Environmental Decision Support Systems for Māori landowners

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ABSTRACT

Environmental Decision Support Systems (EDSS) have been used to incorporate and transfer scientific knowledge to aid decision making processes since the early 1950s. Within the literature on EDSS there is widespread agreement about the importance of stakeholder participation. In the past, researchers have often failed to carry out extensive or unbiased stakeholder participation, resulting in EDSS that do not necessarily meet user requirements. By using more effective stakeholder participation processes, researchers will be able to better incorporate their knowledge with stakeholder requirements into future EDSS, helping landowner groups remove barriers to land development and aid land use decision making.

The aim of this research was to investigate how EDSS can be improved to better meet the stated needs of a particular group of landowners: Māori land trusts and incorporations in New Zealand. Initial research investigated Māori landownership issues, researching with Māori (Kaupapa Māori research) and reviewed current EDSS, concentrating specifically on New Zealand EDSS. Using Dillman's (2000) work as a guide, a survey was developed consisting of 22 questions designed to determine the decision making needs of Māori landowners, influences on Māori landowners' decision making, and future EDSS design. Māori landowners from Māori land trusts and incorporations in the Waiariki rohe were approached regarding participation in this research. Of the 50 groups contacted, five groups agreed to participate. In light of this research becoming a case study, further literature was reviewed to consider the strengths and weaknesses of this approach. The data collected from this survey was then analysed and used to make recommendations to aid the development of future EDSS for Māori landowners.

Two limitations associated with this research are: 1) that it was the researcher's first attempt to undertake cross-cultural research, and therefore based on a limited understanding of how to engage effectively with Māori; and 2) that only 14 participants from five Māori trusts or incorporations, all from Te Arawa entities, took part in the study. While the researcher did her best to overcome, or minimise the impact of these limitations, their impact needs to be considered in regards to the key results of this research.

There were five key results from this work: 1) Building a relationship with Māori stakeholders can take time and is extremely important for the success of a research project. Researchers need to allow time to develop rapport and to establish a good working relationship with stakeholders in order to facilitate effective participation; 2) For the Māori landowners surveyed, social considerations tend to be more important than economic considerations, with

the long term sustainability of different options a key concern; 3) Removing barriers to land use decision making and fulfilling the other decision making requirements of Māori landowners need to be integral parts of future EDSS; 4) Māori values are interlinked, with all the values of equal importance to the Māori landowners surveyed. These values underpin the decision making processes of Māori trusts and incorporations, so researchers need to understand the linkages in order to incorporate them into future EDSS; and 5) The ability to visualise their land was the feature of greatest importance to the Māori landowners surveyed. The ability to share information with others and the ability to connect with experts are also highly desirable EDSS features for respondents.

DEDICATION

I would like to dedicate this work with love to my grandparents

Jean and Bryan Cockell

and

Olive and Arthur Orton

for having the courage to immigrate to New Zealand in the first place, thus ultimately starting me on this journey.

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1. INTRODUCTION

Environmental Decision Support Systems (EDSS) have become increasingly used by researchers, companies and governments (both national and regional) because, when appropriately used, they can be a useful tool for communicating scientific research and other information to the public to aid in decision making (Cox, 1996; Poch, Comas, Rodríguez-Roda, Sànchez-Marrè & Cortés, 2004; Rizzoli & Young, 1997). However, in many cases these systems are not adopted because they are developed with no clear end user in mind, do not deal with multiple problems, are not developed in conjunction with user input, often run over budget, are complex to use, hard to update, and often fail to produce all of the promised functionality to users (Huser et al., 2009; McIntosh et al., 2011). As a result, users often feel they have had inadequate consultation, which leads to limited confidence in the developed system which they feel does not actually address their issues (Arnott & Pervan, 2005; Cox, 1996; Rizzoli & Young, 1997; Walker, 2002). Despite these problems it is believed that in the right circumstances EDSS can prove to be a very powerful tool (Arnott & Pervan, 2005; Poch et al., 2004; Rizzoli & Young, 1997).

Engaging with the end users during the design and development process is a key component of ensuring the success of an EDSS (Cox, 1996; Huser et al., 2009; McIntosh et al., 2011; Poch et al., 2004; Rizzoli & Young, 1997; Walker, 2002). On-going consultation and communication between the developers and end users is crucial, and EDSS developers also need to have a very good understanding about what needs, values and perspectives each of the end user groups hold (Arnott & Pervan, 2005; McIntosh et al., 2011; Poch et al., 2004; Walker, 2002). Failure to incorporate these needs, values and perspectives into an EDSS will mean the EDSS fails to meet the user's requirements and will therefore be unlikely to be adopted (Cox, 1996; Huser et al., 2009; Poch et al., 2004; Walker, 2002).

The incorporation of needs, values and perspectives has even greater importance when an EDSS is being developed for a distinct cultural group (e.g. indigenous landowners such as Māori in New Zealand) (Harmsworth, 1998; Roberts, Norman, Minhinnick, Wihongi & Kirkwood, 1995). Particular care is needed to incorporate cultural needs into the design of the EDSS, and ensure that the developers have not made any assumptions about how the EDSS should look, feel or function. For example, assuming that everyone reads and understands English, when Te Reo Māori may be preferred (Harmsworth, 2002; Ulluwishewa, Roskruge, Harmsworth & Antaran, 2008). Similarly, terminology may be important in cultural understanding; using one group's terminology to describe another user's values, needs and perspectives may not be

appropriate (in this case using English to describe Māori terms) as often the translation is not exact (Roberts et al., 1995; Taiepa et al., 1997).

To date, most EDSS developed in New Zealand have been developed with landowners or land managers in mind, but while different categories of landowners/managers are identified in the design process, EDSS fail to distinguish between these different categories in the final product (Huser et al., 2009). In New Zealand the indigenous Māori people are a distinct subsection of landowners/managers who have a particular cultural view of land and its management. Māori comprise 14.9% of New Zealand's population (Statistics New Zealand, 2013) who, as a result of recent Treaty of Waitangi settlements, now manage large tracts of land throughout the country (Land Information New Zealand, 2014; Taiepa et al., 1997). Māori landowners form strong attachments to the land, and they take their role as kaitiaki (stewards) of the land seriously (Rotarangi & Thorp, 2009). As such, they place serious consideration on how their land management decisions are going to impact upon the land, and thus their future generations (Rotarangi & Thorp, 2009). In this context, it is widely recognised that Māori landowners/managers have a unique set of values, perspectives and requirements that need to be addressed to aid the land use decision making process (Harmsworth, 1998; Harmsworth, 2002; Roberts et al., 1995; Ulluwishewa et al., 2008). Despite past research into this area, EDSS designers and researchers still appear to be struggling to understand this distinct group's cultural needs, and how to incorporate them into their work (Huser et al., 2009).

1.1 Problem Statement

Because of their rather generalised nature, current EDSS systems fail to take account of the cultural perspectives of Māori landowners in New Zealand. EDSS systems lack the underpinning understanding of Māori values and therefore fail to meet the needs of Māori landowners in relation to their long term decision making.

1.2 Research Question

The research question that this thesis seeks to address is:

How can current Environmental Decision Support Systems be improved to better meet the stated needs of Māori landowners?

1.3 Objectives

In order to address the research question, this thesis has five central objectives. To:

a) Review current Environmental Decision Support Systems.

b) Develop a method to elicit needs from Māori landowners.

c) Identify a survey population and undertake data collection.

d) Examine the influences on and the feature preferences of Māori landowners for incorporation into future EDSS.

e) Make recommendations.

1.4 Importance of This Research

The recent Treaty of Waitangi settlements have seen Māori regain control of approximately 6% of New Zealand's land (Controller and Auditor-General, 2004; Land Information New Zealand, 2014). Along with the increasing international recognition that First Nations people must have their cultural, physical and social needs meet through legislation and partnerships (Colchester, 2004), there is now a greater awareness in New Zealand that Māori have distinct needs that are not being fully met (Rotarangi, 2011; Rotarangi & Thorp, 2009). In particular, it is no longer appropriate to group Māori in with other landowners as their needs can be very different (Rotarangi & Thorp, 2009). Government agencies and research organisations see the need to empower Māori, by helping them to make well informed decisions, particularly when it comes to their land and how they can best use it (Harmsworth, 2005; K. Bayne, personal communication, April 10, 2014). While some agencies have already spent considerable time and effort seeking to better understand Māori values, their attitudes towards the land, and the barriers to effective land management, other organisations are just beginning to build their understanding of this unique client base (Controller and Auditor-General, 2004; Harmsworth 2005; Harmsworth & Awatere, 2013). It is hoped that this research will provide a starting point for researchers wishing to create EDSS specifically for Māori landowners.

1.5 The Author's Whakapapa

It needs to be noted early on that I am undertaking this work as a female of Pākehā descent. Originally from Auckland, my ancestors immigrated to New Zealand from Great Britain during the 1960's and 1970's. I spent the first 18 years of my life living in South Auckland, before moving to Christchurch to study forestry at the University of Canterbury. Upon graduating, I then moved to Rotorua, in the Bay of Plenty, working first for a forestry company, before becoming employed in the Computer Science team at Scion (formally the New Zealand Forestry Research Institute). It is while in this role that I have undertaken this work.

The topic of this work was partly driven by a request from Scion, in order to find out how the Computer Science team can take Scion's research and turn it into tools and systems that are applicable to, and utilised by, Māori landowners. This research was also driven by my own

personal desire; a desire to gain a better understanding of Māori values, aspirations and protocols, especially in regards to New Zealand's environments. As such, I am drawing upon my interests in forestry, the environment, and the interactions and relationships that occur when considering people within those settings, and combining it with that desire to undertake a more personal journey to gain a better understanding of, and appreciation for, Māori in New Zealand.

Because of my lack of knowledge regarding Māori research and protocols, I sought the help of a project advisor, Nelson Meha. In addition to having worked at Scion for nearly seven years, Nelson has previously worked for the Māori Land Courts for seven years, including two and a half years in the position of Deputy Registrar. Finally, as Nelson is of Ngāti Tamateatutahi-Kawiti, Ngāti Pikiao, Ngāti Kahungunu and Ngāti Makino descent, he will be able to provide advice and guidance around the correct ways to approach, acknowledge and gather information from Māori participants.

1.6 Limitations of the Research

It should be noted that there are several key limitations associated with this research.

- As stated above the researcher is of Pākehā descent, and this is her first piece of cross-cultural research.
- Due to time and budget constraints the project changed from a broader study of Māori landowners located in Northland, Bay of Plenty and the East Coast to a case study of Bay of Plenty Māori land trusts and incorporations.
- Only five Māori trusts and incorporations, totalling 14 participants, engaged with the researcher.
- All of those who took part were from Te Arawa entities, limiting the validity of any findings with regards to other Māori trusts and incorporations.

1.7 Outline of Thesis

Including this introduction, this thesis consists of seven chapters. Chapter Two provides background information relating to the history of Māori people in New Zealand, and considers how the Treaty of Waitangi, Treaty Settlements and New Zealand legislation have had an impact upon Māori access to land. Chapter Two also includes observations on how land use and land cover have changed over time, and discusses the role of Māori land trusts and incorporations in the management of Māori land. Chapter Three constitutes a literature review exploring the previous research carried out on EDSS. It defines the concept of an EDSS,

discusses why EDSS are important in aiding land use decision making, and examines their strengths and weaknesses, before examining examples of New Zealand EDSS in depth. Key Māori values and environmental concepts are also explored in Chapter Three.

Chapter Four explains the way in which the research question (as described in Section 1.2) was investigated, via a survey. It also considers how limitations with the work were addressed. The results of the survey questions are presented and analysed in Chapter Five. Chapter Six presents an in-depth discussion of the results. The discussion consists of three main sections: further consideration of the projects limitations, points that arose during conversations with respondents and an examination of the main elements that came out of the survey analysis. Finally Chapter Seven will draw together the final conclusions and make recommendations based on the previous six chapters, answering the research question and ideally providing a starting point for future work in this area.

2. MĀORI AND NEW ZEALAND LAND USE

This chapter focuses on building an understanding of the impact of European settlement, both on the land and on Māori people's relationship with the land. As such, it covers a condensed historical perspective of New Zealand settlement, starting with the Polynesian settlement of New Zealand, the later settlement by Europeans, and the Treaty of Waitangi. The chapter explores the ongoing impacts of the Treaty of Waitangi, through to current Treaty settlements and the impact these have had on New Zealand's legislation. The chapter then examines how settlement has modified New Zealand's landscapes, and how the establishment of Māori land trusts and incorporations through the Māori Land Court are helping Māori landowners to administer and use their land. Finally, Kaupapa Māori research methodology is examined, linking into the section on contemporary kaitiakitanga, before closing with a look at Māori values and environment concepts and how EDDS could help Māori landowners to make land use decisions.

It is important to note that up until the 1990s the history of New Zealand was predominantly documented by Pākehā (New Zealanders of European descent), who tended to place a European bias on this process (King, 1997). Indeed, most historians tended to act as if New Zealand had no history worthy of noting before the arrival of Europeans, ignoring any prior Māori history (King, 1997). While historians such as Michael King (1997) and Claudia Orange (2012) have done their best to present less biased views of New Zealand's history, such historians are still presenting a non-Māori version of events. While the account below aims to draw on relatively unbiased sources and to present the key facts, it remains a Pākehā perspective on Māori History in New Zealand.

2.1 History of Māori in New Zealand

The Māori people first came to New Zealand from Polynesia around 1000 years ago (King, 1997; McLauchlan, 2004). Cultural characteristics, carbon dating and population mapping suggest that landfall was made in New Zealand before 1200 AD (King, 1997; Underhill et al., 2001). While the exact origins of Māori have not been decisively isolated, there is strong evidence (mitochondrial DNA, artefacts, language similarities) supporting the theory that Māori originated from Polynesian ancestors whose origins can be traced to the central Eastern Pacific (Underhill et al., 2001). The Eastern Polynesians were a seafaring people who used their strong navigational skills and their ability to recognise the signs and locations of distant land masses (e.g. cloud formations, lagoon reflections, migratory patterns of birds) to predict what they would encounter on their voyages of discovery (King, 1997).

In relation to the settlement of New Zealand by Māori, it is theorised at least one "voyage of discovery" by the Eastern Polynesians resulted in a return trip to Polynesia, which in turn led to planned colonising expeditions (King, 1997). As a result, several different expeditions of waka (canoes) arrived from the islands, landing at different places around New Zealand, with the inhabitants of those waka having to quickly adapt to the new landscape and climate (King, 1997; McLauchlan, 2004). With them they brought kūmara, taro, yams, the cabbage tree, kiore (rats) and kuri (dogs) (McLauchlan, 2004). Pigs and chickens, a staple part of the Polynesian diet do not appear to have survived these voyages, if they were brought along at all (King, 1997; McLauchlan, 2004). Once in New Zealand, the Eastern Polynesians adapted by hunting native birds such as the moa and kereru (wood pigeon), as well as seals and other marine life (McLauchlan, 2004).

Within a couple of generations of the first settler's arrival, cultural differences were starting to occur, primarily because of the harsh differences in climate between the Pacific and New Zealand. One of the biggest changes in their culture would have been the change from a predominantly farming and fishing lifestyle, to a predominantly hunter gatherer lifestyle (McLauchlan, 2004). While some parts of New Zealand would have been relatively easy to settle in, other areas, like Banks Peninsula in the South Island, would have proved to be more challenging, especially for those trying to grow kūmara successfully (McLauchlan, 2004)[1].

The first recorded contact Māori had with Europeans was in 1642, with Abel Tasman and his Dutch expedition (Bawden, 1987; Consedine & Consedine, 2012; Walker, 2004). However, despite a peaceful first encounter in Golden Bay, the situation soon deteriorated, and Tasman made the decision to have no further contact Māori (Consedine & Consedine, 2012). The next encounter Māori had with European navigational exploring parties was over 100 years later, in 1769, with the crew of the HMS *Endeavour* led by British explorer James Cook. Cook and his vessel the *Endeavour* were closely followed by French explorer Jean de Surville (Bawden, 1987; Consedine & Consedine, 2012; Walker, 2004).

The first substantial engagement that Māori experienced with Europeans came from the 1790s onwards. Initially this contact was with the sealers, traders and whalers who were arriving in

[1] From this point onwards, the Early Polynesians shall be referred to as Māori. Until the arrival of other ethnic groups to New Zealand there was no need for the term 'Māori' (which means 'usual' or 'normal'), as there was no need until this point to distinguish from 'ordinary people' (King, 1997). Instead, the Early Polynesian iwi (tribe) and hapū (sub-tribe) identified themselves by their founding ancestor and by the location where they lived, both important aspects in tribal New Zealand life (King, 1997). With the arrival of other people to New Zealand came the need for the identifying words of Māori and Pākehā.

New Zealand (Walker, 2004). Sealing gangs were left for months at a time in isolated parts of New Zealand, where they would proceed to kill as many seals as they could before the ships returned to collect them. However, while sealers did encounter Māori (sometimes trading with or fighting for them), whaling had a greater impact on Māori society and way of life. Whalers tended to establish permanent settlements, typically within close proximity to Māori ones, as they relied on Māori for food and other supplies. This close proximity eventually meant that whalers began to take Māori women as wives, Māori of both sexes worked in the settlements surrounding the whaling stations, and some Māori men joined the whaling crews travelling around the Pacific (King, 1997; Walker, 2004).

During this phase Māori also started to acquire metal tools, European clothing, muskets and alcohol, all introduced to them by the whalers and sealers (Walker, 2004). As trade routes became established Māori also gained access to grains (wheat, maize, oats and barley), vegetables (potatoes and pumpkin) and fruit (King, 1997; Walker, 2004).

Eventually missionaries followed the whalers, sealers and traders. Samuel Marsden was the first missionary, arriving in 1814. Marsden, who represented the Anglican Church Missionary Society, was then followed by the Wesleyans and French Catholics in 1822 and 1838 respectively (Consedine & Consedine, 2012; Walker, 2004). The missionaries tended to settle in, or close to, existing Māori communities (Walker, 2004), but unlike the whalers, sealers and traders, the aim of the missionaries was to change Māori life, through 'civilising the savages'. As a result, many Māori came to have multiple belief systems; a Māori one and a European one (King, 1997).

Up until the 1830s, Māori contact with Europeans had still been mostly limited due to the vast, rugged nature of New Zealand. The geographical spread of individual tribes and hapū meant most contact had occurred around the coastline and main waterways (e.g. the Waikato River). Indeed, Māori still outnumbered the Europeans; in 1840 New Zealand's population consisted of 70,000-90,000 Māori and only around 2,000 non-Māori (Consedine & Consedine, 2012; Phillips, 2013; Pool, 2012; Walker, 2004).

Organised settlement by Europeans began in the late 1830s, along with the desire by the British government to annex New Zealand. King (1997) argues that this was in equal parts an alleged attempt to protect Māori from excesses of European behaviour, to exert some form of governance of the unruly factions of the growing society, and to smooth the way for advanced European settlement. While the British hoped that this would occur with the agreement of the

Māori people, British governance over New Zealand and its people was going to happen regardless (King, 1997).

2.2 Treaty of Waitangi

In 1835 the British had signed a Declaration of Independence with Māori acknowledging Māori sovereignty in New Zealand (Walker, 2004). Because of this, it was imperative that a treaty was signed for the annexation to be legitimate (McLauchlan, 2004). Captain William Hobson was selected as the British representative, charged with the task of drawing up the treaty and getting it signed by Māori chiefs. The official English version of the Treaty of Waitangi was drafted over a few days by James Busby from notes by Hobson and his staff (Consedine & Consedine, 2012; McLauchlan, 2004). This English version was then translated overnight by missionary, Henry Williams, and his 21 year old son, in order to be ready for presentation to Māori chiefs assembled for a hui (meeting, assembly, gathering) the next day (Collier, 2010; King, 1997; McLauchlan, 2004; Walker, 2004).

