

REFLECTING MĀTAURANGA MĀORI IN WATER SENSITIVE URBAN DESIGN

Dr. Emily Afoa (Tektus Consultants Ltd), Troy Brockbank (WSP Opus)

ABSTRACT

This paper complements the ongoing research 'Activating Water Sensitive Urban Design (WSUD) for healthy, resilient communities' commissioned by the Building Better Homes Towns and Cities National Science Challenge. The overarching project aims to enhance capability to address current barriers to the uptake of WSUD in Aotearoa (New Zealand).

Results of the Activating WSUD discovery phase identified a need to review the capacity of current approaches to meet reasonably foreseeable future requirements for urban liveability. Industry engagement identified (among other factors) an increasing sensitivity to Māori values and aspirations.

Māori culture recognises that environmental care has integral links with the mauri (life force) of the environment and concepts of kaitiakitanga (stewardship). Te Ao Māori (Māori world view) links the roles and health of people to the protection of the wellbeing of the environment, through the intrinsic relationship between people, water, and Te Ao Tūroa (the natural environment). Integrating core water sensitive design values with mātauranga Māori (indigenous knowledge) and principles of tikanga Māori (traditional indigenous practices) provides a holistic, culturally enhanced approach to protecting our water for future generations, more in line with natural hydrological water cycle processes, and inherently providing for enhanced socio-cultural outcomes in addition to environmental stewardship. The following is one whakataukī (proverb) reflecting the holistic relationship māori have with the environment:

*Ka ora te wai,
Ka ora te whenua.
Ka ora te whenua,
Ka ora te tangata.*

*If the water is healthy,
The land will be nourished.
If the land is nourished,
The people will be provided for.*

This paper explores what WSUD means to Māori and how WSUD in Aotearoa currently recognises and provides for Māori values. The paper enables improved understanding of Te Ao Māori, to better integrate māori world views and mātauranga Māori to support uptake of WSUD and ultimately enhance mauri and wider socio-cultural outcomes for healthy and resilient communities in Aotearoa New Zealand.

KEYWORDS

Te Ao Māori, stormwater, water sensitive urban design, WSUD, resilient communities, healthy communities, mātauranga māori, kaitiakitanga, mauri

PRESENTER PROFILE

Emily is an environmental engineer at Tektus Consultants Ltd with a passion for water sensitive design. Emily was awarded the CH2M Beca Young Water Professional of the Year award, 2017, recognising her success in academia and her growing position as a leader in civil and environmental engineering.

1 KARAKIA

Na te kukune, te pupuke

Na te pupuke, te hihiri

Na te hihiri, te mahara

Na te mahara, te hinengaro

Na te hinengaro, te tūmanako

Na te tūmanako, te wānanga

Na te wānanga, te matau

Hui e, taiki e!

2 INTRODUCTION

This paper complements the ongoing research 'Activating Water Sensitive Urban Design (WSUD) for healthy, resilient communities' commissioned by the Building Better Homes Towns and Cities National Science Challenge (BBHTC). The overarching project aims to enhance capability and to address current barriers to the uptake of WSUD in Aotearoa (New Zealand).

Results of the Activating WSUD discovery phase identified a need to review management of the urban water cycle in Aotearoa. Specifically, the capacity of current approaches to meet reasonably foreseeable future requirements for urban liveability. Industry engagement identified (among other factors) an increasing sensitivity to Māori values and aspirations.

2.1 PURPOSE

This study explores how WSUD in Aotearoa (New Zealand) values, recognises, and provides for Te Ao Māori and how it could do better. We share an improved understanding of Te Ao Māori, to facilitate integrating Māori world views and mātauranga Māori to support uptake of WSUD and improve wider socio-cultural outcomes for healthy and resilient communities in Aotearoa (New Zealand).

The key areas where we aim to identify opportunity in the WSUD-space in Aotearoa (New Zealand) are:

- How well does WSUD in Aotearoa (New Zealand) provide for Māori values and uses of water?
- Are there opportunities to improve the implementation of WSUD through the integration of Te Ao Māori?

Roles within the water sensitive urban design space are varied, many professions and individuals have the capacity to empower positive change, including town planning, urban design, landscape design, ecologists, engineers, contractors, and residents – the list goes on. This study provides the first step to understanding WSUD through a Māori worldview lens, opening the door to change and discussing future opportunities.

2.2 LIMITATIONS

This review is not an exhaustive survey of the available literature but presents outcomes from a sample. It is intended as a capacity building exercise with future scope to expand review to include a broader range of written literature and oral narratives. Translations of Māori words or phrases reference the source from which they were taken.

It must be acknowledged that the conclusions drawn are those of the authors. This study presents one interpretation; it reflects our understanding of Te Ao Māori, our experiences and learnings to date, and the learning and experiences of those who support us, while recognising there is regional variation – it is not intended to represent the view of all Māori.

Nā ngā tūpuna ngā taonga i tuku iho

Treasures passed down from our ancestors.

3 LITERATURE REVIEW

3.1 WSUD IN AOTEAROA (NEW ZEALAND)

Before opening the door to Te Ao Māori – it is important we consider what WSUD means in the current Aotearoa (New Zealand) context. WSUD is summarised in *Activating WSUD for Healthy Resilient Communities - Discovery Phase: Results and Recommendations* by Moores, Batstone, Simcock, & Ira (2018) as an alternative to conventional forms of urban development which aims to integrate urban planning and water management. While different jurisdictions place emphasis on different aspects of WSUD, the following concepts are particularly evident in a New Zealand ‘understanding’ of WSUD:

- Limit stormwater runoff and contaminant generation at source by minimising the construction of impervious surfaces, such as roads and roofs
- Maintain the function of natural drainage systems, rather than replacing stream networks with piped systems
- Maintain characteristics of catchment hydrology, including infiltration, groundwater recharge and stream flow characteristics, similar to those that existed pre-development
- Use water sensitive or green technologies to better manage stormwater in a way that complements its approach to land use planning

In New Zealand, WSUD has a strong focus on management of stormwater and receiving water bodies. Consideration of its potential role in the water supply and wastewater sectors and in relation to wider (including non-water) contributions to urban liveability have received little attention (Moores, et al., 2018). It is important to recognise that a truly WSUD approach can include a broad suite of potential role(s), for example contributing to urban amenity and community health; providing multi-functional green spaces to recreate shade; or providing an alternative water supply to enhance drought resilience.

Figure 1 presents preliminary analysis from the ‘Activating Water Sensitive Urban Design (WSUD) for healthy, resilient communities’ research team. Refer to the concurrent paper “WSUD Can Be Cost-Effective and Low-Maintenance, Not to Mention all the Other Benefits” by J. Moores (NIWA), S. Ira (Koru Environmental), R. Simcock (Manaaki Whenua Landcare Research), and C. Batstone (Batstone Associates) presenting the preliminary findings of this research.

It is important to recognise WSUD caters to the integrated management of the three (infrastructure) waters; stormwater, wastewater, drinking water, and wider socio-cultural wellbeing considerations – it is broader than stormwater management alone. While the current focus in Aotearoa (New Zealand) is narrow, it should be noted that growing consideration of indigenous cultural values and approaches to water appears to be a driver to uptake specifically local to Aotearoa (New Zealand) (Moores, et al., 2018).

Māori culture recognises that environmental care has integral links with the mauri (life force) of the environment and concepts of kaitiakitanga (stewardship). Te Ao Māori (Māori world view) links the roles and health of people to the protection of the wellbeing of the environment, through the intrinsic relationship between people, water, and Te Ao Tūroa (the natural environment). Integrating core water sensitive design values with mātauranga Māori (indigenous knowledge) and principles of tikanga Māori (traditional indigenous practices) provides a holistic, culturally enhanced approach to protecting our water for future generations, more in line with natural hydrological water cycle processes, and inherently providing for enhanced socio-cultural outcomes in addition to environmental stewardship.

Terminology varies within the literature, but the following are also considered representative of the principles of WSUD – Low Impact Development (LID), Low Impact Urban Design and Development (LIUDD), and Sustainable Drainage Systems (SuDS). Green Infrastructure (GI) or Water Sensitive Infrastructure are also devices or systems which support intended WSUD outcomes. Regardless of terminology, the concepts reflect a paradigm shift from conventional stormwater management techniques to a more sustainable design philosophy (Voyde & Morgan, 2012).

	Non-water Related	Water Related
Environmental	<ul style="list-style-type: none"> Preservation of natural soils Microclimate management Carbon sequestration and mitigation Better terrestrial habitat quality Terrestrial ecosystem connectivity Natural character (land) 	<ul style="list-style-type: none"> More natural hydrological regime Better water quality Better aquatic and riparian habitat quality Drainage network and ecosystem connectivity Natural character
Social	<ul style="list-style-type: none"> Reduced building material consumption Infrastructure resilience Food & fibre production Public safety Connectedness with nature (land) Community health and wellbeing Property values 	<ul style="list-style-type: none"> Provisioning (e.g.: fishing, shellfish collection) Contact recreation (e.g.: swimming) Water-related connectedness with nature Drainage and flood management Supplementary water supply Reduced wastewater / combined sewer system loading Climate change adaptation

Figure 1: Draft Schematic of WSUD Benefits Assessment Criteria

3.2 TE AO MĀORI

In this section we aim to describe the strong connection between Māori and the environment – to share with the reader an understanding of Te Ao Māori, or the Māori world view, before we overlay the western WSUD paradigm. While the following sections describe components of a Māori worldview, it is important to recognise that many of the concepts described are best understood in the context of the language and the culture they derive from. As Tipa & Nelson (2012) caution, a reinterpretation of these meanings in the English language loses context and meaning, however; for non-speakers of Te Reo it provides a platform from which additional knowledge and understanding can grow.

3.2.1 HISTORY & BELIEFS

Māori are acknowledged as *tangata whenua*, meaning “people of the land”. The expression illustrates the profound relationship Māori have with land and the environment (Awatere, et al., 2008). Māori view both themselves and all within the natural world as one in the same, connected through whakapapa (genealogical links) back to Io Taketake (the originator), and regard land as being the basis of their very survival (Rolleston, 2006). More than a physical connection to the land, it is essential to understand the spiritual association with the land (Rolleston, 2005).

*Whatungarongaro te tāngata, toitū te whenua
Ko au te awa, ko te awa ko au*

*Man perishes, but land remains
I am the river, the river is me.*

Traditional creation stories underpin Māori notions of identity, character, and connection with the environment (Awatere, et al., 2008; Williams, 2006; Ataria, et al., 2018). Although cultural variation developed as different iwi established intimate relationships with their tribal lands, similar underlying values and themes are referenced (Panelli & Tipa, 2007; Williams, 2006). Traditional Māori ways of knowing the world and the genealogy of creation begin with Io taketake (the originator) and evolve through different spheres of development until the present day; I te tīmatanga, kō te kore (In the beginning there was a void) and moving to Te Pō (the night/darkness) to Te Ao (the light) (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Royal, 2005). Creation stories broadly reference the personification of, and separation of, Papatūānuku (the earth mother) and Ranginui (the sky father) as primal parents (Awatere, et al., 2008; Morgan, 2006) and reference to how they were responsible for creating the world in which we, the people, inhabit (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Royal, 2005; Awatere, et al., 2008; Morgan, 2006).

Descriptions reflect a widely-held belief that through the many phases of creation, a physical and spiritual element was created when Ranginui (the sky father) and Papatūānuku (the earth mother) were separated by their children (Morgan, 2006). Once the parents were separated their progeny—personified as natural phenomena—occupied and flourished in the various realms created (Awatere, et al., 2008; Morgan, 2006). The children of Ranginui and Papatūānuku are often termed departmental atua (deities), each with supernatural powers who preside over different domains (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014). Figure 2 presents one depiction of the creation story, demonstrating some of the embodied elements represented by the children of Papatūānuku and Ranginui.

As direct descendants of Papatūānuku, Māori see themselves not only ‘of the land’, but ‘as the land’ (Mead, 2003).

Ko au te whenua, ko te whenua ko au.

I am the land, the land is me.

The personification of earth as a mother is significant: similar to a maternal bond, land and environment provide sustenance for its inhabitants (Awatere, et al., 2008; Mead, 2003). The resources or children of Papatūānuku do not belong to tangata (people), but rather tangata are one of the many children who belong to Papatūānuku. People, animals, birds and fish all harvest the bounties of Papatūānuku but do not own them (Environmental Protection Authority—Te Mana Rauhi Taiao, n.d). Rather, the living generations act as guardians of the land, like their tūpuna (ancestors) before them (Mead, 2003). As part of this ancestry, emphasised by the personification of natural phenomena, responsibilities and obligations rest on Māori to sustain and maintain the physical and spiritual well-being of people, communities, and natural resources – of

Papatūānuku, her children, and future generations (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Rolleston, 2006; Panelli & Tipa, 2007).

The creation model shows the interdependencies between land and sea, water and air, flora and fauna, and people and the ecosystem. It is not only all Māori who are connected in genealogical tables – all things are related by descent and so it becomes difficult to separate aspects of the environment for specific comment without considering them in a broader environmental and intergenerational context (Awatere, et al., 2008; Durie, et al., 2017; Rolleston, 2005; Rolleston, 2006; Paul-Burke, et al., 2018). For example, in taking fish for food or trees for timber, Māori are encroaching on the domain of particular atua. They must show respect, not exploiting mindlessly, but taking only that which is necessary and beneficial to others (Durie, et al., 2017); this is the true meaning of Kaitiakitanga (stewardship).

