to meet taiao maimai aroha
maimai aroha
Effort to meet whaanau maimai aroha
Shaded area shows where impacts might occur (positive or negative)
health & wellbeing of taiao
ability to maintain cultural values
health & wellbeing of whaanau
integrity of cultural places and spaces
R1
R2
R3
R4
R5
Knowledge transfer
Taiao whaanau connection
Relationships
Whaanau resilience & ability to respond
ability to learn, grow and pass on maatauranga
ability to tiaki taiao
Ability to tiaki
ability to respond to changes in taiao
strength of relationships
LEGEND
SAME direction influence
OPPOSITE direction influence
DELAYED influence
BALANCING (or cancelling) feedback loop
REINFORCING (or spiraling) feedback loop

4.1 He Maimai Aroha

After Raupatu in 1863, Waikato Maaori were forced off their lands by the government and took refuge in the rohe of Ngaati Maniapoto (AKA 'the King Country'). With the knowledge that he and his people may not see the Waikato River, and its affiliated maunga and whenua for a long time, Kiingi Taawhiao, composed a lament. This lament is known as his maimai aroha - an expression of affection, but also of profound loss.

The maimai aroha of Kiingi Taawhiao paints a clear mental picture about the state of the river catchment, providing a baseline about a point in time when settlement-related activities had not yet had an impact on the land. As a result, he maimai aroha is considered a key driver for Waikato-Tainui social-environmental decision-making and strategic planning (WTTKI, 2013), but also has been identified for guiding Te Puuaha aspirations within this project.

Within the context of this causal diagram, he maimai aroha calls to the restoration of both environmental and community health and wellbeing to a state like that observed by Kiingi Taawhiao when he composed it. Inherent within this is an acknowledgement that it is a multi-generational journey for whaanau and their River. It is therefore an 'anchor' for the causal diagram and has the potential to become the key indicator framework for assessing and monitoring how successful we are as a society in achieving that ('*the difference between the maimai aroha and reality*')[7] as captured under the 'efforts'.

For future use of this causal diagram by Te Puuaha whaanau (and/or others), it will be possible to insert other examples of 'desired states' where he maimai aroha sits as part of working towards an outcome important to the whaanau. In these situations, he maimai aroha might then become an overarching aspiration, with each new iteration of the causal diagram and each new 'desired state' reference being treated as part of the steps to help whaanau work towards achieving that broader goal. For this report, we have kept it as is, to help us explain its potential use (see **s.5** later).

4.2 Key points of interaction within the diagram

'All life is part of taiao. For tangata and whaanau to be well, taiao must be in a healthy state.' - Donna Kerridge[8]

Within the casual diagram are key points of interaction identified by the Tangata whenua roopu which in turn help define the different loops (see **section 4.3** for more information about the loops). These are underpinned by a set of values which were defined by the Roopu (more information about these will be outlined in a paper: Mahuta *et al*., currently in press). Indicators relevant to the monitoring of these can be designed with whaanau 'at place'. The key interaction points are summarised in the table below:

[7] Noting here too that it is a journey that Te Puuaha cannot carry solely on their own but will also require the support and investment from others including the tribal authority and appropriate councils and other government agencies.

[8] Themes for this section are taken from the hui transcripts with the Tangata Whenua Roopu.

Table 2: Summary of key interaction points

Theme	Description
Health & wellbeing of Te Taiao	The general state, condition or health of the natural environment. This presents in many ways and includes the health of whenua (land); wai (water); awa (rivers); ngaahere (forests); repo (wetlands); as well as affiliated (native and endemic) species. And because of our connection to te taiao via whakapapa and as practiced via value systems such as tuakana-teina, our marae, whaanau, hapuu and iwi communities are also viewed as being part of this.
Ability to maintain cultural values	Cultural values are a central part of the ways Maaori view the world. They are both tangible and intangible, covering everything from the responsibilities that Maaori have through to the way that their daily life is lived according to traditions and cultural practices.
Health & wellbeing of whaanau	The general state, condition or health of tangata whenua, including their physical, mental and spiritual health and wellbeing. This manifests in many ways, such as (but not limited to): their physical health and wellness; their mental health and wellness; the strength and health of their connections and relationships with whaanau, hapuu and iwi; their connection and relationships with te taiao and their tuupuna; and their comfort and confidence in (and their ability to express) their identity.
Integrity of cultural places and spaces	The integrity of places and spaces that are important to whaanau as a part of their cultural identity. This can include landscapes (e.g., mountains, rivers, forests), as well as man-made places (e.g., marae).