When Hobson presented it to the chiefs, he smoothed over the differences between the two versions, strongly stressing the advantages of signing the Treaty (McLauchlan, 2004; Walker, 2004). After discussions and debates that progressed into the night, The Treaty of Waitangi was signed on 6 February 1840 by Captain William Hobson, as the British Crown representative, and initially by Māori chiefs from the Northland and Bay of Islands regions (Harmsworth, 2005; King, 1997; McLauchlan, 2004). The Treaty then travelled throughout New Zealand eventually gathering over 500 Māori signatures (Collier, 2010; King, 1997; McLauchlan, 2004; Walker, 2004).

With the signing of the Treaty of Waitangi New Zealand entered into a new phase in its history. The British now believed that they had acquired full sovereignty over New Zealand, as that was what had been stipulated in the English version of the Treaty (King, 1997; McLauchlan, 2004, Ministry of Justice, 2015). Meanwhile, under the Māori version of the Treaty Māori allowed British governance over New Zealand, while both versions of the Treaty promised to safeguard Māori culture, resources and territories, as well as providing protection to Māori under the Crown (King, 1997; McLauchlan, 2004; Ministry of Justice, 2015; Ward, 1999). In reality few British or Māori fully read and understood the Treaty, and to the British at least, it signified Māori acceptance of British sovereignty and citizenship (McLauchlan, 2004).

Having two recognised versions of the Treaty of Waitangi resulted in misunderstanding, (particularly regarding the concepts of kāwanatanga and rangatiratanga) and ultimately

political conflict, between the Māori and the British as both groups tried to assert their dominance over New Zealand (Collier, 2010; Consedine & Consedine, 2012; Ward, 1999). However, both versions are recognised as legitimate founding documents of New Zealand, and it is up to current generations to ensure that both documents are upheld.

2.3 Post-Treaty Land Issues

The British now had the legal means with which to start their full scale settlement of New Zealand. Previously, European settlement had been small scale, and to some extent upon Māori terms. Now Māori realised that they were in danger of losing their customs, identity and land to the settlers (King, 1997; McLauchlan, 2004). In particular, the Wakefield settlements in Wellington, New Plymouth and Nelson, and a French settlement at Akaroa were key areas of disembarkation for newly arrived colonists (King, 1997). These new settlers had been sold the idea of New Zealand as a place where all their dreams could come true and they would have access to hundreds of acres of land to support them and their families (McLauchlan, 2004). This advanced settlement of New Zealand led to conflict between Māori and Europeans as each fought to establish their ownership of the land.

A major contribution problem to the conflict was the difference between Māori and European interpretations of land ownership. To Māori, ownership was determined by a variety of factors, including inherited rights, rights of occupation and use (if purchased land was not utilised immediately, then the sale of the land was forfeited and Māori resumed the right of ownership) and rights of conquest (Consedine & Consedine, 2012; King, 1997). To Europeans, ownership relied on a signed deed and once the transaction for the land had been made, it now belonged to the new owner to do with as they wished, whenever they wished (King, 1997). As such, conflicts often arose when land was purchased for settlement and then left unutilised until the settlers arrived. In some instances this could take several years, during which time Māori believed that they could resume ownership of the land.

In addition, Māori land was collectively owned by iwi or hapū (Controller and Auditor-General, 2004). Europeans did not understand this system and land transactions were often conducted with single Māori 'owners', group members who in fact had no right to sell the land (New Zealand History, 2015). This led to conflict if the wider Māori community refused to acknowledge the change in ownership. In some cases where the conflict escalated the military was called in to settle the dispute (New Zealand History, 2015). Being European themselves, they tended to find in favour of the new owners. Following such conflicts settlers sometimes acquired further land from Māori, via political processes, as a form of punishment (Consedine

& Consedine, 2012; Controller and Auditor-General, 2004; New Zealand History, 2015; Walker, 2004). That the best land was taken, and not always from the tribe involved in the conflict, was of little importance to the settlers.

Some Māori adopted single organisational structures to combat land title fragmentation. This solution to fragmentation started around 1929 with the introduction of the Māori Land Development Scheme, led by Ngāti Porou leader and cabinet minister, Sir Āpirana Ngata (Kingi, 2012). Māori landowners received Government funding to develop the physical infrastructure of their farms. This scheme to develop farms encouraged the amalgamation of land titles into single administrative structures (Kingi, 2012). These organisational structures developed over time into the Māori land trusts and incorporations seen today.

The Native Land Court was established in 1865 in an attempt to resolve ownership conflicts between Māori and Europeans. This court superseded the Native Land Purchase Department and its role was to investigate land ownership claims, rule on the validity of the claims and to then record the outcome (Consedine & Consedine, 2012). While its primary purpose was to facilitate the sale of Māori land to European settlers, many Māori brought their land willingly to the court (Consedine & Consedine, 2012; King, 1997). While some Māori came with the intention of selling their land (in order to purchase other goods or resources), in other cases the sessions were about proving the validity of one tribe's claims over another's (King, 1997). Over time these court sessions became occasions for hui and reunions for tribes and families, and the court documents became the first ever written account of tribal history (King, 1997).

King (1997) describes most historical accounts of Māori history as identifying two main settlement periods: the arrival of Māori in New Zealand and post-Treaty settlement of New Zealand. However, several authors (Consedine & Consedine, 2012; King, 1997; Walker, 2004) identify a third main period, from the 1950s onwards which saw many Māori migrate from rural areas to urban centres. New Zealand had become a more industrialised society which resulted in a severe labour shortage in the urban areas (Best & Love, 2010). Policies were put in place by the New Zealand Government to fill this void by enticing Māori from their rural land blocks into urban environments to take up jobs in unskilled and semi-skilled work sectors (Best & Love, 2010; Walker, 2004).

This urbanisation of Māori communities further highlighted the differences between the Māori and non-Māori cultures (e.g. differences in family units). Urbanisation also saw further alienation of Māori from the land. Due to the lack of financial help for Māori farmers, Māori owned land was becoming less and less viable for supporting Māori communities. This led to a

population shift towards urban centres as Māori searched for employment opportunities (King, 1997; Walker, 2004).

The shift of Māori to urban centres served an important purpose. For the first time Māori people were creating a shared Māori culture as members from different iwi and hapū banded together to create Māori communities in their new environments. Marae that represented the different iwi and hapū were established in towns, and Māori joined on these places to celebrate and reinforce Māori culture (Walker, 2004). Hui continued to play an important role in Māori life, and the urban marae played key roles in the development of a central Māori culture and as places to pass on skills to younger generations (King, 1997; Walker, 2004).

However, by the late 1980s/early 1990s many of New Zealand's large primary sector and manufacturing businesses were restructuring and downsizing. Māori workers were laid off in disproportionate numbers to the rest of New Zealand's workforce, leaving many Māori unemployed (Best & Love, 2010). The Urban Māori Authority emerged around this time as a response to Māori urbanisation. Established by Māori, for Māori (often from diverse tribal backgrounds), such groups were originally established to meet the development needs of their communities (Keiha & Moon, 2008). Today, these organisations have developed to deliver services and business activities regarding social, health and training and employment services to their communities (Keiha & Moon, 2008).

Māori communities have changed significantly since the arrival of the first Eastern Polynesians in New Zealand. Despite facing many challenges, including the settlement of New Zealand by Europeans, Māori society has the ability to accommodate social and economic transformation that have seen them endure as a culture and population (Keiha & Moon, 2008). This is because Māori have been proactive in finding alternative expressions of social, cultural and economic organisation and their development aspirations may be enhanced by supporting Māori communities to create, develop and manage their own development needs (Keiha & moon, 2008).

2.4 Treaty Settlements

Māori who moved into urban environments proved that the Māori culture, rangatiratanga (sovereignty, autonomy, self-government) and tribal identities could survive in such settings. However, the Depression during the 1930s and then the faltering economy of the 1970s proved just how unequal the social situations were in New Zealand. Māori, lacking resources and support, were disproportionately represented in unemployment figures and struggling

economically and socially. Restoring an economic base to Māori was seen by many Māori as an opportunity to reassert their rangatiratanga (King, 1997).

After the hīkoi (land march) in 1975 led by Dame Whina Cooper, the idea of Treaty reparations gathered momentum (Keane, 2014; King, 1997; Walker, 2004; Ward, 1999). In 1975 the New Zealand government finally chose to act upon two commissions of inquiry (1919-20 and 1928) that had previously determined that Māori had been subjected to unfair treatment, and established the Waitangi Tribunal (Orange, 2012). The role of the tribunal was to initially assess any contemporary claims of Treaty breaches, but from 1985 onwards this was expanded to include historical grievances dating back to 1840 (Orange, 2012). In 1989 the Treaty of Waitangi Policy Unit (TOWPU) was established under the then Department of Justice (now Office of Treaty Settlements) (Orange, 2012). TOWPU's role was to advise the government on Treaty policy, and from there negotiations with iwi began on their historical claims (Office of Treaty Settlements, 2015; Orange, 2012).

At first the New Zealand government faced criticism for the Treaty process, with many Pākehā struggling to understand the issue of redress (Orange, 2012; Walker, 2004; Ward, 1999). They also raised concerns about having their own perceived rights impeded upon, if public land or resources were handed back to Māori, preventing their continuing use. As such the government had to carefully balance past grievances with current rights (Orange, 2012; Ward, 1999).

With a time limit of 2008 for all historical claims to be lodged, some iwi chose to deal directly with the government, rather than go through the lengthy Tribunal process. Despite the often drawn out nature of the negotiations, by December 2011 44 deeds of settlement had been passed into law, with 15 other groups having agreed to terms of negotiation and agreements in principle (Hill, 2012). These negotiations cover the majority of land area in New Zealand as shown in Figure 2.1, with the remaining settlements to be finalised over the coming years (Hill, 2012). In most instances settlements included:

- An historical account of the claim issues and events, as agreed to by the Crown and the claimant group;
- Acknowledgement of breaches and apology for them from the Crown;
- Financial redress;
- Cultural redress; and

- Agreements to change the official place names of certain sites, to reflect their original names (e.g. Aoraki/Mt Cook) (Hill, 2012).

The overall way in which the claims were heard and the settlements were carried out has won worldwide acclaim, and is used as a standard for the handling of settlement claims by other countries (Hill, 2012).

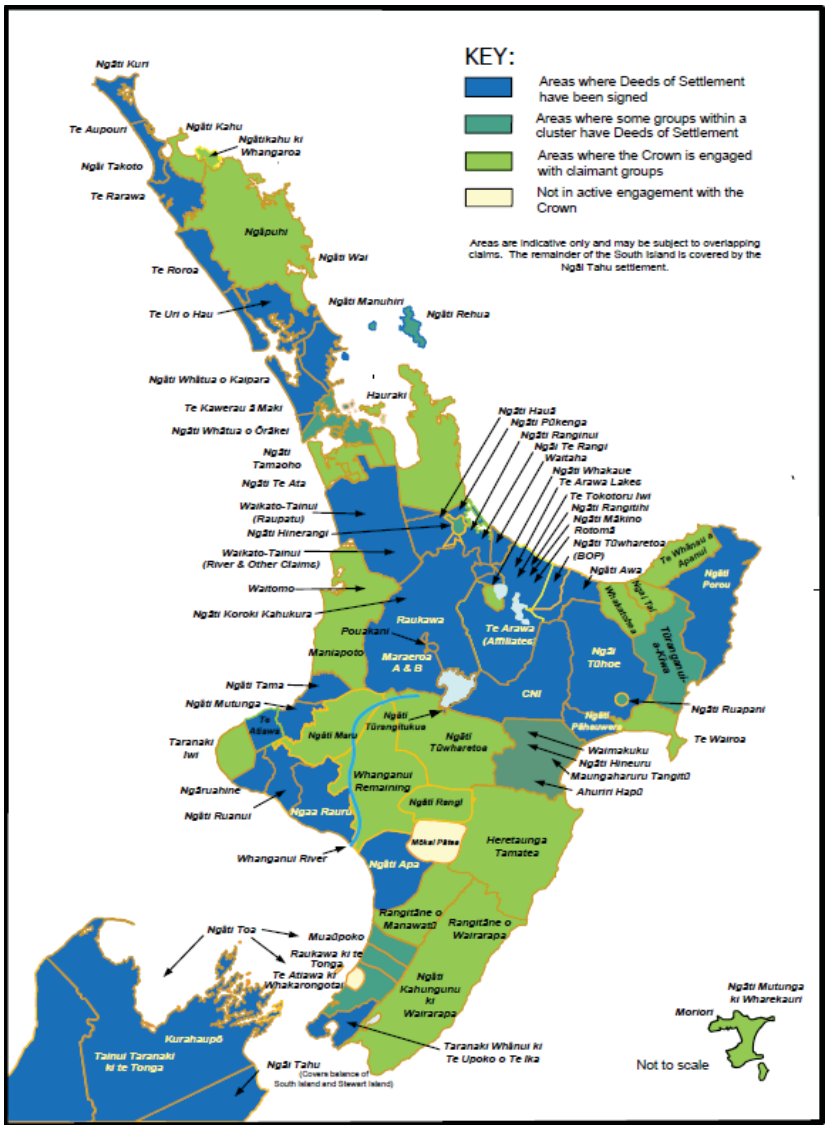

Figure 2.1: Completed Treaty settlements and current negotiations[2] (Office of Treaty Settlements, 2014).

[2] Note: the majority of South Island Treaty claims were carried out with Ngāi Tahu, who settled with the Government in 1998, one of the first iwi to complete the Treaty settlement process (New Zealand History, 2014). The map, produced for the December 2014 report on Treaty settlements, is concentrating on the remaining land where settlements are recently/currently taking place. Hence, why most of the South Island is not shown on the map in Figure 2.1.

2.5 New Zealand Legislation

With the recognition of the validity of both versions of the Treaty of Waitangi and the rights of Māori, came the recognition that New Zealand law needed to recognise and uphold Māori rights (Harmsworth, 2005; Walker, 2004). However, that recognition took over 135 years to occur, starting with the Treaty of Waitangi Act 1975, but really gaining momentum from 1999 onwards (Potaka, 2010). New Zealand laws should be structured in a way that creates equal rights for all New Zealanders. However, some laws required amendment so that they specifically upheld and supported the principles of the Treaty, allowing collaborative relationships between Māori and the Crown to develop (Harmsworth, 2005; Potaka, 2010; Walker, 2004). Of particular importance are the following pieces of legislation:

- Conservation Act 1987;
- Historic Places Act 1993;
- Local Government Act 2002; and
- Resource Management Act 1991 (RMA).

All four Acts are good examples of how Māori rights and the principles of the Treaty of Waitangi have been incorporated into New Zealand legislation. The Conservation Act (1987), Local Government Act (2002) and RMA (1991) require governing bodies to actively seek out Māori views regarding decision making (Harmsworth, 2005). Both the Conservation Act (1987) and the Historic Places Act (1993) work with Māori to better protect and understand sites, landscapes and species of value (A. Vallis, Conservation Partnerships Ranger, personal communication, March 19, 2014; Conservation Act, 1987; Harmsworth, 2005; Resource Management Act, 1991). While the implementation of some of the Acts processes require improvement (e.g. always including local iwi in local government discussions), overall New Zealanders are now well on their way to incorporating Māori rights and the principles of the Treaty of Waitangi into legislation (Harmsworth, 2005; Potaka, 2010).

2.6 New Zealand's Land Use and Land Cover Trends

Before humans arrived in New Zealand 85-90% of New Zealand was covered with forest with only natural disturbances, such as wind events, volcanic eruptions or landslides, creating change to New Zealand's landscapes (Ewers et al., 2006; MacLeod & Moller, 2006; McGlone, 1989). Human arrival significantly changed land cover composition and changed the way in which the land was utilised.

Māori settlement occurred around 1000 years ago. It took between 100-200 years of settlement to build up enough of a human population to have an impact upon the land (McGlone, 1989). However, as more Māori started to arrive in New Zealand, more of the lowland forests were cleared (mainly through use of fire) for the creation of settlements, to make cross-country travel easier and for cultivation of crops, such as bracken fern and kūmara (Ewers et al., 2006; MacLeod & Moller, 2006; McGlone, 1989). As a result of this early Māori settlement, forest cover was reduced to 68% of New Zealand's land area, with around 50% of the lowland forests destroyed (Ewers et al., 2006).

The arrival of European settlers to New Zealand in the early 19th Century further intensified this land use and land cover change. Since the early 19th Century through to present day, New Zealand has undergone five major phases of agricultural development (MacLeod & Moller, 2006). The first phase of colonisation occurred between 1840 and 1870. It was characterised by the burning of large areas of indigenous grasslands, and the introduction of large numbers of sheep (MacLeod & Moller, 2006).

The expansion phase saw the introduction of refrigerated shipping in 1882 (MacLeod & Moller, 2006). This technology was crucial in allowing New Zealand to export fresh goods, such as butter and meat, to the rest of the world, and thus allowing for more intensified land use. A growing European population during this time, plus the development of and improvements to the road and railway network, saw large areas of forested land cleared and the expansion of permanent pasture, especially on the plains (Ewers et al., 2006; MacLeod & Moller, 2006). Early European settlers were required to 'improve' their land, and many achieved this through burning native vegetation (Ewers et al., 2006).

Between 1920 and 1970 New Zealand entered into the phase of early intensification (MacLeod & Moller, 2006). This was facilitated by improvements in animal and plant breeding, new fertilisers and the utilisation of new soil science (MacLeod & Moller, 2006). During this time, the number of stocking units[3] increased by around 150%, despite the area of sown pasture remaining stable (MacLeod & Moller, 2006). National wool production tripled, while meat and dairy productivity doubled during this period (MacLeod & Moller, 2006). Around the time of the Second World War increasing areas of mountainous forested land were converted to farmland or exotic forestry (Ewers et al., 2006; MacLeod & Moller, 2006).

[3] "Stock density is a standard way of measuring the amount of stock on an area of land. Environment Waikato calculates stock density by converting the type of stock (for example, sheep, deer or dairy cattle) to common stock units (ewe equivalents). We then divide stock units by the area of land that the stock graze on, to provide stock units per hectare" (Environment Waikato, 2015).

Following on from early intensification was the diversification phase (1970s to 1990s). Aerial topdressing allowed farmers to access previously remote and inaccessible areas of land, which in turn allowed the development of the infertile hill country of New Zealand (MacLeod & Moller, 2006). The agriculture sector also moved away from just sheep and cattle, and expanded into farming goats and deer, as well as agroforestry and horticulture (MacLeod & Moller, 2006). The final phase of late intensification, characterised by more intensive farming systems, began around the late 1990s and is still continuing today.

As seen in Table 2.1 the overall result of settlement in New Zealand by Māori and Europeans was a drastic decline in native forest cover from 85-90% prior to human settlement to less than 24% in the 21st century. Figure 2.2, taken from Ewers et al. (2006) also highlights the changes in forest cover between pre-human New Zealand and 2002, as well as the overall percentage loss of forest cover and the resulting fragmentation. New Zealand's indigenous land covers have largely been replaced by farms, exotic forests and settlements. This includes the draining or filling of over 90% of New Zealand's wetlands (McGlone, 1989; National Wetland Trust of New Zealand, 2015). Currently 67% of New Zealand's numerous land environments (including alpine, broadleaved indigenous, depleted grasslands, fernland, grey scrub, hardwoods, indigenous forest, manuka/kanuka, matagouri, rock, scrub, tall tussock grassland and wetland/water environments) have had their native cover diminished to <30% of its original extent (Walker, Price, Rutledge, Stephens & Lee, 2006). This loss of native cover has also contributed to a drastic loss in biodiversity, with 30 of New Zealand's bird species now extinct (McGlone, 1989).

Table 2.1: New Zealand's native forest cover over time (from pre-human times through to the 21st Century), expressed as a percentage of New Zealand's total land area (Ewers et al., 2006; McGlone, 1989; Ministry for the Environment, 2002).

