GUIDELINES FOR UNDERTAKING A CULTURAL FLOW PREFERENCE STUDY

Prepared by
Tipa & Associates Ltd
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Acknowledgements

This Guideline describes a method that has been developed and trialed under the NIWA Sustainable Water Allocation Programme, which is funded by MBIE.

It is a participatory method that it dependent on the active engagement of Manawhenua. We are grateful to the whanau and hapu across New Zealand who have shown faith in this kaupapa and allowed us to work with them.

Kyle Nelson (Tipa and Associates Ltd), Mandy Waaka-Home (NIWA) and Myra Tipa deserve special mention and a huge “Thank you”.

This Guideline represents the culmination of a body of work, but there is further mahi to be completed if the beliefs, rights and practices of whanau and hapu are to be meaningfully represented in flow regimes and allocative decisions.

Kua tawhiti ke te harereka,
kia kore e haere tonu.
He tino nui rawa ou mahi,
kia kore e mahi nui tonu.

We have come too far, not to go further.
We have done too much, not to do more

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Executive Summary

In New Zealand, modifications to rivers and streams in New Zealand over the last hundred years have shown the waters of many catchments can be managed primarily as an economic resource that can be dammed, stored, diverted and extracted for use. Competing uses have resulted in many degraded water systems. This may conflict with Māori cultural values of those same waters. If the interests of Maori are to be weighed alongside the needs of other populations, and if environmental flow assessments and allocative decision-making are to benefit from the knowledge of whanau, hapū and iwi, new techniques are needed to assess the appropriateness of flows in culturally sensitive ways.

This Guideline describes ways in which whanau, hapū and iwi can identify their preferences with respect to the flow regimes that they want to see in streams and rivers. In effect it is a guide to show how they can identify their cultural flow preferences. We present some of the results of cultural flow preference studies. We describe how we train whanau members to undertake a study, and how to interface with scientists and resource managers undertaking other flow assessments. References to other publications with more detailed information that may help Manawhenua are also provided.

This Guideline contains eight chapters. Its focus is to set out the information that Manawhenua need to undertake a Cultural Flow Preference Study. It represents the "how to" part of this guideline. It

- introduces the process of Cultural Opportunity Mapping, Assessments and Responses (COMAR) as an integrative planning process that enables Manawhenua to inform freshwater management.
- provides examples of Cultural Flow Preference Studies (CFPS) that were completed in New Zealand catchments.
- describes the process that a whanau or hapu can follow to plan and implement their own Cultural Flow Preference Study. This includes data collection and data analysis. It then discusses how results can be presented.
- describes how the results of the Cultural Flow Preference Study can link with other flow assessments being undertaken by scientists and resource managers.
- discusses the theories that support a preference-based approach to flow setting.

Finally, the Guideline sets out several additional recommendations that relate to the planning context within which a CFPS will be undertaken.

It is recommended that resource managers / developers:

- Fully engage Manawhenua in every aspect of flow assessment and allocative decision-making.
- Be very clear about the Manawhenua values that the flow provisions are to recognise and provide for
- Focus on protecting whole, functioning ecosystems.
- Define flow needs using a holistic approach.
- Work collaboratively with inter-disciplinary diverse teams of scientists and other experts to make best use of available knowledge and tools, that can complement the Matauranga held by Manawhenua.
- Establish a sound hydrologic foundation to support recommended flow regimes.
- Include vulnerability and risk analyses as elements of flows assessment.
- Adopt a precautionary approach to flow management.
- Discuss with Manawhenua the purpose and practicality of applying adaptive management to the implementation of the recommended flow regime.
- Incorporate flow assessments as an integrated component of integrated water resources management.
- Formally recognise and embed Manawhenua engagement in flow setting in policy and regulatory frameworks.
- Invest in capacity-building from local to regional levels

Chapter 1 Introducing the Guidelines

Ko te wai te ora nga mea katoa
Water is the life giver of all things

Purpose of chapter

To explain the need for this Guideline.

Key questions

What is the purpose of the Guideline?

What is the structure of the Guideline?

What is the status of this Guideline?

Take away messages

The Guideline is a resource for Manawhenua to identify their preferred flows for a river or stream

1.0 Overview

Humans require access to reliable supplies of water to flourish. It is the only substance that all living things must have or die. "Nothing can live without water" (M. Walker, pers. com). Water helps define society and cultures. It affects where and how we live. Changes in the quantity and quality of freshwaters represent a strategic threat to humans, environmental sustainability and the "vitality of human cultures" (Ecological Society of America 1998). Historically, water was managed to maximise short-term economic growth from the use of water. Arguably, little thought was given to the implications of extraction and overuse on declining river health. Indigenous communities are particularly sensitive to modifications of freshwaters as they hold distinct perspectives which concern their identity, attachment to a territory, knowledge, and custodial obligations to manage tribal lands and waters (Sheehan 2001, Flanagan & Laituri 2004, Jackson et al. 2005).

New Zealand has some of the world's highest quality fresh water (United Nations 2003). However, variability in the occurrence of water means that New Zealand often has shortages because water is in the wrong place and at the wrong time. In addition, the relationship between water use and water quality may mean that while there is an abundance of water, high demand for quality waters may result in scarcity for certain uses. Issues can arise when, for instance, commercial, recreational, environmental and/or cultural uses are in competition for the same water.

In a New Zealand context, modifications to rivers and streams in New Zealand over the last hundred years have shown the waters of many catchments can also be managed

Photo 1: The braided character of the Waitaki is at risk from regulation of the river flow through damming.

Photo 2: The diversion of water through the Rangitata Diversion Race is an example of large scale river extraction.

Photo **3:** Irrigation via a central pivot system is promoted as an efficient means of applying water.

primarily as an economic resource that can be dammed, stored, diverted and extracted for use. Competing uses have resulted in many degraded water systems.

Māori have, for generations, voiced their concerns at the continual modification and manipulation of the waterways within their tribal territories (Waitangi Tribunal 1984, 1991, 1992, 1995). Most whanau, hapū and iwi can point to their experiences that show that almost all their experiences with water developments have been negative (see Box 1).

In the last two decades Māori have become more vocal in seeking greater recognition of their cultural beliefs, values, and practices. If the needs of Māori are to be seriously considered and weighed alongside the needs of other populations, and if environmental flow assessments and allocative decision-making are to benefit from the knowledge of whanau, hapū and iwi, new techniques are needed to assess the appropriateness of flows in culturally sensitive ways. This Guideline recommends ways in which whanau, hapū and iwi can identify their preferences with respect to the flow regimes that they want to see in streams and rivers, and the critical thresholds with respect to minimum flows. We present the results of cultural flow preference studies. We describe how we train whanau members to undertake a study, and how to interface with others doing other flow assessments. References to other publications with more detailed information that may help Tangata whenua are also provided.

BOX 1:

Impacts arising from modification to rivers (Waitangi Tribunal 1984, 1991, 1992, 1995)

- Wāhi tapu and wāhi taonga areas have been lost with a consequent loss of active associations and cultural relationships with the area.
- Previously valuable kai gathering areas and sources of cultural materials have been similarly destroyed or modified, and in instances access to existing resources has also been adversely affected.
- Fish movement within river systems has been disrupted; both of juveniles into the system and of mature adults attempting to leave the system e.g. hydro power generation physically preventing passage. The success of recent attempts to mitigate these effects is unknown.
- Newly created lake, canal and/or wetland systems are typically adopted enthusiastically by a range of users who then develop these areas as recreational fisheries and boating areas. This results in the further diminution of cultural interests and the erosion of rights in these areas.
- As with existing water allocation regimes in waters New Zealand, Manawhenua property interests in the ownership, management, usage and access to water resource never receives recognition let alone priority attention and are often subordinated to agricultural economic interests.
- The character of highly valued areas is irrevocably altered.
- The “minimum” flows may not be considered adequate for the maintenance of a water body’s mauri.
- Infrastructure construction can have serious environmental implications and can damage fishery and other cultural interests, sometimes irrevocably. Infrastructure has interrupted the continuity of flow from the source to the sea which conflicts with the holistic conceptualisations.

1.2 The Purpose of this Guideline

This Guideline is a structured process to improve the participation of Manawhenua in water management, in particular flow setting. The Guideline forms part of a suite of tools directed towards the recognition of Manawhenua and their management systems. The model of participation promoted in this Guideline progresses from initial engagement, to the identification of values through to the specification of flows sought by Manawhenua. The Guideline is based on multiple studies that have engaged Manawhenua and demonstrates the contribution that they can make to flow setting processes. The work has been carried out under the Sustainable Water Allocation Programme (SWAP).

The primary audience for the Guideline is Manawhenua, however, elements of the Guideline may be useful for resource managers and the wider community.

Photo 4: A whanau member who was being trained by a NIWA staff member to measure flows within a river[1].

[1] Neal Blair from the NIWA office in Alexandra is thanked for providing this opportunity.

1.3 The knowledge held by tangata whenua

It is the knowledge held by whanau and hapu members that informs the identification of cultural flow preferences. Harmsworth and Tipa (2006) explain the characteristics of matauranga Maori or knowledge held within whanau and hapu (see Box 2).

Knowledge of a river and the flow regimes needs to sustain its values and refers to the subset of Mātauranga Māori that is specific to the river environs and the relationship of whanau, hapū and iwi with that river. This is broadly conceived as encompassing knowledge of entities (sites, species, habitats), components (e.g., soils, waters, geology, astronomy, climate), the interrelationships among these, and the processes affecting their application (including human-made impacts). Because such knowledge is geared toward practical engagement and application, it is often bound together with resource utilization behaviours (such as mahinga kai). At the same time, vital aspects of Matauranga Maori are intimately associated with spiritual beliefs, notions of health and wellness and social behaviours.

Due to its multi-dimensional and interconnected nature, the demarcation of environmental knowledge from other kinds of Mātauranga Māori can be somewhat ambiguous and arbitrary. It is therefore important to work with the complete data set provided by Manawhenua rather than applying a filter to isolate that which is deemed to be traditional environmental knowledge (TEK) or in a New Zealand context matauranga Maori.

BOX 2:

1. Local: It is rooted to a particular place and set of experiences and is generated by the people living in those places.
2. Oral and visual transmission - it is transmitted orally or through imitation and demonstration and may be acquired through personal observations and experience. The mode of transmission is usually informal, based on participation in a range of customary activities, closely tied to the cultural and ecological context(s) in which it occurs.
3. Practical: It is the consequence of practical engagement in everyday life and is adapted or reinforced by experience, trial and error, and experiment. The lessons learned from these experiences are often accumulated and passed along from one generation to the next.
4. Repetitive: This is a defining characteristic, aiding retention and reinforcing ideas.
5. Dynamic: It changes, being produced as well as transformed, discovered or lost. This represents its practical responsiveness and connection to other characteristics of the surrounding social and physical environment. When the environmental context changes, indigenous knowledge, like Mātauranga Māori, will usually be impacted.
6. Shared: It is characteristically shared to a greater degree than other forms of knowledge even though its distribution within communities is uneven with some types of knowledge more widely disseminated than others.
7. Fragmentary: It is differentially distributed among community members.
8. Functional: It is organized and oriented toward the pragmatic fulfilment of identifiable goals, which specific to this project include health and well-being.
9. Holistic: It is integrated and situated within broader cultural traditions.

The process described in this Guideline is intended to help Manawhenua work collaboratively with others undertaking flow assessments and setting flows. It is not a tool that can be used to reconnect whanau with waters that they do not have an active association with. The knowledge that comes from living and interacting with a river across seasons and years needs to inform the process.

1.4 The need for a process for Manawhenua

We developed this preferred flow identification process for three reasons.

1. The first is that water is a taonga and a vital, irreplaceable life-giving resource. It links our past and our current lives to our future, because how we use water today will affect the vitality of our lives tomorrow. All of us depend upon water and its significance is affirmed through its special status in many cultural beliefs and practices.
2. We have a conviction that Manawhenua cultural practices have a very strong environmental basis and could enhance the management process; and secondly Manawhenua are obligated, as kaitiaki to protect the natural world. Developing these Guidelines recognises that the kaitiaki system is based on whakapapa and the inherited responsibility and the obligations of kaitiaki are inalienable. A group mandated from elsewhere, such as an environmental group, a CRI or the local Regional Council, cannot fulfill the obligation, as only Manawhenua can be mandated as kaitiaki. The application of the process described in this Guideline encourages a collaborative relationship between Manawhenua, consultants, scientists and resource management staff, and enables the parties to fulfill their respective inherited and statutory obligations.
3. Finally, this Guideline responds to the shortage of tools available for Manawhenua to use to inform flow setting processes. In contemporary society, statutory resource management agencies have an integral role in protecting freshwater resources as they have primary responsibility (pursuant to the Resource Management Act 1991) for controlling man's interaction with the environment. Manawhenua expect resource managers to recognise and provide for their cultural beliefs and practices given the statutory provisions in Part 2 of the Resource Management Act[2]. However, to protect a value, resource management agencies must possess an appreciation of the value and an understanding of the actions necessary to protect it. The difficulty for Manawhenua and resource management agencies to date has been the noticeable absence of appropriate tools and processes that ensure a Manawhenua perspective is incorporated. Water resource managers are now trying to come to terms with the need to take a more holistic view of the river system. This Guideline is intended to help fill this void and enable resource management agencies and Manawhenua to identify specific cultural concerns and identify the necessary management responses.

[2] See sections 5, 6(e), 7(a) and 8 of the Resource Management Act 1991.

1.5 The structure of this Guideline

This Guideline has been divided into several chapters:

Chapter 1 sets out the purpose, scope and structure of the Guideline.

Chapter 2 introduces the process of Cultural Opportunity Mapping, Assessments and Responses (COMAR) as an integrative planning process that enables tangata whenua to inform freshwater management more generally.

Chapter 3 focuses on one type of assessment - a Cultural Flow Preference Study - that has been applied in a few New Zealand catchments. It describes the process a whanau or hapu can follow to plan and implement their own Cultural Flow Preference Study. This chapter includes descriptions of data collection and data entry.

Chapter 4 describes the range of analyses that are undertaken to help whanau identify their preferred flow.

Chapter 5 provides examples of how the results of the Cultural Flow Preference Study have been presented to Manawhenua, stakeholders and agencies.

Chapter 6 describes how to link the CFPS with other flow assessments being undertaken using different methods.

Chapter 7 situates a focus on cultural opportunities and cultural flow preferences within an international context.

Chapter 8 concludes the report with a series of recommendations.

1.6 Status of this Guideline

This Guideline's principal purpose is to inform and aid Manawhenua. It contains narrative only and is not to be misconstrued as policy. It is **not** an iwi planning document and is not to be accorded any status in law. For resource managers it explains the basis for the method and the results that can be expected.

It is hoped however that the method in this Guideline and the resultant flow preferences are in time included in iwi management plans, and the relevant statutory plans.

1.7 Challenges & risks facing Tangata Whenua

A Maori worldview is holistic and stresses the interconnectedness and interdependence of the environment, resources, and people (Marsden 1992, Crengle 2002, Rochford 2003). This Guideline however requires Manawhenua to focus on one aspect of catchment health (stream flow) and to make assessments that involve quantitative measurements (and aggregation). Many may argue that this approach is reductionist. However, we make no apologies for the framework and methods presented in this Guideline. We would respond to this possible criticism by arguing that the default positions sometimes advocated by Manawhenua could also be described as reductionist -

- Seeking flows to sustain (say) inanga habitats, possibly to the detriment of other values, beliefs, uses and practices; or
- Advocating for flows to protect a swimming hole favours and quantifies the flow needed to enable that use.

As we progress through this Guideline we explain how cultural conceptualisations of a holistic river system enable identification of the flows necessary to sustain a range of cultural beliefs, values and uses Manawhenua associate with that catchment. We then conclude by identifying how these individual components can be integrated into a holistic iwi planning process.

1.8 Integration

The authors, along with many other Maori researchers, have developed tools for application by Manawhenua (Nelson and Tipa, 2012). In this Guideline we try to identify how these initiatives can be integrated, thus potentially simplifying planning processes for Manawhenua.

Photo 5: Recreational areas are likely to require specific flow characteristics e.g. deep water in pools to enable jumping in.

Chapter 2
Introducing Cultural Opportunity Mapping Assessments and Responses (COMAR)

We must begin thinking like a river if we are to leave a legacy of beauty and life for future generations
(David Brower)

Purpose of chapter

To introduce an integrative planning framework – Cultural Opportunity Mapping, Assessment and Responses (COMAR) - that can be used by Manawhenua

Key questions

What is COMAR?

Take away messages

COMAR is a multiple step integrative framework

Maori have a range of assessment tools they can utilise.

2.1 Introduction

In this Chapter we present the conceptual framework we used to structure the participation of Manawhenua (in this instance Ngai Tahu) in freshwater management. It responds to the values of Manawhenua and recognizes that their knowledge of the environment is fundamentally different in its treatment of human/nature interactions to that of non-Maori and is a valuable addition to contemporary freshwater management. Secondly, the conceptual framework is proposed as an integrative iwi planning framework that can be applied in many resource management contexts.

2.2 An integrative way forward

The framework proposed explicitly recognizes that Manawhenua engage in planning processes to achieve specific **cultural outcomes.** The impetus for engagement is often concern that their takiwa has been altered and degraded by resource use and development. The causes of many of the alterations can often be identified by Manawhenua, with the incremental degradation experienced over successive generations also described. Consequently, Manawhenua are active in several resource management forums and have multiple restorative initiatives underway. What may be at issue, however, is the extent to which these initiatives inform and shape contemporary resource management and the extent to which contemporary management delivers the outcomes sought by Manawhenua. With limited capacity within whanau, hapu and iwi, it is imperative that the projects undertaken do enable more effective participation, which will be judged by the outcomes delivered. An integrative process that has been trialed within the rohe of Ngai Tahu is shown in Figure 1 (next page).

This process has three parallel streams –

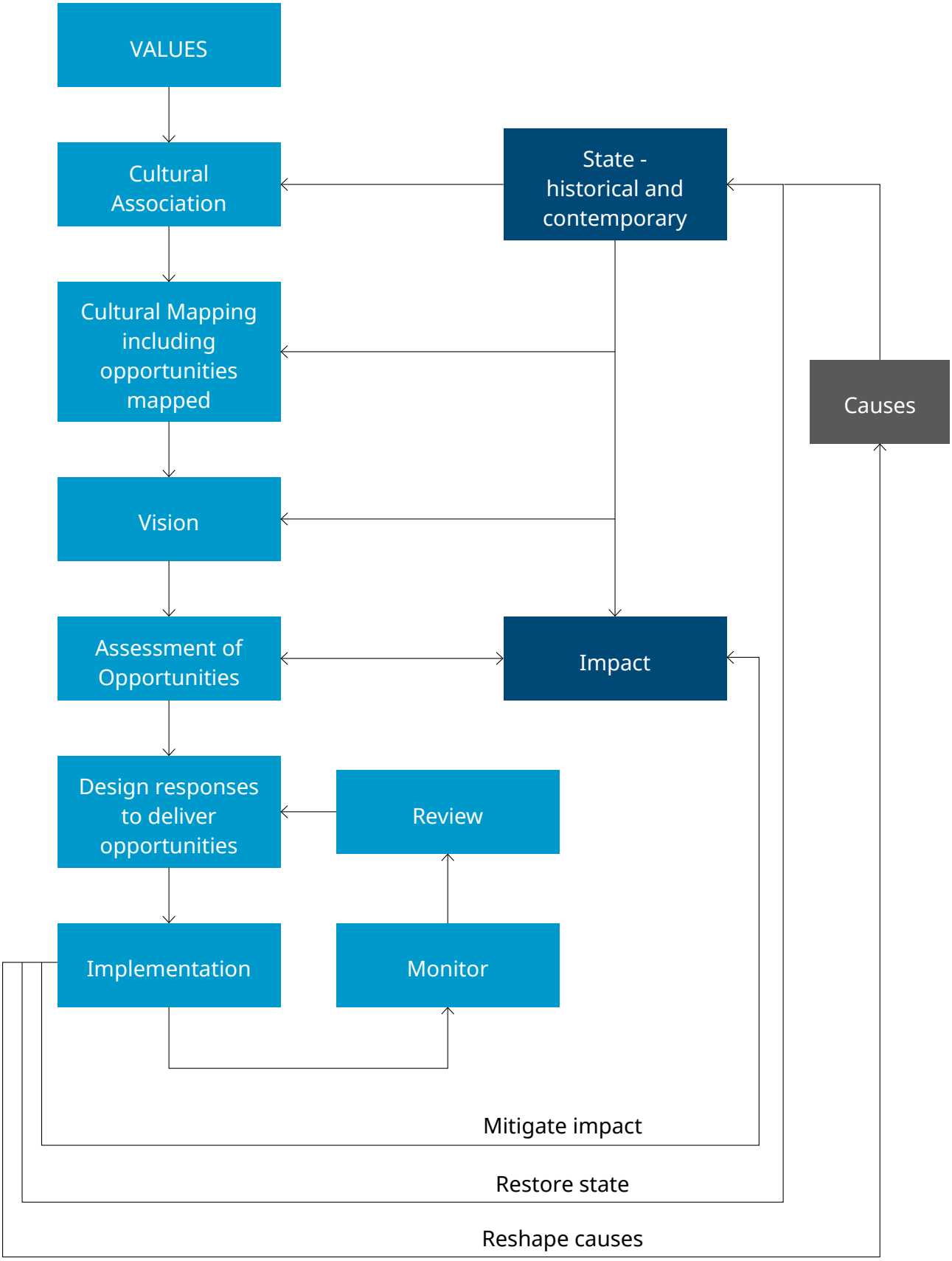
1. identifying the opportunities Manawhenua want to see delivered that drive their engagement in resource management forums;

2. identifying the causes of changes being experienced by Manawhenua; and

3. examining the nature and extent (or scale) of alterations to valued environments.

This process has, as its central tenet, delivering cultural outcomes to Manawhenua. However, it also requires examination of the causes of alterations, and the scale of the alterations that have resulted in cultural impacts both positive and negative being experienced by Manawhenua. Ultimately it is these impacts that may serve to limit realisation of outcomes. Each of the components in Figure 1 is described in the paragraphs that follow.

Figure 1: An example of an integrative planning framework



2.2.1 Stream 1 - Delivering cultural opportunities for Manawhenua

Values - *What are the values and significance of the area / resource?*

'Value' is a subjective concept, but one that lies at the heart of the reason Manawhenua engage in freshwater management. The critical point is that cultural values, beliefs and practices from which the later assessments and responses, are constructed are directly linked to values, including site specific values. Attributes of the respective beliefs, values or cultural practices are documented in this step in the process (Tipa, 2010). Maori values are often detailed in resource management documents including Cultural Impact Assessments[3] and Cultural Values Reports[4]. Although section 6(e) requires managers to recognise and provide for these cultural concepts, it is not always explicit how this occurs within current management processes, especially flow setting processes.

Cultural Association - This step provides a general overview of the relationships of Manawhenua with the defined area or resource and as noted above is akin to a Cultural Values Report. Methods of data collection include hui and interviews with key informants (mandated by Manawhenua) to explore the diversity and complexity of cultural relationships with a catchment before defining how their relationship and interactions are affected by aquatic conditions. Gaining perceptions of changes to conditions over time, and the impact of these changes on values and practices, is fundamental. We acknowledge that whanau across New Zealand are already engaged in documenting their association with freshwater.