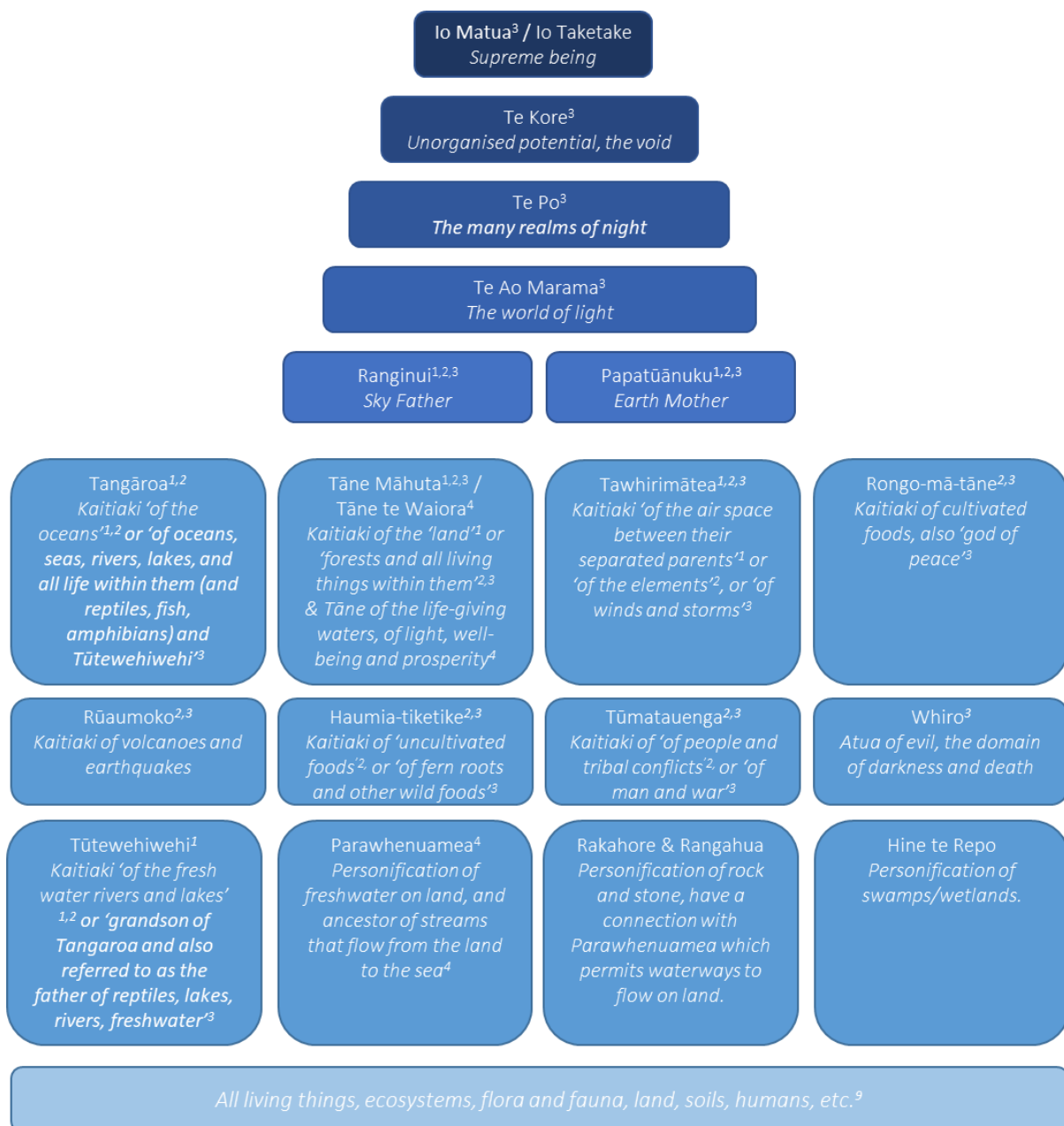


Figure 2: Schematic of the creation story, demonstrating variation (Sources: 1. (Morgan, 2006), 2. (Environmental Protection Authority–Te Mana Rauhi Taiao, n.d), 3. (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014), 4. (Ngata, 2018)

3.2.2 WHAKAPAPA

Whakapapa literally means to place “layer upon layer” – it derives from *papa*, anything broad and flat, and from *whaka-*, a causative prefix that enables something to occur (Durie, et al., 2017). *Whakapapa* is unique to Māori without an exact English language equivalent. Because there is only one set of primal parents (Ranginui and Papatūānuku), from whom everything ultimately traces descent, all things are related (Hikuroa, 2017; Panelli & Tipa, 2007). *Whakapapa* (genealogy) is the central principle that orders the universe: describing the genealogical sequence within the creation story, it traverses both spiritual and physical realms. It demonstrates interconnectivity between everything placing all humans in an environmental context with all other flora, fauna, and natural resources, and expresses our fundamental kinship with the atua and the natural world (Harmsworth & Roskruge, 2014; Hikuroa, 2018; Hikuroa, 2017; Harmsworth & Awatere, 2013; Ngāti Whātua Ōrākei, 2018).

The significance and intergenerational relationship between Māori and cultural landscapes within a catchment can be reflected in the place names assigned (Harmsworth & Roskruge, 2014). Ancestral stories were attached to every part of the landscape sharing the nature of the resource and an assessment of its status (Tipa & Nelson, 2012), linking people and culture to place, establishing spiritual and ancestral significance, and serving to locate points in tribal history (Harmsworth & Roskruge, 2014). These expressions of place were linked to *whakapapa* through stories (Harmsworth & Roskruge, 2014). Specific to waterways, place names may describe the source of the waterway, its character, or discrete features within the catchment, for example:

- Te Awa-makarara – ‘the stream that makes a noise’ or ‘a stream with a noisy tributary’ (Tipa & Nelson, 2012)
- Wairakei – the place where the pools were used as mirrors (Merito, 2017)
- Waitematā – ‘waters glistening like obsidian’, referencing the black obsidian matā rock where the ancestors placed the mauri for fish upon arriving from Hawaiiki (Ngāti Whātua Ōrākei, 2018).

Panelli & Tipa (2007) explain how Māori relationships are sustained in contemporary cultural ways, including the practice of *mihi* (greeting and acknowledgment) and *whakawhanaungatanga* (forming connections and establishing relationships) whereby individuals identify themselves within their environment, integrating their *maunga* (mountain), their *awa* (river), their *moana* (ocean or large lake), their *marae*, and their *tūpuna* (ancestors). The foundation of individual identity includes intergenerational connection to tribal territory. Ecosystems do not simply connect biophysical components but involve a combination of physical, spiritual, and sociocultural phenomena that blur the modern Western scientific division between human and nonhuman elements. (Panelli & Tipa, 2007).

3.2.2.1 WAI

The widely-held belief is *wai* (water), in its various forms, originated from the separation of Ranginui and Papatūānuku through their grief and yearning for one another (Morgan, 2006; Williams, 2006; Ngata, 2018). In one example, Morgan (2006) names rainfall as ‘Ngā roimata o Ranginui (the tears of Rangi)’ and the wellsprings as ‘Ngā puna tapu o nga atua (the weeping of Papa)’. Waterways, the domain of Tangaroa, are of particular significance because their condition is seen as a reflection of the health of Papatūānuku (Panelli & Tipa, 2007; Andrew, 2016). Māori have a range of classifications for water depending on the particular qualities of the water. Table 1 provides examples, although there are regional variations (Grace, 2010; Royal, 2006).

In addition to the physical descriptions provided in Table 1, wai (water) is an integral part of Māori wellbeing and identity (Callaghan, et al., 2018; Grace, 2010). For example:

- Wai-rua: can refer to one's soul or spirit (Durie, et al., 2017; Merito, 2017) as well as one's attitude or mood (Merito, 2017), it may also refer to the waters inside a pregnant woman; the amniotic fluid, and the tamaiti.

Tuatahi ko te wai, tuarua whānau mai te tamaiti, ka puta ko te whenua.

When a child is born the water comes first, then the child, followed by the afterbirth (whenua) .

- Wai-ora: can refer to soundness of body and mind (Durie, et al., 2017; Grace, 2010) or sense of wellbeing across our physical, spiritual, emotional, communal and environmental dimensions (Ngata, 2018).
- Wai-rangi: can refer to a temporary, unbalanced state of mind (Durie, et al., 2017) or a state of emotional and mental upheaval (Ngata, 2018).

Table 1: Types of Wai (Water)

Wai-	Description	Source
Wai-ora	Purest water - Used in rituals to purify and sanctify and has the power to give life, sustain wellbeing and counteract evil. Water of life – especially rainwater or tears; also springs, holy water and water from special places where the mauri of the water changes or where exceptional events have occurred in the past. Waiora can often rejuvenate damaged mauri, even that of humans (through the ceremony known as 'pure').	(Grace, 2010) (Williams, 2006; Douglas, 1984)
Wai-tapu	Sacred water–waters used for ceremonial purposes	(Royal, 2006; Douglas, 1984)
Wai-karakia	Water for ritual purposes	(Royal, 2006)
Wai-Māori	Normal or fresh water - this is referred to as ordinary water which runs free or unrestrained and it has no sacred associations.	(Durie, et al., 2017; Grace, 2010; Callaghan, et al., 2018; Williams, 2006; Douglas, 1984)
Wai-tai	Sea (or salt) water – this term also refers to rough or angry water as in surf, waves or sea tides.	(Durie, et al., 2017; Grace, 2010; Royal, 2006; Williams, 2006; Douglas, 1984)
Wai-mātaimai	Estuarine water, or coastal lagoons 'hāpua'	(Williams, 2006)
Wai-ariki	Thermal water, hot springs or curative waters – the term ariki means "chief" in English and they are referred to as the chiefs or patriarchs of all waters	(Durie, et al., 2017; Grace, 2010; Ngata, 2018)
Wai-kino	Polluted water – the mauri of the water has been altered through pollution (physical or spiritual) or corruption and has the potential to do harm to humans. Stagnant, dead, or death-inducing waters. Mauri has been changed and is susceptible to being changed back again. Dangerous water – sometimes inclement seas or swollen rivers. Mauri has been changed and is susceptible to being changed back again.	(Grace, 2010; Williams, 2006; Douglas, 1984; Ngata, 2018) (Royal, 2006; Williams, 2006)
Wai-mate	Water that is no longer able to sustain life. It is dangerous to all living things (including humans and ecosystems) because it can cause illness or misfortune. Geographically it refers to sluggish water, stagnant or back water. Some tribes refer to it as wai-kawa.	(Grace, 2010; Williams, 2006; Douglas, 1984; Ngata, 2018)
Wai-kawa	Rancid, slow-moving waters	(Ngata, 2018)
Wai-piro	Odorous waters	(Ngata, 2018)
Wai-tangi	Grieving waters – refers to a river or part of a river which through some mishap has caused death, much pain and grieving to the tribe.	(Grace, 2010)
Wai-manawa-whenua	Water from under the land	(Royal, 2006)
Wai-pukepuke	Water that has been whipped by the wind to form peaks	(Ngata, 2018)
Wai-huka	Frothy water	(Ngata, 2018)
Manowai	Water that has deep, strong undercurrents	(Ngata, 2018)
Wai-paru	Clouded waters	(Ngata, 2018)
Wai-whakaika/	Water to assist in the cutting of hair	(Royal, 2006)
Wai-kotikoti	Specific ceremonial waters for the embedding of knowledge	(Ngata, 2018)

3.2.2.2 MAURI

Mauri is the essence that has been passed from Ranginui and Papatūānuku to their progeny and down to all living things through whakapapa in the Māori creation story. It is considered to be the essence or life force that provides life to all living things and the potential to support life to water and land (Morgan, 2006; Voyde & Morgan, 2012; Ngata, 2018; Mead, 2003; Barlow, 1991; Marsden, 2003). It is inherently related with other metaphysical characteristics, including tapu, mana, and wairua. Mauri is the binding force that links the physical to the spiritual worlds and denotes a health and spirit which permeates through all living and non-living things. Damage or contamination to the environment is therefore damage to or degradation of mauri (Harmsworth & Awatere, 2013; Harmsworth & Roskrige, 2014). In very simplified resource management terms, mauri can be likened to the intrinsic value of ecosystems or the concept that ecosystems should be preserved for their own sake, rather than for their value to people (Morgan, 2008).

All water bodies have their own mauri which gives them distinct personality or mana (authority) (Durie, et al., 2017). Particular practices must be observed to maintain harmonic balance and prevent degradation of the mauri of the water. The basic premise is that water, once used, should be returned to Papatūānuku if the mauri of that water is not suitable for the subsequent use (Morgan, 2006). Te Ao Māori requires recognition of the importance of not altering mauri to the extent that it is no longer recognisable; the essential character of a site must not be changed as a result of human intervention (Williams, 2006). Waters of different mauri should not be deliberately or artificially mixed – mixing of incompatible mauri, in an unnatural way, or total pollution so water bodies are no longer capable of sustaining life may result in 'waimate' (Williams, 2006).

The Māori world view acknowledges a natural order to the universe, a balance or equilibrium, and that when part of this system shifts, the entire system is put out of balance (Harmsworth & Awatere, 2013). A key outcome for kaitiakitanga is to restore balance back to the whole system, to maintain or enhance mauri, and to ensure this balance is maintained between people and the natural and spiritual worlds (Harmsworth, 2018). The following philosophy underlies the desire by iwi to deliver on kaitiakitanga obligations (Tipa & Teirney, 2003):

'If you do not sustain the waterways, the mahinga kai sourced from them, and sites of significance in the wider environment, then you cannot sustain yourself, honour your ancestors, or provide for the children of your children into the future.'

Thus, sustainability, the long-term well-being, and healthiness of Māori are seen by some Māori as one and the same thing.

When mauri is viewed in the context of life, energy, and vitality, it is easier to understand how resource use and development can alter the mauri of rivers by altering the food or energy sources, the water quality, the habitat, the energy of the flow regime, and the biotic interactions of the river ecosystem (Tipa & Nelson, 2012). In a study aiming to classify the mauri of wai in Matahuru Awa (river) in North Waikato, Hopkins (2018) conclude that not only was the mauri of the awa degraded through land development practices impacting water quality, a lack of viable ngāhere (forest) required for manu (bird) habitat throughout the catchment resulted in the loss of mana of the hapū because whānau were prevented from undertaking their kaitiakitanga and manaakitanga responsibilities due to land alienation preventing access to their ancient taonga. Similarly, while continued water degradation has a negative impact on the health and wellbeing of downstream mahinga kai (food gathering place), the inability of Māori to continue the

longstanding food gathering tradition also has lasting impacts on overall cultural and social wellbeing (Brockbank, 2018).