Time Period	Pre-human	Early Māori Settlement	Early European Settlement – WWII	21st Century
Forest Cover	85-90%	68%	23%	24%

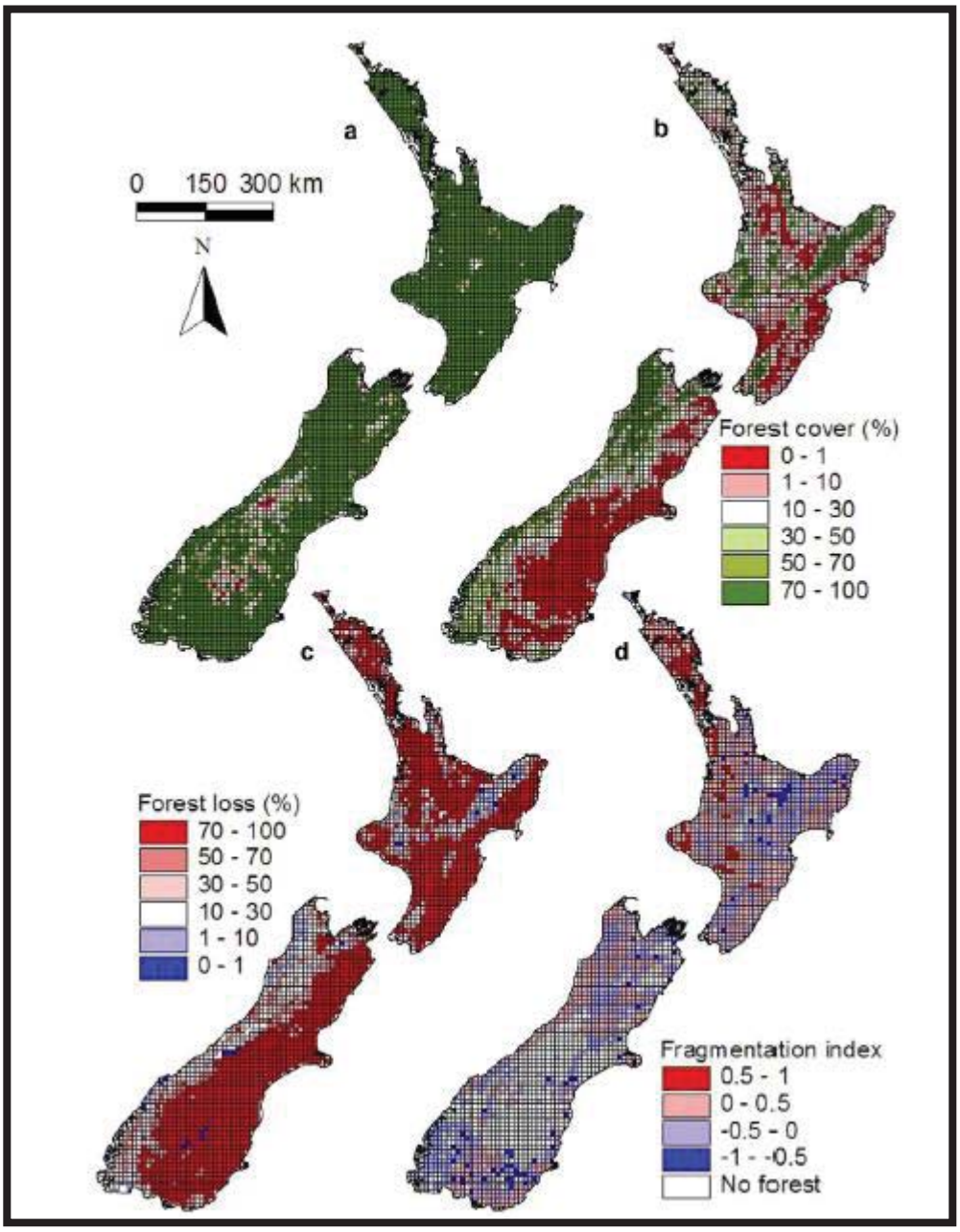

Figure 2.2: Patterns of forest change in New Zealand: (a) pre-human forest cover, (b) 2002 forest cover, (c) total forest loss and (d) forest fragmentation (Ewers et al., 2006).

Overall, these land cover and land use changes have drastically altered New Zealand's landscapes, and have subsequently changed how landowners make land use decisions in modern day New Zealand.

2.7 Māori Land

The way in which Māori have owned New Zealand's land has changed dramatically over time. Before Europeans arrived in New Zealand Māori communally owned the land. Single landownership was unheard of. The arrival of Europeans instigated landownership change, and

with the signing of the Treaty of Waitangi, the Crown now had a legal means to obtain Māori land for European settlers (Consedine & Consedine, 2012; Controller and Auditor-General, 2015; Walker, 2004). Crown acquisition of land was one method used; the passing of the New Zealand Settlements Act 1863 allowed land to be obtained through raupatu (confiscation) (Consedine & Consedine, 2012; Controller and Auditor-General, 2015; Walker 2004).

By 1862 around two thirds of New Zealand's total land area had been seized by the Crown, including most of Te Waipounamu (South Island) (Consedine & Consedine, 2012; Controller and Auditor-General, 2004). The election of the first Māori King (Pōtatau Te Wherowhero of Waikato) in 1858 and the development of the Kīngitanga movement in the central North Island was an attempt to unite tribes against the selling of land (New Zealand History, 2015). Unfortunately, the situation escalated, resulting in the New Zealand Wars of 1860 to 1872 (New Zealand History, 2015; Walker, 2004). The Crown's response to this period of conflict was to pass the Native Lands Act 1862, which created the Native Land Court (renamed the Māori Land Court in 1947) (Consedine & Consedine, 2012; Controller and Auditor-General, 2004; New Zealand History, 2015; Walker, 2004). The aim of the Act and the Land Court was to identify ownership interests in Māori land and to create individual titles for the land, replacing the customary communal ownership and making the land recognisable under English law (which only recognised single ownership) (Consedine & Consedine, 2012; Controller and Auditor-General, 2004; Walker, 2004).

The Native Lands Act 1862 started the process of Māori landownership fragmentation, a process intensified by raupatu and the New Zealand Settlements Act 1863 (Controller and Auditor-General, 2004; Walker, 2004). In particular, the Crown targeted for confiscation the land of those Māori who opposed them during the New Zealand Wars (New Zealand History, 2015). As Walker (2004) states "by the turn of the century all of the best land had been alienated, and only two million hectares remained in Māori ownership" (p. 139).

It was not until the 1950s and 1960s that Māori Land legislation recognised the problems caused by the previous legislation and sought to rectify the situation. Reforms to New Zealand legislation, including the Māori Trustee Act 1953 and the Māori Affairs Act 1953, gave the Māori Land Court more ability to protect Māori land from alienation (Controller and Auditor-General, 2004). Under the Māori Trustee Act 1953, trustees were given the authority for the administration of Māori land (Controller and Auditor-General, 2004). However, not all of the legislative reforms achieved a reduction in Māori alienation from land, with some reforms

having the opposite effect (e.g. Māori Affairs Amendment Act 1967) (Controller and Auditor-General, 2004; Walker, 2004).

Finally, in 1993, the Te Ture Whenua Māori Act (also known as the Māori Land Act 1993) was passed (Controller and Auditor-General, 2004). The Act remains the Land Court's guiding piece of legislation and its primary objectives are to "promote and assist in:

a) the retention of Māori land and General land owned by Māori in the hands of the owners; and
b) the effective use, management, and development, by or on behalf of the owners, of Māori land and General land owned by Māori" (Te Ture Whenua Māori Act, 1993).

Reversing the previous actions of the Native Land Court, Māori land can once again have multiple owners. Today, only 10% of 26,480 Māori land titles have only one land owner (Controller and Auditor-General, 2004; Kingi, 2012). The rest of the land titles are divided into more than 2.3 million interests, with 10% of those land titles having an average of 425 owners per title (Controller and Auditor-General, 2004; Mead, 2003). The number of Māori with interests in the land is only going to increase, because as current Māori owners die their interests are passed on to their descendants (Controller and Auditor-General, 2004; Kingi, 2012; Mead, 2003). Māori trusts and incorporations are continuing to be established around New Zealand to work with Te Kooti Whenua Māori (Māori Land Court) and Te Puni Kōkiri (Māori Public Policy Ministry) to administer Māori land (Controller and Auditor-General, 2004; Te Puni Kōkiri, 2015).

Barriers to Land Management

The Office of the Auditor-General (2004) acknowledges that spiritual and cultural ties to the land are frequently more important than profit from the land to Māori landowners. However, the Office also acknowledges those Māori landowners who wish to make money from their land face problems because:

- 80% of Māori land is non-arable (poorest land use class) and /or is located in remote area;
- ≤30% Māori land may be landlocked, creating access issues;
- 40% of Māori land is underdeveloped; and
- ~50% of the 26,000 blocks of Māori land have not been surveyed.

The Auditor-General's Office (2004) also identifies the following five potential barriers to the development of Māori land:

- *Access to finance* – banks in New Zealand are not well equipped to handle multiple owners, which makes it difficult for Māori groups trying to use the land as security when seeking finances to develop their land;
- *Access to information* – information regarding current land use of Māori land is not complete, and it can be expensive to obtain information regarding potential land uses;
- *Access to land* –≤30% Māori land is potentially landlocked, with implications regarding access, and thus how the land can be used;
- *Governance and management issues* – Māori landowners may lack the expertise required to plan and make decisions regarding their land's administration; and
- *Multiple ownership* – this can reduce economic return to individual owners and can also create problems regarding land use and development (e.g. not all of the owners want to convert the land to manuka forest for honey).

Both the Māori Land Court and Te Puni Kōkiri work with Māori landowners, through Māori land trusts and incorporations, to help them overcome these barriers so that they can utilise and administer their land (Te Kooti Whenua Māori, 2010; Te Kooti Whenua Māori, 2010b).

2.8 Māori Land Trusts and Incorporations

*"The Māori Land Court (Te Kooti Whenua Māori) is the New Zealand court that hears matters relating to Māori land. The special bond between Māori people and the land is recognised by the Māori Land Court, and the records held by this Court form an invaluable part of the whakapapa of all Māori. The Māori Land Court operates under the provisions of the Te Ture Whenua Māori Act 1993" (*Te Kooti Whenua Māori, 2010b, p. 1).

When the New Zealand Government chose to acknowledge Māori people, their claims and the Treaty of Waitangi, it created the Te Ture Whenua Māori Act 1993. The purpose, or kaupapa, of the Act is to "promote the retention of Māori land in the hands of its owners and their whānau and hapū and to facilitate the occupation, development, and utilisation of that land for the benefit of its owners and their whānau and hapū" (Te Kooti Whenua Māori, 2010b, p. 2). Māori land trusts and incorporations are the main groups that work to administer and care for the land on behalf of the landowners, shareholders and beneficiaries.

Māori Trusts

Trusts take a variety of forms, but at its most simple the Law Commission (2015) defines a trust as "a legal relationship whereby someone (the settlor) gives property to someone (the trustee) to look after it and use it for the benefit of someone (the beneficiary)". Te Kooti Whenua Māori (2010b, p.2A) legally defines a trust as "an equitable obligation binding a person (the trustee), to deal with property over which he or she has control (the trust property) for the benefit of certain persons (the beneficiaries), any one of whom may enforce the obligation. The trustee may also be a beneficiary". A trustee is someone "who has been given the legal responsibility of looking after someone else's assets and liabilities for that other person's benefit" (Law Commission, 2015; Te Kooti Whenua Māori, 2010b, p. 2). A trustee's primary duties are to minimise the trust's liabilities, and to maximise the assets, to the best of their ability and within the law. Other duties include:

- To act jointly with the other trustees;
- To act without personal profit;
- Acquaintance with the property;
- Adherence to the trust order terms;
- Declaration any conflicts of interest;
- Delegation of responsibilities, such as employing professionals to assist the trust;
- To act with diligence and prudence;
- To be impartial – trustees cannot be influenced by, or partial towards, any one beneficiary;
- To be prudent with trust funds and seek expert financial advice before investing;
- To keep true and accurate trust account information;
- To pay the right people; and
- To keep their beneficiaries regularly informed about trust activities, financial position and trust performance (Law Commission, 2015; Te Kooti Whenua Māori, 2010b).

Part 12 of Te Ture Whenua Māori Act 1993 recognises five different types of trusts, as shown in Table 2.2. For the purposes of this work no distinction will be made between the different types of Māori trusts.

Table 2.2: The five different types of Māori trusts (Law Commission, 2015; Mead, 2003; Te Kooti Whenua Māori, 2010b).

Trust Type	Description
Ahu whenua	The most common, and most flexible, type of Māori trust, ahu whenua trusts are designed to promote the administration and use of the land in the interest of the owners. Ahu whenua trusts are often used for commercial purposes, as it allows the trustees to conduct their business in a business-like and professional manner, whilst providing for the landowners' cultural needs.
Whenua tōpū	A whenua tōpū trust is iwi or hapu based and is designed to facilitate the use and administration of the land in the interest of the iwi or hapu. Land, typically whole blocks, received as part of Treaty of Waitangi settlements is commonly administered by this type of trust.
Kaitiaki	Kaitiaki trusts are solely for individuals who are minors (<20 years old and not legally married) or who have a disability (in this case someone who lacks the competence to manage their affairs in relation to their property
Whānau	Family or whānau orientated trusts allow the whānau to bring their land interests together, in order to benefit the whānau and their descendants.
Pūtea	This type of trust allows the owners of small and uneconomical interests to pool their interests together.

Māori Incorporations

Māori incorporations have a similar structure to a company, with their main purpose being to "facilitate and promote the use and administration of Māori freehold land on behalf of the owners" (Te Kooti Whenua Māori, 2010, p. 2). Māori incorporations are the most commercial of all Māori land management structures, and are designed to manage whole blocks of land. Whilst a Māori incorporation can legally achieve almost anything, the sale of the incorporation's land can only be carried out under very strict circumstances, lest it breach the Act's kaupapa (Te Kooti Whenua Māori, 2010). All Māori incorporations must have a constitution that includes requirements regarding the general meetings of the shareholders, committees of management, voting and shares (Te Kooti Whenua Māori, 2010).

Māori incorporations are run by a management committee made up of committee members. Committee members are nominated by shareholders, who select suitable candidates with appropriate skills to protect the assets and to provide a return to shareholders (Te Kooti Whenua Māori, 2010). Anyone can be selected to be a committee member; they do not have to be a shareholder in the Māori incorporation (Te Kooti Whenua Māori, 2010).

2.9 Researching with Māori

This section explores the literature on researching with Māori communities. In particular it explores the concept of Kaupapa Māori, where the concept comes from, what it means, and the implications it has for carrying out Kaupapa Māori research. In turn Kaupapa Māori research is examined to determine the underlying principles that shape the methods used by researchers to engage with Māori, and why this type of research is important.

Kaupapa Māori

While Kaupapa Māori means many things to many people, in its simplest terms Kaupapa Māori is the practice and philosophy of being Māori (Eketone, 2008). The Māori Dictionary (2015) defines Kaupapa Māori as a "Māori approach, Māori topic, Māori customary practice, Māori institution, Māori agenda, Māori principles, Māori ideology - a philosophical doctrine, incorporating the knowledge, skills, attitudes and values of Māori society". Eketone (2008) goes further to say that for many in Māori communities Kaupapa Māori typically refers to groups or organisations who operate using Māori cultural values (e.g. Māori language schools), while for academics Kaupapa Māori typically refers to a "Māori philosophical approach to a field of practice of theory that focuses on challenging well established Western ideas about knowledge" (Eketone, 2015, p.1). The catchphrase often associated with Kaupapa Māori is "by Māori, for Māori" (Forster, 2003). This does not mean that Pākehā knowledge and culture are rejected; rather it is a desire to access both Māori and Pākehā cultural frameworks to their fullest extent without one being seen as better than the other (Durie, 2004; Mahuika, 2008)

Kaupapa Māori theory is often regarded as stemming from two, almost contradictory views. The first view is that Kaupapa Māori theory closely aligns with, and grew out of, Critical Theory. Critical Theory is a perspective that holds that the social world is defined by differences stemming from conflict between the powerless and the powerful (Eketone, 2008). For change to occur there needs to be understanding of the forces that created the imbalance so that they can be exposed and ultimately challenged. As an indigenous people who have suffered an ongoing erosion of language, culture and knowledge, many Māori people are drawn to this concept of exposing and challenging Western ideas in order to bring about change (Eketone, 2015).

Kaupapa Māori practice is also supported by the idea of Constructivism – the belief that "society, reality and meaning are manufactured, confirmed and validated though our interactions with the world" (Eketone, 2015, p.4). Constructivism is also based on the premise that language is key, as it is through language that people construct and make sense of their

world (Eketone, 2015). Since what is known is determined by people's construction of reality through language, it follows that there are multiple constructed realities, based on numerous languages, and supported by related cultural, historical, political and economic factors (Eketone, 2015). Ultimately, there is no one "truth" or "reality", but each truth and reality is strengthened through common sharing and community. Therefore, Māori people have a shared reality and truth, based on te reo Māori, their values and world view (Māoritanga). This truth remains despite Māori marginalisation and colonisation (Barnes, 2000; Eketone, 2015).

While Critical Theory and Constructivism could be seen as two contrasting positions Eketone (2015) proposes that both theories can work together to inform Kaupapa Māori theory. By taking the key components from Constructivism (Māori knowledge, values, processes and self-determination) and Critical Theory (power analysis, empowerment, resistance and emancipation) to inform Kaupapa Māori research and practice, the goals of Māori achievement, Māori development as Māori and a more just society could be realised (Eketone, 2015).

It is important to emphasise that Western ways are not always the only "correct" way of doing things (Bishop, 1999). At the same time as challenging Western concepts, Māori also need to work on building up that collective Māori knowledge base, building up the skill sets of te reo and other Māori practices, values and customs, so that the issued challenges are not unsupported (Bishop, 1999; Eketone, 2015; Mahuika, 2008). By expanding this knowledge base, or reality, to Māori and non-Māori communities there should eventually be greater acceptance that multiple realities can be considered valuable. From there, the sharing of ideas, processes and values should follow, in order to strengthen and enrichen all communities. It is these ideas that underpin the practice of Kaupapa Māori research (Barnes, 2000; Durie, 2004; Thompson & Barnett, 2008).

Six elements, or principles, underlie the concept of Kaupapa Māori (Mahuika, 2008; Smith & Reid, 2000). They are:

1. Tino Rangatiratanga (the self-determination principle);
2. Taonga tuku iho (the cultural aspirations principle);
3. Ako Māori (the culturally preferred pedagogy principle);
4. Kai piki ake I nga raruraru o te kainga (the socio-economic mediation principle);
5. Whānau (the extended family structure principle); and
6. Kaupapa (the collective philosophy principle).

These principles are seen as the starting point; elements necessary for bringing about change and making Māoritanga and te reo accepted and recognised as valid options for Māori in New Zealand (Mahuika, 2008).

Kaupapa Māori Research

Kaupapa Māori research developed as part of a wider Kaupapa Māori movement based on questioning westernised notions of culture, knowledge and research (Barnes, 2000; Walker, Eketone & Gibbs, 2006). Building upon the concept of "by Māori, for Māori", Kaupapa Māori research is research conducted "by Māori, for Māori and with Māori" (Thompson & Barnett, 2008). This is important because traditionally, Māori research has been carried out by Western researchers who have misinterpreted and misrepresented Māori knowledge, taking the information and providing no benefit for Māori (Bishop & Glynn, 1999). As a result Māori are wary of participating in research as in the past they have lost control of their knowledge and customs to Western research practices (Bishop & Glynn, 1999). Kaupapa Māori research is about challenging Western notions of what constitutes research, as it seeks to readdress power imbalances by accepting Māori research practices as valid in their own right (Barnes, 2000; Bishop, 1999; Mahuika, 2008; Thompson & Barnett, 2008)

Kaupapa Māori research stems not only from the Kaupapa Māori movement, but also from the wider movement of indigenous peoples worldwide to increase their self-determination over culture, land and language (Durie, 2004; Thompson & Barnett, 2008; Walker et al., 2006). Greater commitment to the Treaty of Waitangi, facilitating increased collaborations between Māori and non-Māori and the sharing of research skills, plus increased protection of Māori participants and data also aided the development of Kaupapa Māori research (Thompson & Barnett, 2008; Walker et al., 2006).