Cultural Mapping, including cultural opportunity mapping - The process for identifying the cultural aspirations of Manawhenua is via an attention to cultural opportunities. Aquatic conditions can impact the quality and condition of a site and consequently the opportunities afforded Maori. Significantly, these same aquatic conditions can also be manipulated to provide cultural opportunities. This stage, however, is premised on Manawhenua being able to describe the opportunities they seek. Diversity of belief, value and practice is accommodated within the process as the cultural opportunities sought are informed by traditional, historic and/or contemporary values of participants, and may be akin to ecological, economic, recreational, aesthetic and social opportunities sought by others, while some are distinctly cultural. Importantly it does not separate economic aspirations from a cultural context.

Graphically representing interests has been used successfully in environmental conservation (Puginier, 1999). Using a participatory mapping methodology also recognises that visual depictions, especially maps and aerial photographs, are an important tool for communicating with hapu and whanau. They can be used at a variety of scales and have the potential to integrate with GIS to further manipulate and analyse data in different themes or layers to produce an overall map/dataset that can be useful for a range of planning purposes. Figure 2 is an example of a topographical maps upon which Manawhenua marked their cultural interests during a mapping exercise.

[3] See www.qualityplanning.org.nz.

[4] See www.qualityplanning.org.nz.

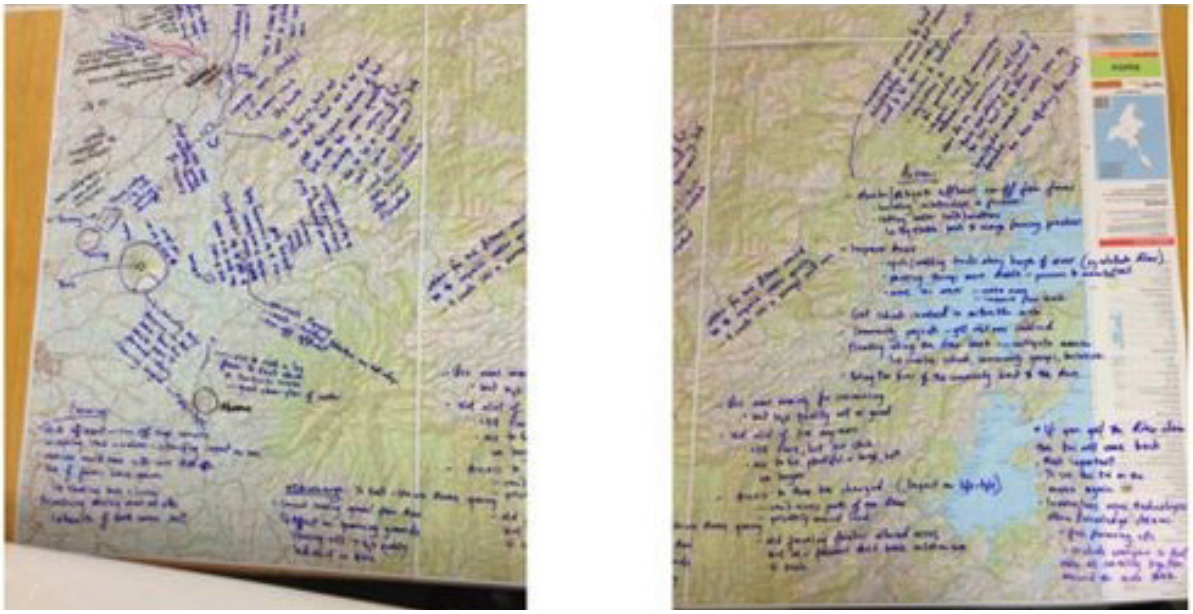


Figure 2: An example of a participatory mapping project (Tipa et al, 2104)

Cultural Mapping therefore requires three distinct tasks to be completed.

(a) The first task involves preparation of a base map or aerial photograph upon which sites throughout a catchment are identified together with the values of each - in other words, the reasons for the site being of cultural significance are recorded. Participants and the facilitator accept that this style of mapping differs from conventional digital mapping in terms of accuracy because it is concerned with memories and observations in specific areas. Not all participants know, access and use every site drawn on these maps. Capturing the diversity of knowledge within the iwi, hapu, and whanau is important, and the groups are generally comprised of kaumatua, resource users, tangata kaitiaki, etc.

(b) Opportunities sought by tribal members (given the nature and extent of the values they have just mapped) are then recorded. This starts to move the mapping session to an aspirational – outcome focus.

(c) Finally, informants are to identify water related concerns they perceive to impact the provision of cultural opportunities at the sites mapped. These can be represented as a concept map, as shown below in Figure 3, which is recognized as an effective tool to elicit the belief systems that are used to perceive and analyse situations (El Sawy & Pauchant 1998, Weick 1979, 1995).

Visioning - A vision helps unite Manawhenua towards a purpose. It expresses ideas about what they want to see in a year's time, or in ten years' time, or any time in the future. A shared vision is an important element within their approach to management and, like opportunity mapping, is aspirational.

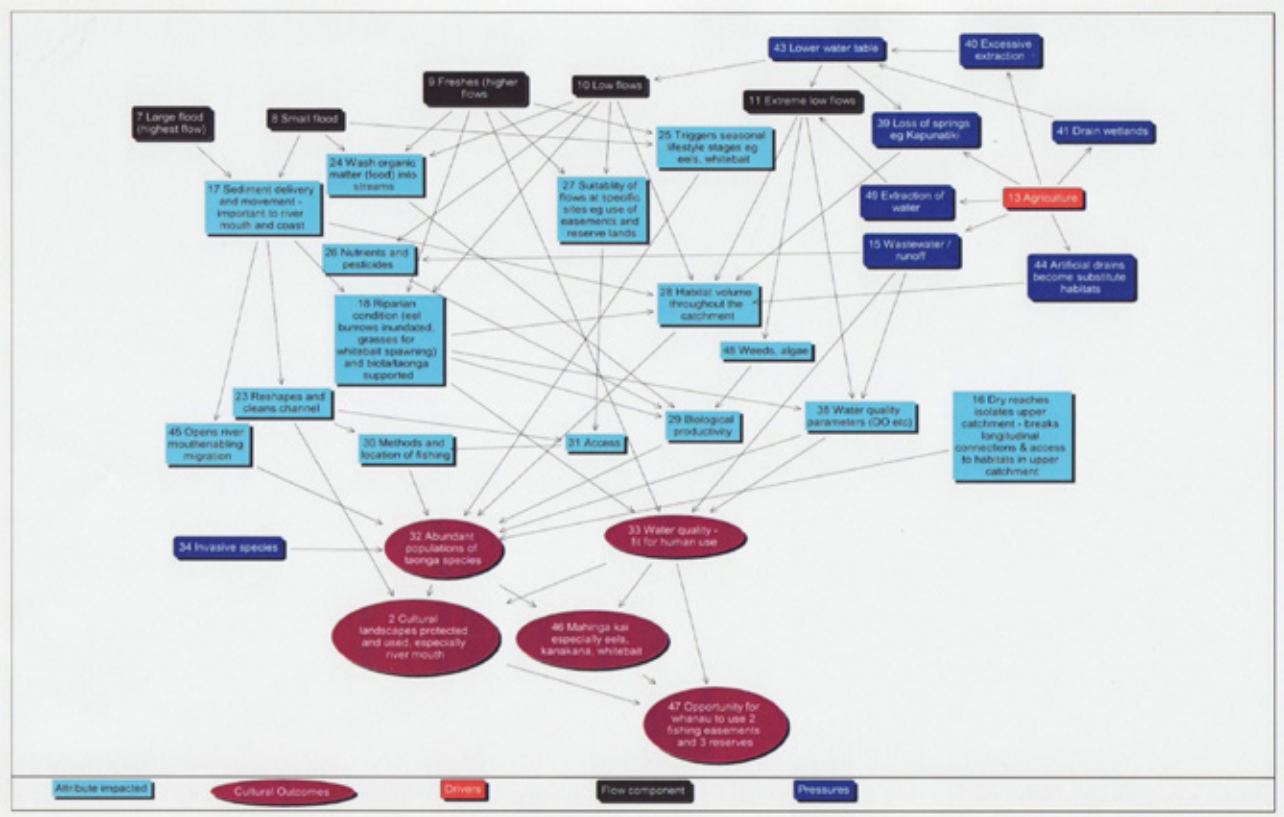


Figure 3: An example of a conceptual diagram specific to flow issues (Tipa, 2011)

Cultural Assessments - Cultural Assessments require detailed field assessments to be undertaken by representatives of Manawhenua mandated as having the knowledge necessary to inform the assessments. Cultural Assessments utilise the outputs of the opportunity mapping exercise, specifically the maps and aerial photographs and is premised on sites of cultural significance being assessed using indicators (of attributes) previously identified by Manawhenua. Several assessment tools are available and are currently in use by Manawhenua, for example:

- The Cultural Health Index for Streams (Tipa & Teirney 2003, 2006);
- State of Takiwa (Pauling 2003);
- Eel surveys (with training provided by NIWA);
- Cultural Impact Assessments (see www.qualityplanning.co.nz);
- A Cultural Flow Preference Study (Tipa & Nelson 2012);
- Cultural Indicators for wetlands (Harmsworth 2000);
- Mauri Compass (Ruru, 2017); and
- Mauri Model (Morgan, 2011)

Whanau and hapu across the country are undertaking cultural monitoring. The Ministry for Environment's Environmental Performance Programme provided an impetus for an interest in monitoring. However, Figure 1 recognises that monitoring needs to take place within a context – it needs to add value to whanau, hapu and iwi planning processes.

It is important that Manawhenua identify the assessment methods that are best suited to help them understand the barriers to their aspirations being realized.

2.2.2 Stream 2 - Causes of alteration

Although "causes" is a term that captures many agents and types of change, in resource management contexts often these are separated into three categories: drivers and pressures.

Drivers result in pressures, which can change a state of the resource. We understand these pressures by monitoring the state. But changes to the state have impacts which may or may not be acceptable to Manawhenua. Unacceptable impacts call for responses that mitigate an impact, restore the state, or reshape the drivers of change. Many whanau and hapu comment that they are reactive rather than proactive in resource management forums. Although the process in Figure 1 has the potential to change this by actively mitigating and restoring the state and seeking to deliver cultural opportunities sought by Manawhenua, ultimately, they still risk continually being caught in a reactive cycle unless they reshape the drivers of the alterations being experienced in their takiwa.

Photo 6: A specific pressure, hydro-electricity infrastructure has had an adverse effect on many catchments. At left was the construction site when the Pukaki Control Structure was created. From a Manawhenua perspective the structure:

- Dewatered the main source of water to the Waitaki River;
- Disrupted the continuity of flow – ki uta ki tai; and
- Impeded fish passage for migratory native fish species, many of which are taonga species

Photo 7: A second pressure, infrastructure to store water for irrigation has had an adverse effect on many catchments. At left are some of the Rangitata South Irrigation ponds

2.2.3 Stream 3 - Scale of alteration and cultural impact

Manawhenua have a unique perspective that has shaped their association with the waterways within their takiwa. This perspective, which is underpinned by values and continues to be reflected today in their beliefs, practices and their vision for the future state of their takiwa. A starting point therefore is reconstructing the historic sate of the catchment (or study area). This historic understanding of the "state" is fundamentally important as it often represents the historic reference condition that Manawhenua often seek to restore of recreate. They may be seeking environmental flows to help achieve this desired state.

Manawhenua, because of the experiential and interactive relationship with aquatic ecosystems can describe changes observed over time. For example, they are usually able to identify how river management regimes have impacted:

Cultural uses:

- fishing sites and the species harvested from each;
- cultural materials harvested;
- swimming holes – that were safe for different age groups; and
- reaches used for waka ama or boating.

Land forms and landscapes:

- vegetation – the species and the location of these;
- rock formations including shelters

Dynamics of a river system:

- floods, including the functioning of flood plains and any disconnections that have resulted from river engineering (e.g., stop banks, floodgates etc.);
- dewatering of river reaches;
- river mouth characteristics;
- flow regime components – e.g. seasonality of low flows, droughts and freshes;
- Changes to water quality; and
- Algal blooms

Biodiversity changes

- Weed infestation;
- Habitat changes including losses;
- Species changes including losses; and
- Invasive species including introduction of exotic species

The material collected as part of this participatory exercise will also provide the context within which to assess the extent to which changes within the takiwa have impacted the health and wellbeing of Manawhenua. Having access to data about historic, contemporary and future states enables several comparative analyses that can help guide a pathway forward.

Photo 8: Phormidium, algae that is of concern to river users, not just Maori.

Photo 9: An aesthetically undesirable proliferation of filamentous green algae in a shallow gravel-bed river during summer low flows downstream of intensive agricultural development (Hakataramea River, North Otago).

Photo 10: A dewatered reach within the riverbed of a South Canterbury Stream. Manawhenua contend the dry reach is getting larger and staying dry for longer than it did historically.

Photo 11: A dewatered stream in the Waitaki. The irrigation race that runs parallel to this stream was carrying the water.

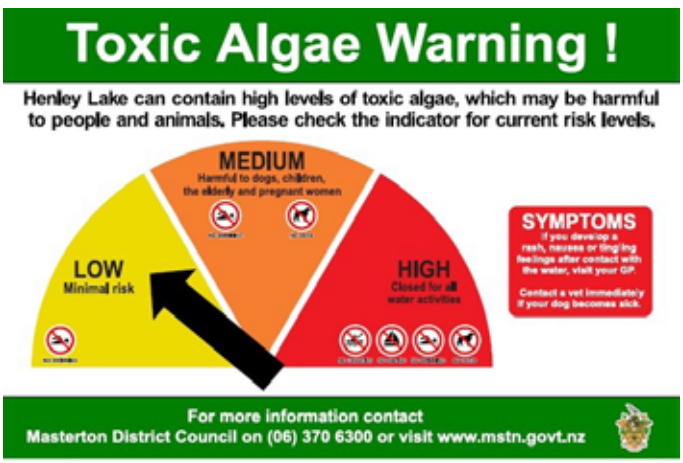


Photo 12 & 13: Sites warning against use are increasingly found at sites around New Zealand waterways.

Developing Targeted Responses - Clearly the three streams described in this chapter run in parallel. However, the realities of whanau, hapu and iwi capacity and the nature of resource management forums within which they operate may mean that they progress at different speeds. Despite this, the data gathered from each stream can be woven together to inform freshwater management. Figure 1 explicitly links the cultural assessments undertaken by Manawhenua to the formulation of responses. In other words, it is premised on their responses being evidenced based. Figure 1 also identifies the need for three types of initiatives that need to be implemented to:

- address impacts,
- restore or rehabilitate the state of valued environments; and
- to be effective in the long term, reshape causes of the degradation.

Implementation, monitoring and review - The process described in Figure 1 potentially aids implementation by providing a greater level of specificity than currently utilised by resource managers. Evaluation remains a critical tool for accountable, transparent and effective management and should utilise both quantitative and qualitative techniques.

Photos 14 & 15: Initiatives can range from planting in a catchment to implementing improved land management practices.

2.3 Implications for determining cultural flow preferences of Manawhenua

The Cultural Flow Preference Study is a specific type of cultural assessment. Manawhenua assess the extent to which they are satisfied that the flows they are observing are sufficient to deliver the cultural opportunities they seek. The application of a Cultural Flow Preference Study is described in the next chapter.




Photos 16-19: Manawhenua teams in the field completing their CFPS assessment

Chapter 3
Introducing the Cultural Flow Preference Study

It is easy to become completely enthralled by the sounds, music and movement of running water
(Mike Kirkpatrick)

Purpose of chapter

To set out the stages of a Cultural Flow Preference Study

To explain how whanau can undertake their own study.

To demonstrate how a CFPS was applied in a New Zealand catchment

Key questions

What is a CFPS?

How do I initiate and plan a CFPS?

Take away message

A CFPS is a method for whanau, hapu and iwi to identify the flows they prefer.

3.1 Introduction

The COMAR process, as illustrated in Figure 1, includes as a specific step the need to undertake cultural assessments. A Cultural Flow Preference Study is an example of one type of assessment developed in response to the need to improve the effectiveness of whanau, hapu and iwi in the setting of flow regimes.

3.2 Framing a discussion of cultural values

A CFPS responds to the observations of Groenfeldt (2005) that the "perspective embedded in indigenous views about nature and water is largely missing from the western toolkit on water management". As previously stated, the difficulty confronting managers may be translating an articulation of cultural beliefs, values and practices associated with a resource (such as freshwater) into contemporary management practice. Currently, dependence on technical expertise occurs when undertaking environmental flow assessments. But it is unclear to what extent managers are cognisant of, and responsive to cultural values. More specifically, what cultural practices would be jeopardised by decisions to set stream flows?

3.3 Application of the six-step participatory process

The first five steps in the participatory process, as illustrated in Table 1, are summarised below. Step 6, analyses to identify flow thresholds, flow related issues, and management priorities, is discussed in the results.

Table 1. A summary of the process to incorporate the cultural interests of Maori in determining flow regimes (Tipa & Nelson, 2008).

Step	Objective of step and application in the case	Methods	Outputs
1. Initiate the project	To identify the body representing Maori and secure mandates.	Meetings with tribal leaders, elders, and tribal members.	1. Research agreement. 2. Mandates.
2. Document the association	a. To identify the multiple dimensions that collectively represent cultural association with the study area. b. To identify the attributes used to assess whether environmental flows are sufficient to sustain cultural interests. c. To examine how their experiences are impacted by aquatic conditions, in particular river flow. d. To document perceptions of changes to flow patterns over time, and the impact of these changes on cultural values	Focus groups. Semi structured interviews with key informants.	3. Report describing the cultural association. 4. Maps of association. 5. List of attributes used by Maori.
3. Cultural Opportunity mapping	a. To identify the cultural values associated with specific sites, together with the opportunities sought at each site given the values identified. b. To formulate a catchment wide concept map that visually depicts water management issues (including flow) perceived by Maori as impacting their experiences at the sites identified. Interrelationships between issues are also mapped.	Focus groups. Semi structured interviews. Focus group to validate the data	6. Detailed (site specific) maps of values and opportunities sought. 7. Draft concept maps of perceived issues.
4. Focus the investigation	a. To critically review the data collected and to focus on environmental flows and specific flow issues affecting the waterways being investigated. b. To distinguish between (1) cultural values, opportunities, and issues to be evaluated as part of existing EFAs; (2), cultural values, opportunities, issues (and consequently flow attributes) that are place specific but could be addressed within an existing EFA; (3) those cultural values, opportunities, issues and flow attributes that were unlikely to be adequately addressed via existing EFA methods and are more appropriately addressed through a cultural assessment.	Focus group.	8. Assessment framework comprising attributes identified by Maori. 9. Refined concept map.

Step	Objective of step and application in the case	Methods	Outputs
5. Cultural Flow Preference field assessments	a. To undertake assessments at sites to assess whether environmental flows sustain cultural values and provide the opportunities sought. b. To assess each site under different flow conditions using the attributes previously identified by Maori. Assessors assess: • Significance – the significance of each attribute at that site. • Satisfaction – whether they were satisfied that the flow being observed sustains the attributes associated with the cultural values at that site. A rating of 1-7 is given by Maori assessors for all flow attributes at each site (1 being totally satisfactory, 7 being totally unsatisfactory). For each **attribute** the individual ratings are averaged producing a single 1-7 score. Then the flow attributes within each **theme** are averaged - for example the nine attributes scores for the mahinga kai component are averaged. The output is a single score for each of the four themes. These averaged scores can then be directly compared with recorded flows for the time/date of assessment. By examining the data for all nineteen attribute scores, attributes that contributed to the level of satisfaction/dissatisfaction at the flows observed are identified.	Mandated representatives undertaking field assessments. Focus groups.	10. Assessment forms completed. 11. Sketches of each site with key flow issues highlighted. 12. Photographic profiles of each site.
6. Analysis to inform decision making	Qualitative analysis and statistical analysis to identify flow thresholds, flow related issues, and management priorities.	Focus groups. Statistical analyses.	13. Report

Step 1: Initiating the project

An initial hui (meeting, focus group) with representatives of Te Runanga o Moeraki secured support for the flow investigation in the Kakaunui Catchment, confirmed the individuals to be interviewed, and mandated members to participate in assessments to observe the sites under different flows.

OUTPUT FROM THIS STAGE
A formal research agreement setting out the commitments of each party.

Step 2: Documenting the Manawhenua association with the river

The diversity and complexity of cultural relationships with freshwater was explored before defining how their relationship, and interaction with the Kakaunui, is affected by river flows. Gaining perceptions of changes to flow patterns over time, and the impact of these changes on cultural values, was important. It is noted that a range of frameworks have evolved that assess the impact of flow alterations on ecological values (e.g. Range of Variability Approach and Indicators of Hydrological Alteration) and assume that river ecosystems are evolved from and are adapted to the natural flow regime.

Importantly, this stage enables an initial examination of flow related issues because interviewees were challenged to identify how their values and experiences are impacted by aquatic conditions, in particular river flow.

OUTPUT FROM THIS STAGE
A set of maps and diagrams and transcripts summarising the association.

Step 3: Cultural mapping including cultural opportunity mapping

The participatory mapping exercise saw sites of cultural significance mapped together with the cultural opportunities sought. There were four distinct areas of data collection:

1. how the river was valued and used by Manawhenua;
2. the hydrological characteristics that Manawhenua believe essential to protecting the sites valued and used;
3. how the current hydrological characteristics compare to historic patterns; and
4. how the current hydrological characteristics of the river impact cultural values and uses.

Specific issues related to the Kakaunui were examined, such as the impact of the flow on the rate of sediment erosion and/or accumulation. Sites that Manawhenua perceive as “clogged” by sediment were also mapped. The frequency and magnitude of flushes sufficient to clear excess sediment and reshape habitats were described and the spatial extent of flushing and flood flows mapped. The timing and frequency of low flows and extremely low flows were also recorded. Consistent with cultural concepts of whakapapa and whanaungatanga connections within a river system are fundamentally important to Manawhenua. Participants mapped springs, tributaries, riparian wetlands, and described the impact of seasonally variable flows on these connections. How these contemporary connections relate to historic patterns were described and validated by reference to historic maps and photographs? Photographs and maps have already been promoted to authenticate the cultural vitality of indigenous communities

and their knowledge (Collier and Collier 1986; Edwards and Hart 2004; Egan and Howell 2005).

With respect to the Kakaunui, given the significance of freshwater species as a source of food and cultural materials, the flow related needs of valued species were a focus. Flow related cues/triggers (e.g., spawning migrations) for the range of species present in and around the river were described, as were their observations of frequency of flow related concerns such as seasonal strandings or isolating of species in identifiable reaches of the river. Where possible this information was mapped. A map providing an overview of the cultural association with lands and waters of the Kakaunui and an overview of flow related issues in the Kakaunui catchment, as identified by Te Runanga o Moeraki, is included in Figure 4.

OUTPUT FROM THIS STAGE

A set of maps identifying the sites that Manawhenua wo

Step 4: Focusing the investigation

Discriminating the flow related issues identified - The data collected was reviewed to identify those cultural values opportunities, issues, and flow attributes that would be more suited to a cultural assessment undertaken by Maori. Three examples specific to the Kakaunui illustrate these distinctions and how issues identified by Manawhenua can be addressed. Firstly, some cultural interests can be assessed via existing EFAs.