4.3 Key interaction/reinforcing loops

'…this particular project has quite a unique context, historical context, because it involves confiscation of both land and water from a people, which is now I guess compounded the issues that we're, our people are facing in the Lower Waikato. You throw all that historical context into the equation, it actually makes like climate change, sea-level rise issue even more complicated.'

- Tim Manukau.

Each of the interaction points outlined in **section 4.2** (above) as identified by the Roopu were noted as circling around key mechanisms or processes that facilitate responses or feedbacks. These feedback loops might then either enhance (spiral up) or exacerbate (spiral down) an outcome as a reinforcing loop (denoted by **R** on the diagram). The example of the quote from Tim Manukau above, is one of the myriads of challenges that whaanau in Te Puuaha (but also elsewhere in Aotearoa) face in light of climate change impacts such as sea-level rise.

It is the task of the users of the diagram - as either an implementer and/or decision-maker - to identify points of influence in the reinforcing loops to leverage directional responses that will generate change needed to meet the aspirations of whaanau (he maimai aroha).

The loops are summarised in more detail in table 3 below.

Table 3: Summary of key interaction/ reinforcing loops

Loop	Description
R1: Knowledge transfer	This occurs through active engagement with the environment and provides the opportunity for creating platforms for intergenerational exchanges of knowledge, language and practices.
R2: Taiao-Whaanau Connection	The health and wellbeing of one is linked to and supported by the health and wellbeing of the other.
R3: Ability to Tiaki	The application of the best available tools and information (maatauranga and science) to support protection and enhancement of the health and wellbeing of the environment.
R4: Relationships	The strength of whaanau, hapuu, iwi and inter-iwi relationships. Whanaungatanga (relationships) and reciprocity between and within whaanau is a critical component of identity, and therefore community and environmental health and wellbeing.
R5: Ability to respond to changes in Te Taiao	Much discussion in the climate change space talks of 'adaptation'. This was considered by the whaanau as a reactive framing and does not allow for positive agency that whaanau have in their relationship with the environment. The term 'respond' as used here is intended to have a wider framing than 'adaptation' with focus on ***opportunities*** as well as ***challenges***.

5 Using the causal diagram to explore impacts and influence

- **R. Mahuta, C. van Schravendijk-Goodman & J. Connolly.**

5.1 The difference between our desired state and our current reality

To begin with we must lay bare the truth of history, for he who does not know the past will never understand the present. – Waitangi Tribunal (1985)