Several principles underpin Kaupapa Māori research. They are as follows:

- " A respect for all people – allowing people to define their own space and meet on their own terms;
- He kanohi kitea – the importance of meeting with people face-to-face;
- Titiro, whakarongo … korero – the importance of looking and listening so that one develops understandings and finds a place from which to speak;;
- Manaaki kit e tangata – collaborative approach to research, research training and reciprocity;
- Kai tupato – politically astute, culturally safe and reflective about our insider/outsider status;

- Kaua e takahia te mana o te tangata – Not trampling on the mana of the people. It is about sounding out ideas with people, about disseminating research findings, about community feedback that keeps people informed about the research process and the findings; and
- Kaua e mahaki – not flaunting your knowledge and it is about sharing knowledge and using our qualifications to benefit our community (Hutchings, 2002, p. 71; Jones, Ingham, Davies & Cram, 2010).

These seven principles support the six principles underpinning Kaupapa Māori theory described earlier. If researchers can undertake work based on these seven Kaupapa Māori research principles then they will be upholding and accepting Māori culture, customs, language, self-determination and family (Smith & Reid, 2000; Thompson & Barnett, 2008).

While Kaupapa Māori is a research methodology in its own right, in keeping with the above principles, each piece of research is carefully tailored to meet the needs and aspirations of the participants (Barnes, 2000; Cram & Kennedy, 2010; Jones et al., 2010). Therefore a range of different research methods have been used including hui, semi-structured interviews (both with individuals and whānau), structured questionnaire as an interview framework, focus groups and surveys (Barnes, 2000; Cram & Kennedy, 2010; Jones et al., 2010). These methods are typically ones that focus on oral and visual approaches for data collections; approaches that naturally reflect Māori practices (Jones et al., 2010). Whatever method is chosen it should be designed in consultation (where possible) with Māori, and should result in culturally acceptable and useful outcomes for Māori (Jones et al., 2010). Each piece of research should also seek to build trust between researchers and participants (important in dispelling the past of Māori being "researched on"), while empowering Māori (the tino rangatiratanga principle) (Jones et al., 2010; Mahuika, 2008; Thompson & Barnett, 2008). Researchers should not be afraid to share their knowledge with their participants, as this can lead to an enriched experience for all, and may lead to researchers ultimately gathering more fully informed data from participants (the Manaaki kit e tangata principle) (Jones et al., 2010).

2.10 Contemporary Kaitiakitanga

Kaitiakitanga is typically translated as guardianship, but its wider translation also includes stewardship, protection, resource management, preservation and sheltering (Akiyama, 2010; Econation, 2015; Royal, 2015). Based on the mātauranga Māori world view, kaitiakitanga is seen as a way of managing the environment.

According to Royal (2015) tiaki is the basis for kaitiakitanga, and means to guard, preserve, protect, foster and shelter. As such, these concepts of protection and care are at the heart of kaitiakitanga, and provide its conservation ethic. The prefix of kai is someone who carries out an action, so a kaitiaki is a person, group or being that acts as a guardian, conserver and protector (Akiyama, 2010; Royal, 2015). The gods of the natural world were considered to be the original kaitiaki (e.g. Tāne was the kaitiaki of the forests), a role now taken over by hapū and whānau (families) as they work to address environmental problems and reclaim traditional knowledge (Akiyama, 2010; Royal, 2015).

Kaitiakitanga is underpinned by the concepts of mana (spiritual power of an object or being), tapu (a spiritual restriction, sacred), rāhui (prohibitions, restrictions; e.g. to set aside an area and ban the harvesting of resources, such as fish or birds, until that resource has recovered) and mauri (life force of an object or being) (Akiyama, 2010; James, 1993; Māori Dictionary Online, 2015; Royal, 2015).

Contemporary kaitiakitanga is very different from traditional kaitiakitanga. Originally, kaitiakitanga played an important role in the survival of Māori through the management of resources. With the arrival of Europeans kaitiakitanga was, to a certain extent, lost, as a result of loss of culture and disconnection from the land (Akiyama, 2010). Today, kaitiakitanga is being rediscovered and explored by iwi, hapū and whānau, as well as Māori land trusts and incorporations. Māori communities are working to reconstruct and express the traditional knowledge of their land, in order to facilitate their land's restoration (Econation, 2015; Royal, 2015). The application of kaitiakitanga is not always easy, with Māori groups needing to understand mana, tapu, mauri and rāhui, and how to apply those traditional concepts to modern frameworks (Royal, 2015). Māori must also deal with non-Māori engaging with kaitiakitanga, including regional authorities and landowners who may have different values and world views (Akiyama, 2010; Royal, 2015). However, Māori groups are supported by the inclusion of kaitiakitanga in legislation, such as the Resource Management Act 1991 and the Foreshore and Seabed Act 2004 (repealed on 1 April 2011, by section 5 of the Marine and Coastal Area (Takutai Moana) Act 2011). By including kaitiakitanga in legislation, the New Zealand Government is supporting the concept within the wider community (Akiyama, 2010; Royal, 2015). As such, non-Māori are able to reflect on the notion of kinship with nature and how this is important, while Māori are able to feel they are meeting the responsibilities and hopes of their ancestors (Royal, 2015).

2.11 Māori Values and Environmental Concepts

Māori values and environmental concepts stem from a traditional belief system grounded in mātauranga Māori, called tikanga Māori (Mead, 2003) Tikanga stems from the word tika, meaning to be right; therefore tikanga is the correct way of doing something. As such tikanga can be the correct way of behaving, or the body of rules/principles or customs that guide Māori people (Mead, 2003). Tikanga Māori and mātauranga Māori rely on each other, with one informing the other. Where mātauranga Māori informs the thoughts, tikanga Māori puts that knowledge into practice, combining that actions with the aspects of ritual support, and correctness (Mead, 2003).

Mātauranga Māori, Māori world view, is a perspective encompassing all aspects of "knowledge, comprehension or understanding of everything visible or invisible that exists across the universe" (Harmsworth & Awatere, 2013, p. 275). It includes all Māori ways of knowing and doing (knowledge systems) and is a holistic approach encompassing the interconnection and relationship between soil, water, plants, animals and humans (Harmsworth, 1998; Mead, 2003; Ulluwishewa et al., 2008).

Māori values form the basis of te ao Māori (Māori world view) and are seen as "the instruments through which Māori make sense of, experience, and interpret their environment" (Harmsworth, 1998; Harmsworth & Awatere, 2013, p. 275). Māori values provide the lore, principles and concepts that are used in everyday life, forming Māori principles and ethics (Harmsworth & Awatere, 2013; Jollands & Harmsworth, 2007). Values can heavily influence the relationships and governing responsibilities that Māori have with the environment and the way in which Māori make decisions (Harmsworth & Awatere, 2013; Jollands & Harmsworth, 2007; Mead, 2003). Māori values also form the foundation for Māori looking to explore, assess and understand ecosystems (Harmsworth & Awatere, 2013). Combined, Māori values and environmental concepts form the basis for assessing cultural impact, cultural understanding of adverse effects, planning to protect/manage areas of cultural significance, planning ecosystem restoration/enhancement projects and prioritising issues; in short, sustainable resource management (Jollands & Harmsworth, 2007; Ulluwishewa et al., 2008).

Mead (2003) identifies several values that underpin tikanga Māori:

- Whanaungatanga – the value of relationships and whakapapa. The importance of individuals being supported by their families, while in return an individual supports the wider community.

- Manaakitanga – the nurturing of relationships, looking after people and taking care about how others are treated.
- Mana – prestige, of a person or a group. People with high levels of mana tend to be in leadership positions, and Māori draw their mana from the prestige and power of their ancestors.
- Tapu – the state of being set apart. Tapu is present in all aspect of the Māori world and is inseparable from mana, Māori identity and Māori cultural practices.
- Utu – the concept of reciprocity, revenge or compensation. The purpose of utu is to restore balance and to maintain relationships.
- Noa – balance or neutrality. Often noa works in conjunction with tapu as a means of restoring the balance, especially in a situation with a high level of tapu.
- Ea – satisfaction. The state that is arrived at after the process of tapu, utu and noa have been worked through.

In relation to land, the concepts or values of tūrangawaewae and mauri are also important. The concept of tūrangawaewae, a place for the feet to stand, links Māori to the land by providing a place for a person to feel secure, to feel at home and to be unchallenged (Mead, 2003). Mauri is the considered to be the spark of life that resides within all objects and beings. When a being dies their mauri ceases to exist, vanishing completely (Mead, 2003). Safeguarding an object or a being's mauri is very important to Māori, as without mauri the life principle is extinguished and systems stop (Mead, 2003).

Whare Tapa Whā

Linking into and underpinning Māori values is Durie's (2006) concept of whare tapa whā, first presented in December 1982 at a hui in Palmerston North. The whare tapa whā model is used to describe Māori approach to, and view of, health, where each of the four characteristics represent one of the four walls of a whare (house) (Durie, 2006). All four walls are necessary to ensure strength and symmetry. The four characteristics of whare tapa whā are as follows:

- *Taha Wairua* – provides a spiritual focus, allowing people to have faith while understanding the links between people and the environment (Durie, 2006). Belief in a God is one reflection of wairua; relationships with the environment, and understanding of mauri another (Durie, 2006). This aspect links most closely to the environment, as it is believed that if a person lacks access to their tribal lands, then they lack in identity and the fundamental sense of well-being that comes from interaction with natural environments (Durie, 2006).

- *Taha Hinengaro* – is the aspect of thoughts and feelings, and how knowledge and recognition of both of those are essential to a person's health (Durie, 2006). This concept relies on the unspoken messages that convey thoughts or feelings (Durie, 2006). The link to the natural environment here comes through the outwards search for explanations to thoughts and feelings; rather than the more Westernised concept of internal soul-searching (Durie, 2006). Lack of external searching equates to a breakdown in the harmony between a person and the wider environment and is regarded as a sign of poor health (Durie, 2006).
- *Taha Tinana* – is the aspect of bodily health, with the emphasis and distinction of tapu (sacred) and noa (ordinary, unrestricted) (Durie, 2006). For example, certain parts of the body, and in particular the head, are regarded as tapu. Bodily health is important in that certain rituals and actions are required to maintain it (e.g. keeping eating, sleeping and toileting areas separate).
- *Taha Whānau* – is the aspect of extended family, important in that family provide the primary support mechanisms for a person, including nurturance and care, physically, culturally and emotionally (Durie, 2006). Secondly taha whanau relates to identity and sense of purpose, where interdependence with and on the wider family and hapu/iwi is considered healthy (Durie, 2006). This aspect links into environmental values in that Māori have a strong sense of whakapapa which relates not only to their family lineage, but also to the area that they come from (Mead, 2003). It is common for a person relating their whakapapa to state their mountain and/or river, as these features link them back to the natural environment, providing not only a reference point to others, but also strengthening their links to the land (Mead, 2003).

The whare tapa whā model aligns the concepts of Māori health and well-being with the broader concepts and values that underlie environmental management. To harm the environment leads to detrimental health and wellbeing – spiritually, physically, mentally and emotionally. The wider community is also negatively impacted upon through the aspect of taha whānau. This model also helps to explain why contemporary kaitiakitanga is so important to Māori. Table 2.3 presents a wider list of Māori values and environmental concepts extracted from the literature. While not comprehensive, it provided a starting point for this project highlighting the importance of these values and concepts to Māori landowners when making land use decisions.

Each Māori trust or incorporation will typically have their own set of guiding values and concepts when it comes to managing their land and resources. For example, Taheke 8C & Adjoining Blocks (Inc.) (2014) base all of their group's actions upon the following values:

- Mana Whenua;
- Accountability;
- Consultation;
- Transparency; and
- Fiduciary Obligations.

While Mangorewa Kaharoa Te Taumata Trust (2014, Home page) uses the following values to shape their management decisions:

- "Whakapapa - through these sacred connections we uphold mana whenua over our land and will invest in and advocate on behalf of our people;
- Inquisitive - we will look for and debate new opportunities;
- Prudent - we are, and will act, as prudent trustees of the trust;
- Respect- we will have and show respect for the past, present and future relationships; and
- Sustainability - we will ensure we have the capacity to remain in existence forever".

Table 2.3: A list of Māori values and environmental concepts. Some terms are purely considered to be a value, others only an environmental concept, while some terms can be considered to be both a value and an environmental concept (Harmsworth, 1998; Harmsworth, 2002b; Harmsworth & Awatere, 2013; James, 1993; Jollands & Harmsworth, 2007; Mead, 2003; Roberts et al., 1995; Taiepa et al., 1997).

Term	Values Definition	Environmental Concepts Definition
Arohatanga	Compassion Love Respect Notion of care	
Kaitiakitanga	Environmental guardianship Guardians of all natural resources Responsibilities and obligations Reinforces the spiritual link to the natural environment	Environmental stewardship/guardianship Active not passive relationship
Ki uta ki tai		Whole landscape approach Integrated catchment management Understanding/managing interconnected resources and ecosystems from sea to mountains
Mana	Influence, prestige, power, control and authority.	Having authority or control over the management of natural resources
Manaakitanga	Acts of caring for and giving	
Mana whenua	Status, authority, prestige over a defined area. Authority over land and resources	

Mauri	Life force	Maintenance of mauri in all parts of the system Striving for balance Denotes health and spirit through all living and non-living things Binding force that links the physical to the spiritual worlds.
Ritenga		Likeness, custom, customary practice, habit, practice, resemblance, implication - the normal way of doing things The area of customs, protocols and laws that regulate the behaviour/actions related to the physical environment and people Includes concepts like tapu (sacred, prohibited, restricted), rāhui (to put in place a temporary ritual prohibition, closed season, ban, reserve) and noa (be free from the extensions of tapu, ordinary, unrestricted). These were practical rules put in place to ensure the sustainability or resources and the wellbeing of people and the environment
Taonga tuku iho		Intergenerational protection of highly valued taonga (treasure), passed from one generation to the next in a respectful and caring manner Heirloom, something handed down, cultural property or heritage
Te Ao Turoa		Intergenerational concept of resource sustainability
Tikanga	Customary practice Protocols Values	Set of principles and practices to achieve the goal of mauri maintenance
Tino rangatiratanga	Self determination	

Tau utuutu	Principle of reciprocity Give back what you take	
Wairuatanga	Spiritual dimension	Spiritual dimension Spiritual energy and dimension as a concept for Māori wellbeing.
Whakakotahitanga	Consensus Participatory inclusion for decision making Respect for individual differences	
Whakapapa	Ancestral lineage Genealogical connections Links to ecosystems Relationships	Connection, lineage or genealogy between humans and ecosystems and all flora and fauna. Seek understanding through whakapapa of the total environment/whole system and its connections. Holistic and integrated perspective.
Whānaungatanga	Family connections	

Incorporating mātauranga Māori and thus Māori values and environmental concepts into an EDSS will be crucial in developing a tool that better represents Māori. If such values and concepts can be included so as to support and enhance Western scientific thinking then that will make future tools even more powerful.

2.12 How EDSS could help Māori Landowners

With the closure of the Treaty settlements, and the ongoing settlement process, Māori in New Zealand are now regaining access to land from which they have been alienated for centuries. While some of the land is not able to be developed (e.g. it is in national parks), Māori freehold land can be used for the benefit of its owners or shareholders. However, Māori land trusts and incorporations are faced with the difficult job of selecting the appropriate land use option/s for their land and their people. These land use options include the more traditional options of dairying and exotic forestry, as well as the more modern options of recreation, eco-tourism, hunting blocks, manuka honey, industrial development, ginseng and native plantings (for harvest, medicinal and restoration purposes).

Māori land trusts and incorporations can face many barriers when trying to develop their land. Between the barriers and numerous land use options, it can be very hard for Māori people to establish management groups, let alone make land management decisions (Controller and Auditor-General, 2004; Te Kooti Whenua Māori, 2010; Te Kooti Whenua Māori, 2010b).

Environmental Decision Support Systems (EDSS) are seen as a way with which to engage with Māori landowners. A well designed tool could remove the barriers to management, and provide Māori landowners with enough information to make informed decisions about the best use for their land. Crown Research Institutes (CRIs) in New Zealand, such as Scion and Landcare Research, are particularly interested in carrying out this work in partnerships with Māori. Chapter 3 will explore the concept of EDSS, how they work and provide examples of current New Zealand EDSS that have attempted to incorporate Māori needs and values.

3 LITERATURE REVIEW

This chapter examines the concepts of environmental decision support systems (EDSS), stakeholder participation and its importance in EDSS research and design, the importance of indigenous knowledge and Māori values and environmental concepts. These ideas are then brought together to examine some New Zealand examples of EDSS and to consider how EDD could help Māori landowners to make land use decisions.

3.1 What is an Environmental Decision Support System?

In simple terms, a Decision Support System (DSS) is anything that facilitates complex decision making and problem solving (Gough & Ward, 1996; Rizzoli & Young, 1997; Shin et al., 2002). An EDSS is any system or tool which allows users to make better decisions regarding the environment (Rizzoli & Young, 1997). All EDSS are a subset of DSS. While EDSS have evolved over time to typically become computer systems that allow modelling and scenario analysis to occur, they can be anything from a piece of paper, a conversation with an expert, an excel spreadsheet through to a complex computer program (Gough & Ward, 1996; Shin et al., 2002). EDSS may begin life as a system for the purposes of the piece of research, only to be developed into a tool (e.g. an iPhone app) at a later date. For the purposes of this research, all EDSS will be considered to be computer based from this point onwards, unless otherwise stated.

While the concept of DSS first emerged in 1951, research into their development is acknowledged as truly starting in the 1960s (Bhargava, Power & Sun, 2007; Shin et al., 2002). This research began on the premise that the original DSS concept was deemed to be an integration of management activities (strategic planning, management control and operation control) and described decision problems (Bhargava et al., 2007; Shin et al., 2002). Between the 1970s to 1990s DSS development was rapid as changes in technology led to changes in how the systems functioned. For example, the advent of the personal computer in the 1980s allowed DSS to support individual decision makers.

The development of telecommunications technology and the Internet also created new opportunities for DSS. All of these technologies now allow greater, global connections between people in sometimes remote locations. Companies need systems and tools that allow for the making of decisions while building connections and allowing for the flow of communications. DSS deployed on Web-based platforms can allow these things to happen.

Today EDSS are computerised systems and tools that allow the processing of large bodies of data, on many factors and with multiple criteria applied, to extract analyses that inform decision making. Many can work at considerable scale (e.g. a whole country or region), can process different data forms (e.g. spatial data, climate data, biological data), and can apply multiple criteria to the processing (Bhargava et al., 2007; Walker, 2002). Some New Zealand examples of EDSS are the New Zealand Land Use Capability model (which models spatial and biological data to generate a land use rating), and Mauri Assessment Model (a Life Cycle Assessment model), which uses indicators to determine the changes in the mauri of a project over time (Harmsworth & Awatere, 2013; Mauri-o-Meter, 2014). Other examples, including some that particularly apply to Māori land, are outlined in Section 3.4.

According to Shin et al. (2002, p.111) classic DSS are typically comprised of the following components:

i. "Sophisticated database management capabilities with access to internal and external data, information and knowledge;
ii. Powerful modelling functions accessed by model management system; and
iii. Powerful, yet simple user interface designs that enable interactive queries, reporting and graphing functions".

They argue that Figure 3.1 is the most common model of the decision making process used in DSS. The first step in the process is recognising the problem, which is then defined in a way that will lead to the creation of models. Alternative solutions to the problem are considered and then the models are used to analyse all of the alternative solutions. While this process should form the basis of all good decision making, by implementing it into computers, more complex data is able to be analysed over shorter time frames, and allowing the user to consider more complex scenarios (Bhargava et al., 2007; Gough & Ward, 1996; Shin et al., 2002; Walker, 2002).