3.2.3 MĀTAURANGA MĀORI

Māori have an intricate, holistic and interconnected relationship with the natural world and its resources, with a rich knowledge base – mātauranga Māori – developed over thousands of years and dating back to life in Polynesia and trans-Pacific migrations (Clapcott, et al., 2018; Hikuroa, 2017; Harmsworth & Awatere, 2013; Ataria, et al., 2018). Traditional knowledge has been reinforced through whakapapa and kōrero tuku iho (creation narratives) which have informed cultural values and ethics (Ataria, et al., 2018).

There are numerous definitions of mātauranga Māori. Harmsworth & Awatere (2013) cite Marsden's (1988) definition as one of the more generally accepted:

"the knowledge, comprehension or understanding of everything visible or invisible that exists across the universe"

Mātauranga Māori includes all Māori knowledge systems or ways of knowing and doing and can also be simply defined as wisdom (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014). It is a holistic perspective encompassing all aspects of knowledge and seeks to understand the relationships between all component parts to gain an understanding of the whole system – human and non-human, and the natural and spiritual worlds (Kitson, et al., 2018; Clapcott, et al., 2018). Mātauranga Māori has been described as the ūkaipō (source / origin) of knowledge in Aotearoa (New Zealand) (Hikuroa, 2017).

Mātauranga is specific to geographic place and local context (Kitson, et al., 2018; Paul-Burke, et al., 2018). Kitson, et al. (2018) caution 'the whakapapa of knowledge is important' and argue that there is a need to protect mātauranga Māori by seeking appropriate permissions to use information, acknowledging historical sources and biases, and exploring how to support kaitiakitanga and tino rangatiratanga (self-determination) of mātauranga.

Māori culture is based on strong oral narratives, including maramataka (Māori lunar calendar used to guide planting, harvesting, fishing, and hunting; dynamic and tested through experiential learning), whakataukī (proverbs), whakapapa (genealogies), pūrākau (stories, traditional Māori narratives), waiata (songs), mōteatea (chants, poems), and whaikōrero (oratory, speechmaking) (Rolleston, 2005; Rolleston, 2006; Andrew, 2016; Hikuroa, 2017). Huge quantities of ancestral and traditional knowledge were memorised and retained by people such as tohunga (priests, specialists), rangatira (chiefs), kaumātua (elders), kuia (elderly female), and pakeke (adults) (Harmsworth & Roskruge, 2014).

The ancestral landscape and environment are of critical importance for Māori communities – each of the elements of landscape have kōrero tāwhito (ancient histories) and whakapapa woven into their landscapes with generations of uri (descendants) engaging in these places and practices (Jackson, et al., 2018). These histories provide a link between the past, present, and future ancestors of the place, and give voice to the significance of the areas so as to promote the safeguarding of the places for sustained the well-being. Ataria et al. (2018) open with the whakataukī:

He hanga nā te waha o te ngutu nō mua iho anō. Although seeming to be only from the lips, it is actually of ancient origin
(Williams HW 1908)

Ataria et al. (2018) further explain – ancient sayings and customs gain force from their antiquity, providing guidance for modern times.

Oral narratives are frameworks by which Māori understand and comprehend Te Taiao—the universe, the natural world (including us)—add to and test that knowledge, share it within generations, and pass it down through the generations (Hikuroa, 2017; Hikuroa, 2018). Ataria, et al. (2018) explain that mātauranga Māori spans knowledge, culture, values and worldview, and incorporates knowledge generated using techniques consistent with the scientific method but explained according to a Māori world view. It is this understanding of mātauranga that supports application alongside western science.

Whakataukī shed light on the connections between humans and their environment, beyond physical use to incorporate deeper social and behavioural engagement with the surrounding environment (Whaanga, et al., 2018; Andrew, 2016). Whakataukī in the literature recognise the special value of specific places as well as associations and identifications. For example:

Ma te mauri kei Ōmāpere ka ora te whenua *When the mauri of Ōmāpere is strong, the land is healthy*
(NRC, MPI, & MfE, 2015)

Te toto o te tangata he kai; te oranga o te tangata he whenua *Food supplies the blood of man; his welfare depends on the land*
(Rolleston, 2005)

He kura whenua e hokia; he kura tangata e kore e hokia *The treasure of land will persist; human possessions will not*
(Brougham et al., 1987) in (Rolleston, 2005)

However, oral narratives are not well represented in western-science based considerations. Dismissing oral narratives as just myths, ancient legends, incredible stories and folklore does not value Te Ao Māori or the importance of pūrākau, maramataka, and whakataukī (among other oral narratives) in teaching, learning and the intergenerational transfer of knowledge (Hikuroa, 2017). Meanings may not be immediately apparent without knowing the historical, cultural and linguistic context from which the narrative originated. What those who disregard oral narratives fail to comprehend, is that the knowledge was generated using the scientific method, explained according to a Māori world view (Hikuroa, 2017). Oral narratives comprise knowledge generated using methods and techniques developed independently from other knowledge systems, comprise codified knowledge, and include a suite of techniques empirical in nature for investigating phenomena, acquiring new knowledge, and updating and integrating previous knowledge. (Hikuroa, 2017; Hikuroa, 2018). Empowering understanding of Māori oral traditions is essential to gain insight to traditional knowledge and practices in the context of contemporary applications of that knowledge. Capturing these oral narratives requires establishing relationships through correct protocol, acknowledging mana, and taking the time to talk and listen (Andrew, 2016).

Mātauranga Māori is the pursuit and application of knowledge and understanding of Te Taiao (the natural world), following a systematic methodology based on evidence, incorporating culture, values, ethics, and world view (Hikuroa, 2018; Ataria, et al., 2018; Paul-Burke, et al., 2018). Mātauranga Māori is a dynamic and evolving knowledge form that represents more than the past, it adapts and changes but does not lose its integrity nor sense of origin (Harmsworth & Awatere, 2013; Kitson, et al., 2018; Paul-Burke, et al., 2018; Awatere, et al., 2013; Ogilvie, et al., 2018; Bargh, 2014). Mātauranga Māori incorporates both qualitative and quantitative aspects (Kitson, et al., 2018), and is continually being used, adapted and incorporated into people's lives which allows for innovative ideas and practices including those evolving from fresh discoveries and research (Ataria, et al., 2018; Awatere, et al., 2008; Hikuroa, 2017). Mātauranga Māori has an important part to play in modern urban planning and design— more contemporary

forms of mātauranga Māori include Māori adoption of water sensitive urban design features and renewable energies (Rolleston & Awatere, 2009).

3.2.4 VALUES

Māori values are derived from the traditional belief system based on mātauranga Māori and can be defined as instruments through which Māori make sense of, experience, and interpret their environment (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Durie, et al., 2017). Important Māori values presented frequently within the literature are provided in Table 2. Table 3 provides a range of environmental concepts that are guided by the foundation values. Beyond these overarching values and concepts, iwi-specific approaches to management are defined and implemented based on local environment and customs.

There are many areas of overlap in these values and concepts stemming from the inherently interdependent and interconnected nature of indigenous knowledge and lived experience. Paul-Burke, et al., (2018) define whanaungatanga as including the principles of kotahitanga, manaakitanga, kaitiakitanga and rangatiratanga. Northland Tangata Whenua Freshwater Values (2015) also note that many of the values are interdependent – for example, mana can be compromised by failure in manaakitanga, and mana has a tapu dimension. Koroi (2017) considers the overlap expresses the various layers of mātauranga Māori and their hierarchical dependence on one another – firstly, when there is an understanding of Māori histories and beliefs, one can understand whakapapa and its importance for Māori; then when whakapapa and our (human) position spiritually and physically interconnected to the wider environment is understood, then one can understand tikanga and its location specific context.

Table 2: Overarching Values

Value	Description	Source
Tikanga	Customary practice, tradition, values, protocols	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Harmsworth, 2018; Koroi, 2017; Maxwell, et al., 2018; Rolleston, 2006; Rolleston, 2005; Tipa & Teirney, 2006) (Tipa & Nelson, 2012)
Whakapapa	Ancestral lineage, genealogical connections, relationships, links to ecosystems Māori seek to understand the total environment or whole system and its connections through whakapapa, not just a part of these systems Holistic and integrated perspective Link to ki uta ki tai	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Harmsworth, 2018; Koroi, 2017; Durie, et al., 2017; Maxwell, et al., 2018; Brockbank, 2018; Panelli & Tipa, 2007) (Rolleston, 2006) (Tipa & Teirney, 2006) (Tipa & Nelson, 2012)
(Tino) Rangatiratanga	Sovereignty, empowerment, self-determination, autonomy, control, leadership, management, identity, decision making, and independence Allows Māori to control their own culture, aspirations and destiny Māori values and iwi rights and interests are central to decision making	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Clapcott, et al., 2018; Awatere, et al., 2009; Awatere, et al., 2008; Rolleston & Awatere, 2009; Harmsworth, 2018; Brockbank, 2018) (Blair, 2009) (Tipa & Teirney, 2006) (Tipa & Nelson, 2012)
	The right to exercise authority and self-determination within one's own iwi / hapū realm	(Auckland Council, 2019; Maxwell, et al., 2018; NRC, MPI, & MfE, 2015)
	Recognition and acknowledgement	(Rolleston, 2005; Rolleston, 2006)
Mana Mana whenua	Authority over land and resources	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; NRC, MPI, & MfE, 2015)
	Represents authority, power, control, status, leadership (based on whakapapa) Also: mana moana, mana atua, mana whakahaere, mana tangata, and whakamana	(Harmsworth, 2018; Maxwell, et al., 2018)
Whanaungatanga	Family connections, relationships, kinship. Regards the extended family structure and acknowledges the relationships that Māori have to one another and to the world around them	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Clapcott, et al., 2018; Harmsworth, 2018; Brockbank, 2018; Panelli & Tipa, 2007; Blair, 2009; Tipa & Nelson, 2012)
	Participation and membership	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Rolleston, 2005; Rolleston, 2006)

Value	Description	Source
	A relationship through shared experiences and working together which provides people with a sense of belonging	(Auckland Council, 2019; Maxwell, et al., 2018)
Kaitiakitanga	Environmental guardianship, stewardship (also mana-tiakitanga), An active rather than passive relationship with intergenerational responsibilities Link to tau utu utu	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Rolleston, 2005; Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Harmsworth, 2018; Maxwell, et al., 2018; Brockbank, 2018) (Blair, 2009; Tipa & Teirney, 2003; Tipa & Teirney, 2006)
	Managing and conserving the environment as part of a reciprocal relationship, based on the Māori world view that we as humans are part of the natural world	(Auckland Council, 2019; Tipa & Nelson, 2012)
	The responsibility of all and strives to regulate and sustain the well-being of people and natural resources Underpinned by values such as whakapapa, mana, and mauri, and using tools and methods (ritenga) such as rāhui (temporary prohibition, reserve)	(Clapcott, et al., 2018)
	Exercise of customary custodianship, incorporating spiritual matters	(Panelli & Tipa, 2007)
	Use of natural resources governed and regulated through cultural lore and traditions of tapu, rāhui, and noa (sanction). Conservation and protection of the natural environment promotes community awareness of inherent values contained within the environment.	(Rolleston, 2005; Rolleston, 2006)
Manaakitanga	Acts of giving and caring for, looking after, hosting	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Harmsworth, 2018; Maxwell, et al., 2018; NRC, MPI, & MfE, 2015)
	Hospitality and security.	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009)
	The ethic of holistic hospitality whereby mana whenua has inherited obligations to be the best hosts they can be. Fostering and nurturing of relationships between a host and a visitor (manuhiri), the well-being of the visitor is paramount.	(Auckland Council, 2019; Tipa & Nelson, 2012)
Whakakotahitanga	Consensus, respect for individual differences and participatory inclusion for decision-making	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014)
Arohatanga	The notion of care, respect, love, compassion	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Maxwell, et al., 2018; NRC, MPI, & MfE, 2015)

Value	Description	Source
Wairuatanga	A spiritual dimension, embedded emotion/spirit, spiritual wellbeing	(Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Harmsworth, 2018; Maxwell, et al., 2018; Panelli & Tipa, 2007; Tipa & Nelson, 2012)
	The spiritual connection of everything, the immutable spiritual connection between people and their environments	(Durie, et al., 2017; Auckland Council, 2019; Brockbank, 2018; NRC, MPI, & MfE, 2015)
Kotahitanga	Unity, solidarity, consensus, participation, cohesion, collective action, and collaboration, respect for individual differences and participatory inclusion for decision making	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Rolleston, 2005; Auckland Council, 2019; Harmsworth, 2018; Maxwell, et al., 2018; Brockbank, 2018)
Mauri Mauritanga	Life principles, essence, life-force, derived from whakapapa	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Rolleston, 2005; Harmsworth, 2018; Brockbank, 2018; NRC, MPI, & MfE, 2015; Panelli & Tipa, 2007) (Tipa & Teirney, 2003) (Tipa & Teirney, 2006) (Tipa & Nelson, 2012)
Mātauranga	Knowledge, expertise, understanding, comprehension, of aspects both visible and invisible, wisdom	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Rolleston, 2005; Auckland Council, 2019; Brockbank, 2018; NRC, MPI, & MfE, 2015; Rolleston, 2005)
Orangatanga	Health and wellbeing Links human and environmental health as interdependent	(Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Harmsworth, 2018; Brockbank, 2018; NRC, MPI, & MfE, 2015)