For example, some of the dimensions of gathering aquatic species may be incorporated within existing EFA methods. In contrast some cultural interests may be place specific, for example, a swimming site may be dependent upon the site's unique combination of geology, ease of access, privacy, and flow. Even if a flow sufficient to afford bathing opportunities is provided, the characteristics arising from the combination of factors may not be able to be replicated elsewhere. Although flows sufficient to sustain opportunities somewhere in the catchment may be provided, relocation would only serve to dislocate and deprive them of their cultural context. Finally, there are Maori values, opportunities, and flow attributes that are appropriately incorporated into the CFPS. Developing this overview and focusing the assessment, ensures that calculating cultural flow preferences complements rather than replaces more conventional EFAs.

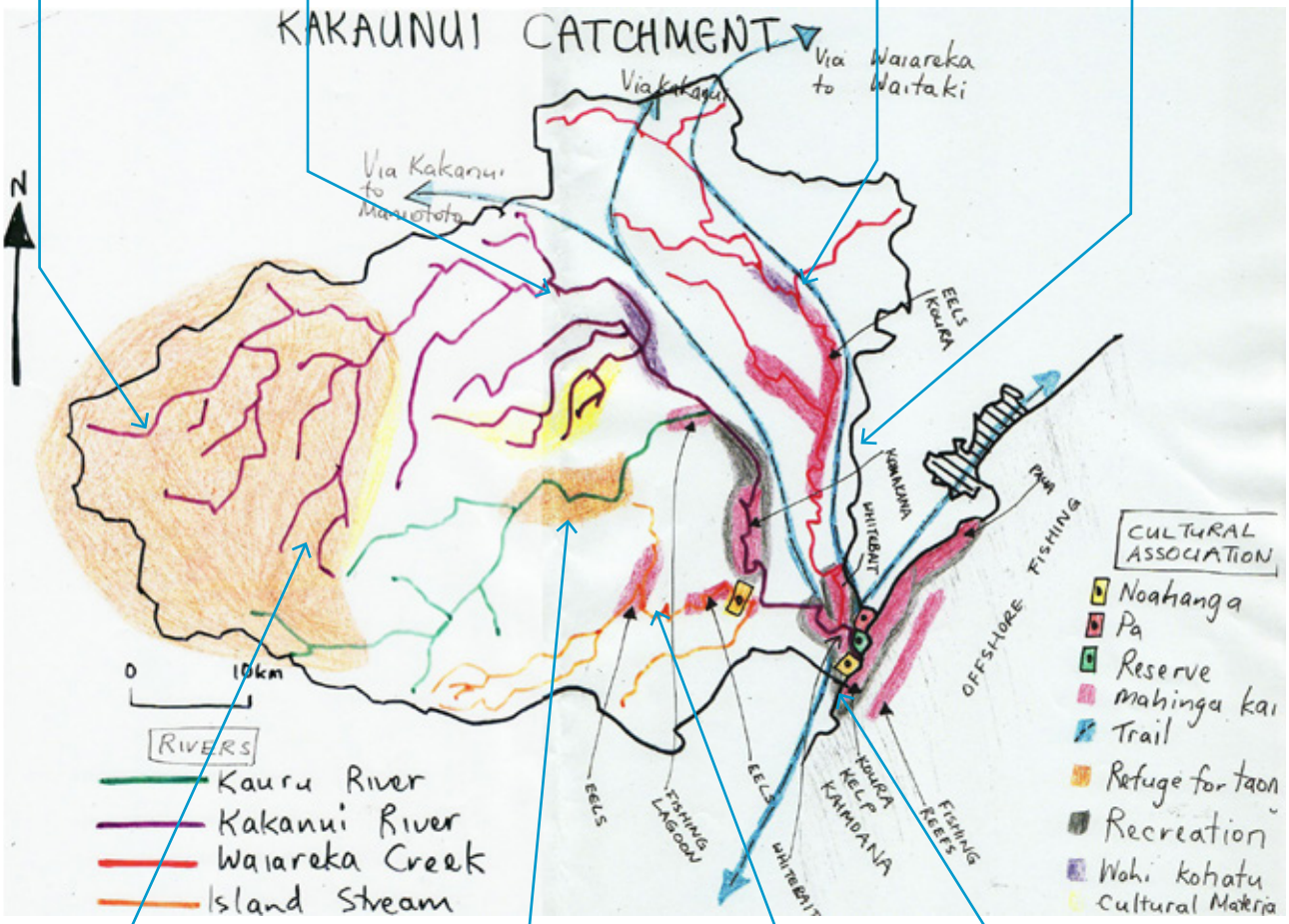
Figure 4: Cultural associations with the Kakaunui Catchment together with a summary of flow issues (Tipa, 2012)

Interception of many small streams

- Passage
- connections tributaries – mainstem
- interception
- gravel management
- dewatering
- passage

Impact of interception for storage

- Riparian links
- duration of low flows
- gravel management
- depth of water
- passage



- Connections upstream and downstream
- passage
- dewatering

- Passage
- connections to mainstem
- risk of flow stopping

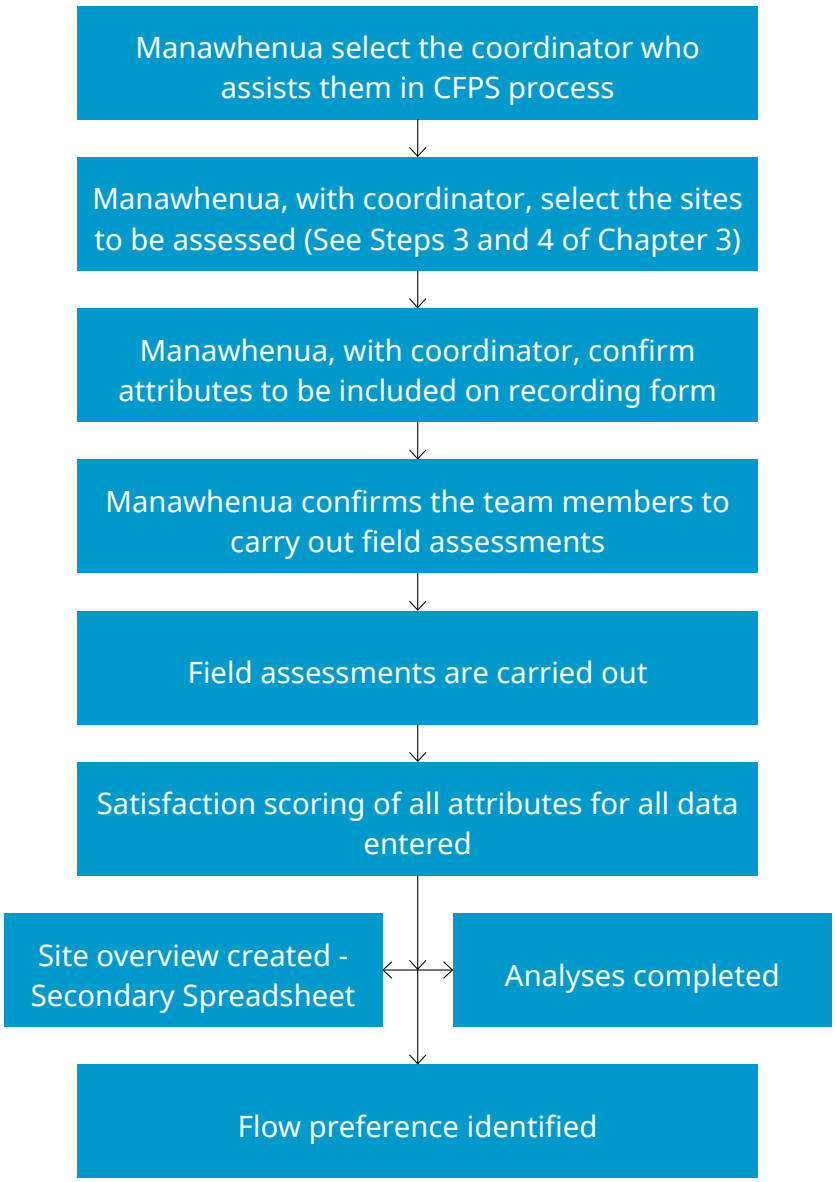
- Connection tributary – mainstem
- passage

- Coastal erosion
- impact reefs / kelps
- changing estuary
- riparian links

3.5 Initiating Step 5 - the fieldwork component of the CFPS

In the next sections we explain the practicalities and the logistics of organizing the field component of the CFPS. The process we recommend is set out in Figure 5.

Figure 5: Overview on how to carry out a CFPS



Selecting a coordinator

To organize the team, plus collect and process all the data, a coordinator is required. Appointment of the coordinator and their involvement in the entire process hopefully will maximise efficiency and assist in maintaining the relationship between the team, coordinator and Manawhenua. It's recommended the coordinator have the following skills including:

- Ability to or experience in interviewing individuals;
- Project management experience;
- Able to collect and process qualitative data;
- Can work with others at a flax roots level; and
- Able to adapt to changing situations.

Once selected the coordinator will be required to:

- Carry out individual or group interviews;
- Organise and train the team who will carry out the assessments;
- Facilitate and coordinate a field visits to a vary of sites; and
- Correlate and variety of data.

Reviewing the interview data collected from whanau members

Section 3.4 of this report describes the data that is collected by whanau during hui and interviews. Before any field assessments can be carried out Manawhenua and the coordinator are required to:

- Select the sites to be assessed (within a catchment or multiple catchments); and
- Review the recording form to be used in the field to confirm the attributes that are to appeal on the form.
- Assign a significance rating for each attribute. This step is optional as Manawhenua may say that all attributes are of equal significance.

It's recommended that some of the individuals involved in the interview process should participate in the field assessment process.

Site selection

The coordinator needs to be cognisant of factors such as

- the number of sites that can be assessed in a single day of fieldwork;
- the location of sites within catchment and the travel time between sites;
- access considerations; and
- the health and safety of whanau who will be accessing the site.
- Where are the nearest flow recorders? Can you access the data from them?

The coordinator should visit each of the sites to:

- record is GPS reference;
- identify photo points at the site;
- check accessibility of site, and assess safety issues; and
- identify more generally any potential issues with field visit

Finalising the recording form

The CFPS recording form that our assessment teams use in the field (Table 2) includes several attributes of flow. To reiterate, the attributes are confirmed following the hui and interviews with Maori at commencement of the study. For each attribute there is a 7-point Likert scale and open-ended questions to measure preferences.

Table 2: Flow attributes included on the recording form

1.	Flow will enable use of the site for kai gathering
2.	Flow will keep the riverbank vegetation watered
3.	Flow will provide a range of habitats instream and along the riverbank
4.	Flow will protect species in and around this site
5.	Flow will enable fish to move throughout the catchment
6.	Flow will help populations of kai species to re-establish and be abundant throughout the catchment
7.	Flow will keep sands and gravels moving through the system
8.	Flow will keep riparian wetlands, springs, or tributaries connected to mainstem
9.	Flow will create features that are important e.g. eddies, pools etc.
10.	Flow will enable cultural use of connected wetlands, springs & tributaries
11.	Flow will enable a range of recreational activities
12.	Flow contributes to a good feeling about this site
13.	Flow enables whanau to be proud of this site
14.	Flow will maintain a link between this site and other cultural sites downstream
15.	Flow will protect features of the river that are important in tribal stories, waiata etc
16.	Flow will enable use of Maori lands, reserves and easements in the catchment
17.	**Overall – are you satisfied with the flow you are seeing today?**
18.	**Overall – are you satisfied with the health of this site today?**

Because fourteen to nineteen attributes are many attributes to work with, we also categorise attributes under a series of components (or themes) as shown in Table 3.

Table 3: An example of attribute categories and their attributes used in the Cultural Flow Preference Assessment[5]

Cultural use	• Flow will enable use of the site for kai gathering • Flow will keep the riverbank vegetation watered • Flow will protect kai species in and around this site • Flow will enable cultural use of connected wetlands, springs and tributaries • Flow will enable a range of recreational activities
Wai	• Flow will provide a range of habitats instream and along the riverbank • Flow will enable fish to move throughout the catchment • Flow will help species to re-establish and be abundant throughout the catchment • Flow will keep sands and gravels moving through the system • Flow will keep riparian wetlands, springs, or tributaries connected to mainstem • Flow will create features that are important e.g. eddies, pools etc.
Cultural landscape	• Flow will maintain a link between this site and other cultural sites downstream • Flow will protect features of the river that are important in tribal stories, waiata etc • Flow will enable use of Maori lands, reserves and easements in the catchment
Health and well-being	• Flow contributes to a good feeling about this site • Flow enables whanau to be proud of this site

[5] Please note that for some whanau the attributes are grouped into three categories only. Cultural landscape and health and wellbeing are often grouped together.

Six sites in the Kakaunui were assessed fortnightly from December 2007 to June 2008 and monthly from July 2008 to January 2009. Over the course of a year a total of 18 assessments were completed for each site. The level of satisfaction was assessed, specifically whanau were asked whether they were satisfied that the flow being observed sustains the attributes of the river at that site. Three of the sites chosen to correspond with sites monitored by the regional council, thus data from the flow recorders were available. Although the team of assessors did not know the flow they observed when they visited, by noting the time and date of the assessment we were able to correlate their assessments to the flows for that day.

Significance scoring – THIS IS OPTIONAL. This is a weighting process. It requires Manawhenua to rate on a scale of one to seven (or 0 if an attribute doesn't apply at the site) how significant each of the "attributes" are at a specific site. This exercise is only completed once before fieldwork commences. Below in Table 4 is a section from the significance scoring assessment form.

Choosing the team - The key dataset that is used within the CFPS is the data collected by the Manawhenua field team. It is up to Manawhenua to select the individuals who will carry out the field assessments. It is helpful to have the some of the same individuals who were involved in the interview process.

Whoever is selected by Manawhenua will be required to go out to all the sites, each day of the field assessment, so they should be committed to the kaupapa. Other considerations for Manawhenua when selecting the individuals to do the field assessments include:

- Individuals with background knowledge of the waterway;
- Individuals with a variety of ages. This is a great opportunity for kaumatua and rangatahi to share experience and knowledge.

Table 4: Section from significance scoring assessment form

For each attribute listed below you are to decide how significant that attribute is to this site. You are to assign a 1 -7 rating

Assess if the factors in bold in the attribute column are significant at this site

1	Little or no significance
4	Moderate significance
7	Very significant
0	Not applicable to this site / not used in assessment

SIGNIFICANCE AT THIS SITE	ATTRIBUTE
(1) 2 3 4 5 6 7	Flow enables use of the site as a mahinga kai
1 2 3 4 5 6 (7)	Flow keeps the riverbank vegetation watered

Please note, this CFPS is not a "reconnection tool" to re-introduce whanau to a catchment they might not have been active in for years or generations. It is dependent on assessments being undertaken by people who know their rivers.

Training - Training days will be facilitated by the coordinator, who will organise the logistics and equipment. Training will take place at one of the sites to be assessed. The purpose of the training is to introduce team members to the assessment form, in particular the attributes of flow that appear on the form. Once the attributes have been explained and the team is to carry out an assessment of the site. They are to be encouraged to ask questions. After the team has filled out the form the coordinator can facilitate a discussion with the entire team to see how scores have been awarded, how whanau understand the 1 -7 rating. The coordinator needs to be confident that the team can carry out the field assessments.

Equipment - The coordinator and team will need the following equipment when scouting out sites and undertaking field assessments:

- Road map with locations of sites to be assessed
- Assessments forms
- Clipboards
- Pens
- GPS unit
- Camera
- Hi visibility vests
- First aid kits, and other health and safety equipment

Photo 20: Team members in the field for training.

Photo 21: Whanau completing forms in the field

Photo 22: The team from Te Runanga o Arowhenua at the Orari River

3.6 Undertaking the Fieldwork

Each team member is to complete an assessment form at each site. The form that is to be used by the assessment team is set out in Appendix 1. A segment of it is included below in Table 5.

While the team members are completing the forms, the coordinator is to take photos upstream and downstream plus it is recommended that any site-specific issues are photographed. A GPS reference should be recorded for the site and for any photos that are taken.

Identification - The form starts by asking team members to write their name, (or initials or number assigned), the site name and the date. If team members' names are used, they will only be known by the coordinator and are only required for book-keeping.

The 14 - 19 attributes - Team members consider the attribute in question then score the site in terms of how satisfied they are that the flow protects that attributes.

Comments

Following the attribute column, the team members are asked some concluding questions. They are to provide an overall score for their level of satisfaction and rate the level of access. The open-ended questions then ask them to identify the actions they would like to see undertaken at the site. It is vitally important that team assessors use this to highlight any issues with a site. Examples of issues raised by teams undertaking assessments are shown in the photos (next page).

Table 5: Part of the field assessment form

For each attribute listed below you are to decide whether you are satisfied that today's flow is sufficient to protect that attribute. You are to assign a 1 -7 rating

1 Little or no satisfaction
4 Moderate satisfaction
7 Very satisfied

ATTRIBUTE	SATISFACTION THAT OBSERVED FLOW PROTECTS THE ATTRIBUTE
Flow protects mahinga kai species in and around this site	1 (2) 3 4 5 6 7
Flow enables fish to move throughout the catchment	1 2 (3) 4 5 6 7
Flow enables gathering at this site (i.e. is accessible, safe)	1 (2) 3 4 5 6 7

Photo 23: A healthy riparian margin is a priority for whanau. This photo highlights two issues - the lack of riparian vegetation and inappropriate management of aquatic weeds

Photo 24: Dead fish (trout) observed with other fish gasping for air when the flow is 345 l/s. The current minimum is set at 300 l/s.

Photo 25: This site raised many concerns among assessors, specifically the lack of riparian cover, excessive sedimentation, excessive aquatic weeds and developments in close proximity to the stream.

Because the recording form is to be used on subsequent assessments, it is important to ask what other attributes should be included on the recording form. If additional attributes are identified by whanau member it is important that the coordinator and the field team agree:

- That the new attribute can be scored on a 1-5 scale.
- That adding and scoring the new attribute will add valuable information for their assessment.

One off assessment – to be completed by the field team at each site during the first visit.

The last part of the assessment requires the team members to answer a selection of yes / no questions as shown in Table 6. This form only needs to be completed on the first assessment.

The discussion where the team members decide the answer to these questions should be recorded. The questions also highlight why it is important to include as team members those who know the river.

Table 6: Some of the "one off" questions the team needs to answer on the first visit to a site

General Question	Yes	No
1. Is the vegetation of the river bank sufficient to protect it from erosion?		X
2. Is the rate of sediment erosion or accumulation that is occurring what you would expect it to at this site?		X
3. Is the river channel neither aggrading nor degrading?	X	
4. Is there a range of sediment types on the river channel?		X
5. Does this site experience algae blooms?		X

3.7 Collating and entering the data

Depending on the number of sites and the frequency of visits the coordinator will be handling a lot of data. This data includes:

- Maps written on by Manawhenua;
- Completed field assessment forms;
- Photographs;
- GPS data; and
- Weighting of attributes data (to reiterate, this task is optional).

Once the data has been collected it needs to be copied and placed in a secondary location. Whanau, hapu or iwi may choose to scan the forms to ensure an electronic backup.

All data collected is to be entered to an Excel spreadsheet. The spreadsheet requires the coordinator to enter the site name, general information about site, the GPS reference, comments from Manawhenua, the attributes scores and the overall site score. The coordinator should assign a number to each team member to record on their forms and use this in the spreadsheet as an identifier.

The spreadsheet then automatically calculates the averages from all the team and enters it into the CFPS framework and gives an overall average for each of the four components I.e. the specific components (Mahinga kai, Wai Maori, Hauora and Landscape). It is a simple visual representation of the data.

The second spreadsheet or the site overview (Table 7) compares site assessments scores over the full course of the fieldwork (typically over a period of months). It requires the coordinator to enter the averaged scores for the four components for a specific site, the significance scores for that site, the average overall score, and the average flow for the day. Once entered to the spreadsheet it's up to the coordinator to assign the appropriate colour codes.

The analyses that are undertaken to produce the metrics in Table 7 are described in greater in the next chapter.

Table 7: Section from the Site Overview Summary

	Date				Date				Date				Date			
	MK	WM	H	L	MK	WM	H	L	MK	WM	H	L	MK	WM	H	L
Component scores	3.8	5.4			2.4	1.9	1.9	2.6	1.4	1.7	1.8	1.4	3.6	3.6	4.2	4.7
Overall	5.1				1.9				1.3				4.4			
Actual flow	1.3				0.4				0.27				1.1			

Chapter 4
Analysing Data

Purpose of chapter

To describe the range of analyses that can be undertaken with the data collected by Manawhenua

Key questions

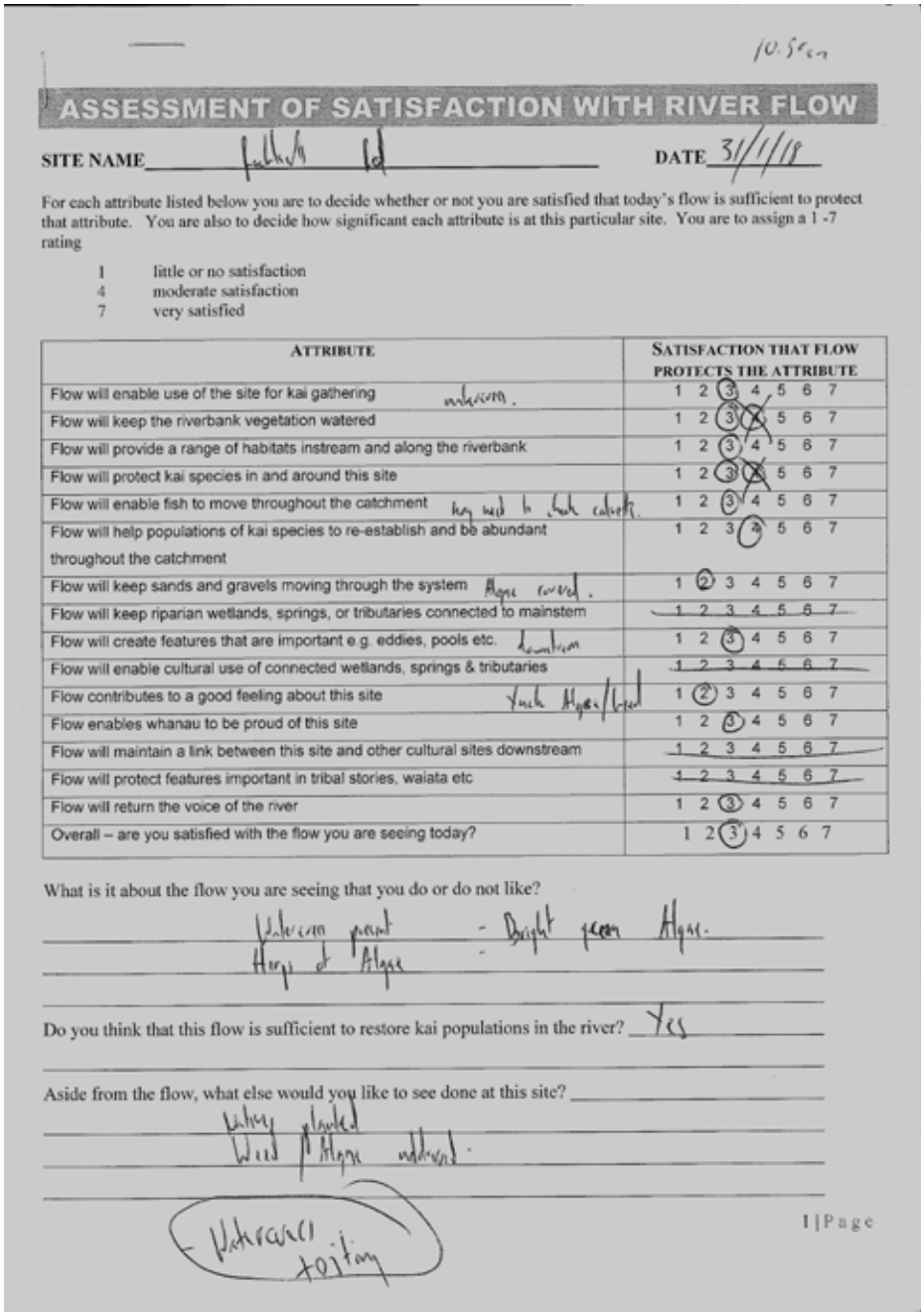
How do I analyse the data and identify preferred flows?