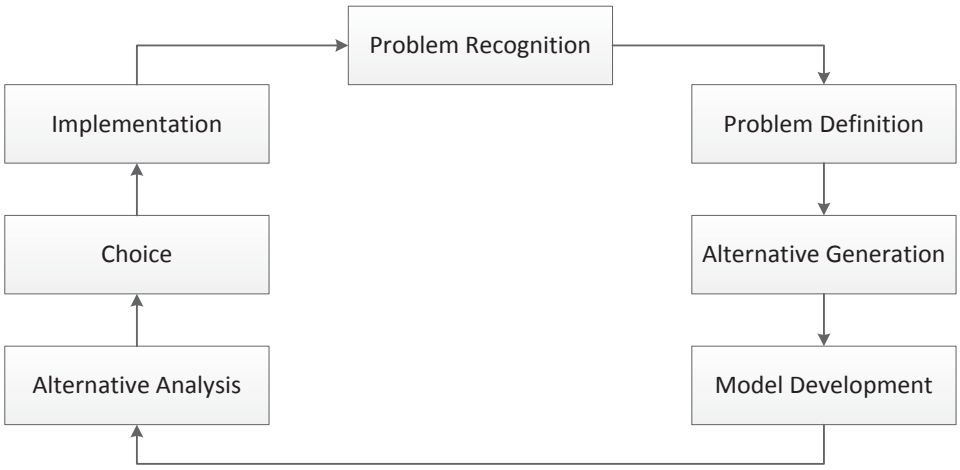

Figure 3.1: The DSS decision making process (Shin et al., 2002).

3.2 The Strengths and Weaknesses of EDSS

Ever since the creation of the first DSS, researchers and government agencies have been enthusiastically creating and distributing them for use (Power, Berstein & Sharda, 2011). However, despite the far reach of EDSS, in many cases the "identified" end users decline to utilise these systems for a variety of reasons (Arnott & Pervan, 2005; Cox, 1996; McIntosh et al., 2011; Rizzoli & Young, 1997). An example of a DSS is Google Earth which allows users, among other uses, to determine how land cover is changing over time. Other examples of New Zealand specific EDSS are given in Section 3.4. This section looks at why EDSS often fail, and why researchers and government agencies continue to produce them.

Targeted end users declining to utilise an EDSS is a major problem. End users may refuse to use an EDSS for a variety of reasons, but one of the main reasons is that the EDSS simply does not do what the end user requires it to do. In some cases researchers create an EDSS because it contains a model or a solution that they think will benefit the end user (Cox, 1996; Walker, 2002). The model or the solution may not actually be the best way to solve the problem (indeed the problem may only exist in the eyes of the researchers), but because researchers often have to justify their work in order to obtain further funding or research opportunities, they see the creation of an EDSS that contains their models as an easy way of proving that their work is valid (Cox, 1996; Walker, 2002).

Not clearly identifying the end user/s often contributes to EDSS failure. Often market research is carried out to identify end users after an EDSS has been released when the researchers have become concerned by the low uptake of the product (Cox, 1996). Projects that have attempted to identify the end user at the start of the project consistently have better uptake, than those

where an EDSS is developed with no clear end user in mind (Arnott & Pervan, 2005; McIntosh et al., 2011; Poch et al., 2004; Reed, 2008). Taking that a step further, projects which identify all end users, and then actively engage them throughout the entire design process, creating solid terms of reference, often create the EDSS tools which have the highest uptake by users (Arnott & Pervan, 2005; Hansen & Prosperi, 2008; McIntosh et al., 2011; Reed, 2008).

Even if end users are identified and engaged with during the design process, problems can still occur which can limit the uptake of the EDSS. Systems or tools which only deal with one problem may be used initially by users, but if the system or tool is unable to be easily updated to solve future problems then its uptake will be limited (Booty, Lam, Wong & Siconolfi, 2001; McIntosh et al., 2011; Walker, 2002). Likewise, a simple system that only deals with one aspect of solving the problem, forcing the user to use multiple systems to get an answer is less likely to be used than a system which covers all aspects of the solution (Booty, et al., 2001; Poch et al., 2004). Users do not like having to use multiple systems to get an answer, as it can be expensive if they have to purchase several different pieces of software, as well as time consuming having to learn how to use all of the different systems (Booty et al., 2001). Time is also wasted if the user has to switch between the different systems when one system could have provided the answers (e.g. failure to integrate a mapping component into the EDSS, resulting in the user having to switch repeatedly between the EDSS and Google Maps or Arc GIS) (Booty et al., 2001).

On the other hand, if the EDSS tries to solve multiple problems, but solves none of them very efficiently then end users uptake will also be limited. Researchers who try to solve multiple problems may create systems that are complex to use and/or understand, which in turn can make them hard to update in the future (although this can also occur with simple and single problem systems too) (Rizzoli & Young, 1997). Similarly, the more complex the system, the more likely it is that it will run over budget and may not be delivered within the specified time frame. Finally, failure to deliver on all of the promised functionality, due to time and budget constraints, can also lead to end users having limited confidence in the EDSS resulting in its limited uptake and use (McIntosh et al., 2011).

However, in spite of associated problems, the field of EDSS design is still very strong. This is because researchers see EDSS as a very powerful tool for communicating scientific research and other information to their end users (Huser et al., 2009; Rizzoli & Young 1997). This information may be purely educational in its purpose, but other information and research can

be aimed at helping the end users to make better decisions or to help them make an educated choice between different scenarios (e.g. which land use option is more profitable).

Rizzoli and Young (1997) identified six desirable features which should be incorporated into all EDSS. They are:

- *Knowledge acquisition and representation* – by talking with experts and stakeholders, researchers and developers can develop an understanding around the important ideas and issues that need to be communicated via an EDSS, and ways in which to communicate them (e.g. via graphs, maps, pictures, models etc.);
- *Model re-use and integration* – by taking existing models and integrating them into the EDSS, developers can avoid duplication, and are also able to potentially link previously separate models;
- *Spatial data management* – this is often a necessary component of any environmental decision making, which is aided by incorporating geographic information systems (GIS) into the EDSS;
- *Expert help* – facilitates choice regarding model selection, data preparation and interpretation of results. It can also be used to help a user choose between different plausible scenarios;
- *Problem definition and solving* – while an EDSS should be able to simulate and optimise different scenarios, it should also offer the flexibility of being able to "intelligently interpret user questions, and to translate these into the necessary computations" (Rizzoli & Young, 1997, p. 242); and
- *Planning, management and optimisation* – despite the recognised ability of EDSS to model complex scenarios, many end users refuse to trust the models and their answers. This lack of trust can be prevented by engaging with the users throughout the development and testing process. This allows for greater user understanding of the models and algorithms that are being used.

Other authors have also identified key ways which should make the development and uptake of the EDSS more successful (McIntosh et al., 2011; Poch et al., 2004; Voinov & Bousquet, 2010). There is agreement that the development of any EDSS should be a repetitive process that allows for on-going adjustments. While different researchers/developers have their own preferences for the finer details of this cyclic process, in general it should contain the following steps:

- Analyse environmental problem analysis;
- Identify project goals;
- Identify and invite stakeholders to participate;
- Choose modelling tools;
- Collect and process data;
- Select and build model;
- Run model and discuss results;
- Model implementation and integration;
- Present results to stakeholders; and
- Produce final EDSS (Poch et al., 2004; Voinov & Bousquet, 2010).

While EDSS design may not contain all of these steps, if researchers and developers follow the above process in developing their EDSS then it should help them produce products which offer greater consistency and usability to the end users. Similarly, by following the process outlined above, and by not being afraid to revisit previous steps in order to incorporate more data or engage repeatedly with stakeholders, researchers and developers of EDSS should create a system or tool that better understands stakeholder issues, thus increasing the likelihood that stakeholders will utilise the final EDSS.

3.3 Why Stakeholder Participation is Important in the Design Process

Once the research problem has been identified, stakeholder participation is the next step of the EDSS design process. In order to include stakeholders in the design process researchers/developers must first identify the stakeholders who are linked to their research problem. While the definitions for a stakeholder can range broadly depending upon the topic, in general a stakeholder is anyone who affects or is affected by a decision or action (Reed et al., 2009). Stakeholders can also include non-human and non-living entities, such as animal or plant species which dwell within a landscape or future generations (Reed et al., 2009). In those instances where non-living/non-human stakeholders are identified researchers may choose to consider their needs separately, or enlist someone to speak on their behalf (e.g. a primate expert may be asked to represent orang-utans in stakeholder discussions about deforestation).

Identifying stakeholders is the first step of the process. Often this is a lot easier to do if the project has clear boundaries. However, there is always the risk that some stakeholders may not be identified which may result in a final tool that does not encompass all stakeholder requirements. As such, identifying stakeholders is often an iterative process where different

stakeholder groups are added as they are identified (Luyet, Schlaepfer, Parlange & Buttler, 2012; Figure 3.2). Once identified, stakeholders are then characterised and organised to understand the exact nature of their participation. This information is then used to determine the appropriate participatory techniques for the stakeholders, who having participated in the research, will then provide an evaluation of the process to researchers, for use in future stakeholder participation events (Luyet et al., 2012). The inputs are the items researchers are seeking stakeholder feedback on, while the outputs are the results of the participation process (Luyet et al., 2012).

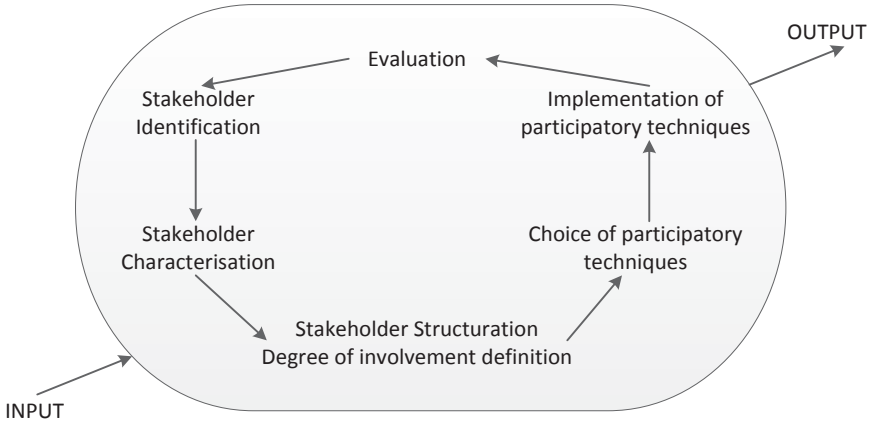

Figure 3.2: Framework for stakeholder participation (Luyet et al., 2012, p. 214)

It is also important for researchers to be aware that it may not be practical to have all identified stakeholders participate in the design process of an EDSS. Sometimes setting well founded criteria, such as a geographical boundary may serve to limit the number of stakeholders. In other instances, researchers may choose a representative sample of stakeholders to reduce duplication of ideas and values. Focus groups, knowledge mapping, snow-ball sampling, social network analysis and stakeholder-led stakeholder categorisation are just some of the ways which researchers can employ to help identify stakeholders (Reed et al., 2009).

Having identified the relevant groups of stakeholders, researchers must then choose how they will engage with them in order to obtain the required information. Often several different approaches to engagement will be required; partly because different groups will work better using different participation strategies and partly because different stages of the design process may require different levels of participation. Sometimes researchers may need to split stakeholder groups so that previously marginalised or powerless groups are able to voice their opinions without being overpowered by stakeholders with more resources.

Reed (2008) suggests that researchers need to determine which of the different levels of stakeholder participation (often referred to as typologies) they want to use before participation occurs. One example of a typology is the "ladder of participation" or continuum, where participation of stakeholders ranges from passive dissemination of information on the bottom rung to active participation on the top rung (Reed, 2008). Different researchers may give the rungs on the ladder different names, but the end result is still a continuum (Reed, 2008).

If stakeholders are involved from the start of the project, then they can help to develop the 'terms of reference' for the EDSS. The terms of reference will specify exactly what the stakeholders want from the EDSS and will be used throughout the project by the developers/researchers to achieve the agreed upon objectives. As the project progresses, the developers may require further stakeholder consultation if the desired criteria is unable to be met (e.g. the stakeholders want the EDSS to be translated into ten languages, but there is only enough money in the budget to do six etc.). It is then up to the stakeholders and developers to renegotiate the terms of reference to reach a compromise that everyone is happy with.

By ensuring that relevant stakeholders are a part of the design process, developers are ensuring that their system will be more likely to meet the stakeholder's needs and this in turn will enhance the uptake of the final product (McIntosh et al., 2011; Reed, 2008). By getting the different stakeholder groups together at the start of the project to negotiate the terms of reference, the EDSS will meet a range of different objectives and will suit the majority of stakeholders, rather than the finished EDSS just meeting the requirements for one group (Hansen & Prosperi, 2005). This also prevents groups on the periphery of the process from being ignored (Hansen & Prosperi, 2005; Reed, 2008). By including marginalised groups in the design process, researchers are to an extent empowering them, by giving them a chance to equally voice their own thoughts, values and opinions (Hansen & Prosperi, 2005; Reed, 2008; Reed et al., 2009).

Involving the stakeholders also leads to the development of trust and genuine working relationships. By getting stakeholders from different groups to engage with each other, researchers can also promote a shared learning experience (Reed, 2008). As the design process progresses, the stakeholders must learn how to work with each other and compromise, as they build upon their relationships and learn how to see the situation from different perspectives (Reed, 2008; Reed et al., 2009). Trust builds within the group, as the stakeholders provide more honest and valuable information which in turn may improve the robustness of

the research (Kingston, Carver, Evans & Turton, 2000; Reed, 2008). Stakeholders will have greater confidence in the information the tool contains and have a greater knowledge that it will work in beneficial ways which should lead to greater EDSS uptake at the end of the project (Reed, 2008). Ultimately, stakeholders who participate in the design process of an EDSS should feel greater ownership and pride in the final tool (Reed, 2008).

3.4 New Zealand Examples of EDSS

Having examined the strengths and weaknesses of EDSS, explored the importance of stakeholder participation and considered how EDSS could aid Māori landowners to make decisions, Section 3.4 will now bring these aspects together. Table 3.1 lists some of the common DSS types, their key characteristics and examples of what each DSS type can be used for.

Table 3.1: Different types of DSS used by people to aid environmental, social and economic decision making.

DSS type	Definition	Key Characteristics	Example
Environmental Impact Assessment (EIA)	Environmental impact assessment (EIA) can be defined as: "the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs, or legislative actions, relative to the physical–chemical, biological, cultural, and socioeconomic components of the environment" (Canter, 1977, p. 28). or "the evaluation of the effects likely to arise from a major project (or other action) significantly affect the environment" (Jay, Jones, Slinn & Wood, 2007).	Need to consider: • If impact is significant or not; • Short vs. long term impacts; • Beneficial vs. adverse impacts; • Human health and safety; and • Unique characteristics of the geographic area (e.g. historic sites, wetlands, species present etc) (Canter, 1977; Jay et al., 2007). Often involves public participation; Often linked/combined with Social Impact Assessment, Health Impact Assessment and Strategic Environmental Assessment (Canter, 1977; Morgan, 2012). EIA will assess factors such as: • Air quality; • Energy; • Ground water; • Natural resources; • Noise; • Plant and animal life; • Public service; • Traffic; and • Tourism (Canter, 1977; Jay et al., 2007).	*The proposed monorail development into Fiordland/Milford Sound, New Zealand* (Wildland Consultants, 2010).
Social Impact Assessment (SIA)	SIA is "the process of identifying the future consequences of a current or proposed action, which are related to individuals, organisations and social macro-systems" (Becker, 2001, p. 312).	SIA is becoming a standard requirement in policy formation; Deals with actions undertaken to mitigate or eliminate a problem, by examining the nature of the problem and why it needs to be mitigated/eliminated; Need to avoid false problems;	*The development of the New Zealand health care system in Māori communities used SIA to assist the process of evaluation of alternative health care solutions* (Burdge & Vanclay, 1996).

DSS type	Definition	Key Characteristics	Example
		Often involves public participation; and Often linked with EIA (Becker, 2001).	
Environmental Risk Assessment (ERA)	The Environmental Protection Agency (EPA) "considers risk to be the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor", where a stressor is "any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact" (Environmental Protection Agency, 2014). ERA characterises the nature and magnitude of the health risk to humans and ecological receptors, then uses this information to determine how to best mitigate the risk (Environmental Protection Agency, 2014).	Important part of environmental policy development; Trends towards greater stakeholder involvement and reduced emphasis on quantitative characterisation of uncertainty and risk; Deals with the nature, frequency and magnitude of the stressor; Iterative process; and Often to do with the amount of a chemical in the environment (Environmental Protection Agency, 2014; Power & McCarty, 1998).	*New Zealand Environmental Protection Agency: Te Mana Rauhī Taiao.*
Geographic Information Systems (GIS)	Cowen (1988, p. 1554, in Maguire, 1991, p.11) defines GIS as "a decision support system involving the integration of spatially referenced data in a problem-solving environment".	"Information is derived from the interpretation of data which are symbolic representations of features" (Maguire, 1991, p. 10). Although, GIS can be manual information systems, they are typically computer-based. Comprised of remote sensing, computer cartography, database management and computer-aided design (Maguire, 1991).	*MyLand* *Whenua Viz*
Life Cycle Assessment (LCA)	LCA is "a tool to assess the potential environmental impacts and resources used throughout a product's life cycle, i.e., from raw material acquisition, via production and use phase, to waste management" (Finnveden et al., 2009, p. 1).	Covers a diverse range of environmental impacts; Impacts equal the sum of all past, present and future impacts caused by emissions released throughout a product's life cycle; Can include comparison of impacts across life	*Lamb carbon footprint project* (Life Cycle Association of New Zealand, 2010)

DSS type	Definition	Key Characteristics	Example
		cycle categories; and Can use weighting to assign higher/lower weights to certain impacts (Finnveden et al., 2009). LCA can assess the impacts of: • Different land use options; • Water usage; • Toxicity; • Indoor air on human health (Finnveden et al., 2009).	
Multiple Criteria Decision Analysis (MCDA)	MCDA is "an umbrella term to describe a collection of formal approaches which seek to take explicit account of multiple criteria in helping individuals or groups explore decisions that matter" (Mendoza & Martins, 2006, p. 1). Three broad method categories: • Value measurement models; • Outranking models; and • Goal, aspiration or reference level models (Mendoza & Martins, 2006).	Helps to structure management problems; Provides a model that can aid discussions regarding a problem; Takes explicit account of multiple and often conflicting criteria; Leads to justifiable, rational and explainable decisions; Can deal with mixed data set, including expert options; Can deal with knowledge gaps; Structured in a way to allow collaborative planning and decision making; Widely applied to forest management; and Scale varies from a land unit (stand) to a forest estate, watershed, region or district (Mendoza & Martins, 2006).	*Mauri-o-meter*

Table 3.1 demonstrates just how broad the concept of decision support systems is. In many cases a DSS can often fit into multiple categories. For example, geographic information systems, a type of DSS, are often used in conjunction or integrated with the other DSS types listed in the table above. This is because decision makers often find that a visual representation of their land can aid their decision making process, as well as the additional analysis offered by the GIS.

Having examined examples of DSS across a broad range of categories, the following sections will provide a more in-depth description of New Zealand examples of EDSS. These EDSS seek to incorporate Māori viewpoints in environmental land use decisions, so each example will be reviewed and will use the headings in Table 3.1 to determine which of the above EDDS categories they could fit into. The review of each New Zealand EDSS was primarily carried out by the author, who drew upon her five years' work experience in software support and tool testing for the forestry industry to undertake each review. The author approached each EDSS from the perspective of a first time user, recording observations about ease of use, user interface, supporting documentation for each EDSS and comparing these observations with those found in the literature (where available).