Table 3: Additional Concepts

Value	Description	Source
Ritenga	Sanctions and restrictions, regulation and use Customs, protocols and laws that regulate actions and behaviour related to the physical environment and people. Includes concepts such as tapu (sacred), rahui (restricted), and noa (unrestricted), practical rules to sustain the well-being of people, communities and natural resources. Requires balance between regulated and de-regulated states.	(Rolleston, 2005; Harmsworth, 2018; Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; NRC, MPI, & MfE, 2015)
Taonga iho	Asserts the centrality and legitimacy of Te Reo Māori, tīkanga and mātauranga Māori and allows the Māori ways of knowing, doing and understanding the world to be considered valid in their own right Intergenerational protection of highly valued taonga, passed on from one generation to the next, in a caring and respectful manner	(Clapcott, et al., 2018) (Harmsworth, 2018; Harmsworth & Awatere, 2013; NRC, MPI, & MfE, 2015; Panelli & Tipa, 2007; Tipa & Teirney, 2006)
Te Ao Tūroa	The natural world, the long-standing world, or the enduring world Intergenerational concept of resource sustainability	(Harmsworth, 2018; Harmsworth & Awatere, 2013)
Ki uta ki tai	A whole-of-landscape holistic approach, understanding and managing interconnected resources and ecosystems from the mountains to the sea. Acknowledges the reciprocal relationship between people and the environment. Relies on the idea that the mauri of a river cannot be assessed in isolation of its surroundings and must be based on the mauri of interrelated components in the wider catchment (the Māori concept of integrated catchment management) Also: “Ngā maunga ki te ngutu awa”, “Ngā maunga ki te moana”, “ko au te awa, ko te awa ko au”	(Harmsworth, 2018; Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014; Brockbank, 2018; Grace, 2010; Koroi, 2017; Clapcott, et al., 2018; Kainamu-Murchie, et al., 2018; Tipa & Teirney, 2003) (Tipa & Nelson, 2012)
Mana motuhake	The importance Māori place on identity for the wellbeing of an individual and their community	(Koroi, 2017)
Mana whakahaere	Access and admission, traditionally restricted and regulated access to certain areas through the use of tapu, rahui and noa	(Rolleston, 2005; Rolleston, 2006)
Tohatoha	To disperse, spread, distribute, share, allocate	(Maxwell, et al., 2018)
Pūrākau	A narrative that aids in learning knowledge, rituals, karakia, history and creation	(Maxwell, et al., 2018)
Mahinga kai	All-inclusive term encompassing places for food gathering, food production and sources of rongoa, and the activity of gathering –requires healthy and diverse ecosystems to ensure the resource is fit for cultural usage Mahinga kai species as tohu (indicators) for environmental monitoring; if mahinga kai is not present, or is unsafe to harvest, then that natural system is under stress and requires remedial action	(NRC, MPI, & MfE, 2015; Tipa & Teirney, 2003; Tipa & Teirney, 2006) (Grace, 2010; Tipa & Nelson, 2012)

Value	Description	Source
Wāhi tapu & wāhi taonga	The need to provide for and protect sacred sites – sites significant due to their tapu or taonga status, as mandated by kaitiaki	(Grace, 2010; Tipa & Teirney, 2006)
Uru te ngangana	Balance between complementary or conflicting forces and needs	(Panelli & Tipa, 2007)
Tohungatanga	The retention and use of knowledge to benefit the tribe or business	(Harmsworth, 2018)
Tau utu utu	Reciprocity, giving back what you take – e.g. humans provide benefit to the ecosystem, through guardianship and sustainability, which means the ecosystem is sustained and can then provide benefit back to humans Link to Kaitiakitanga	(Harmsworth, 2018; Harmsworth & Awatere, 2013; Grace, 2010)

3.3 CONTEMPORARY SETTING

Ka mua, ka muri

We look to the past as we move forward into the future

The Treaty of Waitangi (Te Tiriti o Waitangi) 1840 provides the basis for partnership and engagement between Māori and the Crown (the Government). The Treaty, written in Māori and English, has been the origin of much debate between Māori and Europeans since 1840, with various interpretations of the text and what it means (Harmsworth & Awatere, 2013; Harmsworth & Roskrugge, 2014; Koroi, 2017; Panelli & Tipa, 2007). It is beyond the scope to enter that debate herein. However, the principles of partnership, participation and protection which underpin the relationship between the Government and Māori under the Treaty of Waitangi provide a basis for participation and decision-making by Māori with the Crown and with other stakeholders (e.g. community groups, industry, landowners) (Harmsworth & Awatere, 2013).

3.3.1 TE MANA O TE WAI

The National Policy Statement for Freshwater Management (NPS-FM) recognises that fresh water has deep cultural meaning to all New Zealanders. Te Mana o Te Wai is a concept described within referring to *the integrated and holistic well-being of a fresh water body* (Ministry for the Environment, 2017).

Te Mana o te Wai acknowledges each water body has its own mauri and its own mana which must come first to protect the integrity of the water body (Ministry for the Environment, 2017; Porou, 2017). Upholding Te Mana o te Wai requires provision for Te Hauora o te Taiao (the health of the environment), Te Hauora o te Wai (the health of the waterbody), and Te Hauora o te Tangata (the health of the people). Porou (2017) explains Te Mana o te Wai is all encompassing ensuring the first right to the water goes to the water, it recognises that wai is nurturing and teaches us the lesson:

Ko au te wai, ko te wai ko au

I am the water and the water is me

While the concept is expressed in te reo, te mana o te wai applies to freshwater management on behalf of the whole community aiming to incorporate the values of tangata whenua and the wider community in relation to each water body based on their unique relationship with that water body (Ministry for the Environment and Ministry for Primary Industries, 2018; Ministry for the Environment, 2017).

The NPS-FM and te mana o te wai align with wider WSUD objectives, recognising an objective to improve integrated management of fresh water and the use and development of land in whole catchments, including recognising interactions '*ki uta ki tai*' (Table 2) between freshwater, land, ecosystems and the coastal environment (Ministry for the Environment, 2017).

3.3.1.1 URBAN WATER PRINCIPLES – NGĀ WAI MANGA

The development of ten urban water principles began with the concept of Te Mana me Te Mauri o Te Wai – this means that we owe the greatest obligation to that which 'gives us life' (Ministry for the Environment, 2018).

The principles are intended:

to guide decision-making promotes sustainable behaviours and the creation of water sensitive urban spaces by drawing on mātauranga, the lessons of the past, international best practice, the needs of our present communities, and a vision of a sustainable, resilient future. (Ministry for the Environment, 2018)

The principles are summarised as follows:

PAPATŪĀNUKU – Our relationship with the land–Papatūānuku–will pre-determine our relationship with water

1. Protect and enhance ecosystem health of all receiving environments.
2. Co-design with nature an integrated and regenerative approach to urban development.
3. Address pressures on waterbodies close to source.

NGĀ WAI TUKU KIRI – "Our waters are a gift of life provided to us by our tūpuna"

4. Recognise and respect mana motuhake – the whakapapa and relationship that mana whenua have with water ecosystems in their rohe.

TĀNGATA – "Our environments are places of human occupation"

5. Identify and consider the community values for urban water and reflect them in decision-making.
6. Optimise environmental, social and cultural benefits when investing in buildings and infrastructure.

TE HĀPORI ME TE WAI – "The community's love and care for water is enduring"

7. Uphold and foster kaitiakitanga and custodianship of urban water ecosystems.
8. Collect and share information to promote common understanding of urban water issues, solutions and values.

TIAKINA MŌ APŌPŌ – "In building future resilience, our connectedness with the environment is our strength"

9. Increase resilience to natural hazards and climate change.
10. Conserve and reuse water resources.

These principles condense many of the overarching values and concepts presented in Table 2 and Table 3 which reflect Te Ao Māori and demonstrate how to apply them in the context of urban water management. While driven from the urban water space, they specifically intend to support and guide the implementation of water sensitive design – and Te Ao Māori– which recognises an inability to disconnect water from land, and people from the ecosystem.

3.3.2 AUCKLAND COUNCIL WATER STRATEGY

The Auckland Council Water Strategy (out for public consultation until April 19th 2019) poses a significant mind shift for the way water is dealt with in the Auckland region. The strategy considers an overarching vision of one water, where water in all its different forms is considered in a system-wide view: in rivers and streams, in underground aquifers, in estuaries, harbours and marine areas, and in the three (infrastructure) waters: drinking water, wastewater, and stormwater.

The priority of the strategy is "Te mauri o te wai (the life supporting capacity of water)". This vision puts water at the centre with people, more in line with Te Ao Māori views.

Te mauri o te wai: putting water at the centre					
Vision	Te mauri o te wai o Tāmaki Makaurau – the life supporting capacity of Auckland’s water – is protected and enhanced.				
Values	Ecosystems <i>Healthy water systems nourish the natural environment.</i>	Water Use <i>We can meet our everyday water needs, safely, reliably and efficiently.</i>	Culture <i>Water contributes to our identity and beliefs, as individuals and as part of communities.</i>	Recreation and Amenity <i>We enjoy being in, on and near the water.</i>	Resilience <i>Our communities, catchments and coastlines are resilient to natural hazards and the impacts of climate change.</i>
Issues we need to work on	Cleaning up our waters	Meeting future water needs	Growth in the right places	Adapting to a changing water future	
Processes we need to work on	Creating our water future together		Setting priorities for investment	Achieving net benefits for catchments	
	Applying a Māori world view				
Principles to guide our work	<ul style="list-style-type: none"> Recognise that water is a treasured taonga Work with natural ecosystems Deliver catchment scale thinking and action 		<ul style="list-style-type: none"> Focus on achieving right-sized solutions with multiple benefits Work together to plan and deliver better water outcomes Look to the future 		

Figure 3: The proposed Te Mauri o Te Wai framework for an Auckland Water Strategy (Auckland Council, 2019)

3.3.3 ESSENTIAL FRESHWATER WORK PROGRAMME

The Essential Freshwater work programme aims to reverse water quality trends and achieve long-term improvements in freshwater health (Ministry for the Environment and Ministry for Primary Industries, 2018). The programme has three main objectives: to stop further degradation and loss, to reverse past damage, and to address water allocation issues.

While not referenced within the body of the issued document, the Cabinet Paper appended specifically identifies a vision (Ministry for the Environment and Ministry for Primary Industries, 2018):

"Mauri must be restored to waterways subjected to pollution and practices that have compromised the relationship that Māori have traditionally had with these taonga;"

As a companion to the Essential Freshwater work programme, the MfE published *Shared Interests in Freshwater: A New Approach to the Crown/Māori Relationship for Freshwater* (Ministry for the Environment and Māori Crown Relations Unit, 2018). The document clarifies that the Essential Freshwater work programme cannot be progressed without a "concurrent and substantive" discussion with Māori about their rights and interests in freshwater under the Treaty of Waitangi.

The document recognises there is a wide range of views within Māoridom about how to address freshwater issues, but broadly summarises aspirations for improvements to the health of ecosystems and waterways, governance and decision making, and recognition of iwi/hapū relationships with particular freshwater bodies. A foundation to these

aspirations is the need to ensure protection of customary activities (such as food gathering, access to wāhi tapu, and use of water for spiritual practices) and recognising, protecting, and enhancing the mauri of the water bodies (Ministry for the Environment and Māori Crown Relations Unit, 2018).

While not specifically referenced, the Essential Freshwater programme and the intended empowerment of Te Ao Māori within the framework strongly parallel the outcomes intended by WSUD – for healthy resilient communities we must achieve a healthy and resilient ecosystem *ki uta ki tai*. As is consistently represented through whakapapa and mātauranga Māori we cannot separate people from the land, and therefore we must consider a holistic approach.

3.3.4 IWI/HAPŪ MANAGEMENT PLANS

Iwi/hapū management plans are planning documents used to express kaitiakitanga for a specific region/rohe. They act as a guideline for resource management practitioners – particularly developers and decision makers operating under the Resource Management Act 1991. Their format depends on the priorities of the iwi/hapū preparing the plan, addressing a single issue or resource such as freshwater or Māori heritage, or providing a regional assessment of issues of significance in a given area. They may address economic, social, political and cultural issues in addition to environmental and resource management issues.

Te Pou O Kāhu Pōkere: Iwi Management Plan for Ngāti Whātua Ōrākei 2018 (Ngāti Whātua Ōrākei, 2018) is introduced as a wero, a challenge, *'to work together to better understand the views, perspectives and priorities of Ngāti Whātua Ōrākei in relation to resource management matters'*. New Zealand Herald (2018) quotes Ngāti Whātua Ōrākei Trust deputy chair Ngarimu Blair, noting iwi and the council had been trying to "weave the two world views together" – kaitiakitanga and resource management:

"At the heart is kaitiakitanga, sustainability, and thankfully [this council] and the world is moving towards that, which Māori and indigenous peoples around the world have been pushing for generations."

Key themes in the Kaitiakitanga Framework reflect intergenerational responsibility, a reciprocal and balanced relationship with the natural world, and emphasise whakapapa and connection to the physical and spiritual worlds (Ngāti Whātua Ōrākei, 2018):

"If the land and sea is polluted then the health of the people will be affected as will the mana of the iwi"

"Our role as kaitiaki requires us to protect and nurture our environment and it will in turn protect and nurture us."

The Ngāti Whātua Ōrākei Kaitiakitanga Framework specifically references objectives for water sensitive urban design within the "Water" section. However, additional sections reference wider principles of water sensitive urban design than those typically applied in Aotearoa (New Zealand) – including climate change considerations, energy and water efficiency objectives, urban planting, spatial planning, and waste minimisation, highlighting parallels between Te Ao Māori and WSUD when considered in its broadest context (Figure 1).

The *Northland Tangata Whenua Freshwater Values: A Literature Review* (NRC, MPI, & MfE, 2015) and companion report *A Framework to Guide Decision Making 2015* (NRC, MPI, & MfE, 2015) describe Taitokerau tangata whenua freshwater values and

2019 Stormwater Conference & Expo

frameworks for implementation under the NPS-FM. While local issues and values differ from river to river and from whānau to whānau, there is a high degree of agreement on the overarching values. Freshwater is essential to the fabric of communities –it is essential for human health and prosperity, but also for identity and other means of connection to the environment. One aim encapsulated the study findings more than any other:

*kia pai te kaukau i nga awa nui,
kia inu pai i nga awa iti*

*swim safely in the big rivers,
drink safely from the small rivers*

Similar to the Ngāti Whātua Ōrākei Kaitiakitanga Framework, the Northland Tangata Whenua framework identified the need for an integrated management approach – *ki uta ki tai* (from inland to the sea) – to achieve desired liveability outcomes (NRC, MPI, & MfE, 2015).