Take away message

Whanau, hapu and iwi can analyse the data they gather

4.1 Introduction

In this chapter we present examples of the data collected from case studies across the South Island of New Zealand before examining the range of analyses that are now available to assist Maori and resource managers with their decision making. We conclude the chapter with examples of how resource managers have responded, via regional plans, to the stated flow preferences of Maori.



10.Sept

ASSESSMENT OF SATISFACTION WITH RIVER FLOW

SITE NAME Feltham Rd DATE 31/1/18

For each attribute listed below you are to decide whether or not you are satisfied that today's flow is sufficient to protect that attribute. You are also to decide how significant each attribute is at this particular site. You are to assign a 1 -7 rating

1 little or no satisfaction
4 moderate satisfaction
7 very satisfied

ATTRIBUTE	SATISFACTION THAT FLOW PROTECTS THE ATTRIBUTE
Flow will enable use of the site for kai gathering (mahinga)	1 2 (3) 4 5 6 7
Flow will keep the riverbank vegetation watered	1 2 (3) X 5 6 7
Flow will provide a range of habitats instream and along the riverbank	1 2 (3) 4 5 6 7
Flow will protect kai species in and around this site	1 2 (3) X 5 6 7
Flow will enable fish to move throughout the catchment (eg weir in Ashley catchment)	1 2 (3) 4 5 6 7
Flow will help populations of kai species to re-establish and be abundant throughout the catchment	1 2 3 (4) 5 6 7
Flow will keep sands and gravels moving through the system (Algae covered)	1 (2) 3 4 5 6 7
Flow will keep riparian wetlands, springs, or tributaries connected to mainstem	1 2 3 4 5 6 7
Flow will create features that are important e.g. eddies, pools etc. (downstream)	1 2 (3) 4 5 6 7
Flow will enable cultural use of connected wetlands, springs & tributaries	1 2 3 4 5 6 7
Flow contributes to a good feeling about this site (Much Algae/Weed)	1 (2) 3 4 5 6 7
Flow enables whanau to be proud of this site	1 2 (3) 4 5 6 7
Flow will maintain a link between this site and other cultural sites downstream	1 2 3 4 5 6 7
Flow will protect features important in tribal stories, waiata etc	1 2 3 4 5 6 7
Flow will return the voice of the river	1 2 (3) 4 5 6 7
Overall – are you satisfied with the flow you are seeing today?	1 2 (3) 4 5 6 7

What is it about the flow you are seeing that you do or do not like?

Waterway great - Bright green Algae. Heaps of Algae

Do you think that this flow is sufficient to restore kai populations in the river? Yes

Aside from the flow, what else would you like to see done at this site?

Litter, planted Weed & Algae removed.

Waterway testing

1 | Page

Figure 6:
An example of a completed assessment form

4.2 The dataset

The data collected when the assessment team completes the assessment form in the field is the key component of the data set. Selected sites in a study catchment are typically assessed fortnightly over the period November – April and monthly from May to October. For the studies completed to date, over the course of a year, 15 - 18 assessments were completed for each site. Although the team of assessors do not know the magnitude of the flow they observe when they visit a site, by noting the time and date of the assessment it is possible to relate their assessments to the recorded flows for that day. A record of the flows for specific dates can then be requested from the relevant regional council. An example of a completed form is shown in Figure 6, while a summary of the data collected, and the analyses undertaken are summarised in Figure 7.

A rating of 1–7 was given by each of the Manawhenua assessors for each flow attribute at each site visited (1 being totally unsatisfactory, 7 being totally satisfactory). The worksheet that is populated by the data collected in included as Appendix 2. Averaging the scores from all assessors produces a single score for each of the attributes. The average scores for each attribute were then recorded in a table along with the recorded flow for the time and date of the assessment.

In addition to rating each attribute, at each site Manawhenua were asked to score two other factors:

- They were to rate their overall level of satisfaction with the flow they were observing. This was also rated on a 1-7 scale.
- As a final question, they were asked to rate the overall health of the site. This score is important as we need to be assured that flow is the factor determining the scores and not more general concerns about the health of the site.

An example of a spreadsheet for one site, showing the collated average scores, is presented in Table 8. This data is from an assessment of a small stream in a Canterbury catchment. Please note this table is for illustrative purposes only and contains eight days of data (not the full dataset of 17 days). Similarly, only 10 attributes (a subset) is provided and not the full list of attributes.

At the completion of the fieldwork, we have a workbook that comprises a spreadsheet for each of the sites assessed for each day the team was in the field. It is the data in this comprehensive workbook that we then subject to several analyses.

Figure 7: An overview of the dataset and the types of analyses

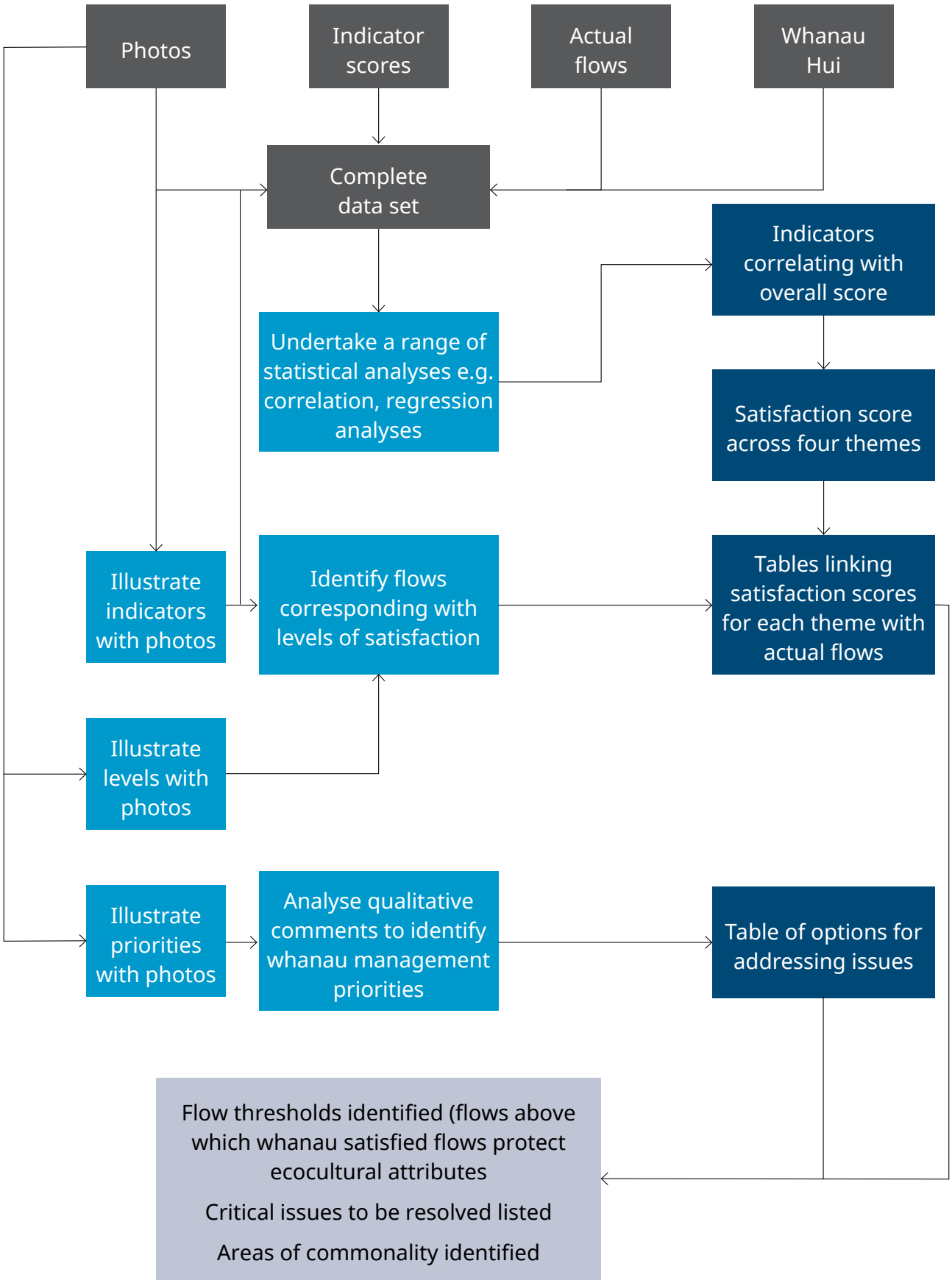
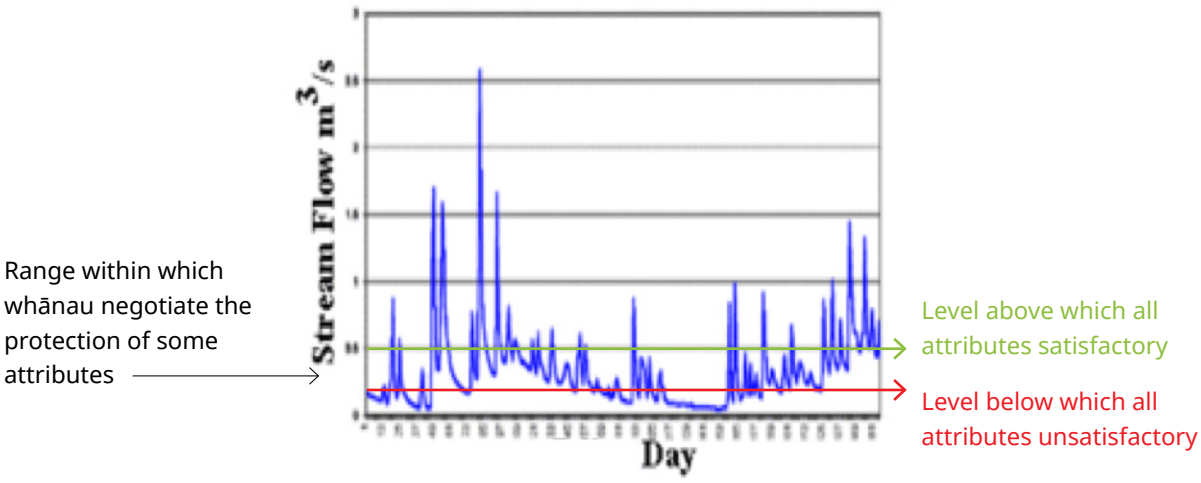


Table 8: An example of part of a spreadsheet that contains all the averaged attribute scores for a river in a Canterbury catchment. Only some of the attributes are scored, for some of the days.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Flow enables use of the site as a mahinga kai	3.60	4.33	3.50	4.00	3.67	3.67	4.20
Flow keeps the riverbank vegetation watered	3.20	3.33	3.50	3.50	3.50	2.33	3.20
Flow keeps the river free of weed / algae	2.00	3.67	2.83	3.00	2.50	2.50	2.60
Flow provides a range of habitats instream and along riverbank	2.80	3.83	3.00	3.25	2.83	3.00	3.40
Flow protects mahinga kai species in and around this site	3.00	4.00	3.50	3.25	3.00	2.33	3.80
Flow enables fish to move throughout the catchment	3.20	4.50	3.33	3.50	3.17	2.33	3.60
Flow keeps riparian wetlands, springs, and/or tributaries connected to mainstem	3.00	4.33	3.83	3.75	3.17	3.17	3.00
Flow enables cultural use of connected wetlands, springs & tributaries	2.80	4.17	3.83	3.75	2.67	2.83	3.60
Flow enables whanau to be proud of this site	2.60	4.33	3.50	3.00	3.83	3.33	3.40
Flow protects valued features at this site	2.40	4.40	4.67	3.25	2.50	3.17	4.20
Plus, an additional 7 attributes not reported in this spreadsheet							
FLOW (cumecs)	0.1	0.093	0.081	0.065	0.112	0.049	0.089
OVERALL SATISFACTION WITH FLOW	3.2	4	4	3.25	3.33	3.17	3.4
OVERALL STREAM HEALTH	2.4	3.17	3.17	2.5	3.2	3.17	3.4

This the spreadsheet that is analysed. It holds scores for all attributes across all days of observation.

Figure 8: Purpose of the Cultural Flow Preference study assessment analysis (source Tipa, 2013).



4.3 Analyses to help whanau identify preferred flows

The purpose of the analyses is to provide a level of confidence around a flow threshold above which Manawhenua are likely to be satisfied with the flow (see Figure 8). Conversely, we also want to understand the threshold below which are the flows that whanau will not be satisfied with.

Analysis 1: Individual attribute scores - The recording forms have between 14 and 19 individual attributes. Each of these can be analysed. Using a spreadsheet with collated scores for a site in a South Canterbury catchment, at the simplest level the data show that:

- Across all days of observation, when the flow was less than 900 l/s, eighty-nine percent of the attributes received a score that showed dissatisfaction with the flow being observed.
- Across all days of observation, when the flow was in the range 950 l/s – 1000 l/s, fifty-four percent of the attributes received a score that showed an average level of satisfaction.
- When the flow was 1000 l/s or above, all attributes received a score that showed a level of satisfaction average or above average. No attributes received a score that reflected dissatisfaction.

In another example, the data for a site in the Kakaunui catchment in North Otago showed

- When the flow was 340 l/s or below, eighty-three percent of the attributes received a score that showed dissatisfaction with the flow being observed.
- When the flow was increased to around 360 l/s only seventeen percent of the attributes received a score that showed dissatisfaction.
- When the flow was 650 l/s or above, all attributes received a score that showed a level of satisfaction average or above average. No attributes received a score that reflected dissatisfaction.

With this type of analysis, we can refer to the values associated with a site and the opportunities that whanau want to see delivered in the future. If the site is valued as a mahinga kai, the scores need to show a level of satisfaction across the mahinga kai attributes – at the very least.

We also use the scores to focus on the individual attributes to identify the lowest flow above which that attribute receives a satisfactory score (as shown in Table 9). The design of this table is based on the structure of habitat retention tables.

Again, we recommend that this information be considered alongside the values and opportunities mapping. If a key value is the supply of water from riparian wetlands or springs (which could represent vital cool water inputs at certain times of the year), then Table 9 suggests that Manawhenua could be advocating for flows around 42l/s.

It is also possible to undertake sensitivity analysis. For example, whanau, hapu or iwi may decide that instead of analyzing scores above, because of the range of values in a catchment, they will consider scores above say 4.0 as shown in Table 9.

Table 9: Flows likely to result in average levels of satisfaction for valued attributes for a smaller stream

		Flow above which attributes score a 4 as their level of satisfaction (l/s)
Cultural use	Flow enables use of the site as a mahinga kai	18
	Flow keeps the riverbank vegetation watered	31
	Flow keeps the river free of weed / algae	26
	Flow provides a range of habitats instream and along riverbank	35
	Flow enables gathering at this site (i.e. is accessible, safe)	24
Wai	Flow enables a range of recreational uses	24
	Flow keeps this site free of unnatural gravel buildups	36
	Flow keeps riparian wetlands, springs, and/or tributaries connected to mainstem	42
	Flow enables cultural use of connected wetlands, springs & tributaries	42
	Flow appears to have been higher recently - evidence is present	65
Hauora	Flow contributes to a good feeling about this site	31
	Flow enables whanau to be proud of this site	17
Cultural landscape	Flow will maintain a link between this site and other cultural sites downstream	42
	Flow will protect features important in tribal stories, waiata etc.	26

To aid interpretation of the scores by whanau, hapu and iwi, the scores can be colour coded using a simple traffic light system (see Table 10 and 11).

Table 10: Colour coding and definitions for the average attribute scores[6].

Attribute score	Colour code	Preference
< 1.50		Poor
1.51–2.5		Dissatisfied
2.51–3.5		Slightly less than average
3.51–5.5		Average
> 5.51		Satisfied

[6] Please note we may choose to revise the colour coding in instances where all the scores are very low and the grading shown in Table 8 does not enable distinctions to be made.

If a stream is classed as wai tapu, which is to be accorded protection pursuant to the provisions of the National Policy Statement: Freshwater, whanau may seek to maximise satisfaction scores. We can identify the days of observation where and when the highest and lowest scores were recorded for each attribute and importantly identify the corresponding flow. Generally, however, the intent of the analysis is not to identify the flows that will maximize their level of satisfaction. The study highlights the range of flows Maori will be satisfied with. Philosophically, this means that the flows may be lower than the flows that Maori aspire to see in the river. Drawing this distinction to the attention of Maori is another important aspect of this type of preference study. It is also important to convey to others with an interest in water, that the recommendations from whanau already represent a balanced appraisal and in effect a trade-off between the maximum and the satisfactory value.

Please note: colour coding can aid understanding. Tables 8 and 11 contain the same data, which relates to a stream in a Canterbury catchment. The only difference is that one table (Table 11) is colour coded.

Table 11: An colour coded example of part of a spreadsheet that contains all the averaged attribute scores for a river in a Canterbury catchment. Only some of the attributes are scored, for some of the days.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Flow enables use of the site as a mahinga kai	3.60	4.33	3.50	4.00	3.67	3.67	4.20
Flow keeps the riverbank vegetation watered	3.20	3.33	3.50	3.50	3.50	2.33	3.20
Flow keeps the river free of weed / algae	2.00	3.67	2.83	3.00	2.50	2.50	2.60
Flow provides a range of habitats instream and along riverbank	2.80	3.83	3.00	3.25	2.83	3.00	3.40
Flow protects mahinga kai species in and around this site	3.00	4.00	3.50	3.25	3.00	2.33	3.80
Flow enables fish to move throughout the catchment	3.20	4.50	3.33	3.50	3.17	2.33	3.60
Flow keeps riparian wetlands, springs, and/or tributaries connected to mainstem	3.00	4.33	3.83	3.75	3.17	3.17	3.00
Flow enables cultural use of connected wetlands, springs & tributaries	2.80	4.17	3.83	3.75	2.67	2.83	3.60
Flow enables whanau to be proud of this site	2.60	4.33	3.50	3.00	3.83	3.33	3.40
Flow protects valued features at this site	2.40	4.40	4.67	3.25	2.50	3.17	4.20
Plus, an additional 7 attributes not reported in this spreadsheet							
FLOW (cumecs)	0.1	0.093	0.081	0.065	0.112	0.049	0.089
OVERALL SATISFACTION WITH FLOW	3.2	4	4	3.25	3.33	3.17	3.4
OVERALL STREAM HEALTH	2.4	3.17	3.17	2.5	3.2	3.17	3.4

Table 8 shows that flows as low as 49 l/s (0.049 cumecs) are considered sufficient to sustain use of the site as a mahinga kai if whanau set a satisfaction level of 3.5. However, when the flow is 49 l/s not all the attributes within the mahinga kai component receive a satisfactory score. For example, there are concerns about the species themselves and their ability to move within the system, and the presence of weed and algae. These issues require further investigation with help of bio-physical scientists. For this stream, when all attributes were assessed a flow of 890l/s was preferred by whanau, which was the flow set by the regional council.

Analysis 2: Using aggregated component scores to identify satisfactory flows

As noted earlier with respect to Table 3, the attributes can be grouped under a series of components (or themes). With the second set of analyses, we aggregate the scores for the different components and colour-code them. Once again, the scores for each component can range from 1–7 and the colour coding and definitions for the average scores are as shown in Table 10. The example shown in Table 12 shows that a flow of two cumecs was satisfactory for all four components.

In contrast, Table 13 shows that at the same site confirm that a flow of 340 l/s is perceived as unsatisfactory (scoring less than 3.5 on a 1–7 scale) by assessors across all four themes. In fact, for this site flows at or below 350 l/s were consistently scored as being unsatisfactory across all four themes.

Photo 26: Mill Dam in the Kakaunui catchment

Table 12: Example of an aggregated component scores for the site at Mill Dam on an Otago River

Cultural Use (incl. Mahinga Kai)	Wai Maori	Health	Cultural Landscape
3.63	3.75	4.17	3.52
Flow 2 cumecs			

Table 13: Example of an aggregated component scores for the site at Mill Dam on an Otago River

Cultural Use (incl. Mahinga Kai)	Wai Maori	Health	Cultural Landscape
3.11	2.38	2.83	3.17
Flow 340 l/s			

The data in Tables 12 and 13, specifically the four theme ratings, shows that a flow of 2000 l/s was totally satisfactory. In contrast, the scores confirm that a flow of 340 l/s is perceived as unsatisfactory (scoring less than 3.5 on a 1–7 scale) by assessors across all four themes. In fact, flows at or below 350 l/s were consistently scored as being unsatisfactory across all four themes. However, whanau also rated flows between 350–650 l/s as unsatisfactory and of concern for at least one of the themes (usually the attributes associated with Wai Maori). These initial analyses, that consider the ratings for satisfaction with the observed flow, suggest that the current minimum flow of 250 l/s could be considered too low by Te Runanga o Moeraki.

This analysis could be interpreted as "more water is better" from a cultural perspective. However, high flows that are seen by whanau as cleansing the river, may also make the river unsafe for some cultural uses. The ratings therefore need to be analysed alongside the results of the mapping exercise (described for Step 3). Manawhenua had identified the periods of the year when low flows are expected. Conversely by mapping the spatial extent of higher flows and when they are expected insights were gained to the expected seasonal flow variability. This analysis represents another opportunity for Manawhenua to link with others undertaking EFAs so that the seasonality of low flows, higher flows, and the links between biophysical processes and cultural values can be explicitly examined.

Table 12, 13 and 14 enable us to examine the scores for a specific date, we are also able to collate all the component scores and colour code them.