Cultural Health Index (CHI)

The Cultural Health Index is primarily an EIA type of DSS, but it also contains components of SIA and ERA. It was originally developed in the late 1990s to aid catchment decision making, by relating customary resources and river and stream health to Māori cultural values (Harmsworth & Awatere, 2013). The CHI uses cultural indicators, including taonga (treasured/iconic/customary) species, wāhi tapu and wāhi taonga (heritage sites), mahinga kai (food gathering areas) and water quality, as a part of a scoring index for assessing the health of rivers and streams (Harmsworth & Awatere, 2013). Together these indicators characterise the concept of mauri (a sustaining life force/spirit/soul found in all living and non-living things). The index is calculated from the following three components:

- *Mahinga kai measure* – The data and indicators required to derive this measurement was obtained from interviews with kaumātua (elders/persons of status) and contemporary assessments of mahinga kai availability (Tipa & Teirney, 2003). By utilising detailed, local knowledge about historical mahinga kai species, the mahinga kai measure can assign greater values to sites where important species were sourced in the past, as well as comparing the measure to mahinga kai species present at the site currently (Tipa & Teirney, 2003);

- *Site status* – sites are classified depending upon their traditional association with iwi/hapū, and whether or not the iwi/hapū believe that they will utilise the site in the future (Harmsworth & Awatere, 2013; Tipa & Teirney, 2003); and
- *Stream health measure* – comprised of a number of critical cultural indicators of stream health (based on ideas such as 'is it safe to fish here/safe to drink the water?') that were discussed by rūnanga (council, assembly). The robustness of the results was confirmed when they were checked against the Macroinvertebrate Community Index (MCI) and the Stream Health Monitoring and Assessment Kit (SHMAK) - both Western scientific measures of stream health (Tipa & Teirney, 2003).

The CHI was originally developed as a decision making aid for Ngāi Tahu (South Island iwi), and was tested in the Kakaunui and Taieri river catchments. By creating a system that incorporated the cultural values of mauri, mahinga kai, kaitiakitanga and ki uta ki tai (freshwater management in its entirety from mountains to the sea), and produced results that are comparable to Western science systems, the researchers have made a huge step forward in the New Zealand EDSS development space. Because the system produces comparable results to both the MCI and SHMAK systems, non-Māori cannot dismiss the system as invalid, in spite of the way results are achieved. Likewise, because the researchers sat down, listened and did their best to incorporate Māori values into the CHI, Māori will be more likely to use the CHI in the future to monitor and manage their stream and river health (McIntosh et al., 2011).

While the CHI was originally developed only using Ngāi Tahu information, it was recognised by Tipa and Teirney (2003) that additional research was needed in order to adapt the CHI for other iwi. This is an important step, for had they tried to publish the CHI using only Ngāi Tahu information, then it would possibly have been discredited by other iwi/hapū. In 2006 Tipa and Teirney published an additional report which expanded upon their original work to make the CHI applicable to all of New Zealand. As part of this work additional cultural indicators were included in the index and the concept of mahinga kai was expanded to include other resources (e.g. flax fibres) (Tipa & Teirney, 2006). The modified CHI was then applied to different types of rivers and streams, and to those in a different rohe (district/region) to determine if the tool could be used more widely (Tipa & Teirney, 2006). The validation process worked and "from the data collected, a Cultural Health Index was developed that is generic in the sense that it can be used confidently by any iwi at sites in streams of any size or river type" (Tipa & Teirney, 2006, p. 26). Along with the release of the CHI in 2006, guidelines were also released to aid iwi in their use of the CHI.

Since its design in 2006, the CHI has had very little formal use or review. The Waikato River Authority (2014) is currently looking to use the CHI to monitor and evaluate the Waikato River. However, to date the CHI has only been applied to wadeable streams, so the Waikato River Authority is going to have to undertake its own research in order to adapt the CHI for the Waikato River, especially its wider sections and lakes (Waikato River Authority, 2014).

While it is good that Tipa and Teirney validated their tool against other river/stream types and in a different rohe, greater validation would have given the people more confidence in the CHI. Selecting one additional site or one different river/stream type for one other iwi is not extensive validation. While time and budget constraints probably played a role in this reduced validation, including a wider selection of sites from around New Zealand would have been beneficial to the tool. Particularly, it would give iwi/hapū from rohe outside of the two selected districts confidence that their values had been incorporated into the CHI, and that it would work for them.

Land Use Capability

The land use capability (LUC) classification system is another good example of an EDSS designed for New Zealand purposes. Designed in 1969 as a joint effort by councils, scientists and researchers from New Zealand Crown Research Institutes (CRIs), the LUC combines rock type, soil, slope, erosion, vegetation and climate information to classify land into eight LUC classes (Lynn et al., 2009). These classes provide landowners with a general understanding of what their land could be based on the land's limitations (Figure 3.3). While the basic LUC classification is presented in the LUC Handbook (Lynn et al., 2009) which landowners can retrieve from a variety of sources (e.g. via an internet search, councils, CRIs etc), it has also been incorporated into online, web-based EDSS, such as the Māori Land Visualisation Tool (Landcare Research, 2014) or the LRIS Portal (LRIS Portal, 2014).

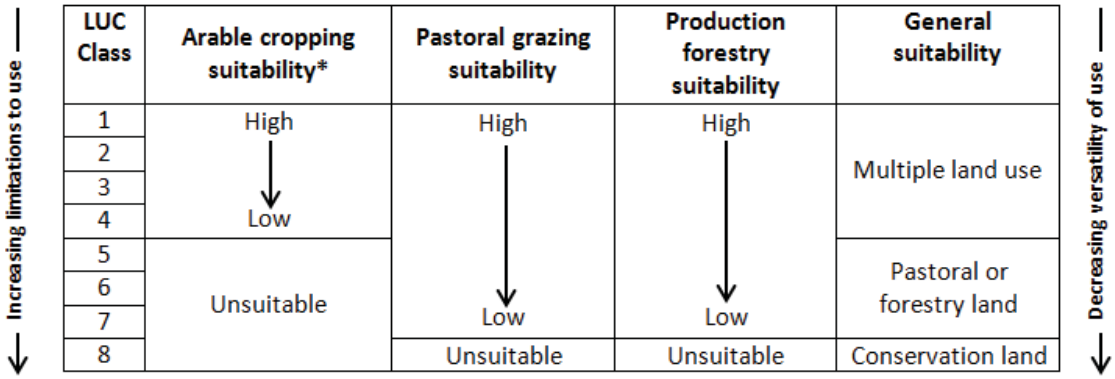

Figure 3.3: New Zealand's Land Use Capability classification system. **"**Increasing limitations of use and decreasing versatility of use from LUC Class 1 to LUC Class 8. *Includes vegetable cropping" (Lynn et al., 2009, p. 9).

These online versions fall into the DDS category of GIS. These systems use a mixture of aerial photography and GIS capabilities allowing landowners to map out or select their property. An LUC layer will provide broad level information about what their land is considered suitable for (Landcare Research, 2014; LRIS Portal, 2014). The LUC handbook was developed first, but advances in technology require the handbook and the online tools to be updated in tandem. Indeed both provide much of the same basic information (such as how to contact expert advice), but their different forms (paper based versus web or computer tools) allow their information to be utilised by different categories of landowners.

The LUC can provide landowners with broad recommendations for land use covering three main categories: arable cropping, pastoral grazing and production forestry. The system does not provide in-depth detail and further research is required by the landowner to meet specific needs. At this broad level, the LUC may be more suitable for land consultants and council advisors (e.g. Regional or District Councils). Using online tools, and geographic information systems, they are able to examine appropriate digital layers such as legal boundaries, NZLRI Land Use Capability, streams and roads. In this way the LUC tool provides a good starting point for landowners allowing them, via a range of different facilitators, to determine the best land use option for their land. Without providing that initial starting point, many landowners would probably become swamped with land use information, becoming disheartened by the process of trying to work out the most appropriate land use for their land. By providing that starting point, the LUC classification system allows landowners to quickly determine if their initial ideas will work or not, saving them from potentially bad situations further down the land use

options pathway (e.g. trying to farm on steep, erosion prone land that would be better suited to planting in order to stabilise the soil) (Lynn et al., 2009).

Mauri Assessment Model

The Mauri Model has been developed by Morgan from 2002 onwards. It is a "decision making framework that combines a stakeholder assessment of worldviews, with an impact assessment of indicators to determine sustainability and trends over time" (Mauri-o-Meter, 2014, p. Introduction). The model uses the concept of mauri (vital essence, life principle) as a measure of sustainability, which allows for a more accurate representation of impacts caused by actions (Harmsworth & Awatere, 2013; Mauri-o-Meter, 2014). As part of the concept of mauri the model uses the four dimensions of taiao mauri (environmental wellbeing), whānau mauri (economic wellbeing), community mauri (social wellbeing) and hapū mauri (cultural wellbeing), with selected indicators based upon the impacts on mauri for each dimension (Harmsworth & Awatere, 2013; Mauri-o-Meter, 2014; Morgan, 2006).

From its initial development, the Mauri Model has been used in a variety of indigenous projects, and has now been developed into an online tool. Both the Mauri Model and the Mauri-o-Meter webpage cover multiple categories of DSS: predominantly EIA, ERA and SIA, but also LCA and MCDA depending upon the indicators selected by the user.

The Mauri-o-Meter webpage provides an introduction to the tool, and also gives examples of recent projects that have used the tool, such as managing the aftermath following the Rena disaster. The website is clear and easy to navigate. It also offers users the choice of having the content displayed in English or Māori language, the first Māori DSS examined for this research that provides this feature. There is a step-by-step guide that includes images and clearly shows users how to use the tool to start their own online assessment of mauri for their project. For those who need additional help, a contact email is supplied.

The Mauri-o-Meter provides users with a range of templates that they can select from a list, or users can create a custom template for their project. Each template provides a list of dimensions (ecosystem, cultural, community and economic) and users can then chose the most relevant indicators for each dimension (Figure 3.4). Once the indicators for each dimension have been selected the user can then determine the state of each indicator (destroyed, diminishing, neutral, enhancing or restored). The state of each indicator is represented at two points in time, to show how a project is impacting on the Mauri over time. The diagram above the data entry section of the template helps users by showing them visually the state of Mauri at each level. Once the template has been filled out users can then

create a report on the Mauri of their project (red box), or reset the state of their Indicators (blue box).

The only real limitation of the Mauri-o-Meter is that it tends to focus more on the marine environment, with less emphasis on other ecosystem types. Having the ecosystem indicators in the drop down lists focus more on other indictors of Mauri, such as a reduction in pest or weed species or erosion levels, could also be helpful for users. However, the custom templates do allow users to create a project based upon their criteria/setup so there is provision there for other ecosystems.

Since 2002 the Mauri Assessment Model and the Mauri-o-meter appear to have been used frequently by groups and researchers looking to understand how the mauri of a site has changed. The ability to provide users with easy to follow steps, screen shots, language choice, frequently asked questions and examples shows that the usability of the tool has been seriously considered. By creating an online version of the tool, the Mauri model has been made accessible to a wider range of people, enabling them to use the tool for themselves whenever they want to. A publications list, including peer reviewed articles, also provides users with a sense of robustness about the model and how it was formed. Overall this is a well thought out and simple, easy to use DSS tool that incorporates social, cultural, economic and environmental factors into the decision making process (Fa'aui & Morgan, 2014).

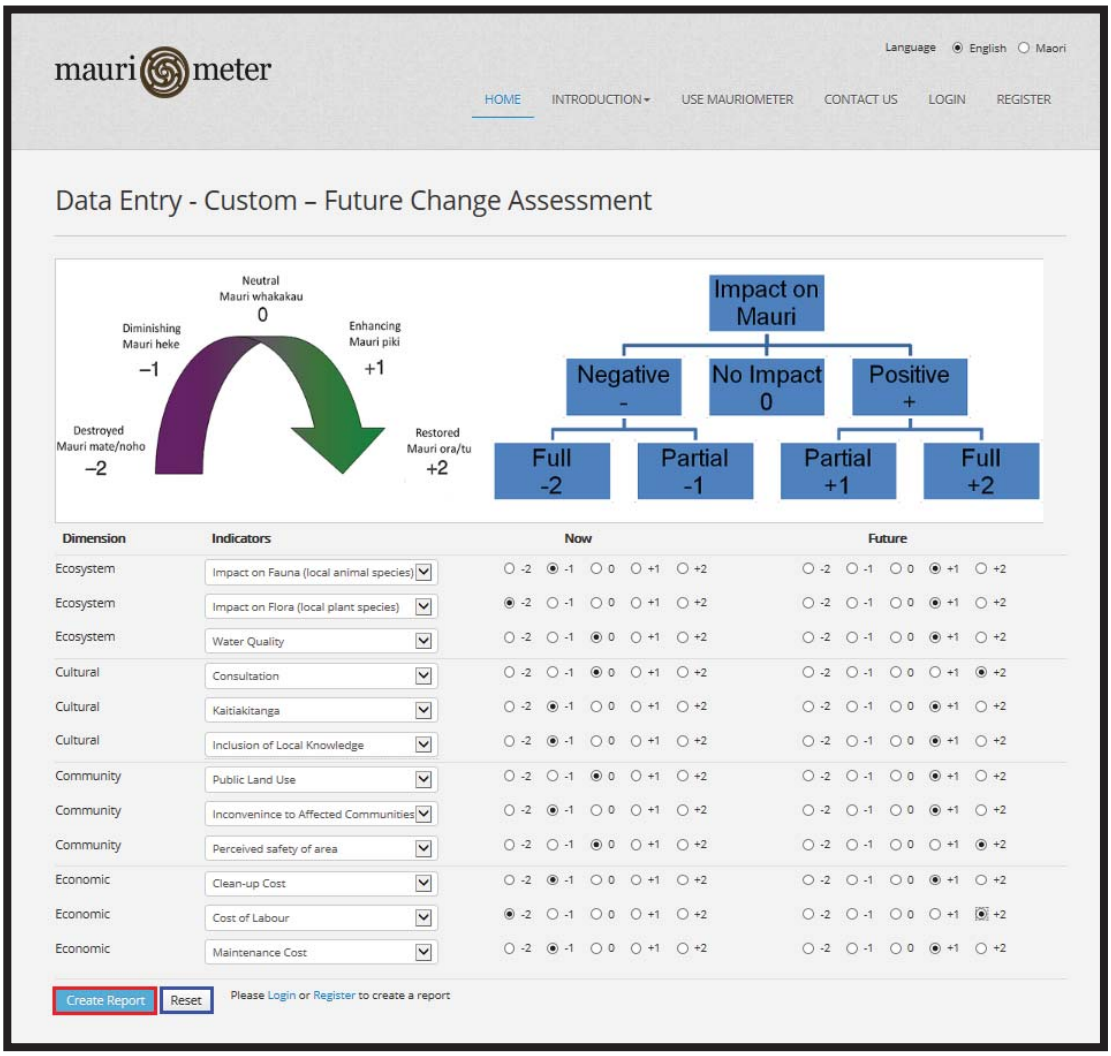

Figure 3.4: Custom template from the Mauri-o-Meter, showing the dimensions, indicators and level of Mauri (at two points in time) that are selected by the user to create a report for their project.

Māori Wetland Indicators

The Māori wetland indicators were developed during the second phase of the 'Co-ordinated Monitoring of New Zealand Wetlands' project (Harmsworth, 2002b; Harmsworth & Awatere, 2013). This phase of the project was designed to create a Māori-based monitoring approach for the assessment of wetlands, as well as a set of mātauranga Māori based indicators (Harmsworth, 2002b; Harmsworth & Awatere, 2013). These mātauranga Māori based indicators would then be trialled, verified and calibrated in the field for national application (Harmsworth, 2002b).

Because it was important for Māori that the Māori wetland indicators accounted for indigenous knowledge, Māori cultural perspectives and complemented existing scientific

knowledge, a number of iwi and hapū from around New Zealand participated throughout the research process (Harmsworth, 2002b; Harmsworth & Awatere, 2013). To achieve this blend of scientific and indigenous knowledge for the development of Māori wetland indicators the research was based upon the following questions:

- "How do Māori see their environment changing in time?
- How do Māori assess the state of health of the environment?
- What indicators do they use?
- There is a strong link between environmental change and Māori wellbeing. How can this be taken into account in environmental monitoring?
- How can Māori knowledge be used to underpin environmental monitoring?
- How can monitoring by Māori complement other approaches?" (Harmsworth, 2002b, p. 5).

Wetlands are seen by Māori as an important source of traditional materials (harakeke, raupo and toetoe for weaving and medicinal plants) and food (tuna, birds, reptiles, insects, fish etc) (Harmsworth, 2002b). Wetlands are often important historically and culturally, and some are regarded by Māori as taonga or may be wahi tapu (Harmsworth, 2002b). By using the above questions in hui with Māori, Harmsworth (2002b) was eventually able to create a list of nine key Māori wetland indicators (derived from a list of over 100 initially recorded scientific and Māori indicators). These nine indicators were all based upon Māori knowledge and expertise, they express how Māori see the environment changing over time, the way they view and perceive the state of health of the environment and how they wish to assess and report on the environments health. The indicators can also monitor positive and negative environmental changes, with indicators 4 to 8 being the most critical for assessing environmental change from a Māori perspective (Harmsworth, 2002b).

1. "Percentage area of land uses/riparian factors affecting cultural values;
2. Number of point (sites) sources of pollution degrading te mauri;
3. Degree of modification (draining, water table, in-flows, out-flows) degrading te mauri;
4. Number (and change) of unwanted (e.g. exotic, introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting cultural values;
5. Number (and change) of taonga species within wetland;
6. Percentage area (and change in area) of taonga plants within total wetland;
7. Percentage area (and change in area) of unwanted (e.g. exotic, introduced, foreign) plants covering total wetland;

8. Assessment of, and change in, te mauri (scale); and
9. Number of cultural sites protected within or adjacent to wetland" (Harmsworth, 2002b, p. 32).

These nine indicators were designed to complement scientific and other Māori approaches, as well as to support long term monitoring programmes and cultural impact assessments (Harmsworth, 2002b; Jollands & Harmsworth, 2007). To date, the above indicators have been incorporated into several iwi and hapū monitoring plans, have been examined to determine their validity and have been recognised by the national wetlands monitoring handbook and WETMAK (Wetlands Monitoring and Assessment Kit) as a complementary cultural method to western scientific methods (Jollands & Harmsworth, 2007; New Zealand Landcare Trust, 2012; Robb, 2014).

According to Robb (2014), while more work could be done to improve the ability of nine indicators, overall the Māori Wetland Indicators provide a good indication of site health. They also provided a "wealth of information that could not be captured through scientific sampling, such as the presence of dye sources, loss of bird/fish species and baseline information on the past condition" of the wetland which "confirms that our understanding of wetland health is enhanced through the inclusion of cultural values" (Robb, 2014, p. ii). Potentially, these indicators have the ability to be modified over time as they are used more frequently and people gain a better understanding of their strengths and weaknesses. Different Māori groups, who may have their own indicator preferences, could also modify these indicators to suit their own needs. Overall though, these indicators provide a good starting point for including Māori cultural values in the assessment of wetland health (Robb, 2014).

Visualising Māori Land (Whenua Viz)

Visualising Māori Land is a "prototype tool for accessing and interpreting environmental information about Māori land" (Landcare Research, 2014). Developed by Landcare Research and Swirling World with funding from Te Puni Kōkiri, Whenua Viz (common name) is an online DSS that was created in order to aid anyone with an interest in Māori land access or who wants to visualise the underlying environmental data of Māori land (Landcare Research, 2014). While the DSS can be used by anyone, it has been specifically designed for Māori landowners to help them answer the following questions:

1. "Where is my land? What is the location of my land block?
2. What does my land look like? What are its physical characteristics?
3. What is around my land? Other blocks? Land resources?

4. What can I do with my land? What is its potential? Opportunities? Constraints?" (Landcare Research, 2014).

Whenua Viz is a GIS type of DSS which aims to answer the above questions by taking data from a range of different national datasets (Table 3.2), and undertaking some basic modelling to provide basic information for Māori landowners on land suitability, resource characteristics, land potential, versatility for use and sustainable land use recommendations.

Table 3.2: The national datasets that underpin the environmental modelling in Whenua Viz, the groups that maintain the datasets and how those datasets are used.