3.3.5 HEALTH & WELLBEING

The link between health and well-being is stated clearly in the World Health Organization's (WHO) description of human health: "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" (WHO, 2019). There is growing scientific recognition that people in suburban and urban areas with fewer experiences of nature (including home gardens and public green spaces) tend to have worse health across multiple domains, but have the potential for the greatest gains from spending longer in nature, or living in green areas (Cox, et al., 2018; Dennis & Philip, 2017; Ekkel & De Vries, 2017; Joye & Dewitte, 2018). Viewing nature through a window, living in environments with a high percentage of green space, and having access to nearby green areas and parks have all been positively associated with health aspects (Ekkel & De Vries, 2017).

With increasing numbers of people living in urban areas, daily contact with nature is reducing. Space is costly in an urban context, and the maintenance costs of the greenery (real or perceived) add to this. Studies suggest that cumulative exposure to nature – including blue spaces (access to surface water), areas smaller than 1 ha, small scale horticulture, and isolated natural elements (i.e. street trees & green verges) – show more consistent and positive associations with health indicators than proximity to a formal "greenspace" alone (Ekkel & De Vries, 2017; Dennis & Philip, 2017).

The very identity of Māori is inextricably intertwined with the environment. There is growing understanding of the reciprocal relationship linking healthy ecosystems and people's cultural, spiritual, and physical wellbeing (Harmsworth & Awatere, 2013; Brockbank, 2018; Ataria, et al., 2018; Panelli & Tipa, 2007). While the resources sustained by tribal lands and waters contribute to physical well-being, tribal lands also nourish a sense of continuity between generations, reinforcing spiritual well-being in the form of whakapapa (Panelli & Tipa, 2007). Humans and ecosystems are inter-connected through whakapapa and the interaction between them is what determines the welfare of both (Harmsworth & Awatere, 2013; Andrew, 2016).

The following whakataukī reflects the holistic relationship Māori have with the environment:

*Ka ora te wai,
Ka ora te whenua.
Ka ora te whenua,
Ka ora te tangata.*

*If the water is healthy,
The land will be nourished.
If the land is nourished,
The people will be provided for.*

Modern urban expansion has a propensity to overlay natural features and historic land-use and activity with little acknowledgement of what was there before (Rolleston, 2005; Rolleston, 2006). To fully appreciate the past lives and activities of Māori, it is necessary to view traditional sites within their wider context, and to focus on the relationships between the sites and the wider cultural landscape (Tipa & Teirney, 2003).

Intensification of urban settlements has not only affected the natural and built environment but also the relationship Māori have to traditional landscapes. With increased urbanisation and social mobility, high numbers of Māori are living away from their homelands. There is risk that Māori are becoming increasingly disconnected with their environment and weakening the intergenerational knowledge transfer process (Ataria, et al., 2018; Panelli & Tipa, 2007). Urbanisation has changed the Māori cultural experience of their natural world (Callaghan, et al., 2018; Ataria, et al., 2018). Students are taught a mainstream science curriculum that is devoid of cultural anchor points, reinforcing the environmental disconnect that Māori students encounter particularly in our urban environments (Callaghan, et al., 2018). Callaghan, et al. (2018) present a collaborative school project established to look after the waterways and re-connect rangatahi (youth) with these environments. Fundamental to this project was the opportunity to integrate science with mātauranga Māori as equally valid knowledge systems, aiming to bring to life a cultural narrative of science.

The disconnect with nature can be viewed as a wider symptom of urbanisation, not restricted to Māori communities. There is evidence that people with a greater orientation to nature have better mental health, social cohesion, and physical behaviour, highlighting the importance of supporting the development of a connection to nature across a person's life-course (Cox, et al., 2018). Van Dijk-Wesselius, Maas, Hovinga, & Van Vugt (2018) conclude that greening of school yards – to reconnect children with nature – has a positive impact on children's appreciation of the schoolyard, their attentional restoration after recess, and social well-being. Implementation of WSUD provides a clear opportunity to enhance urban greenspaces and reconnect people with the natural environment. Te Ao Māori encompasses the holistic intent of WSUD and is enhanced through the growth of a Māori renaissance in social, cultural, and political spheres, increasing articulation of mana whenua as kaitiaki; guardians of both their cultural identity and environment (Panelli & Tipa, 2007).

3.3.5.1 MODELS OF HEALTH & WELLBEING

A number of holistic models of health and well-being have been proposed, based on Māori traditional knowledge and understanding (Harmsworth & Awatere, 2013). Te Whare Tapa Whā compares health to the four walls of a house (Figure 4). All four are necessary for balance, and each represents a different dimension:

- taha whānau (extended family wellbeing)
- taha wairua (spiritual wellbeing)
- taha hinengaro (emotional/mental wellbeing)
- taha tinana (physical wellbeing)

To achieve wellbeing all four dimensions must be in balance (Harmsworth & Awatere, 2013; Mark & Lyons, 2010). Taha wairua extends to include relationships with the environment, whereby environmental features including te whenua (land), ngā roto (lakes), and ngā maunga (mountains), have a spiritual significance beyond functional considerations. The Whenua or Te Ao Tūroa dimension, presenting the environment as a

strong foundation, is not shown in all depictions of the model. Heaton (2015) explains Māori, in their role as tangata whenua, recommended that a taha whenua dimension be added to the model, acknowledging the implicit interrelationship of whenua as the foundation for a whare. However, a taha whenua dimension was ultimately excluded in the final Health and Physical Education in the New Zealand Curriculum (HPENZC) (Ministry of Education, 1999) document, with Heaton (2015) commenting the inclusion may have been too contentious at the time, considering Treaty of Waitangi land grievances before the state.

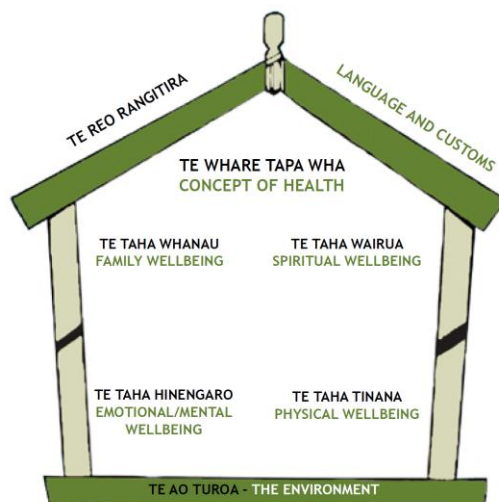


Figure 4: Te Whare Tapa Whā model developed by Mason Durie (BPAC, 2006)

The Ngā Pou mana (four supports) model places greater emphasis on the external environment and the significance of oral tradition (Harmsworth & Awatere, 2013). It describes a full set of values and beliefs as pre-requisites for health and well-being (Harmsworth, 2018). With four key supports (Figure 5), the interacting variables for both individual and group well-being include:

- whānaungatanga (the importance of the family)
- taonga tuku iho (cultural heritage)
- te ao tūroa (the natural environment)
- turangawaewae (the land base, a place of belonging, standing and identity)

The Ngā Pou model emphasises that well-being is affected not just by access to or quantity of natural resources but also by their state or condition (Harmsworth & Awatere, 2013).

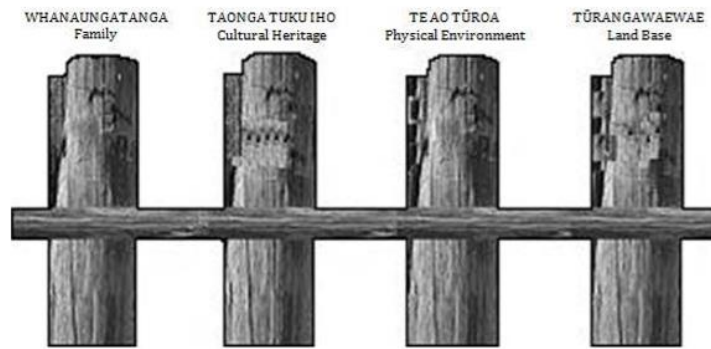


Figure 5: Ngā Pou Mana model developed by Mason Durie (BPAC, 2006)

Te Wheke model extends the four dimensions of Te Whare Tapawhā to eight, adding:

- mana ake (the unique qualities of each individual and family, to create positive identity)
- mauri (vitality, the life-sustaining principle in all people and objects)
- hā a koro mā a kui mā (breath of life from ancestors, inherited strengths)
- whatumanawa (the open and healthy expression of emotion).

Te Wheke employs an octopus metaphor to illustrate the interdependence of all things: the head or eyes represents the collective waiora – the total well-being for the individual and family – and each tentacle represents an intertwined dimension that helps give sustenance to the whole (Harmsworth & Awatere, 2013; Harmsworth, 2018; Mark & Lyons, 2010).

Mark & Lyons (2010) explored Māori spiritual healers' views on healing practices in Aotearoa (New Zealand) ultimately proposing an alternate model called Te Whetu (The Star), with five interconnected aspects: mind, body, spirit, family, and land. They found that Māori cultural perspectives influenced views of the mind, body, spirit but healers also identified whānau/whakapapa (family and genealogy) and whenua (land) as significant and fundamental to a person's health (Mark & Lyons, 2010). The connectedness of mind, body, and spirit was highlighted, but the external relationships people have with their family/genealogy and with the land are viewed as just as important for maintaining good health.

These models, among others, are particularly useful when linking Māori well-being to the natural environment as they demonstrate Māori relationships with and dependency on environmental conditions. There are many variations of these models and concepts, but Harmsworth (2018) notes – most stress a set of principles and practices to achieve a goal of mauri maintenance and human well-being. The models reflect how Māori observe the world in both spiritual and physical terms (Koroi, 2017) and recognise that well-being is affected not just by access to or quantity of natural resources but also by their state or condition. Therefore, the loss of land, pollution (through sewage effluent and other contaminants) affecting traditional areas of food gathering, and the depletion of natural resources are all destabilising factors on health and well-being to the detriment of spiritual and cultural values (Harmsworth & Awatere, 2013).

3.3.6 URBAN DESIGN & CULTURAL LANDSCAPE

The western paradigm for land development has relied heavily on manipulation of the land – with cut to fill earthworks and modification to watercourses frequently employed to create a landform desired for development. This style of development fundamentally conflicts with Māori views of development where Te Ao Māori emphasises reciprocity with the environment and a respect for the carrying capacity of ecosystems (Koroi, 2017).

There is growing recognition that no single skill or profession can deal with the complexity of change associated with urban development (Awatere, et al., 2008). To solve complex societal and environmental problems, the western view of the world is becoming increasingly holistic. Harmsworth & Awatere (2013) note that in many areas we are seeing a re-alignment between indigenous and non-indigenous thinking. We are moving from a narrow single-perspective focus to recognise the need for integrated studies and collaborative learning; understanding the sensitive balance between human beings and nature; and working towards greater equity, inclusivity, and participatory decision-making (Harmsworth & Awatere, 2013). A water sensitive approach is one such mechanism aligning indigenous and non-indigenous thinking – development through a water sensitive lens aligns far more strongly with Te Ao Māori and Māori aspirations for development than the traditional western approach.

Te Aranga (2008) present a Cultural Landscape Strategy which aims to enable iwi to positively influence and shape the design of cultural landscapes within their tribal boundaries. The term “cultural landscape” was adopted by mana whenua as a more appropriate term than “urban design” as it acknowledges a Māori world view that not differentiate between urban and rural areas and where physical landscapes are inseparable from tūpuna, events, occupations, and cultural practices (Te Aranga, 2008). The following outlines the concluding message:

To kaitiaki – whānau, hapu, iwi:

Mā to rourou, mā tōku rourou e ora ai te Iwi

With your food basket and my food basket (by working together) the people will be well

To territorial authorities:

Whatungarongaro te tangata – toitū te whenua

People come and go, the land remains

To crown agencies:

Ma te huruhuru ka rere te manu

*With feathers the bird can fly
(with the right support the strategy will succeed)*

To Māori professionals:

*Hokia ki o maunga kia purea e koe I nga hau o
Tawhirimatea*

*Return to your ancestral mountains to be
cleansed by the winds of Tawhirimatea*

To professionals and their professional bodies:

*Ehara taku toa I te toa takitahi, engari taku toa
he toa takitini*

*My achievement is not that of an individual, but
is that of many (we can achieve much together)*

Urban design is more than just the construction and placement of physical structures, and the papakāinga means far more than housing alone – they are about making connections with people and places and achieving goals of unity, cohesion, autonomy, community, and culture (Rolleston, 2005; Rolleston, 2006; Blair, 2009; Awatere, et al., 2009). The term papakāinga originates from two Māori words that refer to “land and home” – settlements are not just physical spaces where people live but are an expression and extension of identity (Awatere, et al., 2008). Building the mana and pride of the community is foremost, while housing complements and supports those goals (Blair, 2009). The notion of connections between people, places and spaces is inherent in Te Ao

Māori and is encapsulated within the broader concept of whakapapa, encompassing kaitiakitanga, rangatiratanga, and whanaungatanga (Table 2). Development through the lens of Te Ao Māori is inherently holistic. To implement mātauranga Māori into design processes, development must occur in a manner that acknowledges kaupapa Māori processes and considers the indelible link between whenua, whānau/hapū/iwi, and identity (Awatere, et al., 2008; Rolleston, et al., 2009).