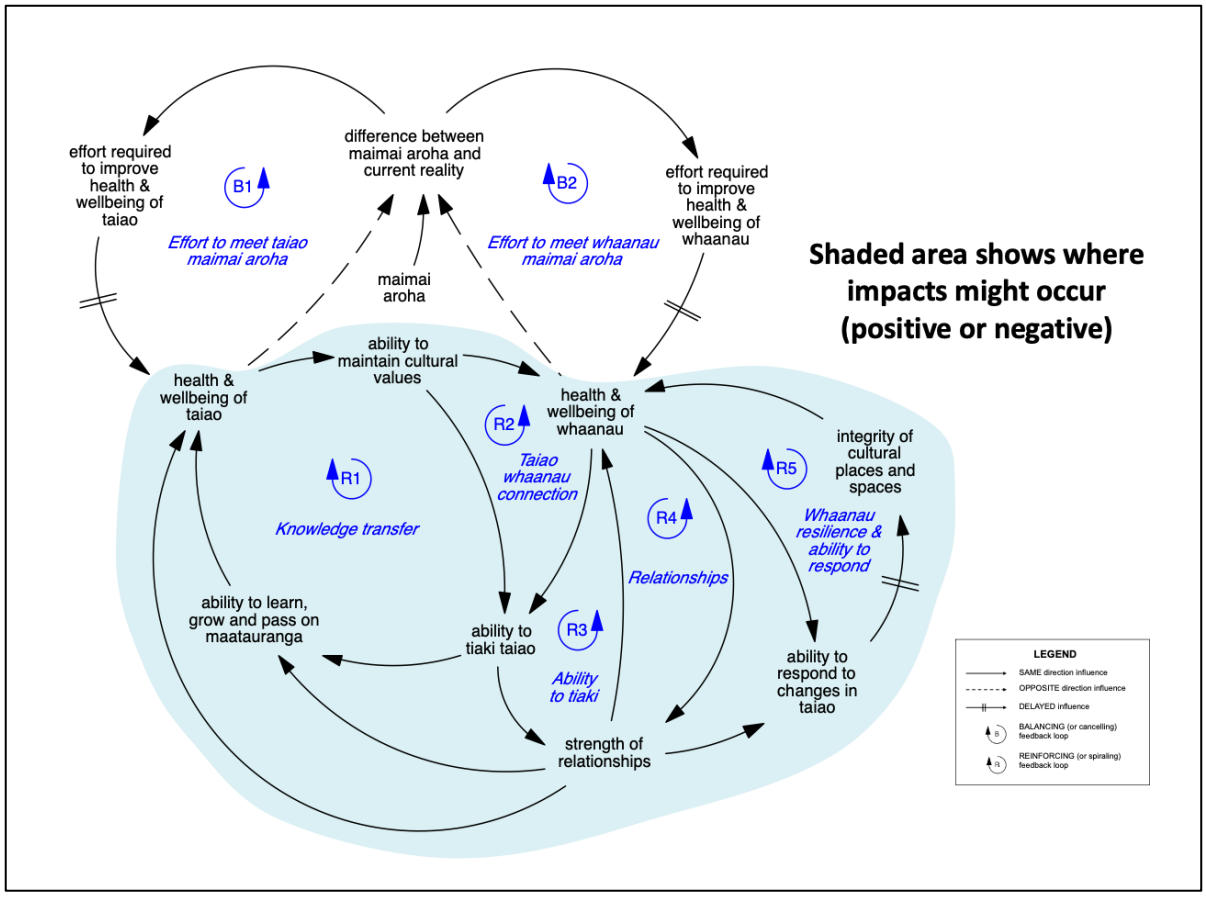
It cannot be stressed enough, the profound impact that Raupatu had on the peoples of Waikato (Mahuta, 1993)[9], and the influence that it can and will continue to have regarding how our people in Te Puuaha can best respond to climate change.

When Kiingi Taawhiao first composed he maimai aroha the following observations could be made:

- There were no barriers to flow of the River such as hydrodams and stopbanks. This meant the River could maintain natural patterns of movement across the landscape to sea, with associated peaks of high-energy inundation events, followed by moments of calm as is typical of a large and dynamic river system.
- There were still large tracts of a diverse range of wetland systems within the catchment – from the geothermal systems near Taupoo-nui-aa-Tia, to swamps, fens and peatlands in the lower catchment, and then out to the coastal wetlands found in the estuary of Te Puuaha and the dune lake systems along the west coast.
- There were still large areas of mature native forest with towering kahikatea, northern raataa, kauri, tootara and miro stands.
- The lakes were pristine and were bordered by robust ecosystems with a diversity of animal and plant life.
- The large municipalities that we know today, such as Hamilton and Auckland were not threatening to swallow up the ecologically and economically productive lands that were known to the peoples of Waikato with the extensive expressways, industry and reclaimed land we recognise now.
- Peoples of Waikato were prosperous, at least from a quality-of-life point-of-view. They successfully maintained large gardens which also served to help 'feed England and the colonies'. They were successful traders and entrepreneurs with their own currency and bank. They had access to a diverse range of natural resources with healthy populations that kept their people sustained and nourished for centuries. But most importantly, they were confident in who they were as a people, in their knowledge systems, in their socio-economic structures and in their relationship with their River and their cultural story-, and memory-scapes.

These strengths and points of success were all undermined with Raupatu; as was the integrity of the environment. Rather than dwell on the negative though, our Tangata Whenua Roopu viewed a climate changing world as something that we should be wary of, but also view as a potentially beneficial reset. Within that reset there may manifest associated advantages accruing to both human communities and the environment. They highlighted that we needed to be brave enough to draw on and learn from our experiences of the past, underpinned with the values that held our people stable after Raupatu to design the best responses we need for our new future.

[9] Also see Fisher (2016) for a synopsis of the discussions related to the historical accounts to be included in the River Settlement which highlights the differing ways the Crown viewed Raupatu in comparison to that of Waikato-Tainui.