Organisation	Dataset	Use
Landcare Research	Fundamental Soil Layers	Soil properties analysis
	NZ Land Resource Inventory Land Use Capability	Land use capability analysis
	FSL Soil Drainage	Soil drainage
	Predicted Pre-human Vegetation	Historical vegetation
	Land Cover Database v2	Current vegetation
	Wetland database	Historical and current wetland extent
	Generated and derived climate surfaces	Climate surfaces
Te Puni Kōkiri	Māori Land Information Base	Māori land parcel data
DigitalNZ	DigitalNZ search API	Place name search
Statistics NZ	2009 Census boundary data (NZMG)	Regional and urban area boundaries

Whenua Viz is a prototype tool that was developed in 2009 to 2012 by Landcare Research, under contract to and in partnership with Te Puni Kōkiri (Landcare Research, 2014). Since that time no work has been undertaken to turn this from a prototype into a fully functioning and supported DSS. In addition to this, the cadastral information for the land blocks (administered and owned by the Māori Land Court and Ministry of Justice) was last updated in February 2011 (Landcare Research, 2014). Given that some tribal groups are still negotiating with the New Zealand Government over land hand backs, Whenua Viz is effectively three years out-of-date regarding the addition of subsequent land blocks and any updates to existing land blocks that may have occurred. The DSS also relies on ten underlying national datasets that are maintained by four different organisations. Therefore, Landcare Research is responsible for ensuring that Whenua Viz is maintained with all of the latest releases of those layers at all times.

Whenua Viz has some problems that would not be difficult to fix. The mapping functionality is basic, but allows users to choose between terrain, map or satellite imagery for the base map. Overlays of the different national databases can then be added from a drop down list, located in the top right hand corner of the map. These layers can help users to determine the most appropriate land use options for their land blocks. However, because Whenua Viz uses the LUC classes, it really only concentrates on the main land use options in New Zealand (forestry, cropping, horticulture, pasture and protection). Having different land use categories available, such as viticulture, manuka honey, flax fibres or native timber production, could be beneficial by encouraging landowners to think about alternative land use options.

Whenua Viz also relies upon the users of the tool knowing that they are landowners and that they know where their land blocks are located or called. The tool offers users three different ways of locating their blocks from zoom in/out map functionality, through to a search bar where users can either enter their block's name (e.g. Rangitoto A 24B) or the area where they suspect the block to be located (e.g. Rotorua) (Landcare Research, 2014). However, a more active link between Whenua Viz and Māori Land Online could be beneficial; the latter being a tool that provides users with the ability to find out if they have shares in any land blocks, the location of those blocks and if those blocks are currently under the care of a trust/incorporation. By linking these two tools together, the developers would make one super EDSS for users, providing them with the ability to go to one place to obtain all of their answers regarding the location of their land, other owners, and what that land would be suitable for.

Whenua Viz is not intuitive to use. It was hard to find the information showing users what types of land use options could be best suited for their land. This is because the tool calls them overlays, which unless a user has a technical background, makes no sense and could lead to frustration as they try to work out how to find and add this information to their map. The lack of supporting documentation for users to gain a better understanding of how to use the tool does not help the situation either. It is hoped that such documentation would be developed when the transition is made from a prototype to a fully functioning DSS tool.

Overall, Whenua Viz is another tool that has not been greatly utilised since its development[4]. It is a basic online tool that would benefit from further engagement with end users. Issues which could be rectified include: Ensuring the Client Enquiry Form will close when the close button is selected and including a wider selection of Māori words/phrases. While it is understood that

[4] The researcher was unable to locate any reviews/documents relating to the use of Whenua Viz by Māori since its development. As such, this paragraph is a summary of the researchers own review of the tool.

any prototype will not have the functionality of the final tool, the lack of finesse could discourage potential users. Despite these failings Whenua Viz holds a lot of promise for helping Māori landowners to find out about appropriate land use options.

As the above examples have shown, researchers and developers are working with Māori landowners to create EDSS that include features that aid Māori decision making, including the ability to locate their land, changes in mauri over time and the modelling of different scenarios. In some instances, Māori are being included in the design process from the start, enabling clearer communication and incorporation of their needs, concepts and features. Section 3.5 builds on the above sections to show why it is important to including indigenous knowledge in EDSS.

3.5 The Importance of Indigenous Knowledge

When it comes to the natural world there are many different ways of understanding and managing landscapes and the environment. Most scientists, researchers and policy makers often only utilise specific scientific knowledge appropriate to a landscape or an environment of interest that they seek out when devising management strategies or policies. However, there is increasing recognition that there are other types of knowledge that can also aid decision making processes or the formation of management strategies; specifically indigenous, traditional and local knowledge (Jollands & Harmsworth, 2007; Stevenson, 1996; Taiepa et al., 1997).

Around the world, indigenous peoples have been increasingly isolated and alienated from their lands, often facing decision making barriers regarding how they manage their resources. This is often because central and local government frameworks do not adequately reflect the indigenous approach to management. For example, Māori have strict rules regarding the management of resources, using the concepts of mana, tapu, rāhui and mauri to underpin their management strategies; concepts Pākehā are only just beginning to understand and include (Akiyama, 2010; Colchester, 2004; Royal, 2015; Taiepa et al., 1997). Such differences have seen policy makers historically shun offers by indigenous peoples to help manage landscapes/environments and the resources contained within them.

However, indigenous peoples around the world have fought this alienation, taking their cases to the United Nations (UN) and other governing organisations, seeking both national and international recognition. As a result, in 1983 the UN created the ‘Working Group on Indigenous Populations’ followed by the ‘Declaration on the Rights of Indigenous Peoples’ in

1993 (Colchester, 2004). The Kinshasa Resolution in 1975, the Rio Earth Summit and Agenda 21, as well as a host of other events, have also recognised the rights of indigenous peoples around the world and have put increasing pressure on local governments to uphold these rights (Colchester, 2004; Taiepa et al., 1997).

Following these international agreements national policies emerged, acknowledging and reinforcing the rights of indigenous people in their own countries. In New Zealand both versions of the Treaty of Waitangi were recognised as the founding documents of New Zealand, and as such important to Māori cultural, spiritual, historical, social, environmental, traditional rights and mental and physical well-being (Ministry of Justice, 2015). This recognition gave rise to the inclusion of Māori rights in many significant pieces of New Zealand legislation (see Section 2.5) (Harmsworth, 2005). This inclusion of Māori rights was often specified by consultation processes and the inclusion of Māori indigenous knowledge about an activity, environment or species in policies and plans (Harmsworth 2005).

Stevenson (1996, p.280) describes indigenous knowledge as "the knowledge, experiences, wisdom, and philosophies that aboriginal people can bring to bear on environmental assessment and management". Berkes and Berkes (2009, p. 7) describe indigenous knowledge as body of knowledge built up by a group of people through generations of living in close contact with nature". Stevenson (1996) argues that indigenous knowledge is comprised of both non-traditional and traditional knowledge (Figure 3.5). Non-traditional knowledge is knowledge obtained through interactions with non-aboriginal institutions and people; formal schooling in literacy and numeracy; television and modern media; exposure to foreign philosophies, values and attitudes; and adoption of Western scientific thinking (Stevenson, 1996). Traditional knowledge is formed from a community's unique shared experiences, social interactions, teachings passed down through generations, spiritual beliefs, customs and traditions and consists of both traditional ecological knowledge and other traditional knowledge (Berkes & Berkes, 2009; Stevenson, 1996). The way in which non-traditional knowledge combines with the traditional knowledge systems creates a world view or frame of reference that validates and provides meaning to contemporary indigenous peoples (Stevenson, 1996).

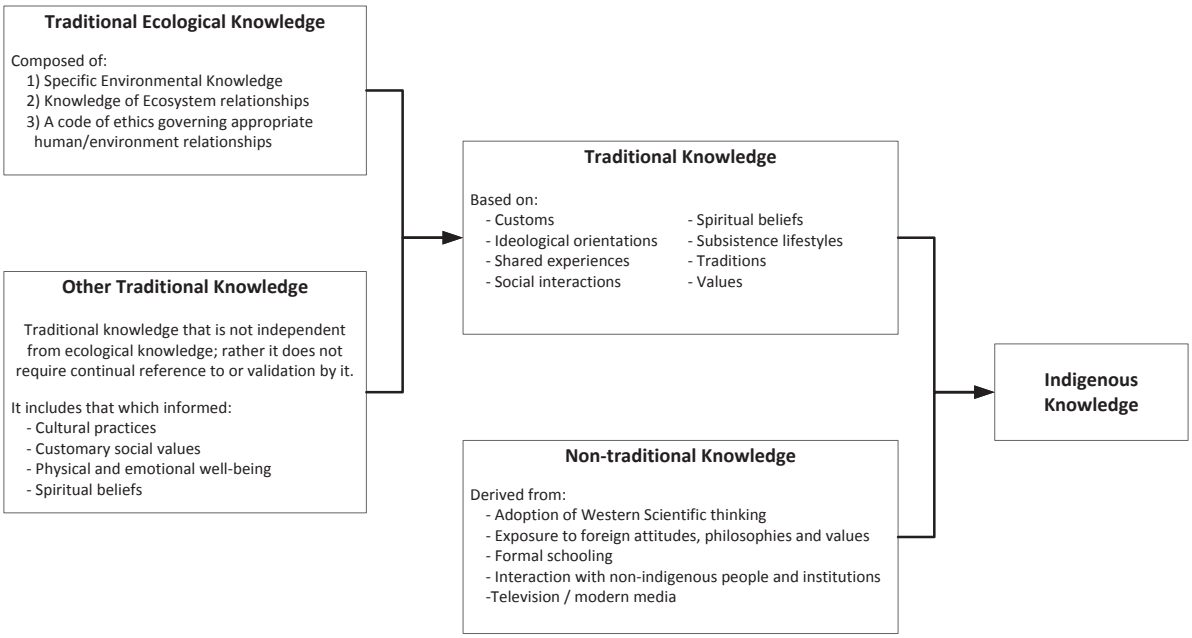

Figure 3.5: Flow diagram showing the various components of indigenous knowledge, and what those components consist of (Berkes & Berkes, 2009; Stevenson, 1996).

It is important for indigenous knowledge to be included, both in the development of policies or EDSS, or in the management of land and resources. While including indigenous knowledge is often seen as an easy way of meeting the legal requirements around indigenous peoples' rights, if accepted, indigenous knowledge can provide a different perspective or important supplementary information about a landscape and its resources. Indigenous knowledge has largely been excluded from Western research primarily because research struggles to incorporate such information, other than to call it social values or value judgements (Arquette et al., 2002; Stevenson, 1996). Indeed Western research sometimes has a tendency to focus on the standard population, not being overly concerned with dealing with those who fall outside the main population (Arquette et al., 2002). Western research also tends to be more quantitative in nature, while indigenous knowledge tends to be more qualitative, focusing on years of observations and discussions with other people to form intricate mental models (Berkes & Berkes, 2009).

By talking and listening to indigenous peoples, and not just treating their knowledge as "nice stories", or something belonging to a time long ago that has no relevance for today (Arquette et al., 2002, p.261), researchers can learn a lot about the history and patterns of the landscape and its resources, which can supplement their own scientific knowledge. By combining scientific with indigenous knowledge researchers can build up a holistic picture of the land,

thus giving them the ability to make more fully informed decisions (Arquette et al., 2002; Berkes & Berkes, 2009; Colchester, 2004; Raymond et al., 2010; Stevenson, 1996).

However, researchers need to be careful about the ways in which they gather and interpret indigenous knowledge. Much like Western knowledge, indigenous knowledge is "contextual, dynamic and forever being revised" (Stevenson, 1996, p. 282). Therefore, the way in which indigenous knowledge is collected, interpreted and applied should be determined by the indigenous people themselves (Stevenson, 1996). Researchers should also be careful that having gathered the knowledge from the indigenous people, they do not then reinterpret the information (Hayes, 2003; Stevenson, 1996). Reinterpretation may give the terminology used a clearer meaning to the researchers, but it may not be the correct meaning (Stevenson, 1996). Such reinterpretation defeats the purpose of collecting indigenous knowledge in the first instance, and can lead to hostile relations with the indigenous people (Stevenson, 1996). Overall, modern researchers are becoming much better at including indigenous knowledge into their research by using processes like stakeholder participation, or co-ownership of projects with indigenous people, to improve the research outcomes for all concerned (Taiepa et al., 1997).

The harvesting of tītī (mutton birds) by Rakiura (Stewart Island) Māori is a good example of the use of indigenous knowledge to manage a resource. Tītī chicks or fledglings were originally harvested as a food source, and their harvesting was governed by a strict code of regulations first introduced in 1910 by the Rakiura Māori (Taiepa et al., 1997). This code still governs the harvest of tītī today. In 1993 the Rakiura Māori joined forces with the University of Otago to create a joint ten year research programme (Taiepa et al., 1997). The aim of the programme was to supplement generations of indigenous knowledge with modern scientific knowledge to better understand the influences on tītī population numbers (e.g. the impact of fishing nets and longlines) (Taiepa et al., 1997). In order to disprove disparaging attitudes the research also aimed to produce scientific evidence that the harvest of mutton birds was sustainable and did not have a major impact upon their overall population (Taiepa et al., 1997).

This research programme is very important for New Zealand and indigenous people. The Rakiura Māori recognised the clear need to support their indigenous knowledge of tītī with scientific knowledge. Using a joint research programme to produce knowledge on the impact modern society was having on the tītī provided the Rakiura Māori with knowledge about impacts that they may not necessarily be able to observe first hand. They could also use the research to examine traditional impacts on the birds. Finally, by using scientific knowledge to

challenge Western thinking, they could validate their indigenous knowledge, supporting their right to manage resources in the manner of their choosing (Taiepa et al., 1997).

The tītī research programme is a good example of the importance of combining indigenous knowledge with Western scientific knowledge. It also shows how indigenous knowledge can provide a different perspective on natural resource management. This perspective difference is important to capture in EDSS, via stakeholder participation, as it should help to create a more robust tool for making decisions regarding land and other natural resources. The following chapter will consider the importance of stakeholder participation and indigenous knowledge, as well as the strengths and weaknesses of EDSS, to design the research methods for this study.

4 RESEARCH DESIGN

The research question that this thesis seeks to address is “How can current Environmental Decision Support Systems be improved to better meet the stated needs of Māori landowners”. Chapters 2 and 3 have laid out why it is important to consider Māori landowners as a distinct stakeholder group when it comes to developing EDSS. Māori values have also been explored, as have examples of EDSS that have already been developed for Māori. The history of Māori people, their values and the learnings from current EDSS failings and successes will influence the design of future EDSS.

This chapter works to understand the stated needs of Māori landowners, by building upon the previous chapters to outline the research design. The research methods, including survey development, identification of stakeholders and data analysis, are presented next. The procedures for recruiting and obtaining informed consent, and the strengths and weaknesses of a case study approach follow, before the final section identifies and addresses the limitations of this work.

4.1 Research Design

When determining the appropriate approach for this research the literature on designing EDSS strongly suggests using stakeholder participation in order to design a tool that will be of use to people for their specific purpose (Hansen & Propseri, 2005; Kingston et al., 2000; Luyet et al., 2012; Reed, 2008; Voinov & Bousquet, 2010). Once the stakeholders are identified the researchers or developers can use a wide range of strategies to gather the data and information that will be used to design the final product. This study does not focus on the design of a specific tool; rather it looks at how different stakeholder groups have different needs, values and preferences and how that can influence the fundamental initial design of a tool.

Stakeholder participation methods range from workshops, table top exercises, interviews (both structured and semi-structured), online forums, task forces and group sessions to surveys and questionnaires (Hansen & Prosperi, 2005; Kingston et al., 2000; Milbrath, 1981; Reed, 2008; Reed et al., 2009). As this work is also going to benefit Scion going forward, it was deemed wise to engage with social scientists at Scion in order to determine if Scion had a standard methodology for engaging with stakeholders.

Consultation with Scion social scientists revealed that there was no standard methodology for engaging with stakeholders. Indeed the process varied depending upon the stakeholder groups

and the research being conducted (K. Bayne, personal communication, April 10, 2014). However, workshops, working groups, interviews and surveys were the preferred methods used at Scion, including mixed-modes (K. Bayne, personal communication, April 10, 2014). Surveys had already been shortlisted as a potential method for this research. If groups with a wide geographical spread need to be contacted then surveys provide an effective mechanism to do so (Dillman, 2000). Surveys can also be easily combined with interviews as a means of engaging with the identified stakeholders (Milbrath, 1981). Finally, surveys can be sent out in a variety of mechanisms (paper-, electronic- or internet- based surveys), which enable a greater range of participants to take part in answering the survey, and can reduce the cost of the study (Milbrath, 1981). It was suggested by Bayne (personal communication, April 10, 2014) that Dillman's *The Tailored Design Method* be used to help create my survey, as he is a recognised expert in this field. Following Bayne's advice, the surveys used for the data collection in this study, and the accompanying contact information, follow Dillman's (2000) methodology for mail and internet surveys.

4.2 Research Methods

Survey Development

When designing a survey Dillman (2000) recommends that certain principles are followed in order to achieve the best results, including:

- Use simple words so that the question can be understood by as many people as possible.
- Have a question that every person should be able to answer as the first question. More people will be more likely to answer the following questions if the first question is simple to understand and answer as it increases their confidence. However, this question should not be a personal question, as this may make the respondents feel uncomfortable or that they are being judged and so they will be less likely to answer the questions or complete the survey.
- Group similar types of questions together (e.g. have all of the open ended questions, followed by all of the ranking questions etc). This makes it easier for the participants as they do not have to switch between question types.
- The survey should flow and questions in the same category should be grouped together (e.g. all of the demographic questions grouped together).
- Finally, if the key question is likely to be controversial (e.g. 'have you ever stolen something') then there needs to be an appropriate lead in to that question. By giving

the respondent time to relax and answer other questions first, then they are more likely to answer controversial questions later on. Wording of such questions, so that they are seen as being non-judgemental, will also increase a participant's willingness to answer such questions.

The final surveys (one tailored for trusts/trustees and one tailored for incorporations/committee members) comprised of 22 questions (Appendix 2). The first question was an easy one that all respondents could answer (Dillman, 2000), with the next four questions grouped around the topic of decision making (stage, resources used to make decisions and land use options). Questions six to eight focused on what influenced Māori land use decision making processes (including values and social, environmental and economic considerations). The following block of questions (9-15) were about decision making tools: whether respondents use current EDSS, positives and negatives of the tools and the medium and feature preferences for EDSS tools developed in the future. The remaining seven questions were aimed at collecting demographic information about the respondents (age, iwi/hapū, education etc.). The survey also included space for respondents to communicate any additional comments, as well as a final page containing information regarding participants' rights, confidentiality, key contacts and ethics information.

When designing the communication that goes with the survey there are certain principles that are recommended as they will yield a greater number of returned surveys (Dillman, 2000). A detailed account can be found in Chapter Four of *The Tailored Design Method* (Dillman, 2000).

Initially the trusts and incorporations were approached via email or phone to see if they were interested in participating. In the initial email a cover letter (Appendix 3) was sent out along with a copy of the survey for the trust/incorporation to look over. This initial contact requested meetings with the groups in person, so that any questions could be dealt with promptly.

Next a pack containing cover letters and surveys was sent out to each of the groups. Where requested, groups were visited in person so that I could answer their questions, describe my whakapapa and start building a personal relationship. At this time, if the groups or individuals desired it, the surveys could also be carried out orally, with the answers recorded. Only one group chose to orally record their answers with the researcher.

If after three weeks nothing had been heard from a group a reminder email or phone call was used to re-establish contact. The aim of the follow up was to act as a gentle reminder that their input was welcome. Following on from this initial reminder was the second reminder,

including another copy of the survey (in case the participant had misplaced their original copy). This reminder focused more closely as to why each participant's response was important, making this follow up more personal.

The final request for participants to return the survey was carried out by phone. This was for groups that had previously indicated that they would like to participate, but had not yet done so. It was hoped that when participants were faced with a more personal form of contact that they would respond more favourably. If no response was forthcoming after this attempt then it was highly unlikely that the participant would ever respond to the survey.

Identification of Stakeholders

Stakeholders were identified through discussions with Scion staff members, who are Māori themselves, or have experience working with Māori. Initially the possibility of surveying a random sample of Māori people about how they make land use decisions was considered.