Awatere, Rolleston, & Pauling (2009) provide example projects merging Māori values with western development disciplines to produce frameworks to guide development. The frameworks promote integration between cultural, social, environmental, and economic aspects of urban design and favour more water sensitive, energy-, resource- and cost-efficient design, to achieve socially and culturally sensitive sustainable development. Nine guiding mātauranga Māori cultural design qualities (Table 2 & Table 3) aim to preserve culturally significant resources and landscapes and build community identity and social cohesion (Awatere, et al., 2008; Awatere, et al., 2009; Rolleston & Awatere, 2009; Rolleston, 2005)

Traditional knowledge, values, and concepts – aligning with the implementation of WSUD – are of continuing relevance and may support resolving the contemporary sustainable development dilemmas faced in New Zealand (Awatere, et al., 2008). However, a lack of implementation by the mainstream requires a more integrative and progressive framework in order to achieve an inclusive New Zealand sustainable urban development paradigm (Awatere, et al., 2008; Awatere, et al., 2009). Greater effort is required to collate, articulate, and illustrate a range of examples across New Zealand that show how Māori values can be effectively incorporated into mainstream planning and design and therefore contribute to greater goals of WSUD (Awatere, et al., 2008; Brockbank, 2019).

As modern frameworks move towards collaborative and integrated design approaches, we recognise that although there are multiple and often competing visions of and pathways towards sustainable management, to be effective the many stakeholders associated with environmental problems must develop solutions cooperatively rather than acting single-mindedly in their own interest (Greenaway, et al., 2005). Ongoing commitment to Māori involvement and activity in the design of sustainable developments is needed to achieve integrated urban outcomes and meet Māori aspirations (Awatere, et al., 2009). Establishing meaningful relationships is the first step in considering the role of tangata whenua and is key to achieving beneficial development outcomes for all involved (Awatere, et al., 2013).

A key intended outcome of WSUD is to create resilient, healthy communities – we conclude that design through the lens of te ao Māori, applied as a mainstream principle through the WSUD framework, will create the desired social and environmental connections; create spaces which encourage community participation and membership; and prevent isolation or segregate members of the community. The effective implementation of mātauranga Māori to achieve goals for sustainable urban development will be essential if cultural identity, history and traditions of both Māori and Pākehā are to be truly reflected in the built environment. We argue that integration of mātauranga Māori into WSUD is not the goal – rather we conclude the principles of WSUD and intended outcomes are already interwoven within the fabric of Te Ao Māori. The desired outcome is to remove the compartmentalisation of mātauranga Māori as a separate “cultural bottom line” indicator, and to instead recognise the holistic values reflected in Te Ao Māori benefit the wider community as a whole and should be embraced in parallel.

3.3.6.1 WATER SENSITIVE URBAN DESIGN

WSUD as a principle is strongly linked to the broader concept of urban design and cultural landscape, although it is assessed in a narrow stormwater centric perspective in Aotearoa (New Zealand). A single paradigm has traditionally dominated conventional stormwater management practices in New Zealand. Stormwater runoff is viewed as undesirable and must be removed from the site as quickly as possible – contaminated stormwater runoff discharges directly into the receiving water body at accelerated flow rates and increased volumes, negatively affecting the mauri of the water.

Fenelon & Hellberg (2015) trace the evolution of stormwater management in Auckland; and show how water sensitive design is the natural progression for stormwater management in Auckland. The development strategy acknowledges that people and nature are inseparable and provides WSUD as the pathway to achieve integrated built and natural form and character in Auckland (Fenelon & Hellberg, 2015). While not directly referenced, these conclusions reflect Māori values.

Voyde & Morgan (2012) describe commonalities between indigenous concepts and sustainable design principles, suggesting that WSUD principles may have been implemented sooner in Aotearoa (New Zealand) if mātauranga Māori had informed design decisions. One example provided, the Haumingi 10a2b Papakāinga constructed in the 1980s (Morgan, 2006), was designed based on the collective aspirations of the Māori owners, and demonstrates clear parallels to current WSUD design principles. Morgan (2006) concludes the result was and is an economically and environmentally superior solution to the conventional development approaches typically implemented at the time. Māori efforts to explore alternative development paths have been largely overlooked, yet what is becoming more apparent is that WSUD principles run parallel to the traditional Māori relationship with the environment (Voyde & Morgan, 2012). By incorporating mātauranga Māori into design and development, another channel is opened to promote WSUD whereby the intrinsic value and integrity of the ecosystem is considered in the design process to enhance urban development and socio-cultural outcomes (Voyde & Morgan, 2012; Morgan, 2006).

Māori prefer stormwater runoff to be treated (preferably land based) before discharge into waterways, the mixing of water and waste pollutes the mauri of the waterbody. Tikanga Māori did not permit the discharge of waste of any kind into water - bodily waste, food scraps, fish scales and gut, and pipi shells were discharged only to land (Durie, et al., 2017; Harmsworth & Roskrige, 2014). Discharging impure water into waterways is offensive to Māori, no matter how well treated (Durie, et al., 2017; Harmsworth & Roskrige, 2014; NRC, MPI, & MfE, 2015; Morgan, 2008) affirming Papatūānuku as the appropriate filter for impure water (such as through terrestrial and artificial wetlands), and emphasising the importance of maintaining the integrity of the mauri of each waterbody (Harmsworth & Roskrige, 2014; Morgan, 2006). Essentially, Māori want water to be treated as water, ensuring it goes through the processes of transformation from tapu to noa, to ensure it is safe for humans (Brockbank, 2018).

Brockbank & Jonathan (2017) note some contradiction with the use of water sensitive infrastructure for stormwater treatment - the use of vegetated systems such as engineered wetlands, for stormwater quality treatment means that these systems are specifically designed to absorb or retain contaminants at levels beyond those encountered in a comparable natural wetland. In an effort to protect the receiving environment, designers create new sacrificial "green" environments. Brockbank & Jonathan (2017) propose that a hybrid solution, for example an upstream gross pollutant trap prior to a treatment wetland, can avoid or reduce this unintended outcome but utilising grey infrastructure to reduce the concentration of contaminants entering the

vegetated system through a treatment train type approach. The outcome is a more natural stormwater treatment system; an environmental outcome better aligned with Māori values to protect the mauri of the system.

Blair (2009) demonstrates how the Ngāti Whātua o Ōrākei (NWŌ) papakāinga plan, based on traditional cultural values, reflects the principles of water sensitive design approach. NWŌ is 10 years into a major ecological restoration programme on its reserve land. Water sensitive outcomes and aspirations driven by Māori values include: community gardens, recycling and composting with a future zero-waste goal, future grey-water treatment, applications to utilise roof water for potable use and install composting toilets, and exploration of alternative energy options, from wind to solar and passive solar heating (Blair, 2009). Blair (2009) directly links te ao Māori and WSUD, specifically noting “better knowledge of LIUDD and its relationship to kaitiakitanga should improve the quality of future tribal housing at Ōrākei” (Blair, 2009). NWŌ have identified how its cultural values can be applied to the design and development of its housing land and raised awareness and group knowledge of kaitiakitanga and its practical application in development.

Water sensitive design and water sensitive systems not only reduce the volume of water but have the potential to treat it onsite using planting media, in line with the ethic that Papatūānuku is responsible for the ultimate treatment of a pollutant. The integrity of the receiving waters and surrounding environment is retained, thus maintaining the mauri (life giving force) of the water and ecosystem as a whole. Morgan (2006) defines an integrated holistic approach to water management following te ao Māori as requiring:

- Maintain sufficient water flow to support ecosystems
- Increase water use efficiency and recycling
- Decrease wastage of the water resource
- Reduce, recycle or eliminate wastewater flow
- Reduce, recycle or eliminate stormwater flow
- Encompass the views of Tangata Whenua

Considering core Māori values in parallel with a water sensitive approach to development provides a holistic approach to development, benefiting the wider environment (people and natural) by prioritising the mauri of the community, and their surroundings. This ensure that cultural and social outcomes are not diminished as a result of more typical monetary focused cost-benefit analysis for decision making (Brockbank, 2018).

3.3.7 ASSESSMENT TOOLS

A number of Māori-led cultural assessment and monitoring approaches based on a blend of mātauranga Māori, traditional concepts, and Western scientific knowledge have been developed to provide Māori with tools to articulate their values and perspectives by recording or assessing changes to ecosystems (Harmsworth & Awatere, 2013; Harmsworth, et al., 2016). The models and tools help connect humans, activities, and use, to ecosystems and are increasingly being used to provide cultural perspectives (Harmsworth & Awatere, 2013). Harmsworth, et al. (2016) note that New Zealand provides an exemplar internationally in the integration of indigenous knowledge into freshwater management science, policy, and practice through the adoption of indigenous concepts within a national policy framework.

The Freshwater Cultural Health Index (CHI) is an environmental monitoring and reporting tool developed to enable Māori groups to express their cultural values (Table 2 & Table 3) relating to river and stream health and customary resources (Harmsworth & Awatere, 2013; Tipa & Teirney, 2006). Details of the tool are well documented (Tipa & Teirney, 2003; Tipa & Teirney, 2006; Tipa & Teirney, 2006; Tipa & Nelson, 2012). The information merge between established scientific approaches and traditional Māori values informs a *ki uta ki tai* (Table 3) environmental strategy in both rural and urban waterways (Harmsworth & Awatere, 2013; Tipa & Nelson, 2012; Ataria, et al., 2018). Tipa & Teirney (2003) conclude one of the major advantages of developing the CHI was how the two knowledge systems complemented each other. Linking Western scientific design and analytical skills and cultural knowledge was shown to be an innovative way of developing an effective tool for iwi and resource managers. Respecting the values and beliefs of each party was fundamental – when respect of sensitive tribal knowledge was demonstrated, mutual trust and respect grew, which enhanced relationships (Tipa & Teirney, 2003). The tool commentary and application support the conclusion that the activation of WSUD will be enhanced through revitalisation of Te Ao Māori.

The Mauri Model was developed as a framework, assessment method, and decision-making tool that integrates qualitative indigenous values (Awatere, et al., 2008). It is based on the concept of mauri and measures the impacts of anthropogenic activities and practices on the mauri within four key concentric aspects: ecosystems (which encompass all), hapū (cultural), communities (social), and whānau (economic) (Morgan, 2008; Morgan, 2006). The Mauri Model uses the combined analyses of stakeholder worldviews and the impact upon indicators to determine the absolute sustainability of options. The analysis first identifies differences in worldviews and values, quantifies these, and then leverages these to identify relevant performance indicators (Fa'au & Morgan, 2014). Participants are assisted to better understand the limitations of their own worldviews, which is essential to fairly represent the values of others (Fa'au & Morgan, 2014; Cunningham & Morgan, 2016). Koroi (2017) describes the mauri model as enabling the use of multiple ways of knowing in decision-making, concluding the framework provides space for multiple knowledge systems to work together while at the same time ensuring that indigenous knowledge is recognised and valued. Motu Economic and Public Policy Research (2017) concur, stating the mauri model

"...facilitates recognition and respect of Mātauranga Māori alongside mainstream science, seamlessly integrating quantitative and qualitative data to provide a more complete understanding of the problem".

Wai Ora Wai Māori is a kaupapa Māori assessment tool – it was developed with specific reference to the Waikato Region enabling Māori groups to assess the condition of freshwater (Awatere, et al., 2017). The tool comprises qualitative and quantitative measures for stated attributes, comparable to the mauri model approach in that they provide a scale from low to excellent, consistent with National Objectives Framework (NOF) bands for assessing and reporting standards and condition of selected attributes. This kaupapa Māori approach can be used to assess and articulate resource condition and impact (e.g. resource degradation, water quality, mauri) related to human activities and land management practices (Awatere, et al., 2017). When used alongside scientifically based quantitative attributes and measures, the tool helps provide a robust, holistic, and complementary data set to inform freshwater management within a kaupapa-based assessment framework to measure progress on stated iwi/hapū aspirations and outcomes (Awatere, et al., 2017).

Moores, et al. (2017) developed a decision support system (DSS) to help assess the impacts of urban development on attributes such as water and sediment quality;

ecosystem health; and cultural, amenity and recreation values. The DSS allows comparisons of alternative urban development scenarios to be made by varying inputs representing land use change, stormwater management and related attributes. The paper describes the development and incorporation of indicators of Māori cultural well-being in the DSS. The indicators aim to provide a relative assessment of the extent to which urban development recognizes and provides for mana whenua interests and values, including opportunities for resource use; access to culturally significant waterbodies; restoration of lost waterbodies; wai and wahi tapu protection; and the availability and quality of cultural resources. The tool is not intended as a replacement for direct engagement, but to provide a basis for a screening-level cultural assessment that is integrated and simultaneous with environmental, economic and social considerations (Moore, et al., 2017).

While there are a number of tools available, all aim to value Māori worldview and relationship with the ecosystem in tandem with mainstream western scientific methods. It is essential to ensure Māori values are appropriately represented rather than diluting them to simplified assessment metrics (Harmsworth & Awatere, 2013). It is not uncommon for assessors to seek to convert, quantify, and express human and cultural values as a number, such as a monetary valuation. Placing a financial figure on Māori values and knowledge is seen as insensitive and lacks understanding or acknowledgement of the validity of alternative world views (Awatere, et al., 2013). Concepts such as wairua and mauri (Table 2) do not fit easily into the scientific paradigm typically associated with WSUD. The Northland Tangata Whenua Freshwater Values Framework (NRC, MPI, & MfE, 2015) notes that “*a value or concept such as wairua is not, and should not be, subject to measurement*”. While measurement is appropriate at times, for example scientific water quality parameters, it is inappropriate to try and quantify fundamental concepts such as wairua. Likewise, mauri is “*more likely to be perceived, understood and appreciated rather than specified and measured*”. Māori are more supportive of qualitative approaches that better express Māori values and knowledge (Awatere, et al., 2013).