Table 14: Component summaries for a site in a catchment in the Otago region River

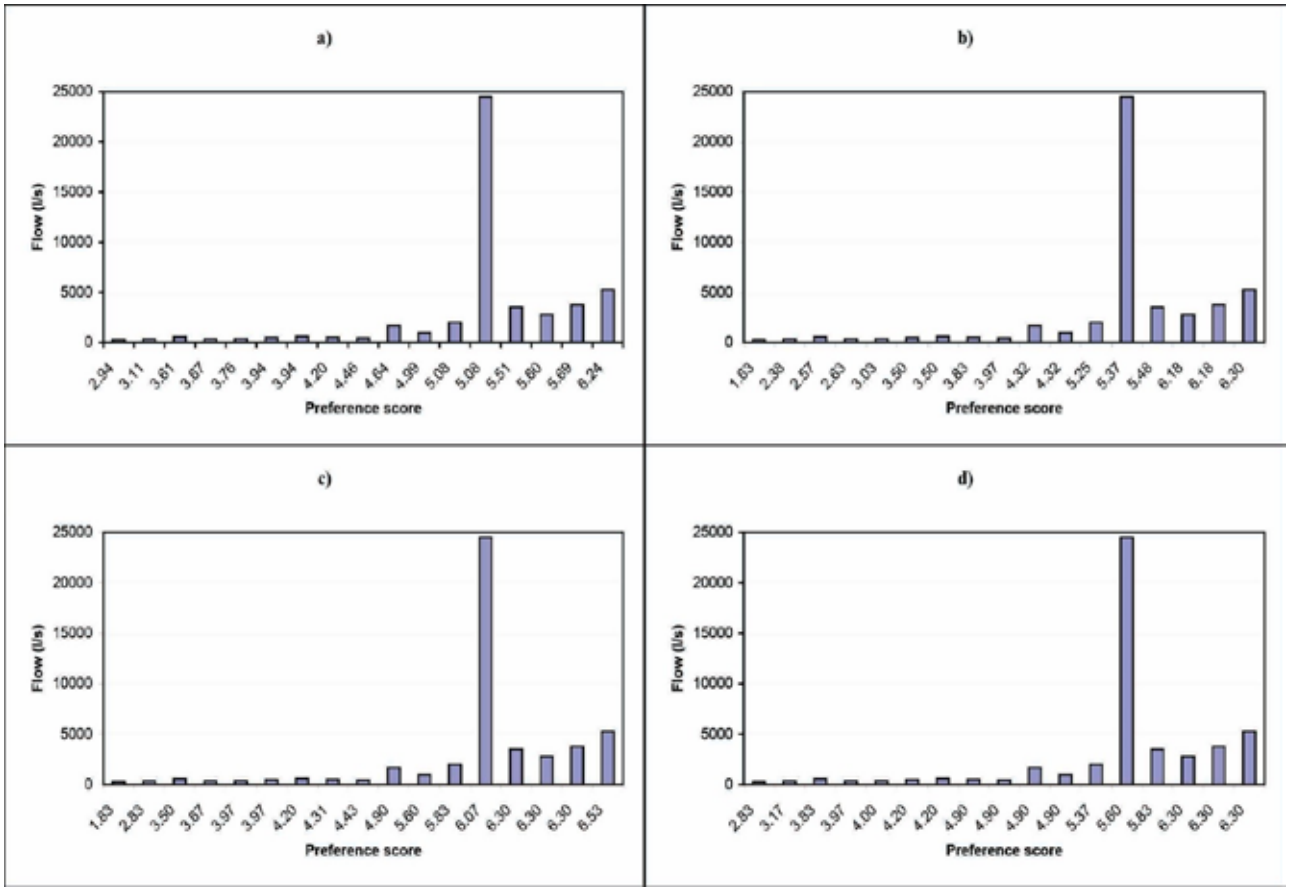
Date	Cultural Use, incl. mahinga kai	Wai	Wellbeing	Cultural Landscape	Flow (cumecs)
7 Nov 2011	4.81	4.11	5.05	3.67	1.5
1 Dec 2011	5.81	4.58	5.22	4.56	0.99
19 Dec 2011	4.36	3.51	3.87	3.23	0.50
30 Jan 2012	5	4.63	4.67	4.33	0.65
27 Feb 2012	5.31	5.56	4.92	4.72	2.30
2 April 2012	4.25	4.58	3.44	3.50	0.77
14 April 2012	4.69	4.38	4.33	4.13	0.67
7 May 2012	3.13	3.08	3	3.62	0.53
21 May 2012	3.75	3.50	3.83	4	0.59
25 June 2012	4.75	4.50	4.67	4.25	1.05
30 July 2012	4.25	4.08	4	3.79	0.90
28 Aug 2012	4.63	5.38	4.83	4.50	6.00

We can use Table 14 to identify the flows that resulted in the highest grading for each of the components. From Table 14 the date of the highest scoring components, along with the corresponding flow, can be identified. When we examine the attributes aggregated into the three components for this Otago site, the scores when flows are below 600 l/s result in at least one of the components receiving a score slightly below average. When identifying their aspirations (opportunities sought in the future), whanau who are the kaitiaki for this catchment stressed the importance of mahinga kai. Flows below 600 l/s are not likely to be acceptable as the mahinga kai values are likely to be highest at flows around one cumec.

Maori may choose to focus on a particular component, such as mahinga kai. This is consistent with the approach recommended in the Guidelines for Determining Instream Flows (Ministry for Environment, 1998) which calls for instream objectives to be formulated. If we focus on one component, data collected can be presented as a bar graph, such as that shown in Figure 9(a) – 9(d). These figures show the component scores over the course of the year.

These bar graphs illustrate when lower levels of satisfaction were scored but it is only by interrogating the scores for the individual attributes, that the root causes behind these scores can start to be understood. This reinforces the need for the range of analyses outlined in Figure 7.

Figure 9: Preference Scores - a) Mahinga kai, b) Wai Maori, c) Hauora and d) Landscape - for flow in a North Otago Stream



Analysis 3: Relationships between attributes - It may be useful for whanau to understand the relationships between the respective attributes. Correlation matrices for each of the sites are produced – again using the average attribute data from the collated tables (such as Table 8). Correlation matrices are simply a two-way table which shows the correlations for each pair of attributes. It helps us understand the relationship between attributes.

Analysis 4: Regression analysis - When in the field, whanau members assessed each of the attributes and then gave an overall rating of their level of satisfaction with the flow observed. They also rated the health of the stream and gave an overall health score. We use the regression analyses and the correlations to examine that the overall flow preference scores were in fact dictated by the individual flow attribute assessments. Because their positions need to be defendable, whanau need to be confident that the data confirm that there are positive relationships between flow and attribute scores so that they can confidently discuss with managers the flow related issues that need to be addressed.

4.4 Additional data

Photo points – Although the team of assessors are mandated to participate, before stating their preferred flows, whanau are usually required to report the results of the analyses back to their hapu or iwi. Photos are particularly useful in enabling whanau to compare flows on different days and how the river changes under different flows. For example, photos 21 and 22 show the differences observed in a Canterbury Stream at 300 l/s which is the current minimum and 890 l/s which is the flow preference of whanau (Tipa, 2013). During the fieldwork a team member was assigned responsibility for taking photographs at each photo point.

Photo points also enables Manawhenua to identify specific issues. For example, the photos on the next page show a site that was assessed that was modified to enable the passage of floods. From the perspective of whanau, river engineering is a risk to the protection of the values held by Manawhenua.

Cultural health assessments - To complement the flow data collected, cultural health (which focuses on the overall health of the site and not just flow) is assessed on the first visit using the Cultural Health Index (Tipa and Teirney, 2003, 2006). It is acknowledged that whanau, hapu and iwi will have their own tools that they may also wish to apply given they have a mandated team in the field. The CHI was one assessment tool that was added to the CFPS in the South Island. At subsequent visits whanau recorded qualitative statements about the cultural health of the site and were encouraged to photograph any issues. Importantly, at each visit over the course of the year they provided an overall qualitative rating for one attribute which is called “overall cultural health”. This enabled us to tease out issues to be addressed through improved management – and not solely through setting the flow regime.

Photos 27 & 28: A stream with a current minimum flow of 300 l/s (left) and the recommended cultural flow preference of 890 l/s (right)

Photo 29: A Stream in Canterbury looking downstream.

Photo 30: The same stream in Canterbury after river engineers had undertaken instream works.

4.5 Flow regime recommendations – linking to other hydrological parameters

Although this Guideline is principally intended to describe a CFPS, it is important to ensure that whanau, hapu and iwi understand how the flow preferences of Manawhenua relate to the aspirations of other parties and other commonly used hydrological parameters. In Table 15 we compare the cultural flow preferences from the Selwyn - Te Waihora study (see Tipa 2013) with other hydrological parameters, such as the current minimum levels that Environment Canterbury operate to, the 7-day Mean Annual Low Flow (7dMALF), and the recommended ecological flow based on the methods set out in the National Standard for Ecological Flows (Beca, 2008).

Photo 31: A site on a stream in the Selwyn Waihora catchment that is a popular recreational site. It was photographed during one of the assessments.

Photo 32: the same site as that shown above but with a higher flow. It was also photographed by the assessment team during one of their visits

Table 15: For the Selwyn Te Waihora Catchment - comparing cultural flow preferences to other means of calculating a minimum flow level.

Waterway	Current Minimum flow	7day MALF	Ecological Flow	Cultural Preference
Boggy	100 50	290	261*	261
Doyleston	60	6	5	50 – 60 – providing this gives depth for eels
Hanmer Rd Drain at Lower Lake Rd	100 200	369	258	260
Harts Creek	1000	1238	748	1200 - 1400
Irwell River at Lake Rd	300 300	910	637	890 l/s – 1100 l/s
L-II River at Wolfes Road	120 120 350 690	1771	1240	2100
L-II River at Moir's Property	120 120 350 690	Not covered	Not covered	290 l/s
Miles Drain at Pannets Rd	30	14	13*	30
Prices Stream and Prices Valley Road	None set	Not covered	Not covered	>50 l/s
Selwyn River at Coes Ford	600 700 1000 600	993	675*	1200
Waikekewai Creek at Taumutu Beach	100	34*	34*	No extraction
Birdlings Brook	150 200 150 150 150	637	446	446
Lee River at Temoana	700	35	655	1500

Returning to the Mill Dam site in the Kakaunui catchment, the cultural preference for the minimum flow, can be compared to the minimum sought by other stakeholders and the recommendations of EFAs, as shown in Table 16.

Because of the need to correlate cultural ratings to the averaged flows on the time and date of assessment, representatives of Te Runanga o Moeraki have been trained in how to use flow recording equipment so that readings can be taken at the time of their cultural assessment. This training is essential as many of the rivers that Maori want to set environmental flows, the regional council or water users do not collect flow data.

Table 16: Comparing cultural flow preferences, the flows sought by other stakeholders, and the recommendations of EFAs

Central South Island Fish & Game (M Webb)	Department of Conservation (Neilson, 1995)	Cultural Flow Preference	EFA Results (Snelder et al 1995)	Negotiated flow regime
400 l/s to maintain the trout fishery. Minimum flows to vary monthly from 400 – 600 l/s.	300 l/s to protect native fish species Plus – 50% of all flows over and above the minimum occurring at the time. Plus – for critical period 1 Sept to 31 Dec maintain an open river mouth.	350 l/s minimum Plus – flushing flows to address - weed & algae build-up - sediment build-up	The minimum flow for native fish is 250 l/s. At flows of 200 l/s the habitat of most native fish is deficient. 400 l/s (March – May) is preferred option for both adult and juvenile trout but 300 l/s should provide the minimum habitat requirements for trout. Recommended that the minimum should not go below 250 l/s. Suggested that the opening of the river mouth is independent of extractive use and is controlled by sea conditions and floods.	250 l/s minimum Should this flow be breached, all extractions are to cease until flows recover to 400 l/s.

4.6 Flow regime decision making

The CFPS represents a participatory process that has been formulated is intended to inform environment flow setting processes. A CFPS is intended to address a shortcoming identified by Connell et al. (2005) that little guidance is available to help water managers work with Manawhenua. The analyses are intended to progress beyond descriptions of how indigenous communities attribute meaning to water (Langton 2002; Toussaint et al. 2005) to an understanding of how river flows impact these meanings and associations.

For example, an attribute that rated poorly and contributed to the low Wai Maori rating in the Kakaunui was the unnatural presence of weed and algae. Another attribute that scored poorly was the unnatural build-up of gravel and sediment, which detracted from the river amenity and utility at low flows. Both attributes can be ameliorated by higher flows that would flush both nuisance weeds and sediment from the channel.

Another example concerned low spring–autumn flows which were seen to limit the width of the wetted area within the river channel. Whanau commented that the connections to some tributaries and riparian habitats were broken or were at risk of being broken in contrast to the connections observed historically. This was of concern because of the migratory fish cycles of indigenous species in the catchment. Identifying these concerns in consistent with the observations of Weir (2009) that indigenous communities have hydrological knowledge that can not only inform water management processes but enable linkages to be made with others undertaking EFAs.

The quantitative scores awarded by Manawhenua also need to be considered alongside the data collected during the participatory mapping exercise in Step 3. The minimum flow and its duration is often the contentious issue for Manawhenua and in the case of the Kakaunui was a focus. However, Manawhenua acknowledge it is only one aspect of a flow regime. In many forums Manawhenua advocate against "flat lining" the river and seek flushing flows, high flows, and seasonal variability. They are aware of the danger of focusing solely on the minimum flow, as values such as "mahinga kai" are sustained by more than just the flows on a particular day. Low flows, moderate and high flows, their timing and duration all contribute to whether a site supports mahinga kai. To support Manawhenua values such as mahinga kai, the EFA must be a partnership combining the expertise of biophysical scientists with the expertise of Manawhenua.

This data also enables the identification of management actions. For example, interrogation of the data for one site suggested that low flows inhibit recreational activities. The scores for specific attributes highlighted concerns with respect to the changed shape and depth of the water at low flows. Further discussion confirmed that the shape of the river was adversely impacted by repeated gravel extractions that are exacerbated by low flows and consequently gravel management was identified as a priority. In another example concerning water quality, low flows were again seen to exacerbate concerns Manawhenua, in seeking water quality sufficient to sustain mahinga kai, were seeking a higher minimum flow. However, it was acknowledged that higher flows (and greater assimilative capacity) need not be sought if land management strategies address water quality concerns directly.

Ultimately it is for regional councils to determine the flow regimes that are to be applied usually via regional plans formulated pursuant to the provisions of the Resource Management Act 1991. Table 17 compares cultural flow preferences identified for three catchments (Waihao, Orari and Selwyn/Te Waihora) with the flows proposed by a regional council in their regional plans.

The intent however is not to enable Maori to strengthen their submissions to statutory plans. The intent is for cultural flow preferences to be reflected in the regulatory provisions of the proposed plans that are notified, and the decisions of regulators. Our final table therefore compares the cultural flow preferences with the flows recommended by the hearings panel (and Council).

Table 17: Comparison of cultural flow preferences with the flows proposed by Environment Canterbury in their regional plans (Tipa, 2013, Environment Canterbury 2013).

Waterway	Department of Conservation (Neilson, 1995)	Environment Canterbury Recommendation l/s		
Waihao Catchment				
Buchanans Creek	200	150 Oct – April 178 May – Sept		
Sir Charles Creek	>100	100 Oct – April 120 May - Sept		
Lower Waihao River	425 summer flow 600 winter flow	100 Oct – April 600 May - Sept		
Merry Stream	>25	5 Oct – April 45 May - Sept		
Orari River				
Orari Mainstem	>900	Current	3 years from plan being operative	2040
		Dec – April 200 (restrict 1724)	Dec – April 300	900
		May – June 900 (restrict 2424)	Self manage above 1500	Self manage above 1500
		Aug – Oct 400 (restrict 1924) Nov 300 (restrict-1824)	1:1 flow sharing 500 – 1500	
Selwyn - Te Waihora		Aug – Oct		
Boggy	261	260		
Hanmer Rd Drain at Lower Lake Rd	260	250		
Harts Creek	1200 - 1400	1100		
Irwell River at Lake Rd	890 l/s – 1100	890		
L-II River at Wolfes Road	2100	1240		
L-II River at Moir's Property	290	160		
Miles Drain at Pannets Rd	30	30		
Prices Stream and Prices Valley Road	>50	-		
Selwyn River at Coes Ford	1200	1200		
Waikekewai Creek at Taumutu Beach	No extraction	No extraction		
Taumutu Creek	No extraction	No extraction		

Table 18: Comparison of cultural flow preferences for streams in the Selwyn – Te Waihora catchment with the decisions of Environment Canterbury for inclusion in the Selwyn Waihora Sub-Catchment Regional Plan (Tipa, 2013, Environment Canterbury 2015).

Waterway	Cultural Preference	ECan decision for Minimum Flows to apply to permits from 1 July 2025
Boggy Creek	261	261
Doyleston	50 – 60 – providing this provides suff8icent depth at eel migration time	-
Hanmer Rd Drain at Lower Lake Rd	260	250
Harts Creek	1200 - 1400	1100
Irwell River at Lake Rd	890 l/s – 1100 l/s	890
L-II River at Wolfes Road	2100	1240
L-II River at Moir's Property	290 l/s	160
Miles Drain at Pannets Rd	30	-
Prices Stream and Prices Valley Road	>50 l/s	-
Selwyn River at Coes Ford	1200	1200
Waikekewai Creek at Taumutu Beach	No extraction	No extraction
Baileys Creek	40	40
Birdlings Brook	446	440
Birdlings Brook	480	450
Hororata River (recorder) [7]	382	80
Knights Creek	228	220
Snake Creek	63	60
Taumutu Creek	No extraction	No extraction
Lee River at Temoana	1500	70% of 7D MALF

[7]There is a significant extraction of water to supply drinking water. It has a significant impact on this site.

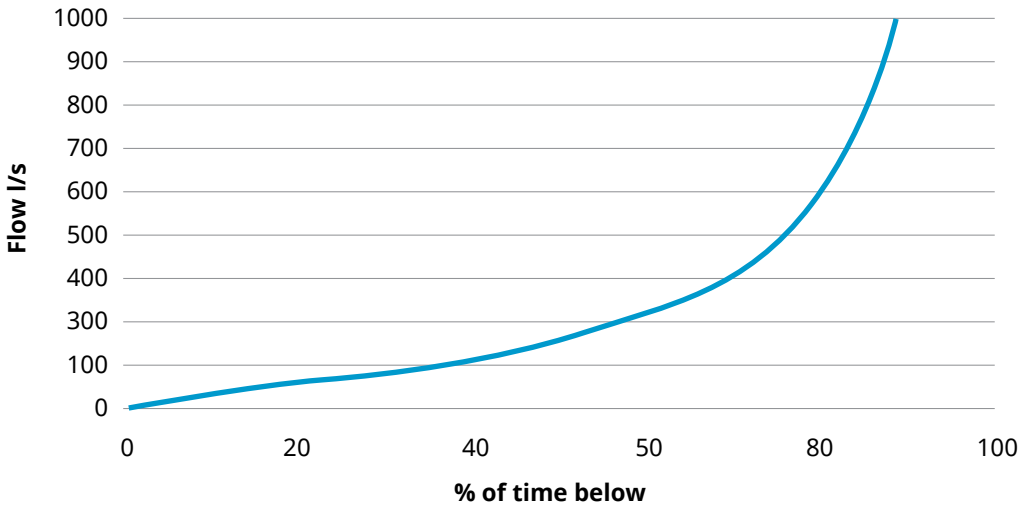
4.7 Flow variability

Some may argue that the CFPS only enables identification of a minimum flow. This is incorrect as Maori identify a range within which they know that all their attributes (and components) are likely to achieve satisfactory scores. Having established low flow thresholds, the expectation of Maori is that the agreed flow regime will include seasonal variability and freshes. In all studies to date Maori have emphasised the importance of a flow regime that incorporates higher flows sufficient to trigger and enable fish migrations at key times of the year. Ecologists and hydrologists can assist with determining the size of flushing flows.

4.8 Flow duration curves

For most of flow assessments undertaken to date a flow duration curve, such as that shown in Figure 10, has helped whanau understand how often the river flow will be above or below certain flow thresholds including their preferred levels.

Figure 10: the Flow Duration Curve for the Kaituna River in Canterbury



Flow duration curves/tables are usually obtained from the regional council. Figure 10 shows that 40% of the time flows will be below 100l/s compared to 80% of the time the flow will be below 600l/s.

Chapter 5
Presenting the Analysis of Data to Manahenua

Water links us to our neighbour in a way more profound and complex than any other
(John Thorson)

Purpose of chapter

To give examples of how data can be presented.

Key questions

When I have completed the analysis of data how do I present it to Manawhenua?

Take away message

Data can be summarised and presented as posters.

5.1 Introduction

As explained earlier in this report, the purpose of the CFPS is to convey to communities and decision makers the expectations of Manawhenua. Consistent with the philosophy of ki uta ki tai, Manawhenua are likely to have aspirations for specific river reaches throughout a catchment. Therefore, we need to consider how data is to be conveyed at a catchment level and at a site level. Tables 19 and 20 are examples of the aspirations of Manawhenua for the headwaters of a catchment (see Table 19) and the lower reaches which includes a river mouth (in Table 20)

Wherever possible photos should be included. Ideally a comparison between the current state of a river reach (or site) and the condition that is aspired to by Manawhenua should be included. Including photographs that highlight specific issues within a river reach is also valuable to communicate with whanau and hapu members who were unable to participate.

Table 19: An Example of a Summary of the Values for a River Reach – the Upper Opihi

Valued Characteristics of Upper Opihi Catchment (from Tipa, 2013)	
Headwaters – including **Opihi down to gorge** **North and south Opuha** **Opuha down to Opihi**	• Upper reaches of Opihi catchment are largely unmodified with tussock lands and remnants of native bush. • Mix of wetlands of varying sizes still found in the headwaters, some have been protected. • Source waters therefore are considered to be largely unmodified • Only the Opuha is dammed which means that the fish populations in the Opihi reflect access throughout most of the system. There is a need however to examine the impact of culverts, bridges etc. • Diverse habitats – instream, riparian and terrestrial are generally of good quality with some tributaries being classed as high quality fisheries. • Still a long fin eel population – although size and numbers are seen to be in decline. • Water appears to be clear and of good quality. • The limestone rock features create important cultural landscapes with rock shelters and rock art found throughout the catchment. • Source waters give appearance of limited hydrological alteration • There is a mix of pools, riffles, runs. • Modifications don't really start until come through the Fairlie Basin.

Photo 33: The Opuha River immediately below Opuha Dam. The Opuha Dam discharge regulates flows in the Opihi River

Photo 34: The Opihi Gorge

Table 20: An Example of a Summary Table for the opportunities sought in the Lower Rangitata and the River Mouth

Opportunities sought for the Rangitata Lagoon	
• Maintain flow variability and flows of sufficient scale to keep multiple braids across the river channel and islands in the mainstem that are free of vegetation. • Protect habitats of taonga species – in the mainstem and the tributaries. • Restore and maintain connections – a flow from the tributaries to the mainstem to the sea • Protect remaining wetlands. • Protect springheads by creating a buffer around them and controlling activities on adjacent lands. • Prioritise protection of springfed streams such as Ealing springs and McKinnons Creek • Improve access to all waterways. • Protect cultural landscape within which the braided river – with multiple braids and a mix of rapids, shallows, boulders – is a central feature. • Protect flow variability • Increase mainstem flows • Maintain connections to the south branch.	
Threats	**Priorities**
• Adjacent land uses encroaching onto riverbeds. • Introduced fauna that are prioritized over taonga species. • Exotic plants – gorse, broom, lupin, willow • Vegetation encroachment into riverbed due to low or no flows. • The risk of further infrastructure to support irrigation. • Extraction of water • Loss of access	• No new water is to be introduced into the catchment (e.g. through initiatives such as MAR). • Restoring flows in tributaries and reconnecting streams to mainstem. • Explore opportunities to restore springs • Prioritise the protection of spring fed systems for indigenous species. • Protect waters (that are afforded protection in the WCO) from the effects of land use.

Photo 35: Looking downstream over the Rangitata River Mouth. Having sufficient flows to maintain the braided character of the river is essential.

Photo 36: the outlet of the Rangitata River. Manawhenua are able to describe the character of the mouth, frequency of changes etc.

Table 21: An Example of a Summary Table of the Opportunities sought in the Rakahuri (State Highway One) together with a summary of current state of the river and recommendations for future water quality and quantity.