The causal diagram (shown again, above) that emerged from the discussions with our Tangata Whenua Roopu highlighted that it can be used at a higher, strategic level to explore how impacts or changes might be characterised. For example, *could changes that whaanau are concerned about most be characterised as changes in their ability to build and maintain relationships with each other or might they be direct physical impacts on their health?* It is of course possible that some impacts might also influence multiple factors, so the diagram can be used to reflect on the definition of both what the impacts **are** and what they may impact **on**. The 'difference between maimai aroha and current reality' therefore, drives the effort to improve both the health & wellbeing of te taiao and whaanau concurrently, recognising that within the worldview of whaanau from Te Puuaha, both are intimately intertwined.

5.2 Effort to improve the health & wellbeing of te taiao & whaanau

'Going back to come forward…we have to go back to the Taiao and revisit how we fix that. Because at the end of the day we created it. We need to fix it otherwise it's not going to sustain us no matter what we do.' – Patience Te Ao

The health and wellbeing of te taiao, adjacent to that of whaanau, are shown as separate but connected factors, forming two key reinforcing loops (**R1 & R2**), which then influence the outcomes sought within the balancing loops ('effort'; **B1 & B2**).

To recap: a reinforcing loop emphasises the direction of responses. In the example of the causal diagram, the arrows are indicating progression towards enhanced health and wellbeing of te taiao and whaanau. However, when the flow moves in the opposite direction, this can reinforce the wrong type of response and exacerbate pressures or impacts. It becomes the prerogative of those in the decision-making and/or strategic planning positions to identify the triggers that can facilitate the loops in the preferred but also, the opposite direction so that they can be proactively enhanced or remedied[10].

The diagram can, therefore, be used to identify important feedback loops that may be impacted, not just individual factors. For example, koorero and use of the causal diagram may highlight that the knowledge transfer loop is being most influenced by a particular impact (e.g., declines in some aspects of maatauranga due to decline in cultural places and spaces). These insights can be used to help understand and direct effort into the feedback loops that may be most affected or are considered most useful to strengthen.

Balancing loops on the other hand are the components of the diagram that seek to stabilise and maintain the system[11]. They can become important tools to identify the causes for destabilisation because they highlight that corrective actions are needed to reduce the discrepancy between the components and bring the system closer to achieving the goal, or desired state. In the case of this causal diagram, those triggers relate to 'effort'. The bigger the difference between the desired state and current reality, the greater the effort required to bring them into balance. And as the gap closes, the effort required will reduce. If the current reality comes into balance with the desired state, then no further effort will be required. A delay is shown on the two influences from the 'effort to improve' factors to the 'health & wellbeing' factors. This is because any effort will take time to present in improvement in either the health & wellbeing of te taiao or whaanau.

5.3 Conclusion

'It's the law of Moorehu. You survive to protect your whakapapa and your legacy.' - Makere Rika-Heke.

In the search to find tools and information to help whaanau navigate the uncertainties of climate change, it is imperative that engagement occurs with those 'at place' who have an intimate understanding of the landscapes and communities that are going to be the most affected by the changes.

As part of the Future Coasts Aotearoa programme, and the wider climate resilience and response strategy developed by Rangi Mahuta for her people, the goal within a Te Puuaha case study was to build a kete of useful tools that whaanau could use. The development of a

[10] For more on this see: https://thesystemsthinker.com/anatomy-of-a-reinforcing-loop/

[11] Also see: https://thesystemsthinker.com/balancing-loop-basics/#:~:text=The%20basic%20structure%20of%20a,to%20bring%20conditions%20into%20equilibrium and https://untools.co/balancing-feedback-loop

causal diagram with tangata whenua representatives affiliated with Te Puuaha was one means for us to do this, although it is not the only mechanism that can do so.

As indicated in this report, the application of the causal diagram is ultimately to help show matters of priority and/or concern for whaanau, and the types of actions we could take to plug the gaps in a climate changing future. Exploring how influences flow downstream from a factor, or those influences that are upstream of a factor and flowing to it, is also a useful way of using the diagram. This can provide insights into what impact any action being discussed might enable. Or similarly, what actions might be required in other factors ‘upstream’ of the factor where change is desired.

Insights with the causal diagram remain qualitative. Yet these can be coupled with koorero and knowledge to generate useful insights and understandings. It is the intention for further work in our Te Puuaha case study to support qualitative models like this with a range of quantitative tools such as modelling and feasibilities for different options. Some of this work has recently been completed (see reports from Garrett, 2023 & WT Partnership, 2023), and others are currently in train and due for release soon (Holland et al., in draft).

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