Similarly, discussions have arisen within Māori networks with concerns around the quantitative outcome of the mauri model and challenging its suitability. Mauri is a metaphysical concept that cannot be quantified (Cunningham & Morgan, 2016) – when viewing any physical element, you are viewing the *tohu* (signs) and processes that demonstrate good health of a system, but you cannot see the mauri of the system. Likewise, you cannot physically enhance mauri, but you can restore the *tohu* and processes that provide the visible display of mauri. For example, a pristine wetland in its natural state may be considered as having strong mauri, but if that wetland is overgrown with weed species some might say its mauri is diminished. This depends on your perspective – in this overgrown state, the mauri of the weeds is strong, even if the wetland is impaired in terms of natural character. Likewise, if you remember the pristine wetland, while its mauri is not visibly present, it still exists through your memory.

Northland Tangata Whenua Freshwater Values Framework (NRC, MPI, & MfE, 2015) queries if integration is a useful goal, citing F. Berkes (pers. comm. 2015):

I am not a fan of 'integrating' two different knowledge systems. I think one can deal with different kinds of knowledge in parallel

Likewise, Harmsworth & Awatere (2013) support the respect and application of Māori values in ecosystems management, where Māori knowledge systems sit equally alongside Western science to manage and enhance ecosystems and taonga. The two paradigms do not always replicate one another but can support one another in parallel. Hepi, et al.

(2018) take the position that Mātauranga Māori and science should not be blended but rather should strengthen and complement each other. Harmsworth & Awatere (2013) suggest introducing more qualitative measures and assessments alongside quantitative measures and assessments, so they are regarded equally. Assessment criteria need to respect and recognise broader holistic values that have validity in all decision-making.

The Māori worldview does not separate spiritual and intangible aspects from the non-spiritual and tangible. Arguably, it is the intangible values ascribed by Māori that are difficult for resource managers and scientists to accommodate within existing frameworks (Tipa & Nelson, 2012). While there are clear parallels linking te ao Māori to WSUD and desire for the two paradigms to work in tandem, there remain challenges to overcome. Iwi and hapū can exercise their right as kaitaki based on mana whenua status and yet within a multi-cultural context, other players – businesses, local and central authorities, environmental and community interest groups etc. – each have their own agenda that may or may not conflict with those of mana whenua (Awatere, et al., 2013). It is important to recognise that Māori are more than just stakeholders; Māori have valuable contributions to make within collaborative planning and design processes which require their own assessment approaches and reporting of values alongside and in support of mainstream science (Awatere, et al., 2017).

4 CONCLUSIONS

Through literature review and the experiences and learnings of the authors, this review aimed to address two overarching questions in support of the activation of WSUD for healthy and resilient communities in Aotearoa (New Zealand):

- How well does WSUD in Aotearoa (New Zealand) provide for Māori values and uses of water?
- Are there opportunities to improve the implementation of WSUD through the integration of Te Ao Māori?

In addressing these questions, it is first important to understand Te Ao Māori – the Māori worldview – and to recognise the breadth of views, and expressions, held by mana whenua are informed by specific relationships with environments that vary regionally. Māori identity is inextricably intertwined with the environment. Te Ao Māori does not separate spiritual and intangible aspects from the non-spiritual and tangible. Māori have a unique perspective on environmental issues and a profound relationship with the land that has developed over many generations, through connection, observation and experience. Therefore, respecting and valuing Te Ao Māori and Māori values is essential to understand the Māori perspective, to protect and manage our environments sustainably, and to ultimately maintain and enhance human well-being and intergenerational sustainability (Harmsworth & Awatere, 2013; Harmsworth & Roskruge, 2014).

Whakapapa recognises that we cannot consider matters in isolation; consideration of the ecosystem as a whole is necessary to truly assess the impacts of engagement within an environment (Koroi, 2017; Ngata, 2018). Embracing the complexities of whakapapa fosters a holistic view of ecosystems and enables practitioners in the WSUD-space to capitalise on a long-established and intimate environmental relationship based upon guardianship, connectedness and reciprocity (Ataria, et al., 2018; Ngata, 2018). WSUD needs to be recognised in the context of catchment management – ki uta ki tai – rather than perceived purely as a stormwater management tool. 'Ki uta ki tai' draws upon

whakapapa recognising that to assess the mauri of a river, the entire catchment through which the river flows must be examined. An intact mauri depends on the status of all components of the catchment (Tipa & Nelson, 2012). The principle informs wider catchment land use decisions, reflecting a holistic WSUD approach. Māori explicitly acknowledge that instream river conditions are determined by processes occurring within the catchment and cannot be isolated out of this context. Tackling these issues requires a collaborative and integrated management model.

For example, mahinga kai reflects the ability to access customary resources, the site of gathering, and the health of the resource itself. The state of mahinga kai can be used to measure the health of an ecosystem. Mātauranga Māori traditionally ensured mahinga kai are maintained through practices such as rāhui, a periodic restriction of resource harvesting to allow stocks to replenish. The degradation of freshwater and physical loss mahinga kai sites has led to the loss of traditional resources. The problems arising under current paradigms extend beyond the challenged which Mātauranga Māori evolved to deal with – for example chemical contamination through urban industrial and intensive agricultural land uses. Scientific and indigenous knowledge can be used in tandem to achieve the best outcome for the revitalisation of these environments (Koroi, 2017). In the example of water degradation impacting both mahinga kai, and the ability of iwi to undertake resource gathering a solution to reverse degradation in a manner that allows for downstream uses and incorporates mātauranga Māori would have positive effects that go beyond water quality management – reaching to enhance social, cultural and environmental outcomes.

The conservation paradigm assumes improved environmental outcomes are achieved though excluding humans from the landscapes. However, there is increasing evidence that the opposite is true –conservation is enhanced when people are living in an environment (Ataria, et al., 2018). This perhaps reflects that as people feel connected to an environment, they are more inclined to protect it for the future and may explain why indigenous people are often considered good custodians – through a stronger connection to the environment they see the triggers early (Ataria, et al., 2018). Māori recognition of the health of an ecosystem typically incorporates relationships to the people –is it abundant enough to harvest from, can we swim in the waterways etc. (Ngata, 2018). This demonstrates a distinction between kaitiakitanga and conventional notions of conservation – which lean towards pristine, untouched ecosystems. Māori notions of care always consider a human dimension and it is our interaction with these systems that underpins our duty of care. Well-being of our waterways is inherently connected with the wellbeing of our people and culture – through whakapapa they are all one and the same thing (Ngata, 2018). Relationships, connections, and intergenerational equity – whakapapa – reflect the importance of the social interactions between people and people, and people and the environment. Collective participation and membership – whanaungatanga – recognise common interests to encourage and build community pride, identification and ownership. One intent of WSUD is to reconnect people to the natural physical environment. Te Ao Māori enhances this by also reconnecting people to the spiritual world in tandem with the physical world, recognising the physical world has intrinsic value in and of itself separate to human use. A strong connection to nature has been demonstrated to support improved mental health, social cohesion, and physical behaviour within communities – linking healthy ecosystems to people’s cultural, spiritual, and physical wellbeing (Harmsworth & Awatere, 2013; Brockbank, 2018; Ataria, et al., 2018; Panelli & Tipa, 2007; Cox, et al., 2018).

There is not a large number of studies specifically linking WSUD with Te Ao Māori. It is concluded that in part, this is because the guiding principles of WSUD parallel fundamental principles within mātauranga Māori (Voyde & Morgan, 2012). WSUD is an

approach consistent with Māori resource management; it is design based on ecological and energy-efficient principles aiming to manage the environment in a sustainable way (Awatere, 2017). The strong cultural link with water and the importance of high-quality waterways within Te Ao Māori offers an opportunity to support the activation of WSUD (Moores, et al., 2018; Brockbank, 2017). WSUD is not a “new approach”, but rather embraces traditional environmental management paradigms and socio-cultural interactions with the environment reflected in Te Ao Māori.

Traditional beliefs, values, and cultural perspectives resonate strongly in contemporary society (Harmsworth & Roskrug, 2014). Mātauranga Māori is a dynamic and evolving knowledge form that continues to adapt and change, without losing sense of its origin (Harmsworth & Awatere, 2013; Kitson, et al., 2018; Paul-Burke, et al., 2018; Awatere, et al., 2013; Ogilvie, et al., 2018; Bargh, 2014). Mātauranga Māori possesses qualities that can support the preservation of culturally significant resources and landscapes as well as build community identity and participation, with more contemporary forms of mātauranga Māori including adoption of water sensitive urban design features (Rolleston & Awatere, 2009; Awatere, et al., 2008). However, in the context of WSUD in Aotearoa (New Zealand), mātauranga Māori is often poorly understood (Harmsworth & Awatere, 2013). Current approaches struggle to respectfully recognise and provide for tangata whenua values in a climate of multiple and often conflicting demands (Kitson, et al., 2018). Poor understanding of Māori values, perspectives and knowledge; lack of recognition of the validity of different knowledge forms; and limited mana whenua capacity are contributing factors limiting the incorporation of Mātauranga Māori in urban planning and WSUD (Harmsworth & Awatere, 2013). To facilitate the recognition of, and uptake of, te ao Māori in WSUD we recommend upskilling practitioners to better understand mātauranga Māori and empowering more Māori practitioners to enter the disciplines supporting the WSUD industry – for example: town planning, urban design, landscape design, ecology, engineering, and construction. Science and mātauranga Māori should be working together to address complex issues like freshwater management in Aotearoa (New Zealand). Callaghan, et al. (2018) conclude, it takes courage and a willingness for both parties to engage respectfully in a bi-cultural process to work together, but this collaboration of worldviews can enhance outcomes. Resurgence and revitalisation of Te Ao Māori can reconnecting urban Māori, or those otherwise disconnected, with mātauranga Māori while also sharing the Māori worldview with non-Māori practitioners. Trust and relationships – whanaungatanga – are critical to scaffolding collaborative worldviews. Mātauranga Māori must be protected so it is not shared or used outside the cultural context in which the information was generated and is intended to inform (Kitson, et al., 2018).

The economic, social, amenity, and environmental values of stormwater management are widely understood and seen in practice. However, cultural involvement and knowledge incorporated within these core values, either as a standalone value or weaved throughout, is often considered as a ‘last minute addition’ or at times completely ignored (Brockbank, 2018). It is important to recognise that Māori are more than simply stakeholders; Māori have valuable contributions to make within collaborative planning and design processes which require their own assessment approaches and reporting of values alongside and in support of mainstream science (Awatere, et al., 2017). Māori knowledge systems sit equally alongside Western science to manage and enhance ecosystems and taonga. The two paradigms do not always replicate one another but can support one another in parallel. Hepi, et al. (2018) take the position that Mātauranga Māori and science should not be blended but rather should strengthen and complement each other. Harmsworth & Awatere (2013) suggest introducing more qualitative measures and assessments alongside quantitative measures and assessments, so they are regarded equally. Assessment criteria need to respect and recognise broader holistic

values that have validity in all decision-making. The activation of WSUD needs to avoid marginalisation of mātauranga Māori to a 'cultural objective' and instead consolidate engagement and integration across the entire approach. WSUD needs to provide opportunity for mātauranga Māori to enrich contemporary scientific thinking, to support Māori culture and identity but also benefit all New Zealanders (Ataria, et al., 2018). The challenge in building capacity in the industry is how to effectively incorporate Māori perspectives and Mātauranga Māori into WSUD without altering the original meaning and conceptual understanding, and while remaining true to a Māori worldview and philosophy. A further layer of complexity is recognising and providing for regional differences.

As has been presented across a range of disciplines the overarching principle values representing Te Ao Māori cannot be viewed in isolation and permeate all facets of life. It is these principles that reflect the aspirations of water sensitive design to support healthy and resilient communities. A number of supporting frameworks can guide the application of Te Ao Māori alongside WSUD – for example, Te Mana o Te Wai, the Urban Water Principles, the Essential Freshwater work programme, the iwi management plans. This review provides the first step to understanding WSUD through a Māori worldview lens, recognising that the principles of WSUD mirror Te Ao Māori – rather than trying to integrate Te Ao Māori, we need to recognise that WSUD and its intended outcomes already draw upon fundamental Māori values – for example: whakapapa, whanaungatanga, kaitiakitanga, manaakitanga, and mātauranga Māori. Recognising the validity of this alternate worldview and embracing qualitative measures alongside quantitative scientific assessment will open the door to change and future opportunities for enhanced environmental and socio-cultural outcomes in Aotearoa (New Zealand).

REFERENCES

- Andrew, A., 2016. Sustaining The Native Freshwater Fishery of Te Tau Ihu: An Iwi Perspective. Nelson, WaterNZ.
- Ataria, J. et al., 2018. Whakamanahia Te mātauranga o te Māori: empowering Māori knowledge to support Aotearoa's aquatic biological heritage. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 467-486.
- Auckland Council, 2019. Our Water Future / Tō tātou wai ahu ake nei: A Discussion document, Auckland: Auckland Council.
- Auckland Council, 2019. Te Aranga Principles. [Online] Available at: http://www.aucklanddesignmanual.co.nz/design-subjects/maori-design/te_aranga_principles
- Awatere, S., 2017. Maori Perspective. [Online] Available at: <http://www.cleanwaterways.org.nz/maori.html>
- Awatere, S., Harmsworth, G., Rolleston, S. & Pauling, C., 2013. Kaitiakitanga o ngā ngahere pōhatu: Kaitiakitanga of urban settlements.. In: *Reclaiming Indigenous Planning*.. Montreal: McGill-Queen's University Press, pp. 236- 259.
- Awatere, S. et al., 2008. Tū Whare Ora – Building Capacity for Māori Driven Design in Sustainable Settlement Development, Auckland: Landcare Research.
- Awatere, S. et al., 2017. Policy Brief No.19 Kaupapa Māori Assessment Tool: Wai Ora Wai Māori – a kaupapa Māori assessment tool, s.l.: Landcare Research Manaaki Whenua.