<table>
<tr><td rowspan="2">TE MOEMOEA
• Improved water quality
• Summer flows sustain aquatic life
• Whitebaiting continues to be a significant activity undertaken by whanau. Habitats, including spawning habitats are restored.
• Use of the river possible during summer months as a result of improved flows and improved water quality.
• The amenity of the river is improved and whanau use the river for a range of cultural purposes.
• The lower river is restored as a significant cultural landscape and connections to the reserve are restored.
• The Rakahuri is in a state that the whanau from Te Ngai Tuahuriri are proud of.</td><td colspan="2">TAONGA SPECIES
(whole Rakahuri catchment not just this site)</td></tr>
<tr><td>Inanga
Long fin eel
Short fin eel
Flounder
Canterbury galaxias</td><td>Common bully
Torrentfish
Upland bully
Blue gill bully</td></tr>
<tr><td>VALUED FEATURES
• The Rakahuri is the river central to the identify of whanau from Te Ngai Tuahuriri
• Braided river
• Whitebaiting
• Should be high water quality</td><td colspan="2">THREATS
• Stopbanks break connections
• Fish strandings are a risk due to low summer flows.
• Algal blooms “these occur every year so we are unable to use the river over the summer months- we can’t even take the dog to the river”</td></tr>
</table>

CULTURAL ASSESSMENT

Site Status	Cultural use	Health measure
A-0	2.25	1.93

- As with the other mainstem sites, the river does not sustain cultural use at times when whanau may want to use the river, especially during summer
  - o Algal blooms were raised as a concern.
- The majority of cultural health indicators receive a slightly below average score.
  - o Eroding riverbanks are evident. In some places whanau described it as severe erosion.
  - o Water quality concerns
  - o Limited habitats
  - o Weeds in riparian margin and a need to reintroduce native plants.
  - o Modification of channel and riparian margin (stopbanks).

OTHER ASSESSMENTS

WATER QUALITY	MCI
• Met the LWRP target for fine sediment. • Annual maximum temperature failed to meet LWRP target at least once • Annual dissolved oxygen failed to meet LWRP target twice since 2011. • Average dissolved oxygen failed to meet LWRP target.	The mean for the scores 2011 - 2015 fails to meet LWRP

RECREATION	NUTRIENTS
• The "Suitable for Recreation Grade" was rated as "fair" • Potential for cyanobacteria in the Lower River to pose a health risk	• Median DIN levels exceed thresholds in LWRP

RECOMMENDATIONS

NUTRIENTS	WATER QUALITY BANDS				
Going forward - • Levels in the LWRP are not to be lessened (weakened). • There is to be 100% compliance with the thresholds in the LWRP.		**Nitrate toxicity**	**Ammonia toxicity**	**E-coli median**	**E-coli 95th percentile**
	CURRENT	**A**	**A**	**A**	**A**
	WHANAU PREFERENCE	**A**	**A**	**A**	**A**

FLOWS

Since July 2014, the frequency and size of flood events (3X median) has been markedly lower.
At the State Highway Bridge the minimum flow is to be
- Summer - sufficient to maintain a visible connected flow provided this is sufficient to protect native fish (especially inanga and eels). If this flow is breach a step up (of at least 250 l/s) is requested.
- Winter – sufficient to a visible connected flow and a braided river

MANAGEMENT PRIORITIES

- Recreate habitats (e.g. wetlands have been filled in. Runanga would like to work with Ecan to identify opportunities to recreate)
- Shingle management needs to be reviewed. It is unclear how dry reaches, low flows and flood control measures cumulatively impact fish habitat and fish populations.
- Improved weed management.
- Review of the willow management programme
- Plant natives on the riparian margins – include flaxes for weavers to use
- Agree to a water quality standard that means water is safe for swimming
- Increase summer flows that improve water quality and support whanau use.

Having identified the opportunities sought within a river reach, site specific recommendations are also made. For example, Table 22 provides an illustration of the recommendations for a site in the Selwyn Te Waihora catchment.

Photo 37: The Ashley in flood. Whanau want to see flow variability set in the flow regime. Flood management practices need to consider instream needs.

Table 22: An Example of a Summary Table detailing the cultural flow preference for a site in a Selwyn Waihora Catchment

Current minimum flows	Ecological Recommendation	Cultural Flow Preference
300 300	637	**890 l/s – 1100 l/s**

Photo of current - Whanau observed flow of approximately 350 l/s – the flow closest to the minimum. It received an overall satisfaction score of 1 and a cultural health score of 1.2. At this level none of the attributes were rated as satisfactory. When the flow was observed in January 2013 "The flow was gone"

When flows were at 890 l/s 60% of the attributes were rated as satisfactory – mainly mahinga kai attributes. If flows were at 1100l/s 89% of attributes would be rated as satisfactory including some health & wellbeing, and cultural landscape attributes. Photo of recommended (approximately 890 l/s)

Values & Opportunities sought

- Mix of shallows, riffles, pools,
- Spring and rainfall fed
- Gets flows from Selwyn when floods
- Very deep springs in upper river (valued as waipuna)
- Wahi tapu at mouth
- Harakeke highly valued
- Sustains tuna (long fin, short fin)
- Connections to lake, to Selwyn important.
- Connections – ki uta ki tai – important as part of old trail.

Photo 38a: shows 350 l/s

Photo 38b: shows 890l/s

Table 23: A summary of the of the Opportunities sought in the Temuka River together with a summary of current state of the river and recommendations for future water quality and quantity.

Photo 39: Temuka River – looking downstream from Manse Bridge

Photo 40: Upstream and downstream of Manse Bridge

<table>
<tr><th colspan="3">TE MOEMOEA</th></tr>
<tr><td colspan="2">• The Temuka is restored as a mahinga kai</td><td>• Retention of the variety within the river channel – deep pools, riffles, runs
• The braided river returns</td></tr>
<tr><th>VALUED FEATURES</th><th>WAHI TAONGA</th><th>TAONGA SPECIES</th></tr>
<tr><td>• This was a highly valued and productive part of the river system that is spring fed.
• In close proximity to the marae so it is heavily used.
• Has always been a highly valued and remains heavily used part of the Temuka River</td><td>• Wai Maori, Wetlands, Springs
• Taonga species
• Wahi tupuna (landscapes and formations)
• Papakainga housing, pa, marae, reserves
• Mahinga kai</td><td>Upland bully, Koura, Freshwater shrimp, Freshwater mussel</td></tr>
<tr><th colspan="3">CULTURAL HEALTH ASSESSMENT</th></tr>
<tr><td colspan="2">Using the Cultural Health Index (Temuka River at Manse Bridge)
<table><tr><th>Site</th><th>Cultural use</th><th>Stream Health</th></tr><tr><td>A-1</td><td>3.63</td><td>2.82</td></tr></table>
• This river has always been a focal point for whanau and heavily used as am mahinga kai and for recreation. Its proximity to marae and papakainga reinforces its importance.
• The high mahinga kai score reflects the heavy use by whanau members.</td><td>• Stream health was average across most indicators, with water clarity scoring higher that others on the day of assessment when flows were higher than usual.
• However, whanau believe the water quality is now degraded. The pollutants are believed to come from the Kakahu and Raupo Creek. Willows need to be removed.
• The shingle needs to be managed so that the braided character can return.
• The depth and velocity of water needs to be restored. There are no longer deep pools. It needs to be restored as a mahinga kai.</td></tr>
<tr><td colspan="2">Using the Cultural Health Index (Dobies Stream)
<table><tr><th>Site Status</th><th>Cultural use</th><th>Health measure</th></tr><tr><td>A-0</td><td>2.25</td><td>1.93</td></tr></table>
• Cows were adjacent to the stream and there was a very narrow riparian margin.
• This stream needs to be managed as a source of reliable water to the Temuka.</td><td>• The low mahinga kai score reflects the high level of modification.
• Stream health was below average for most indicators.
• Whanau are aware of the springs that rise in the paddocks but were concerned that there was no protection.
• However, whanau believe the water quality is now degraded. The pollutants are believed to come from the Kakahu and Raupo Creek. Willows need to be removed.
• Two years ago this stream ran dry. This is to be avoided.
• This stream is to be prioritised as a native fishery.</td></tr>
</table>

THREATS TO CULTURAL BELIEFS, PRACTICES	
• Monkey musk is present throughout the reach • Broom, gorse, willows are present along the margins of the Temuka • Vehicle tracks cross several of the waterways in this area. It is heavily used by 4WD vehicles • The risk of algae growth – and the impact on human health - is of concern to whanau • Inappropriate gravel management is a risk to instream habitats.	• Low flows in summer, and the increased temperature of water is a risk for instream species. The Dobies should not run dry. • Compounding effect of extracting water from tributaries and from groundwater affects the flows in the Temuka. Protecting of springs feeding the Temuka is a priority. • Flood control practices are seen to be adversely impacting instream habitats. • Commercial eeling, including fishing illegally within the Mataitai area, is a risk.

NUTRIENTS	TREND	WATER QUALITY	FLOWS
Nitrogen • TN – 1.9 g/ms3 • TON- 1.44 g/ms3 • AN – 0.006 g/ms3 Phosphorus • DRP – 0.009 g/ms3 • TP – 0.011 g/ms3	Ecoli – Meaningful degradation ↓	Using the Water Quality Index • 2011-13 = Fair • 2013-14 = Poor • 2014-15 = Fair Recreational water quality • Ecoli – 134/100mls (above swimming threshold) • Toxic benthic cyanobacteria (there have been warnings in the past) • There is a caution for recreational users at State Highway 1	• Mean flow – 3.18ms/3 • Median flow – 3.42ms/3 • 7 day MALF – 0.29ms/3

RECOMMENDATIONS

FLOWS & ALLOCATION	OTHER
• The minimum flow needs to be at least 1.50cumecs with variability above this level • Allocation is to be no more than 0.650cumecs	• Together with Timaru District Council manage this waterway as a significant cultural landscape • Investigate the extent of leaching from the rubbish dump that was "closed and sealed". • Water quality is to be drinking water standard. • The Temuka River is to be restored as a mahinga kai • Security of supply of good quality drinking water for whanau residing around Arowhenua • Flood control and river engineering practices are amended to take account of instream values such as habitat and mahinga kai. • Protection of the quality and quantity of spring fed water that flows into the river. Source waters are to be identified and protected. All spring heads are to be identified and protected by a buffer zone and plantings. • Gravel takes in the Temuka catchment are reviewed and rationalised. An agreed code of practice is needed and its implementation audited.

WATER QUALITY BANDS				
	Nitrate toxicity	Ammonia toxicity	E-coli median	E-coli 95th percentile
CURRENT	?	?	?	?
WHANAU PREFERENCE	A	A	A	A

Conceptual diagrams such as that shown in Figure 11, which was prepared while a group sat discussing a site that had just been assessed, can also be used to summarise issues.

Every opportunity needs to be found to visualise the data. Even though a mandated team of representatives undertakes the assessments, it is highly likely that they will need to take their recommendations to the wider whanau for discussion and ratification. Visualisations can aid that communication process. The diagrams can vary in complexity from single site sketch (see Figure 11) to a more complex multi value, multi issue, numerous catchment such as that shown in Figure 12.

The purpose of any diagram is to assist communication. Even is a complex diagram is developed, Manawhenua need to understand and approve its components

Figure 11: A Conceptualisation of Flow Related Issues at a Specific Site

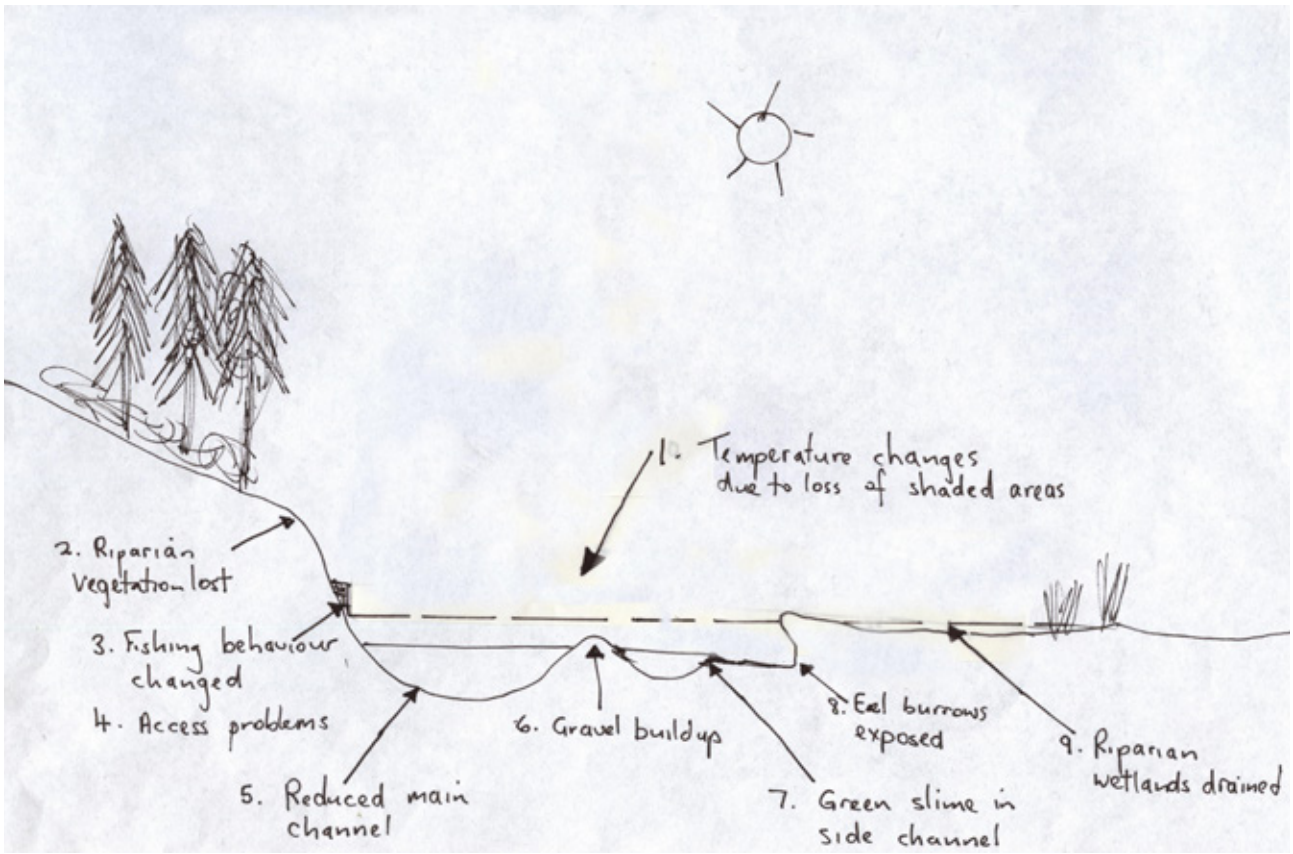
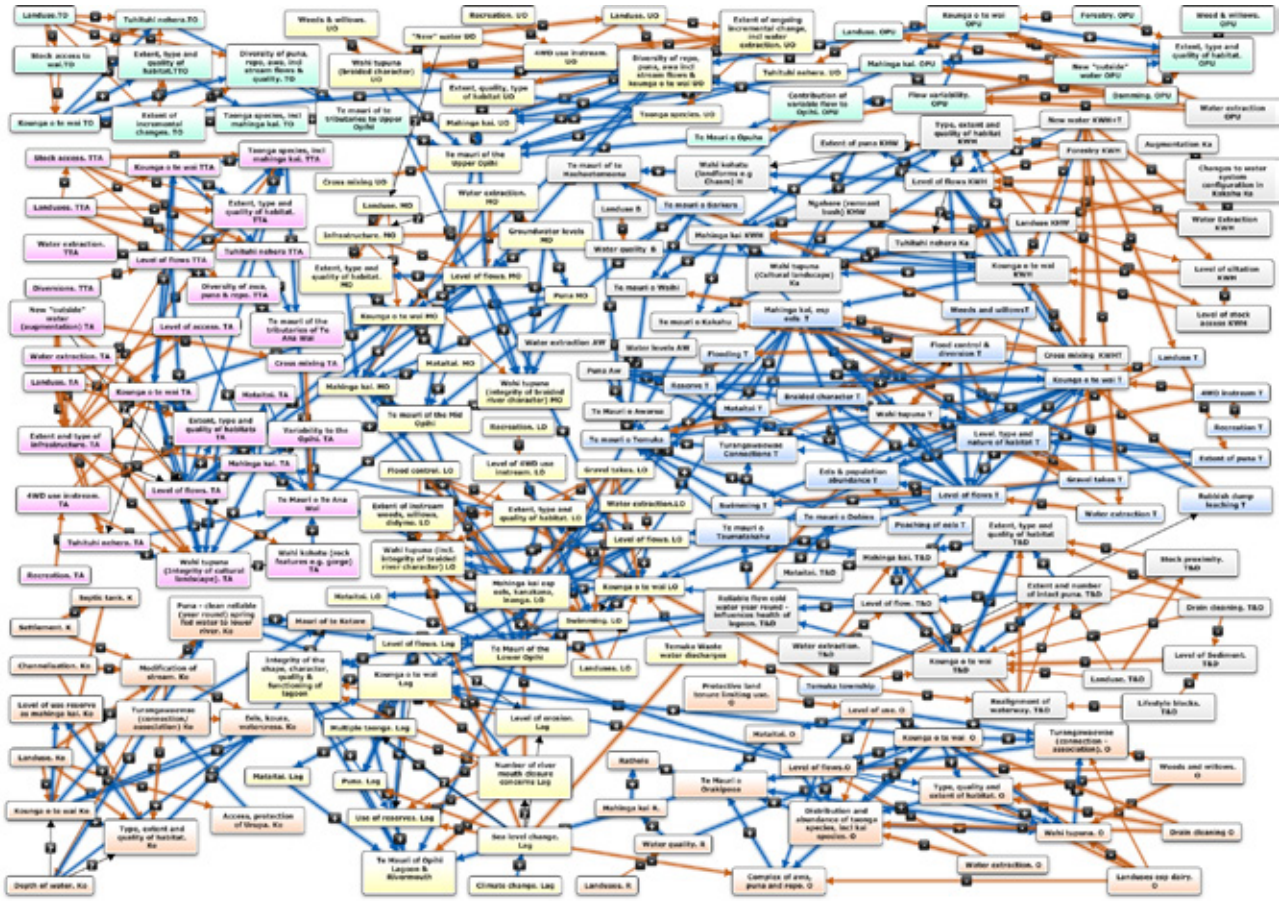


Figure 12: A Conceptualisation of multiple issues, including flow at multiple sites in a catchment



Chapter 6
Linking with Others undertaking Flow Assessments

If there is magic on this planet,
it is contained in water
(Lorain Wisely)

Purpose of chapter

To explain how a CFPS can link with environmental flow assessments being undertaken by others

To set out a process to identify when a CFPS may be required.

Key questions

How does a CFPS relate to flow assessments that are usually undertaken by scientists or Council technical staff?

Take away messages

The CFPS is not a standalone flow assessment method. It is however, a component specific to cultural values of Manawhenua, that can complement other flow assessment methods.

6.1 Introduction

Repeatedly, we have stated that a CFPs is not a stand-alone flow assessment method. It is envisaged that Manawhenua will also have the opportunity to input to other assessments (undertaken by hydrologists and ecologists). Collaboratively they will shape an agreed flow regime. In the paragraphs that follow we suggest how and where this collaboration can occur. We do however with the caveat, that ultimately it is for Manawhenua to decide how they choose to work with non-Maori, in particular resource management agencies.

6.2 Linking with those undertaking environmental flow assessments.

When applying the CFPS process we describe in Table 1, we identify the need to critically review the data collected and to focus on environmental flows and specific flow issues affecting the waterways being investigated. Specifically, there is a need to distinguish between:

a) cultural values, opportunities, and issues to be evaluated as part of existing EFAs;

b) cultural values, opportunities, issues (and consequently flow attributes) that are place specific but could be addressed within an existing EFA; and

c) those cultural values, opportunities, issues and flow attributes that were unlikely to be adequately addressed via existing EFA methods and are more appropriately addressed through a cultural assessment.

The challenge however, is to ensure that Manawhenua are engaged in this process and understand how other flow assessment methods are helping to address their needs.

6.3 Assess Significance of Rivers and degree of hydrological alteration

Not all flow setting processes will be initiated by a regional council that wants to include a flow regime and allocative regime in a statutory plan. There may be other circumstances in which a CFPS may be appropriate:

1. Significance; and
2. Degree of hydrological alteration.

The proposed NES on ecological flows and water levels uses significance as a criterion to help identify the methods to be applied in a particular context. We have adopted a similar approach that could be used to accord significance. However, significance or the relative importance of a river to Manawhenua given its values and attributes can only be determined by Manawhenua. As the relative importance of values increases, the consequences of not meeting the goals and objectives of Manawhenua also increase.

We have chosen not to use the concept of national, regional and local significance as some river reaches are of considerable significance to whanau, hapū and iwi. It is difficult and inappropriate to impose the national regional or local ranking of significance based on non-cultural criteria. We propose according significance of a river based on three criteria:

- presence or absence of wetland attributes;
- level of modification; and
- ability for rehabilitation / restoration / reversibility.

In iwi management plans and or in resource inventories whanau, hapū and iwi identify their beliefs, values and uses of resources. They are likely to engage in planning processes to protect these values and the river / flow attributes that contribute to that value. The presence of those attributes and values will influence determinations of significance.

In addition to the presence of attributes and values, their condition (i.e., the level of modification) will also influence the level of significance accorded as will the ability of whanau to rehabilitate / restore or reverse the impacts of an activity.

Having provided a score each for the three criteria in Table 24 (e.g., 2 for "some site-specific values present", 2 for "some modification", and 2 for "some ability to restore") the three scores are summed. The combined score (of 6 in our example) represents a river/reach that is of medium significance.

Rating rivers is inherently challenging for Māori. However, Table 24 is proposed as a possible means of according significance and is included to promote discussion. To reiterate, it is always the right of Manawhenua to determine significance and they may decide that all rivers in their rohe are of high significance.

Table 24: Proposed instream values and scoring criteria for significance of rivers and river reaches based on a determination of cultural values and attributes.

Values & Attribute – tangata whenua decide whether 1. None of the expected site specific values and uses are present/possible. 2. Some of the expected site specific values and uses are present/possible. 3. All of the expected site specific values and uses are present/possible.	**Score** 3, 4 low significance. 5-6 medium significance. 7-9 high significance.
Degree of modification - tangata whenua decide whether 1. No sign of site specific attributes – destroyed / lost. 2. Some modification - some sign of site specific attributes. 3. Totally natural – no modification.	
Ability to protect, restore, rehabilitate - tangata whenua decide whether 1. No or very limited ability to restore of rehabilitate attributes. 2. Ability to restore and rehabilitate. 3. Realistic to protect all attributes.	

6.4 Degree of Hydrological Alteration

The proposed NES for Ecological Flows and Levels uses the degree of hydrological alteration to help in the selection of appropriate ecological flow assessment methods. To make the assessment process "accessible" to Māori we recommend distinguishing between low, medium and high hydrological alteration based on the nature of the activity and potential level of impact. BECA (2008) explain that water use can be divided into three categories of increasing hydrological alteration.

Consumptive use or abstraction - Water is taken from the river and used for activities such as water supply and irrigation, often with seasonally varying demand. BECA (2008, 10) contend that:

abstraction of up to 10% of the mean annual low flow (MALF) is barely measurable and therefore unlikely to result in significant biological effects in any stream. Abstraction of up to 20% of MALF is unlikely to result in significant biological effects in lake- or spring-fed streams or in streams with frequent floods and freshes, such as those draining mountainous regions exposed to the prevailing westerly winds. When total abstraction exceeds these limits, the magnitude and duration of low flow may have significant effects on biota.

Diversion or large-scale abstraction - Water can diverted from rivers on a relatively large scale and may be returned to the river downstream or discharged into another catchment. A diversion or abstraction is considered large-scale when it can divert more than 90% of the MALF out of a river. With large-scale diversions or abstractions, the quality and amount of habitat at minimum flow will directly affect the biological communities because flows are at the minimum for substantial periods of time.

Photo 41: A non-consumptive example of storage: Aviemore Dam impounds water for hydro reservoir. Water is not diverted or extracted. Water flows downstream via turbines

Photo 42: A consumptive example of storage: a pond that is used for fire suppression, frost fighting and irrigation

Storage - River flows are modified by storage with potential change to the seasonality of flows, minimum flows, and high flows. Storage regulation can be consumptive (water supply or irrigation) or non-consumptive (hydro-electricity). The potential degree of regulation will depend on the storage volume in the impoundment. Storage regulation can affect all biologically important components of the flow regime.

The proposed assessment criteria listed in Table 25 requires significant discussion with whanau, hapū and iwi before it could be finalised. However, it adopts a cautious approach based on the discussions presented in the BECA (2008) report and our interpretation of iwi submission to the proposed NES, but the levels may not address all the concerns of whanau, hapū and iwi given that some argue that any alteration is unacceptable culturally. Therefore, Table 25 below must be considered as "illustrative" with the caveat that it needs to be the subject of further discussion with Manawhenua.

To apply the criteria, Manawhenua are to identify the nature of the proposed activity and the level of impact for example inter-catchment transfers would be classed as a high degree of hydrological alteration. In contrast a proposal that involved out of river but in catchment storage of high flows (highlighted) may be classed as a low degree of hydrological alteration. Once again, however, it is the right of Manawhenua to determine all activities to be of high hydrological alteration.

Table 25: Proposed assessment criteria for level of impact and hydrological alteration

Level of impact	Degree of hydrological alteration
Low impact activities: Extraction of less than 10% of MALF; or Diversion – in catchment - of less than 10% of MALF; or Out of river but in catchment storage that involves harvesting of higher flows; or Activities that are completely reversible.	Low
Medium impact activities Extraction of less than 20% of MALF[8] but more than 10% of MALF; or Instream storage infrastructure on the tributary of the river system; or Diversion less than 20% of MALF[9] but more than 10% of MALF. Activities that are partly reversible	Medium
High impact activities Extraction more than 20% of MALF; or Storage infrastructure on the mainstem of any river; or Diversion of more than 20% of MALF; or Intercatchment transfers; or Activities that are irreversible.	High

[8] The figure of 20% was taken from the Ngati Kahungunu submission to the NES discussion document.
[9] The figure of 20% was taken from the Ngati Kahungunu submission to the NES discussion document.

Having identified the cultural values, assessed the degree of significance and level of hydrological alteration (step 3), the next step (following the approach presented in the proposed NES) is to select an appropriate level of investigation. We have drawn together the significance criteria and the degree of alteration to develop a matrix.

Table 26 is populated with suggested flow assessment methods based on a cultural determination of both significance and hydrological alteration. For example, where an activity that is likely to result in low hydrological alteration is to occur in a river reach considered to be of low significance, then it may be that a cultural values report from Manawhenua may suffice. In contrast, for an activity likely to result in a high degree of hydrological alteration in a river reach considered to be of high significance, then it is recommended that the socio-economic module from DRIFT be undertaken, along with a CFPS. These methods then complement assessments specific to ecological, recreational or amenity values identified by tangata whenua, stakeholders and communities.

Table 26: Recommended cultural methods used in the assessment of flow requirements for degrees of hydrological alteration and significance of values.

Degree of hydrological alteration	Significance of waterway to Manawhenua		
	Low (1-3)	**Medium (4-6)**	**High (7-9)**
Low	**Cultural Values Report** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Cultural Values Report** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Cultural Impact Assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments
Medium	**Cultural Impact Assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Socio-economic module (e.g. DRIFT or similar)** **Cultural Impact Assessment** **Cultural flow assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Socio-economic module (e.g. DRIFT or similar)** **Cultural Impact Assessment** **Cultural flow assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments
High	**Cultural Impact Assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Socio-economic module (e.g. DRIFT or similar)** **Cultural Impact Assessment** **Cultural flow assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments	**Socio-economic module (e.g. DRIFT or similar)** **Cultural Impact Assessment** **Cultural flow assessment** *plus*, other environmental flow assessment methods to enable economic, ecological, aesthetic assessments

6.5 Downstream Response to Imposed Flow Transformations (DRIFT) or similar

This is comprehensive assessment that comprises 4 modules:

- The biophysical module.
- The second module is the sociological module. The subsistence users of the river who are potentially affected by proposed changes to the flows and water levels are identified, their use of the river is quantified, and an understanding of how they will be affected by changes to the river is developed.
- In the third module, modelling several scenarios for possible flows and water levels. For each flow scenario, the biophysical and socio-economic impacts are predicted.
- The fourth module, the costs of mitigating identified effects and/or compensating affected communities for impacts that cannot be resolved are assessed.

Scenario building using the information obtained from participatory processes to understand the perspective of those living with and using the river, is integrative and serves to accommodate differing worldviews, knowledge systems and differing values. King, Brown & Sabet (2003) explain:

Two allied activities should occur in parallel to the DRIFT application…First an assessment of the wider consequences of each flow scenario should be done to illustrate related macro economics such as the loss or gain of irrigated agricultural land, the potential for industrial and urban development and the cost of water to off stream users. Second a public participation process (PPP) should be run parallel to DRIFT throughout its application. Initially the PPP provides input to DRIFT on river concerns that need to be described in each scenario, such as a recreational fishery, a conservation area, a riverside business or a flood hazard. Following this a continuing process of information exchange and education should allow interested parties to understand the scenarios developed in DRIFT and to indicate the degree of acceptability of each. All three activities thus produce independent but related information for the decision maker. (King et al. December 2004)

Like other holistic approaches DRIFT is essentially a data management tool allowing data and knowledge to be used to their best advantage in a structured process. Its central rationale is that different parts of the flow regime elicit different responses from the river ecosystem… the removal of one part of the flow regime will affect the ecosystem differently than removal of another part. Furthermore, it is assumed that:

- *It is possible to identify and isolate these different parts of the flow regime within a long term hydrological data set of daily flow.*
- *It is possible to describe in isolation the probable biophysical consequences of partial or whole removal of any one of these parts.*

- *The parts of the flow regime and their linked consequences can be recombined in various ways to describe the river condition of any flow regime of interest (the biophysical part of the scenario).*
- *The social impacts of each river condition can be described (the socio-economic part of the scenario).*

While it is beyond the scope of this Guideline to delve into each of these modules and the DRIFT methodology in detail, it is important to consider the methodology and the holistic approach that they represent (King, Brown & Sabet 2003). Their strength is that they provide decision-makers with information that usually remains unconsidered in water-resource developments, especially on potential human and ecosystem costs. The scenarios provide several future options on how the river could change with flow changes, and how this would impact overall environmental condition and users. Scenario building is an integrative step.

The trend in setting environmental flows is for these holistic methodologies to increasingly be run along with other hydrological based methods, and for more biodiverse, whole ecosystem approaches. The processes described in Chapters 3 - 4 complement the "socio-economic" focus of both BBM and DRIFT (or similar) by introducing a cultural assessment process for setting flows that could be considered as a "cultural module" to be included within an existing holistic methodology.

In concluding, it needs to be stressed:

- Only Manawhenua can determine the significance of the reach or river to them.
- Manawhenua will assess the level of hydrological alteration likely to result from an activity; and
- Manawhenua will specify the methods they wish to employ to inform a flow assessment process, recognising that multiple methods will be utilised.

Chapter 7
The International Context

Eventually, all things merge into one, and a river runs through it
(Norman Maclean)

Purpose of chapter

To explain the theoretical basis for developing a preference based flow assessment process

Key questions

How valid is a preference based approach?

Take away messages

There is a considerable body of literature available that supports the approach proposed for the CFPS

7.1 Introduction

This Guideline seeks to highlight the association of Maori with respect to freshwater. However, it is imperative that we demonstrate through examples from the international literature how a preference-based approach is supported by international theoretical developments.

7.2 Theories supporting the participation of Manawhenua in flow setting

Development of a responsive framework for Manawhenua drew from the international literature in five areas, specifically: eco-cultural restoration; cultural keystone species; cultural landscapes/aboriginal cultural landscapes; opportunity spectrums; and preference and perception studies.

Eco-Cultural Restoration - The term "eco-cultural restoration" was introduced by Dennis Martinez (1995) to overcome the artificial divide between culture and nature, or between humans and the environment, and to reinforce the need for collaboration between indigenous knowledge and western science. The theories espoused by Martinez are reflected in the mission statement of the Indigenous People's Restoration Network (IPRN), a chapter of the Society for Ecological Restoration International, founded by Martinez in 1995. Their mission statement states that:

> *Indigenous peoples bear a cultural and spiritual tradition that integrates culture and nature. While this tradition has been badly fragmented under the impacts of modern industrial civilization, it persists to some degree in most traditional communities and has been maintained largely intact in remote places scattered throughout the world (Indigenous People's Restoration Network 2005).*

When initiating a project, goals and objectives are defined. Kimmerer (2000) contends that the starting point when seeking to restore an ecosystem must be developing an understanding of the relationship of indigenous peoples and the lands and waters to be restored. Because ecosystems evolved outside of and separate from the western worldview she believes those undertaking restorations must engage in a process of understanding different knowledge bases. She further observes that the goals of indigenous people may be much broader that simply restoring ecological processes. As the term "eco-cultural restoration" suggests, both ecosystems and cultures are restored. This concept of reciprocity or reciprocal benefits is acknowledged by the Indigenous People's Restoration Network (2005) who state that the goal of eco-cultural restoration is to enhance the survival of indigenous people and culture in conjunction with restoring damaged landscapes. As Tudge (2006) explains "integral to the survival of indigenous culture is restoring the ecological communities that are central to their traditional life-ways and that are woven into stories, ceremonies, songs and practices".

Driscoll (2003) and Underwood et al (2003) explain that eco-cultural initiatives range from initiatives involving tribal lands and waters, utilising solely indigenous knowledge and involving indigenous peoples, to partnerships involving government and / or NGOs in the restoration of tribal lands and waters.

Eco-cultural approaches are therefore reliant on community participation. With respect to New Zealand, the examples described in Chapter 5 seek to set an environmental flow that delivers both ecological and cultural outcomes within a defined takiwa and is premised on the active participation of Manawhenua.

Cultural keystone species - Garibaldi and Turner (2004) explain that there are species that are embedded in the cultural beliefs, values and uses of indigenous peoples which can legitimately be considered as cultural icons. More specifically they describe cultural keystone species as

> *the culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine, and/or spiritual practices…Keystone species may serve a particular culture materially in a host of different ways: as a staple food or a crucial emergency food, in technology, or as an important medicine. As well, such a cultural keystone species may be featured in narratives or have important ceremonial or spiritual roles. It would also likely be highly represented in a culture's language and vocabulary".*

The identification and characterization of cultural keystone species is challenging as environmental factors (such as climate, natural disturbance, and fluctuations in populations and productivity) and social factors (such as economic systems, social organization, access to land and resources, and knowledge transmission) all impact the relationship of humans with species.

In the New Zealand context, what constitutes cultural keystone species has not been articulated by iwi, although many do define specific species as taonga. In the case of one iwi, Ngai Tahu, taonga species are designated in Schedule 97 of the Ngai Tahu Claims Settlement Act 1998. Without doubt however, Manawhenua are highly likely to expect flow regimes to recognise and provide for the needs of taonga species.

Cultural Landscapes - The concept of cultural landscapes was introduced to reinforce that culture and nature co-evolve (Naveh, 1998). More recently in Canada, the concept of Aboriginal Cultural Landscapes has emerged. **An Aboriginal cultural landscape**

> *is a place valued by an Aboriginal group (or groups) because of their long and complex relationship with that land. It expresses their unity with the natural and spiritual environment. It embodies their traditional knowledge of spirits, places, land uses, and ecology. Material remains of the association may be prominent but will often be minimal or absent (see http://www.pc.gc.ca/docs/r/pca-acl/sec4/index_e.asp).*

This definition emphasises the complexity of the association of indigenous peoples with tribal lands. With respect to Maori, they also infuse natural and physical resources within their lands with mental and spiritual dimensions, and in setting environmental flows are likely to seek to maintain, protect and/or restore culturally significant landscapes. From the

perspective of Manawhenua, rivers flowing through a landscape are a significant unifying component of that landscape.

Opportunity spectrums - Within the literature (concerning recreation in the wilderness), one approach that focuses on the outcomes of an experience is operationalised in the Recreational Opportunity Spectrum (ROS). The ROS is a tool that has been widely applied within the USA and by the Department of Conservation within New Zealand in the management of recreational resources (Taylor 1993, Borrie & Birzell 2001). A range of related techniques for assessing opportunities that have since emerged include a Water Recreation Opportunity Spectrum, Tourism Opportunity Spectrum, Forestry Opportunity Spectrum, and a Spiritual Opportunity Spectrum. Proposing an opportunity approach to flow setting builds on this body of literature.

An opportunities approach recognizes that the engagement of Maori with environments is experiential and their assessment of environmental condition is sensory and perceptual. They utilize signs to understand ecological conditions and/or change (Crengle 2002). Conceptually, parallels can be drawn between the intent, design and application of the ROS and the monitoring techniques of Maori. Clarke and Stankey (1979) define a recreational opportunity as the combination of conditions and attributes that give value to a place. The experiences of users are fundamental as the ROS is predicated on the assumption that differing conditions will support a diverse range of opportunities thus recognizing that a community comprises individuals with diverse tastes and preferences. Drawing from the earlier work of Clarke and Stankey (1979) a cultural opportunity exists when the combination of physical, biological, social, cultural and managerial conditions at a site support cultural uses as they did in the past and as desired by Maori today and into the future. Quality and condition of sites of cultural significance impact the opportunities afforded Maori. Significantly, conditions can be restored or enhanced to provide cultural opportunities.

While this section introduces theoretical propositions, they should not be viewed in isolation or be seen as mutually exclusive. For example, Tudge (2006) suggests that eco-cultural approaches restore both ecosystems and the human relationship to the cultural landscape. In the case of the South Island of New Zealand, taonga species (akin to cultural keystone species) are often a fundamental component of a significant cultural landscape that Ngai Tahu wants to recognise and provide for when setting river flows. Further, management is intended to provide a range of opportunities for Ngai Tahu to interact with valued environments.

While supporting these theoretical developments, a tactic was needed to enable Maori to move from an intent to maintain their cultural associations with aquatic ecosystems to the formulation and implementation of responsive management regimes. The process employed to aid this transition was via Cultural Opportunity Mapping, Assessment and Responses (COMAR) in Chapter 2. Because COMAR relies on Manawhenua stating and quantifying their flow preferences the next section of this chapter explains why a preference-based approach is considered appropriate for use by Manawhenua.

7.3 Supporting a preference-based approach to flow setting

From a management perspective, all issues associated with freshwater arise because of human values and the perception of risks to those values (Galindo & Rodriguez 2000, Gold 1980). The condition of freshwater resources can directly affect perceptions. This section explains why a focus on preferences was adopted.

In the context of determining flow regimes, our proposed method recognises that humans act in and on landscapes, as well as landscapes providing information and experiences. Manawhenua are actively involved in the catchments being studied and as Bell (1999) explains, perception of the riverscape is mostly through the eyes and when Manawhenua perceive river flow, they will be referring to three things: (1) the physical aspects of the visual stimuli, (2) the intuitive recognition of the quality of aquatic environs, and (3) the ability of the mind to connect sensory information to other knowledge and develop opinions about what has been perceived, (i.e., meaning). If a given scene has attributes that facilitate its comprehension, then that scene is favoured. Kaplan and Kaplan (1989) emphasise that the importance of familiarity to preference of a landscape. We involved Manawhenua in the design of our CFPS process to address this possible shortcoming. Manawhenua are active participants in the identification of sites to be assessed and the assessment of the sites – all within their tribal territory, which they have an intimate knowledge of.

From the perspective of Manawhenua, making sense and involvement are indeed pervasive concepts and it seems logical that aquatic environments known to whanau and sustaining cultural uses and practices highly valued by Manawhenua should be preferred. Valued aquatic environments are likely to be whatever environments sustain a cultural belief or value or enable a cultural practice to be pursued to a successful conclusion.

The information processing theory of Kaplan strikes accord with Manawhenua engagement with river environs and their generation of Matauranga Maori. Matauranga emerges through direct active use of the landscape - one must participate in the real-life processes of hunting, fishing, gathering and processing of resources. This is a form of pragmatic knowledge that ultimately is dynamic and responsive to changes within the environment. In other words, Maori with a history of use and those who continue to use waterways and resources are those that retain and continue to generate matauranga.

The purpose of the discussion in the preceding paragraphs is to describe a different way of thinking about the role of people in the setting of river flows, a new way of conceptualising what goes on in people's heads / Maori when they react to a landscape, river environ, or river flow. What Kaplan proposes is an approach that focuses on what people are trying to do. It recognises that when people view a landscape they are making a judgment, however intuitive and unconscious that process may be. This judgment concerns the sort of experiences they would expect to have, the ease of locomoting, of moving, of exploring, of using and functioning in the environment they are viewing. As noted previously, this perspective is attuned to the multi-dimensional relationship of Manawhenua with freshwater resources. According to the information-processing model, such comprehension is achieved by relating the perceived structure of a

landscape to one's cognitive map. People will feel most comfortable in those environments where previous cognitive maps can be useful. Therefore, it follows that familiarity with a place or type of environment – that would be expected from Manawhenua who have a culturally defined and intergenerational attachment to and knowledge of tribal lands and waters - might play a significant role in environmental cognition and subsequent preference (Kaplan & Kaplan, 1982).

With respect to development of a cultural assessment process for Manawhenua to apply, Daniel (2001) suggests determining the relationship between biophysical features of landscapes (associated with the concept of sustainability) and human responses to these features (i.e., preference or choice). This general approach has been included by Daniel and Vining (1983), in the psychophysical model of landscape visual assessment research. However, the propositions of Bourassa (1990) who suggests a tripartite theory, making a distinction between biological, cultural and personal modes of experience is more akin to the intent of the present research in river flow assessments. Strumse (1996) maintains that Bourassa's framework is of value as it urges researchers to firstly, make explicit distinctions between the three modes of experience (i.e., biological, cultural and personal) and secondly, to clarify the way in which these three modes can be integrated in our own studies of preference.

Thus far we have discussed theories that emphasize the way in which people construct their perceptions of the landscape in cognitive maps. However, people do not stand apart from the landscape, but rather are participants in the landscape in a situation of "mutual influence", which is more akin to Manawhenua values of whanaungatanga and whakapapa. Therefore, the final theoretical perspective to be considered is behavioural which focuses on the interface between environmental structure and human spatial behavior (Golledge and Stimson, 1987 p. 13).

> *The behavioral interface is the black-box within which humans form the image of their world... The key psychological variables intervening between environment and human behaviour within (the behavioral interface) are a mixture of cognitive and affective attitudes, emotions or affective responses, perception and cognition, and learning*

When designing an assessment process for our study of river flows, we accepted that cultural flow preferences are the joint effect of specific features of the riverscape, specifically the valued attributes of river flow, interacting with relevant psychological (perceptual, cognitive and emotional) processes of the Manawhenua observers who have an extensive history of engaging with the waterways being studied that spans generations (Brown & Daniel, 1987; Daniel, 1990, 2001; Daniel & Boster, 1976). In analysing the data, we identify relationships between responses and the flow observed (Uzzell, 1991). In addition to rating the individual flow attributes, we chose to incorporate within our process the principal methods for gathering information in experiential type studies, specifically personal interviews with tribal members, focus groups, the use of pictorial data, a recording form with open ended questions, and the development and analysis of conceptual diagrams or cognitive maps. We complemented our analyses of qualitative data with several statistical analyses. We were guided by the observations of Zube et al. (1982) who asserts that no individual paradigm, per se, is sufficient to meet all the needs of landscape assessment.

7.4 Relating the six-step participatory process to theoretical propositions

A further test is to examine how our participatory process is guided by the literature.

Step	Objective of step and application in the case
1. Initiate the project	In the assessment of environmental flows, like in other forms of scientific assessment, including landscape assessments and perception studies, there is considerable discussion about the use of lay persons rather than experts. If Manawhenua are to engage in flow setting it is important to recognise that they are experts. It is they who hold the matauranga and can 'make sense" of the flows and the affordances the flow that they are observing provides for whanau, hapu and iw. It is they, who are charged with rating the flows in a river according to their preferences.
2. Defining the cultural association with the river	Cultural relationships with freshwater are explored before defining how their relationships, and interactions with a catchment, are affected by river flows. Understanding whanau perceptions of changes to flow patterns over time, and the impact of change are collected through hui and interviews. During this stage, interviewees are challenged to identify how their values and experiences are impacted by aquatic conditions, in particular river flow. We contend that this multi-step process is consistent with the need for cultural/symbolic explanations of the river environs that emphasize that preferences for certain landscape are developed through interactions with different landscapes over a long period of time (Cheng, 2007). The emphasis on understanding the nature and extent of the cultural relationship of Manawhenua with their lands and waters accommodates the proposition of Costonis (1982) with respect to the cultural stability-identity theory and the need to focus on a more abstract factor that influences individuals' preferences for landscapes: the stability of identity. Costonis (1989) suggested that preferences are reflections of a group's desire to protect their identities. That is, people will be more likely to prefer places associated with their identities. This perspective resonates with the aspirations of Manawhenua. It also re-emphasises the point that the members of teams need to know their rivers.
3. Cultural mapping including cultural opportunity mapping	Consistent with cultural concepts of whakapapa and whanaungatanga, connections within a river system are fundamentally important to Maori. The comparison of contemporary connections to historic patterns are aided by reference to historic maps and photographs. Photographs and maps are an accepted means to authenticate the cultural vitality of indigenous communities and their knowledge (Collier and Collier 1986; Egan and Howell 2005). The perception of participants with respect to pressures that impact the provision cultural opportunities at each site can be summarised in a concept diagram or a cognitive map. Garling et al. (1984) explains that cognitive maps are particular to an individual, many individuals' cognitive maps are likely to share certain features of a landscape. Lynch (1960) further observed that people who are familiar with a landscape develop cognitive maps that include smaller scale elements than those in cognitive maps of people who are new to a landscape. The cognitive map of flow related issues for the Orari River was developed from the collated comments of informants using Decision Explorer[10] and subjected to several analyses (see Chapter 4).
5. Undertaking Cultural Assessments and calculating Cultural Flow Preferences	For all catchments, the, sites that are chosen to be assessed are based on their significance to Manawhenua and emerge from mapping exercises. This explicitly responds to the contention that "familiarity" is one of the most important influence on visual preference (Kaplan & Kaplan, 1989).

[10]See www.banxia.com

A final test of our CFPS process is to apply the four criteria proposed by Daniel and Vining (1983) for the evaluation of landscape assessment techniques, specifically: reliability, sensitivity, validity and utility.

- **Reliability** means that an assessment carried out under similar conditions and applied by similar people on a second occasion should yield similar results, and if not, it is deemed unreliable (Taylor et al., 1987). In the CFPS process the mandated team undertakes all assessments. The team does not change. The team will observe sites across a year. Drawing from two case studies, in the Kakaunui, Manawhenua repeatedly scored flows less than 350 l/s as unsatisfactory. For the Orari flows less than 900 l/s consistently received an unsatisfactory rating.