- Awatere, S., Rolleston, S. & Pauling, C., 2009. Developing Māori Urban Design Principles. In: Low Impact Urban Design and Development. s.l.:Manaaki Whenua Landcare Research, pp. 28-30.
- Bargh, M., 2014. A Blue Economy for Aotearoa New Zealand?. Environment, Development and Sustainability: A Multidisciplinary Approach to the Theory and Practice of Sustainable Development, 16(3), pp. 459-470.
- Barlow, C., 1991. Tikanga Whakaaro. Melbourne: Oxford University Press.
- Blair, N., 2009. LIUDD - A Ngāti Whātua o Ōrākei Perspective. In: Low Impact Urban Design and Development. s.l.:Manaaki Whenua Landcare Research, pp. 113-116.
- BPAC, 2006. An Introduction to Te Ao Māori - the Māori World, s.l.: Best Practice Advocacy Centre New Zealand.
- Brockbank, T., 2017. Just Add Mauri. Local Government Magazine, October, pp. 30-31.
- Brockbank, T., 2018. Culturally Enhanced Stormwater – Integration With Te Ao Māori. Queenstown, WaterNZ.
- Brockbank, T., 2019. Culturally Enhanced Stormwater – Interweaving Mātauranga Māori. Auckland, Water NZ.
- Brockbank, T. & Jonathan, K., 2017. When Grey Meets Green – A Hybrid Treatment Story. Auckland, WaterNZ.
- Callaghan, P. et al., 2018. Tuākana/Teina Water Warriors Project: A collaborative learning model integrating mātauranga Māori and science. New Zealand Journal of Marine and Freshwater Research, 52(4), p. 666–674.
- Clapcott, J. et al., 2018. Mātauranga Māori: shaping marine and freshwater futures. New Zealand Journal of Marine and Freshwater Research, 52(4).
- Cox, D. T., Shanahan, D. F., Hudson, H. L. & Fuller, R. A., 2018. The Impact of Urbanisation on Nature Dose and the Implications for Human Health. Elsevier: Landscape and Urban Planning Volume 179, pp. 72-80.
- Cunningham, C. & Morgan, T., 2016. Assessing the Net Benefit of Auckland Council Stormwater Management Using the Mauri Model. Nelson, WaterNZ.
- Dennis, M. & Philip, J., 2017. Evaluating the Relative Influence on Population of Health of Domestic Gardens and Green Space along a Rural-Urban Gradient. Elsevier: Landscape and Urban Planning, Volume 15, pp. 343-351.
- Douglas, E. M. K., 1984. Waiora, Waimaori, Waikino, Waimate, Waitai: Maori perceptions of water and the environment. Occasional Paper No, 27. Hamilton, University of Waikato.
- Durie, E. T., Joseph, R., Erueti, A. & Toki, V., 2017. Nga Wai O Te Maori: Nga Tikanga me Nga Ture Roia; The Waters of the Maori: Maori Law and State Law, s.l.: s.n.
- Ekkel, E. D. & De Vries, S., 2017. Nearby Green Space and Human Health: Evaluation Accessibility Metrics. Elsevier: Landscape and Urban Planning Volume 157, pp. 2-4-220.

- Environmental Protection Authority–Te Mana Rauhi Taiao, n.d. Incorporating Māori Perspectives into Decision Making, Wellington: New Zealand Government.
- Fa'au, T. N. & Morgan, T. K. K. B., 2014. Restoring the Mauri to the Pre- MV Rena State. MAI Journal, 3(1).
- Fenelon, S.-E. & Hellberg, C., 2015. Water Sensitive Design: A Strategic Approach to Managing Stormwater in Auckland. Auckland, WaterNZ.
- Grace, M., 2010. Wai Maori - Maori Values in Water, Wellington: Greater Wellington Regional Council.
- Greenaway, A., Feeney, C. & Heslop, V., 2005. Learning into a low-impact future: collaborative approaches to stormwater management. Auckland, NZ Water and Wastes Association.
- Harmsworth, G., 2018. Mātauranga Māori and science: opportunities for research, planning and practice. s.l.:Manaaki Whenua Landcare Research.
- Harmsworth, G., Awatere, S. & Robb, M., 2016. Indigenous Māori values and perspectives to inform freshwater management in Aotearoa-New Zealand. Ecology and Society, 21(4).
- Harmsworth, G. R. & Awatere, S., 2013. Indigenous Māori knowledge and perspectives of ecosystems. In: J. Dymond, ed. Ecosystem Services in New Zealand. Lincoln: Manaaki Whenua Press, pp. 274-286.
- Harmsworth, G. & Roskrige, N., 2014. Chapter 20: Indigenous Māori Values, Perspectives, and Knowledge of Soils in Aotearoa-New Zealand: B. Māori Use and Knowledge of Soils over Time. In: Maturanga and Soils. s.l.:Landcare Research NZ Ltd.
- Harmsworth, G. & Roskrige, N., 2014. Chapter 9: Indigenous Māori Values, Perspectives, and Knowledge of Soils in Aotearoa-New Zealand: A. Beliefs, and Concepts of Soils, the Environment, and Land. In: Maturanga and Soils. s.l.:Landcare Research NZ Ltd.
- Heaton, S., 2015. Rebuilding a "Whare" Body Of Knowledge to Inform "A" Māori Perspective of Health. Mai Journal, 4(2).
- Hepi, M. et al., 2018. Enabling mātauranga-informed management of the Kaipara Harbour, Aotearoa New. New Zealand Journal of Marine and Freshwater Research, 52(4), pp. 497-510.
- Hikuroa, D., 2017. Maturanga Maori - The Ūkaipō of Knowledge in New Zealand. Journal of the Royal Society of New Zealand, pp. 47:1, 5-10, DOI: 10.1080/03036758.2016.1252407.
- Hikuroa, D., 2018. Mātauranga Māori - The Ūkaipō of Knowledge in New Zealand, Auckland: University of Auckland Policy Briefing 7/2018.
- Hopkins, A., 2018. Classifying the mauri of wai in the Matahuru Awa in North Waikato. New Zealand Journal of Marine and Freshwater Research, 52(4), pp. 657-665.

- Jackson, A.-M., Hepburn, C. D. & Flack, B., 2018. East Otago Taiāpure: sharing the underlying philosophies 26 years on. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 577-589.
- Joye, Y. & Dewitte, S., 2018. Nature's Broken Path to Restoration: A Critical Look at Attention Restoration Theory. *Elselvier: Journal of Environmental Psychology*, pp. Vol 59: 1-8.
- Kainamu-Murchie, A. A. et al., 2018. Indigenous and local peoples' values of estuarine shellfisheries: moving towards holistic-based catchment management. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 526-541.
- Kitson, J. C. et al., 2018. Murihiku Cultural Water Classification System: enduring partnerships between people, disciplines and knowledge systems. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 511-525.
- Koroi, H., 2017. Indigenous Knowledge as Evidence in Local Government Decision Making: Challenges and Opportunities, Auckland: Auckland Council.
- Mark, G. T. & Lyons, A. C., 2010. Maori healers' views on wellbeing: The importance of mind, body, spirit, family and land. *Social Science & Medicine*, Volume 70, pp. 1756-1764.
- Marsden, M., 1988. The natural world and natural resources. Māori value systems and perspectives. Resource Management Law Reform Workingpaper 29. Part A., Wellington: Ministry for the Environment..
- Marsden, M., 2003. The woven universe: selected writings of Rev. Māori Marsden. s.l.:Estate of Rev. Māori Marsden.
- Maxwell, K. H., Te Whānau-a-Hikarukutai Ngāti Horomoana, Arnold, R. & Dunn, M. R., 2018. Fishing for the cultural value of kahawai (*Arripis trutta*) at the Mōtū River, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 557-576.
- Mead, S. M., 2003. Tikanga Māori: Living by Māori values. Wellington, New Zealand: Huia.
- Merito, K., 2017. The Life of a River A Maori Cultural View of Rivers. [Online] Available at: <http://www.seakeepers-nz.com/RIVERS/rivermori.html>
- Ministry for the Environment and Māori Crown Relations Unit, 2018. Shared Interests in Freshwater: A New Approach to the Crown/Maori Relationship for Freshwater, Wellington: Ministry for the Environment and Maori Crown Relations Unit.
- Ministry for the Environment and Ministry for Primary Industries, 2018. Essential Freshwater: Healthy Water, Fairly Allocated, Wellington: Ministry for the Environment and Ministry for Primary Industries.
- Ministry for the Environment, 2017. Changes to Freshwater NPS - 2017: Te Mana o te Wai, Wellington: New Zealand Government.
- Ministry for the Environment, 2017. National Policy Statement for Freshwater Management, Wellington: New Zealand Government.

- Ministry for the Environment, 2018. Urban Water Principles: Recommendation of the Urban Water Working Group, Wellington: Ministry for the Environment.
- Moore, J., Batstone, C., Simcock, R. & Ira, S., 2018. Activating WSUD for Healthy Resilient Communities - Discovery Phase: Results and Recommendations, Auckland: Activating WSUD Aotearoa NZ.
- Moore, J. et al., 2017. Assessing Indicators of Cultural Wellbeing in an Urban Stormwater Decision Support System. Auckland, Water NZ Stormwater Conference.
- Morgan, T., 2006. An indigenous perspective on water recycling. *Desalination*, 187(1-3), p. 127-136.
- Morgan, T., 2006. Lifting The Lid On Lid In Aotearoa / NZ. Rotorua, WaterNZ.
- Morgan, T., 2008. The value of a hapu perspective to municipal water management practice: Mauri and its potential contribution to sustainability decision making in Aotearoa New Zealand., Auckland: Unpublished doctoral thesis, The University of Auckland.
- Motu Economic and Public Policy Research, 2017. Climate Change & Stormwater and Wastewater Systems, s.l.: Motu Economic and Public Policy Research.
- New Zealand Herald, 2018. Rooftop gardens, urban food forests and swimmable waterways part of Ngāti Whātua Ōrākei's plans. [Online] Available at: https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=12102705
- Ngata, T., 2018. Wai Māori. In: M. Joy, ed. Mountains to Sea: Solving New Zealand's Freshwater Crisis. Wellington: Bridget Williams Books.
- Ngāti Whātua Ōrākei, 2018. Te Pou o Kahu Pokere: Iwi Management Plan for Ngati Whatua Orakei, s.l.: s.n.
- NRC, MPI, & MfE, 2015. Northland Tangata Whenua Freshwater Values: A Framework to Guide Decision-Making, s.l.: Northland Regional Council; Ministry for Primary Industries; Ministry for the Environment.
- NRC, MPI, & MfE, 2015. Northland Tangata Whenua Freshwater Values: A Literature Review, s.l.: Northland Regional Council; Ministry for Primary Industries; Ministry for the Environment.
- Ogilvie, S. et al., 2018. Mātauranga Māori driving innovation in the New Zealand scampi fishery. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 590-602.
- Panelli, R. & Tipa, G., 2007. Placing Well-Being: A Maori Case Study of Cultural and Environmental Specificity. *EcoHealth*, Volume 4, pp. 445-460.
- Paul-Burke, K. et al., 2018. Using Māori knowledge to assist understandings and management of shellfish populations in Ōhiwa harbour, Aotearoa New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 52(4), pp. 542-556.
- Porou, T., 2017. Te Mana o Te Wai. s.l., s.n.

- Rolleston, S., 2005. Maori Perspectives of Urban Design: Preliminary Findings. Wellington, Meeting of Urbanism Downunder 2005.
- Rolleston, S., 2006. An Indigenous Cultural Perspective to Urban Design. Gold Coast, New Zealand Planning Institute and Planning Institute of Australia Congress 2006.
- Rolleston, S. & Awatere, S., 2009. Ngā hua papakāinga: Habitation design principles. MAI Review, Issue 2.
- Rolleston, S., Awatere, S. & Pauling, C., 2009. Designing Cultural Values into Greenfields Development. In: Low Impact Urban Design and Development. s.l.:Manaaki Whenua Landcare Research, pp. 74-77.
- Royal, T. A. C., 2005. Te Ara - the Encyclopedia of New Zealand: Māori creation traditions. [Online] Available at: <http://www.TeAra.govt.nz/en/maori-creation-traditions> [Accessed 27 February 2019].
- Royal, T. A. C., 2006. Te Ara - the Encyclopedia of New Zealand: Tangaroa – the sea. [Online] Available at: <https://teara.govt.nz/en/tangaroa-the-sea/page-5> [Accessed 15 February 2019].
- Te Aranga, 2008. Te Aranga: Maori Cultural Landscape Strategy - Second Edition, s.l.: s.n.
- Tipa, G. & Nelson, K., 2012. A Framework for a Cultural Health Assessment of Urban Streams, s.l.: Urban Water Planning Research Programme.
- Tipa, G. & Teirney, L., 2003. A Cultural Health Index for Streams and Waterways Indicators for recognising and expressing Maori values, Wellington: Ministry for the Environment.
- Tipa, G. & Teirney, L., 2006. A Cultural Health Index for Streams and Waterways: A tool for nationwide use, Wellington: Ministry for the Environment.
- Tipa, G. & Teirney, L., 2006. Using the Cultural Health Index: How to assess the health of streams and waterways, Wellington: Ministry for the Environment.
- Van Dijk-Wesselius, J., Maas, J., Hovinga, D. & Van Vugt, M. V. D. B. A., 2018. The Impact of Greening Schoolyards on the Appreciation, and Physical Cognitive and Social-Emotional Well-being of School Children: A Prospective Intervention Study. Elsevier: Landscape and Urban Planning, pp. Volume 180, 15-26.
- Voyde, E. & Morgan, T., 2012. Identifying Commonalities Between Indigenous Values and Current Sustainable Design Concepts in Aotearoa New Zealand. AlterNative: An International Jnl of Indigenous Scholarship 8(2), pp. 215-229.
- Wahaanga, H. et al., 2018. Māori oral traditions record and convey indigenous knowledge of marine and freshwater resources, New Zealand. Journal of Marine and Freshwater Research, 52(4), pp. 487-496.
- WHO, 2019. World Health Organisation. [Online] Available at: <https://www.who.int/suggestions/faq/en/> [Accessed 02 03 2019].
- Williams, J., 2006. Resource management and Māori attitudes to water in southern New Zealand. New Zealand Geographer, Volume 62, p. 73– 80.