- **Sensitivity** refers to the ability of a technique to measure actual differences. If a test is not able to measure a difference, it is considered to have low sensitivity (Taylor et al., 1987). By examining the raw scores for each of the respective individual flow attributes on our assessment form, and the qualitative statements recorded by observers, sensitivities at certain flow thresholds can be explored. We can also employ several statistical analyses to interrogate the data collected for catchments. Visual records (photo points) complement the ratings and qualitative statement of observers providing visual confirmation of the sensitivities.

- **Validity** represents the degree to which a test produces genuine and credible information. Development of the participatory process described in this paper was driven by three imperatives. Firstly, the process had to be grounded in the cultural beliefs, values, and practices of Maori. Importantly, the attributes that appear on the assessment form were initially derived from interviews with Ngai Tahu members across three catchments in the South Island. However, the attributes are reconfirmed with Manawhenua before each study commences. Secondly, the process had to explicitly enable the examination of flow related issues and the identification of flows preferred by Manawhenua who believed the flows would protect their range of cultural interests. Data is collected using both quantitative and qualitative methods and analyses involve content analysis and statistical analyses consistent with the observations of Schroeder who concluded that the combination of quantitative and qualitative research methods yields a more complete understanding of how people experience arboretum landscapes than would either method used alone. Thirdly, the process had to be safe for application by Maori, and their positions defendable given the contentiousness associated with setting environmental flows (as described by Poff et al. 2002). A final test, however, is to compare the results of the CFPS with the recommendations from ecological and hydrological assessments.

- **Utility** refers to the ability of a method to provide simple, accurate and reliable measures that can be implemented (Daniel & Vining, 1983). The process is simple for Manawhenua to apply and is cost effective (Home pers. com, Williams pers com, Smith pers. com). It has been applied im more than 40 streams.

Russell and Ward (1982) in a review of the field of environmental psychology noted the continuing debate between those taking a cognitive approach and those emphasising the study of the objective physical environment. The objective of the present research (to develop a cultural tool) was simply to identify the important underlying dimensions of meaning or content that Maori use to discriminate among the size of different river flows and, in addition, to examine the relationship between these dimensions and their ratings of satisfaction with river flows.

It was important to be cognizant of how Manawhenua are likely to utilise the results of a cultural flow preference study. There is strong evidence within policy and planning literature, as well as in the literature on social and organisational change, that a range of issues need to be adequately addressed to legitimately incorporate preference data in public decision making (Edwards 1981, Studer 1982). We believe that Sancar's (1992) characteristics of an ideal procedure for conducting a preference study have been accommodated in the design of the six-step process we are promoting for use by tangata whenua, specifically:

- maintaining contextual realism, specifically understanding how their data was to inform the flow setting process;
- simultaneous consideration of relevant value dimensions, including the values of others including communities, stakeholders, and resource users;
- clarification of potential alternative actions; and
- allowing for change and development in the assessments of the participants.

Sancar (1992) contends that all relevant aspects of the specific planning situation need to be presented to assessors. Hui before the fieldwork commenced, regular review of the forms completed by assessors, linking with others undertaking field assessments to share data, and hui at the completion of the fieldwork, provide time for reflection and feedback. Assessors are also given the opportunity for critical self-reflection by allowing them to compare their preferences with those of others when in the field.

Discussions with others undertaking flow assessments at the same sites, but using different methods, provide several checks and balances to satisfy the concerns raised by Sancar.

7.5 Conclusion

With respect to designing an assessment process for our river studies, cultural flow preference is the joint effect of specific features of the riverscape, especially river flow, interacting with relevant psychological (perceptual, cognitive and emotional) processes of Manawhenua observers (Brown & Daniel, 1987; Daniel, 1990, 2001; Daniel & Boster, 1976). In analysing the data, we identify relationships between perceptual, cognitive and affective responses and the flow observed (Uzzell, 1991). In addition to rating the attributes, we chose to incorporate within our process the principal methods for gathering information in experiential type studies, specifically personal interviews, focus groups, analysis of textual and pictorial data, open ended questions, and the development and analysis of cognitive maps. Data derived from these methods are analysed to identify common experiences (Daniel & Vining, 1983). We complemented our analysis of qualitative data with several statistical analyses. We are guided by the observations of Zube et al. (1982) who asserts that no individual paradigm, per se, is sufficient to meet all the needs of an assessment.

Finally, attention also needs to be accorded those individuals tasked with undertaking the assessments. Sancar (1992) explains that participants need to have a real, existing or potential interest in flow related issues. These could include active involvement in river activities, knowledge of or access to relevant information, power or influence in decision-making, and/or a share in the costs and benefits of a decision. Manawhenua participants are likely to have extensive experience in multiple resource management forums.

Chapter 8
Conclusions

Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land
(Luna Leopold)

8.1 Introduction

In these guidelines we have described what is involved if agencies and Manawhenua decide to implement a CFPS. We have included case studies to illustrate:

- the steps in the process;
- the range of analyses that can be undertaken with the data Manawhenua collect;
- how to present the data collected in a summary format; and
- how agencies have responded to the cultural flow preferences of Manawhenua.

In this final section we conclude the report by including a final set of recommendations that relate to the planning context within which a CFPS will be undertaken.

8.2 Additional recommendations

A) Fully engage Manawhenua in every aspect of flow assessment and allocative decision-making.

- Manawhenua should be involved in setting goals for waterbodies, defining flow needs and then negotiating which aspects of flow recommendations will be implemented;
- Values and practices of Manawhenua should be given due recognition and provided for when assessing the development and management of water resources infrastructure, including during siting, design, and operations.

B) Be very clear about the Manawhenua values that the flow provisions are to recognise and provide for

- The benefits from allocating river flows should be accompanied by explicitly and comprehensively assessing and justifying to Manawhenua the trade-offs between cultural preferences and other human water demands.
- Differences in river types need to be understood. Water withdrawals differ in their levels and types of impacts. Some water sources are more sensitive and vulnerable to withdrawals than others. Thus, sensitivity needs to be discussed with Manawhenua.

C) Focus on protecting whole, functioning ecosystems.

- The entire interconnected river system, ki uta ki tai, and its key attributes should be considered in a flows assessment.
- To protect the health of the whole ecosystem and ecosystem-related values, adequate knowledge needs to be gained of the ways that river flows, in particular, affect species (especially taonga species), key habitats, processes and ecosystem components.
- Every effort should be made to maintain or restore, to the greatest extent possible, the functions and processes that Manawhenua believe essential to a river's healthy state.

D) Define flow needs using a holistic approach

- The indigenous species in a river have evolved life cycles that respond to natural flow regimes and are adapted to and reliant on specific hydrological events. The needs of indigenous species are to be prioritized in river management.
- It needs to be clear to Manawhenua how the hydrologic regime and its inter- and intra-annual variability, in terms of the magnitude, frequency, timing, duration and rate of change of different hydrologic conditions, from high to low flows, is to be maintained.
- Hydrologic regimes that are protective of the full range of indigenous species, and ecosystems that naturally occur or could be expected to naturally occur in the catchment, should be maintained or restored.
- Single minimum flow recommendations provide an inadequate basis for flow-based ecosystem maintenance or protection. Manawhenua want to see flow variability. Having identified the minimum flows that they prefer, hydrologists and ecologists are to work with Manawhenua to assist in identifying the variability sought by Manawhenua.

E) Work collaboratively with inter-disciplinary diverse teams of scientists and other experts to make best use of available knowledge and tools that can complement the Matauranga held by Manawhenua.

- The process of defining a river's flow needs should be as inclusive and transparent as possible.
- Flows should be derived based on best available information and the professional judgment of as diverse and inter-disciplinary a team of natural, physical, and social scientists as possible. This will be complemented with the Matauranga held by Manawhenua, and knowledge of local communities.

F) Establish a sound hydrologic foundation to support recommended flow regimes

- Consistent with the conceptualization of water as an undivided entity, specification of flows should be underpinned by a sound, current hydrologic information system that includes all parts of the water cycle.
- The foundation should account for all current water demands, be able to factor in future demands, alternatives for meeting such demands, and the effects of climate change on the hydrology of a catchment.
- The hydraulic interconnectivity of groundwater and surface water quantity and quality should be explicitly recognized and provided for.

G) Include vulnerability and risk analyses as elements of flows assessment.

- It is important to explicitly consider climate variability and change and their implications for both water resource availability, ecosystem health and cultural preferences.

H) Adopt a precautionary approach to flow management.

- Flows recommendations should be continually refined as new information or opportunities become available, to secure greater confidence in long-term outcomes. This may necessitate committing to modelling the data collected from monitoring and not simply ending the process with data collection.

I) Discuss with Manawhenua the purpose and practicality of applying adaptive management to the implementation of the recommended flow regime.

- Baseline conditions must be carefully documented, outcomes of flow implementation monitored and evaluated.
- Before Manawhenua can be confident of an adaptive regime, the criteria that will lead to an adaptive cycle being triggered need to be explicit and agreed with Manawhenua.
- Cultural monitoring of responses to flow alteration is necessary to properly inform adaptive management of flows and safeguard values of Manawhenua.

J) Address flows assessment as an integrated component of integrated water resources management.

- Water resource sustainability requires a balance of economic, cultural, social and environmental demands to ensure that the needs of current and future generations are not compromised by current usage.
- Attention should be given to both recovery of water for the environment in over-allocated systems and protection of flows in systems not yet under stress.

K) Formally recognise and embed flow principles and provisions for flows assessment in policy and regulatory frameworks.

- Legal recognition of flows is needed with, ideally, instream flows are accorded priority over consumptive water uses.
- Mechanisms and/or a process should be in place to reallocate water to environmental needs where it has been over-allocated.

L) Invest in capacity-building at regional levels

- Flow assessment processes should be used as an opportunity to build awareness of flow principles and concepts, and to develop both technical, cross-cultural and cross-institutional capacity.
- The better the collective understanding of flows, concepts and of ways to effect flow implementation from the outset, the more successful the result is likely to be in the long term.

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Glossary

Ahi kaa	Continued occupation according to traditional law of Māori tenure ('keeping the fires burning').
Atua	God, supernatural being.
Galaxias	Native fish species.
Hapū	Sub-tribe, extended whanau.
Hau kaika	People that uphold the ahi kaa of a particular area.
Heritage Order	provision made within a district plan to give effect to a requirement made by a heritage protection authority under s.189 or s.189A of the RMA-91.
Hikoi	Journey.
Hinaki	Pots.
Hui	Meeting, assembly.
Inanga/Inaka	A variety of whitebait; also a variety of pounamu.
Iwi	Tribe.
Iwi authority	The authority which represents an iwi and which is recognised by that iwi as having the authority to do so.
Kai Tahu	Descendants of Tahu, the tribe.
Kāi Tahu ki Otago	The four Papatipu Rūnaka and associated whānau and rōpū of the Otago Region.
Kai Tahu Whānui	The collective of the individuals who descend from one or more of the of the five primary hapū of Kai Tahu, Kati Mamoe and Waitaha.
Kaika/Kaik'	Settlement.
Kaika/Kainga nohoaka	Place of residence.
Kaitiaki	Guardian.
Kaitiakitaka	The exercise of customary custodianship, in a manner that incorporates spiritual matters, by tangatawhenua who hold Manawhenua status for particular area or resource.
Kanohi ki te Kanohi	Eye to eye or face to face.
Kanakana	Lamprey.

Karakia	Prayer, incantation.
Ka Tiritiri o te Moana	Southern Alps.
Kaumatua	Respected elder.
Kawanataka	Governance.
Kawenata	Covenant.
Ki Uta Ki Tai	Mountains to the Sea.
Koaro	A variety of whitebait.
Koiwi Takata	Human skeletal remains.
Kohaka	Breeding Ground.
Kohatu Taoka	Treasured Stone Resources.
Kokopara	Giant kokopu (common).
Korero	Discussion.
Mahika Kai	Places where food is produced or procured.
Mahika Mataitai	Places where food is obtained from the sea or seashore.
Mana	Authority, prestige, influence.
Mana Whenua	Customary authority or rangatiratanga exercised by an iwi or hapū in an identified area.
Manaaki	Show kindness to, look after, entertain.
Manawhenua	Those who exercise customary authority or rangatirataka.
Manuhiri	Visitor, guest.
Marae	Courtyard, meeting place for tangata whenua.
Matauraka Maori	Maori knowledge
Mate	Death.
Mauri	Essential life force or principle; a metaphysical quality inherent in all things both animate and inanimate. (Ngai Tahu Fresh Water Policy)
Mauka	Mountain.
Mokopuna	Grandchild, descendant.
Noa	Free from tapu, ordinary.
Pa	Fortification.
Papakaika	Traditional settlement or settlement on traditional land.
Papatipu	Original Māori land.
Papatipu Rūnaka	Traditional Rūnaka.
Papatuanuku	Earth mother.
Pou	Post.
Pounamu	Nephrite, greenstone, jade.
Pūrākau	Stories.
Rahui	Temporary protection of a resource.
Rakatira	Chief.
Rakatirataka	Chieftanship, decision-making rights.

Rohe	Boundary.
Rohe potae	Traditional tribal area.
Rōpū	Group.
Rūnaka	Local representative group or community system of representation.
Takaroa	Deity of the sea.
Takata	Person.
Takatapora	Pakeha/European (lit. 'boat people').
Takatawhenua	The iwi or hapū that holds mana whenua in a particular area.
Takiwā	Area, region, district.
Tangi	Bereavement ceremony.
Taniwha	Legendary serpent-like creature.
Taoka	Treasure.
Taoka Tuku Iho	Treasure handed down from the ancestors.
Tapu	Sacred.
Tauraka Ika	Fishing ground.
Tauraka Waka	Canoe mooring site.
Te Ao Tūroa	The natural environment.
Te Wai Pounamu	The South Island.
Ti (kouka/rakau)	Cabbage tree; also edible products from ti.
Tiaki	Guardianship.
Tikanga	Lore and custom.
Tikaka	Customary values and practices.
Tino Rangatirataka	Full chiefly authority.
Tohuka	Specialist in a particular field of expertise.
Tohuka Whakairo	Master carver.
Trophic	Of nutrition.
Tuhituhi nehera	Rock art.
Tuna	Eel.
Tupapaku	Human corpse.
Tupuna wahine	Female ancestor.
Tupuna/tipuna	Ancestor.
Turangawaewae	Place of belonging through ancestral rights linked to land, place to stand.
Umu-ti	Earth oven used for cooking ti.
Urunga Waka	Canoe landing site.
Urupa	Burial place.
Wahi Ingoa	Placenames.
Wāhi Taoka	Resources, places and sites treasured by Manawhenua.
Wāhi Tapu	Places sacred to tangata whenua.

Waiata	Song.
Wairua	Life principle, spirit.
Waka	Canoe.
Wananga	Customary learning method.
Water Conservation Order	Order made under s.214 of the RMA-91 for the purpose of recognising and sustaining outstanding amenity or intrinsic value of waters and protecting outstanding characteristics.
Waterway	Water in a river, stream, lake, pond, wetland, estuary or acquifer, or any part thereof, including land water margins, beds and banks which the mauri of the waterway is reliant on.
Whakama	Shame.
Whakapapa	Genealogy.
Whakatauki	Proverb, saying.
Whanau	Family.
Whānui	Large, extended, broad.
Whare	House.
Whare Kai	
Whare Kura	Dining hall.
School of Learning.	
Whare Tupuna/Wharenui	Ancestral meeting house.
Whenua	Land.

Appendices

Appendix 1: Example of a recording form

ASSESSMENT OF SATISFACTION WITH RIVER FLOW

SITE NAME DATE

For each attribute listed below you are to decide whether or not you are satisfied that today's flow is sufficient to protect that attribute. You are also to decide how significant each attribute is at this particular site. You are to assign a 1 -7 rating

1 little or no satisfaction **4** moderate satisfaction **7** very satisfied

Attribute	Satisfaction that flow protects the attribute
Flow will enable use of the site for kai gathering	1 2 3 4 5 6 7
Flow will keep the riverbank vegetation watered	1 2 3 4 5 6 7
Flow will provide a range of habitats instream and along the riverbank	1 2 3 4 5 6 7
Flow will protect kai species in and around this site	1 2 3 4 5 6 7
Flow will enable fish to move throughout the catchment	1 2 3 4 5 6 7
Flow will help populations of kai species to re-establish and be abundant throughout the upper catchment	1 2 3 4 5 6 7
Flow will keep sands and gravels moving through the upper system	1 2 3 4 5 6 7
Flow will keep riparian wetlands, springs, or tributaries connected to river	1 2 3 4 5 6 7
Flow will create features that are important e.g. eddies, pools etc.	1 2 3 4 5 6 7
Flow will enable cultural use of wetlands, springs & tributaries	1 2 3 4 5 6 7
Flow contributes to a good feeling about this site	1 2 3 4 5 6 7
Flow enables whanau to be proud of this site	1 2 3 4 5 6 7
Flow maintains a link between this site and the mainstem	1 2 3 4 5 6 7
Flow will protect features important in stories, waiata etc	1 2 3 4 5 6 7
Overall – are you satisfied with the flow you are seeing today?	1 2 3 4 5 6 7

What is it about the flow you are seeing that you like?

Do you think that this flow is sufficient to restore taonga species in the river?

Aside from the flow, what else would you like to see done at this site?

ASSESSMENT OF CULTURAL STREAM HEALTH

1. STREAM HEALTH

For each attribute listed below you are to decide whether or not you are satisfied that the health of the river that you are seeing today is sufficient to protect that attribute

Attribute	Satisfaction that river health protects the attribute				
a. Catchment landuse	1 Lands heavily Modified / a lot of changes	2	3	4	5 Lands unmodified or appear natural & changed
b. Are you satisfied the riverbank vegetation is healthy and that it is the right vegetation?	1 Little or no vegetation erosion obvious	2	3 Cover of vegetation but wrong type not native	4	5 Complete cover of natives
c. Are you satisfied that there are a range of habitats instream and along the riverbank?	1 Little or no habitat	2	3	4	5 Variety of habitats
d. Are you satisfied that the river banks are protected from what you believe is inappropriate use and development?	1 Margins Heavily used	2	3	4	5 Margins appear natural & unchanged
e. Are you satisfied that riverbed condition appears healthy?	1 Covered by mud slime, weeds	2	3	4	5 Beautiful clear of muds sands, weeds
f. Are you satisfied with the water quality?	1 Appears Polluted (foams, oils, slime)	2	3	4	5 Beautiful clean water not polluted
g. Are you satisfied with the shape of the river channel or has it been changed?	1 Many changes stopbanks, gravel Removed, straightened	2	3	4	5 Appears natural no changes
h. Are you satisfied that there are no barriers (e.g. dams, culverts etc) to the water flow?	1 Many barriers dams, culverts, pipes OR a significant barrier	2	3	4	5 No barriers to flow - water running free

3. ANY COMMENTS ON STREAM HEALTH

4. HOW DO YOU RATE THE OVERALL HEALTH OF THIS REACH OF THE RIVER

How would you rate overall health?	1 Very poor health	2	3	4	5 Excellent health

ASSESSMENT OF CULTURAL USE

(Each individual fills this form out once during first visit)

5. CULTURAL USE HISTORICALLY

	Did you do this activity in tis reach in te past?		How good was that past experience? (only fill in this part if you used the site in the past – and circled yes for doing the activity at this site)					Would you use in the future?	
Swimming	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No
Gathering materials	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No
Fishing	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No
Camping	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No
Chill out	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No
Other	Yes	No	1 Bad	2	3	4	5 Excellent	Yes	No

6. CULTURAL USE TODAY

Attirbute	Satisfaction that river health protects the attribute					Don't know
Are you satisfied that fish are able to move throughout the catchment?	1 Barriers to fish movement	2	3	4	5 No barriers	Don't know
Can you use this site for gathering kai or cultural materials?	1 No	2	3	4	5 Yes	Don't know
Are you able to safely access this site?	1 No access	2	3	4	5 Yes	Don't know
Would you return to use this site in the future?	1 No	2	3	4	5 Yes	Don't know
Can you use the site in the same way as your whanau did in the past?	1 No	2	3	4	5 Yes	Don't know

7. WOULD YOU RETURN TO USE THIS REACH IN THE FUTURE? YES NO

Explain why or why not

8. WHAT NEEDS TO BE DONE BEFORE YOU WOULD USE THIS REACH OF THE RIVER?

Appendix 2: Example of a workbook for data entry

COMAR Assessment - Site Overview

Name of site

Name of waterway:

Date & Time:

General location:

GPS Reference: S E

Photopont references:

General information (composition, structure, flow):

Site Questions

What is it about the flow you are seeing that you do or do not like?

P1

P2

P3

P4

P5

P6

Do you think that this flow is sufficient to restore kai populations in the river?

P1

P2

P3

P4

P5

P6

Aside from the flow, what else would you like to see done at this site?

P1

P2

P3

P4

P5

P6

Satisfaction with River flow

Name of site

Name of waterway:

Date & Time:

MAHINGA KAI / CULTURAL USE

	P1	P2	P3	P4	P5	P6	AVG
1. Enable use of site as mahinga kai							
2. Riverbank vegetation watered							
3. Range of habitats instream and along riverbank							
4. Protects mahinga ka species in and around the site							
5. Enables fish to move throughout the catchment							
6. Help populations of kai species to re-establish and be abundant through out catchment							

WAI MAORI

	P1	P2	P3	P4	P5	P6	AVG
7. Sands and gravels moving through the system							
8. Riparian wetlands, springs, or tributaries connceted to mainstem							
3. Range of habitats instream and along riverbank							
9. Features that are important e.g. Eddies, pools etc.							
10. Cultural use of connected wetlands, springs and tributaries							

HAUORA

	P1	P2	P3	P4	P5	P6	AVG
11. Contribute to a good feeling about this site							
12. Enable whanau to be proud of this site							

LANDSCAPES

	P1	P2	P3	P4	P5	P6	AVG
13. Maintain a link between this site and other cultural sites downstream							
14. Protects features important in tribal stories, waiata etc							
15. Return the voice of the river							
16. Overall - are you satisfied with the flow you are seeing today							

Indicator comments:

P1

P2

P3

P4

P5

P6

Cultural Use

Name of site

Name of waterway:

Date & Time:

CULTURAL USE HISTORICALLY

	P1	P2	P3	P4	P5	P6	AVG/Ratio
Activity in the past							
1. Swimming							
2. Gathering materials							
3. Fishing							
4. Camping							
5. Chillout							
6. Other							
Good past experience							
7. Swimming							
8. Gathering materials							
9. Fishing							
10. Camping							
11. Chillout							
12. Other							
Future Use							
13. Swimming							
14. Gathering materials							
15. Fishing							
16. Camping							
17. Chillout							
18. Other							

Indicator comments:

P1

P2

P3

P4

P5

P6

Cultural Use cont.

CULTURAL USE TODAY

	P1	P2	P3	P4	P5	P6	AVG
1. Fish movement							
2. Cultural materials							
3. Access							
4. Future							
5. Past							

Indicator comments:

P1

P2

P3

P4

P5

P6

	P1	P2	P3	P4	P5	P6	Ratio
Reach in the future							
P1							
P2							
P3							
P4							
P5							
P6							
What needs to be done before you would use this reach of the river							
P1							
P2							
P3							
P4							
P5							
P6							