Before beginning the process of selecting participants I spent time talking with the projects advisor (a Scion staff member, of local Māori descent). He advised that only Māori trusts and incorporations be approached as opposed to Rūnanga (n. Council, tribal council or board) or post-settlement Treaty groups. Both trusts and incorporations were formed from Māori Land Court decisions and these groups would be more likely to manage and make management decisions about their land (N. Meha, personal communication, 14th July 2014).

The main reasons for this was because it was suggested that a) not all Māori would know if they had received any land as part of their Treaty settlements; b) even if they did have land they may not know where it was located and c) most such Māori would probably not be involved in the day-to-day decision making processes that surrounded these land parcels (N. Meha, personal communication, February 28, 2014). By using the trustees and committee members as the stakeholder group in question, it was hoped to avoid these issues and obtain the relevant information from the people who are currently making land use decisions.

Data analysis

Given the nature of Kaupapa Māori research and the small final sample size of this study the following method was determined for the data analysis. For each question the answers were converted into a percentage. This enabled comparability between answers to each question. It also enabled ease of analysis as not all respondents answered all questions. For example, in question six, ten respondents answered, but for questions seven and eight, 13 respondents

answered the questions. By converting each set of answers to a value out of 100, it became easier to analyse the results.

Once all of the results had been converted into a percentage, the key findings and their implications from each question were noted for discussion. For ease of interpretation by the reader some of the results in Chapter 5 are presented in terms of number of respondents. This also acts as a reminder of the small sample size obtained for this study (and hence the limitations in terms of implications).

In some cases where it was felt there were gaps in the questions asked of the respondents, or clarification of answers was required, additional information was obtained in a follow up session with one of the respondents from Group D.

4.3 Procedures for Recruiting Participants and Obtaining Informed Consent

Ethical considerations

A "Notification of low risk research/evaluation involving human participants" was submitted to the Massey Ethics Committee before undertaking this research. This was approved on 17 September 2014 (Appendix 4). As part of the ethics approval the following statement was included on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Confidentiality

Confidentiality plays a vital role in studies such as this one. Those taking part in the survey were informed from the outset that all of their answers were confidential and an individual's answers would not be able to be identified. Participants were also made aware that undertaking the survey was a voluntary process and that they had the right to decline or

withdraw at any point. Where detailed analysis is needed, or quotes given, results or comments will be identified by group (e.g. Group A).

Recruiting participants

It was determined that a geographical spread of trusts and incorporations would add greater validity to the results. As Scion is already working with groups in the Bay of Plenty, East Cape and Northland regions of New Zealand it was decided that Māori trusts and incorporations in these regions would be approached for participation within this study. Due to concerns about time constraints, groups within the Bay of Plenty region were approached first. By dealing with nearby groups first it would also be easier to schedule meetings if required. Similarly, the initial interactions would give an indication of time frames involved in working with trusts and incorporations, and procedures for subsequent interviews could be adjusted accordingly.

It transpired that the process of data collection took much longer than anticipated. Most groups required a three month timeframe in which to receive the invitation to participate, ask questions and judge what they wanted to do/thought was the right process for the group and those they represent, and then to complete the surveys and return them. After this initial phase the procedure for recruiting participants was adjusted, and focused solely upon trusts and incorporations within the Waiariki rohe (wider Bay of Plenty area, including Rotorua, Taupo, Tauranga, Whakatane, Murupara, Kawerau, Tokoroa and Waihi). As a result, this study has evolved into a case study involving Māori trusts and incorporations from the Waiariki rohe, so any results should be used with care if future researchers wish to interpolate them for Māori groups outside of this rohe.

Initially, groups were selected for participation after discussion with the project advisor. With his help, a list of ten Māori trusts and incorporations was drawn up and approached, following Dillman's method (2000) for survey implementation. Te Puni Kōkiri was also approached with the request for their updated Te Kahui Mangai database details, as this would provide access to all of the contact information for all of the Māori groups around New Zealand. This database was then filtered to show the groups in the Waiariki rohe, with the final contact list consisting of 50 Māori trusts and incorporations.

Out of the 50 groups approached for this survey, four groups declined to participate, five groups agreed to participate (three trusts and two incorporations) and the remaining groups did not respond at all despite follow up emails (if a group did not respond to the two emails and phone call requesting their assistance with the research, it was presumed that they did not

wish to participate). Completed surveys were returned in person, mailed back to Scion or were scanned and emailed to the researcher's email address. As the completed surveys were received, the results were combined into an Excel spreadsheet and primary analysis was carried out (looking for patterns, responses that required clarification etc.).

4.4 Case Study Strengths and Weaknesses

When originally beginning this work it was hoped that Māori trusts and incorporations from Northland, the East Coast and the Bay of Plenty regions would be able to participate. These three regions of New Zealand were chosen due to the existing relationships that Scion already has with Māori in those areas. Unfortunately time constraints dictated that only trusts and incorporations in the Bay of Plenty rohe were approached, reducing this research to a case study. This section considers the strengths and weaknesses of a case study approach and how they have impacted upon this research.

Gerring (2004) defines a case study as "an intensive study of single unit for the purpose of understanding a larger class of similar units" (p.342). As already noted, one of the key benefits of a case study approach is that it allows researchers with limited time frames and/or budget constraints to still undertake research; in essence greater flexibility to undertake their research (Hodkinson & Hodkinson, 2001; Unitec Moodle, 2012). By focusing on a smaller geographic location, or sample population, researchers do not have to travel as far, or as often, to gather their data. This can save both time and money, which in turn may allow the researcher to return more frequently to their site, to gain deeper insights into a problem , or to gather more complex types of data (depending upon the research being undertaken) (Hodkinson & Hodkinson, 2001; Noor, 2008). Alternatively, a case study approach can allow researchers to spend a larger budget/amount of time of a smaller area or smaller population in order to better focus on their research question (Hodkinson & Hodkinson, 2001; Unitec Moodle, 2012).

With regards to working with Māori this may allow the researcher to spend more time with their participants. By holding more hui relationships can be built up along with participant/researcher trust (Bishop & Glynn, 1999; Carpenter & McMurchy-Pilkington, 2008; Jones et al., 2010). Researchers can also allocate more funds towards food for the meetings, and/or towards the koha (gift, offering, donation or contribution – especially one maintaining social relationships and has connotations of reciprocity (Māori Dictionary, 2015)) for the participants (Bishop & Glynn, 1999; Carpenter & McMurchy-Pilkington, 2008; Jones et al., 2010).

However, reducing the research to a smaller area or fewer participants is not without its own concerns. The sample area or population may not be representative of the whole population (Hodkinson & Hodkinson, 2001; Noor, 2008). Researchers must take extra care to select people or areas that are representative. Unfortunately, even when care is taken, bias in the sample population can still remain. In some instances it can be impossible to remove all bias and to get a representative sample. In those instances researchers can either try to remove the bias from the study, or they can try to minimise its impact on the research. Where mitigation is not possible, researchers can only record the bias and consider it within the limitations section of their work.

Regardless of whether the bias can be removed or not researchers need to be aware that their study may not representative of the whole population (Hodkinson & Hodkinson, 2001). As such they need to state so clearly in their write up. Further studies may be required at a larger scale or in other areas/using other participants in order to validate the findings.

Another advantage to the case study approach, particularly, when dealing with participants, is that the researcher may get a better response rate (Jones et al., 2010; Hutchings, 2002). For example, when working with Māori participants having a personal connection prior to the research is beneficial as the beginnings of a relationship are already in place (Jones et al., 2010; Hutchings, 2002). If a participant responds well to the researcher they may be a source of other potential participants or information, thus increasing the sample size (Jones et al., 2010; Hutchings, 2002). Conversely, respondents/participants may not warm to the researcher, resulting in answers, or data, that provide minimum details. In this instance the case study approach can be put in jeopardy due to the lack of data/information or participants. With the case study approach there are no other participants to bolster the research, and this can put strain on the researcher, their work and the participants.

4.5 Identifying and Addressing Limitations

As with any piece of research, case studies present both benefits and weaknesses in their approach. As long as researchers take care in their planning stage, and take note of and try to mitigate any form of bias, then case studies are a valid research method. Where a case study approach is used uncertainty regarding the validity of the results needs to be realised, with future research possibly being required to validate outcomes for the wider population.

While perhaps all such work about Māori should ideally be carried out by Māori researchers (Hayes, 2003; King, 1997) this is not always possible. As the researcher is not of Māori descent;

nor has any skill in Te Reo (Māori language) or previous experience working with Māori people in this type of situation, this required a different approach than that of a Māori/tangata whenua researcher. In order to minimise the bias from her solely European background the researcher relied upon the online Māori dictionary for translation purposes (Māori Dictionary Online, 2014) and used a support network of tangata whenua to check ideas and facts against. However, it remains that this work is still about Māori by a non-Māori person.

Another hurdle was obtaining a large enough sample size from participants. Although only five trusts and incorporations took part, the sample size is less than desirable. In consequence, the study has become a case study of the participating groups, and the Waiariki rohe, and the results were analysed as such. The recommendations arising from the study should be used merely as a starting point for future EDSS development; unless a representative sample of all Māori landowners in New Zealand are surveyed there is no guarantee that the results will be representative of the whole population.

Originally there was also a problem of trying to contact trusts and incorporations from diverse locations around New Zealand. However, due to time constraints Māori trusts and incorporations from the East Coast and Northland were unable to be surveyed; instead the focus shifted to surveying groups only located within the wider Bay of Plenty area (Waiariki rohe). This means that any results from the study may not be applicable to groups from outside the region. As such, any results would have to be checked against different groups by researchers or developers before undertaking any design work. While this is not detrimental in itself (researchers/developers should already be doing this work as part of their client consultation to ensure the development of the best possible tool), the aim of this work is to provide a starting point for said researchers/developers. If they use this work as a starting point for groups outside of the area then they need to be aware that extra adjustments may be needed.

Another area of potential weakness for this work relates to the way in which the respondents chose to answer the questions. It was requested that as many trustees and committee members within each trust/incorporation as possible answer the survey. The intention was that one survey would be filled in per person. However, to increase the response rate, respondents were encouraged to fill the surveys out in the way that felt most comfortable to them. Thus, the groups approached the surveys in different ways, filling them in as per the group's needs.

For example, in some cases one person from a Trust or Incorporation was selected to fill out the survey on behalf of the group; in others, all of the trustees/committee members sat down and filled out one survey between them all. In yet other cases, several trustees/committee members filled out a survey each. One group requested that the researcher attend their meeting while they filled out their survey, so that they could ask questions, and giving the researcher opportunity to take notes regarding how they approached answering the survey. Therefore, the analysis needs to incorporate some form of weighting, such as converting the answers in percentages, so answers are comparable across the groups.

In the future, this problem could be avoided by identifying the most appropriate Trustee or Committee Member to work with. This may be the chairperson, or even a member outside of the core decision making group, such as a kaumātua (elder, person with status). Researchers would have to be careful that this method of selecting survey participants does not impact upon Māori protocol, particularly regarding the mana (authority, prestige, power, authority) of the person or people approached (K. Bayne, personal communication, March 2, 2015).

5 RESULTS AND ANALYSIS

This chapter presents the results derived from the survey. The analysis is divided into five sections based on the five sections of the survey: Opening questions, Land use decision making, Influences on the decision making process, EDSS design and demographics. All results are based on the responses of the five responding groups that participated. As such they reflect the unique perspectives and experiences of these groups and cannot be safely extrapolated to other Māori trusts and incorporations, both within the Waiariki rohe and around New Zealand.

5.1 Opening Questions

The first two questions in the survey were designed to be easy for respondents to answer.

One hundred percent of respondents indicated that they do contribute to the decision making process regarding land use options for their trust/incorporation. This is a good result as it means that this survey has reached the target respondents, and as such their responses to the remaining survey questions can be included in the analysis.

The groups were then asked at which of three decision making stages regarding land use options for their land they were at:

- Stage One – Learning about the different available land use options;
- Stage Two – Implementing land use decisions; and
- Stage Three – Managing land use options.

Respondents could select as many of the three categories as they felt reflected their situation. As shown in Figure 5.1, 69% of respondents felt that they are encompassing more than one land use decision making stage. Only one respondent (8%) felt that their group was still at the initial stage (Stage 1 only), while two (23%) respondents felt their group had reached the final stage (Stage 3 only) of managing their selected land use options.

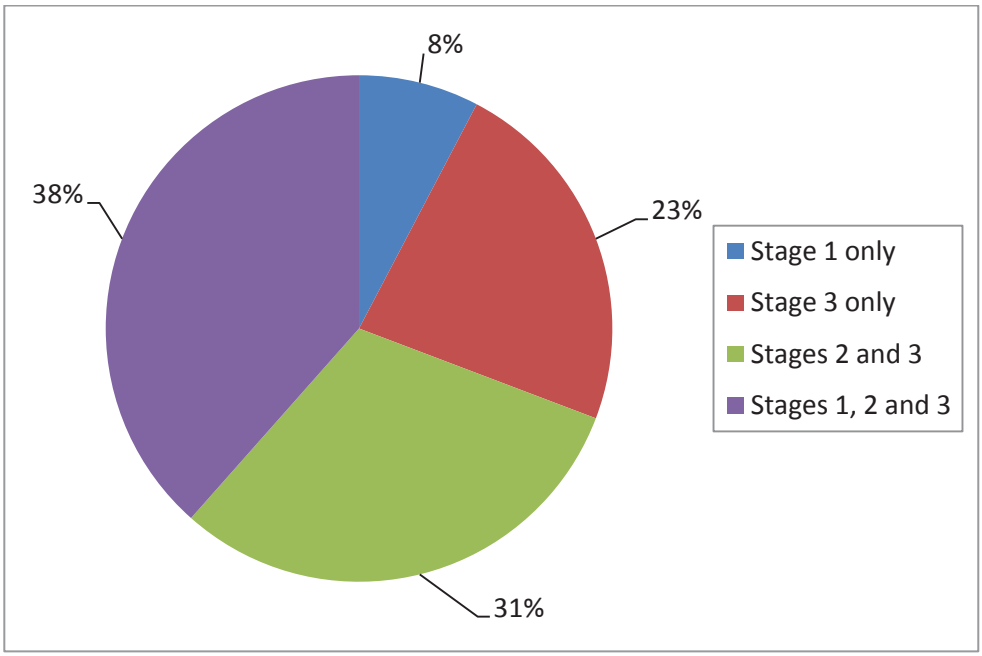

Figure 5.1: Land use decision making stages, expressed as a percentage of respondents.

5.2 Land Use Decision Making

The next three questions related to the resources used by Māori groups to make land use decisions and the land use options that were suggested to and of most interest to the groups.

Resources used to aid land use decision making

Table 5.1 illustrates that external consultants were the resource used most frequently by respondents, with 80% of respondents using external consultants often or frequently. Mātauranga Māori and personal experience were used by 70% of respondents often or frequently to aid their decision making. In comparison, 80% of respondents never or rarely used libraries as a resource and 60% of respondents never or rarely used friends to aid land use decision making.

Table 5.1: Resources used by respondents to aid their land use decision making process, expressed as a percentage of respondents. The Resources are listed from those most frequently used to those never used by the respondents.

Resource	1 Never Used	2 Rarely Used	3 Neutral	4 Often Used	5 Frequently Used	No answer given	Total (%)
External consultants	0	0	20	30	50	0	**100**
Mātauranga Māori	10	0	20	40	30	0	**100**
Personal experience	10	0	10	40	30	10	**100**
Workshops	0	30	30	20	20	0	**100**
Whānau	10	20	30	20	20	0	**100**
Computer software	20	20	40	0	10	10	**100**
Technical documents	0	10	30	60	0	0	**100**
Internet	0	30	30	40	0	0	**100**
Other Trusts	10	20	30	40	0	0	**100**
Regional council	0	40	30	30	0	0	**100**
Friends	30	30	20	10	0	10	**100**
Library	50	30	0	10	0	10	**100**
Field days	10	40	50	0	0	0	**100**
Other	0	0	0	0	0	100	**100**

Given that external consultants were used so frequently by the respondents it would have been beneficial to gather additional information on this resource type. In particular, what types of consultants were used by the groups, how often the groups used the consultants, and why the groups utilised the consultants would all have provided additional information that could be incorporated into future EDSS. These are questions that future studies could examine.

Land use options

Respondents were next asked about which land use options have been recommended to them as suitable options for their land, and which land use options they would like to receive information about. As shown in Figure 5.2, 90% of respondents had the land use options eco-tourism and recreation suggested most frequently to them by consultants. In contrast, only 20% of respondents had received information about orchards. Of the four respondents who received information on other land use options, three were for kaumātua housing or papa kāinga (original home, home base or village), while the person had farming goats suggested as a land use option.

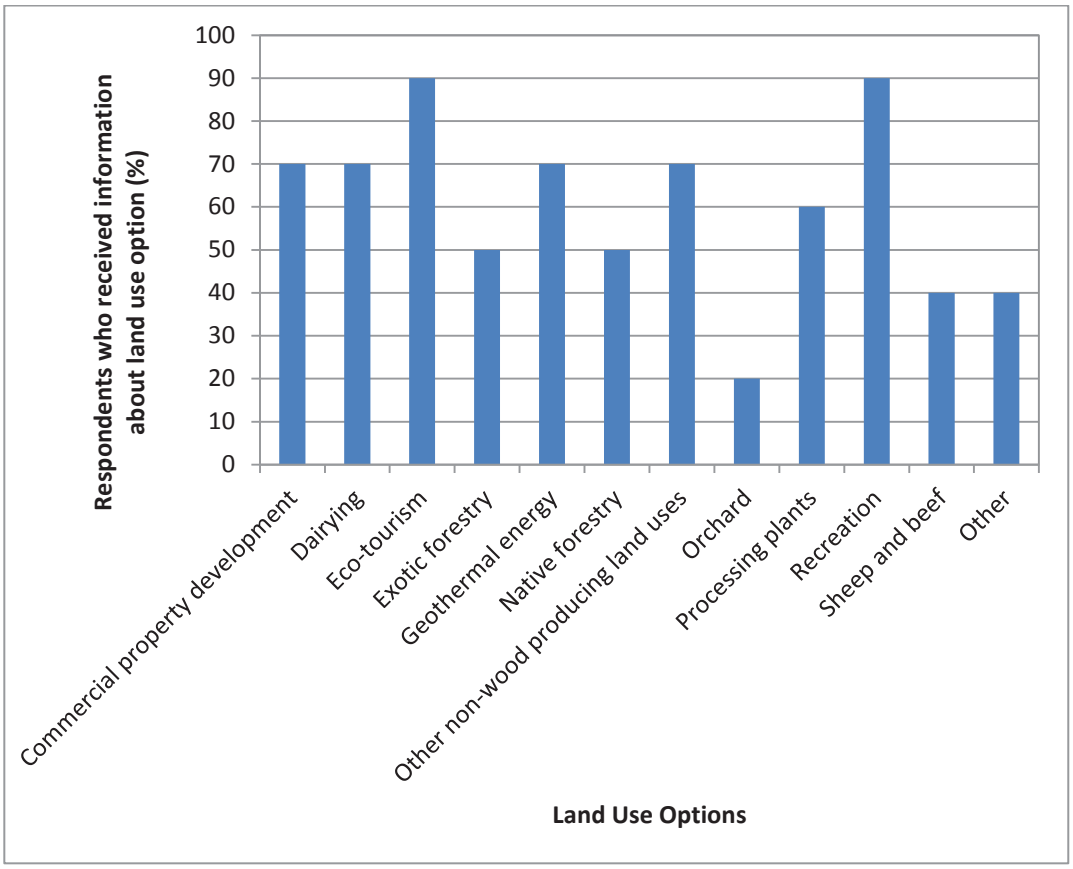

Figure 5.2: Land use options that were suggested to the respondents as suitable land use options for their trust's/incorporation's land, expressed as a percentage of respondents.

Figure 5.3 demonstrates that the land use options that most respondents wanted information on were eco-tourism (90%) and recreation (80%). Native forestry and renewable energy also featured strongly (70% and 60% respectively). The land use options that fewest respondents wanted to receive information on were sheep and beef (zero respondents), orchards (two respondents), exotic forestry (two respondents) and dairying (four respondents). These results clearly show that the Māori groups surveyed favour non-production land uses.

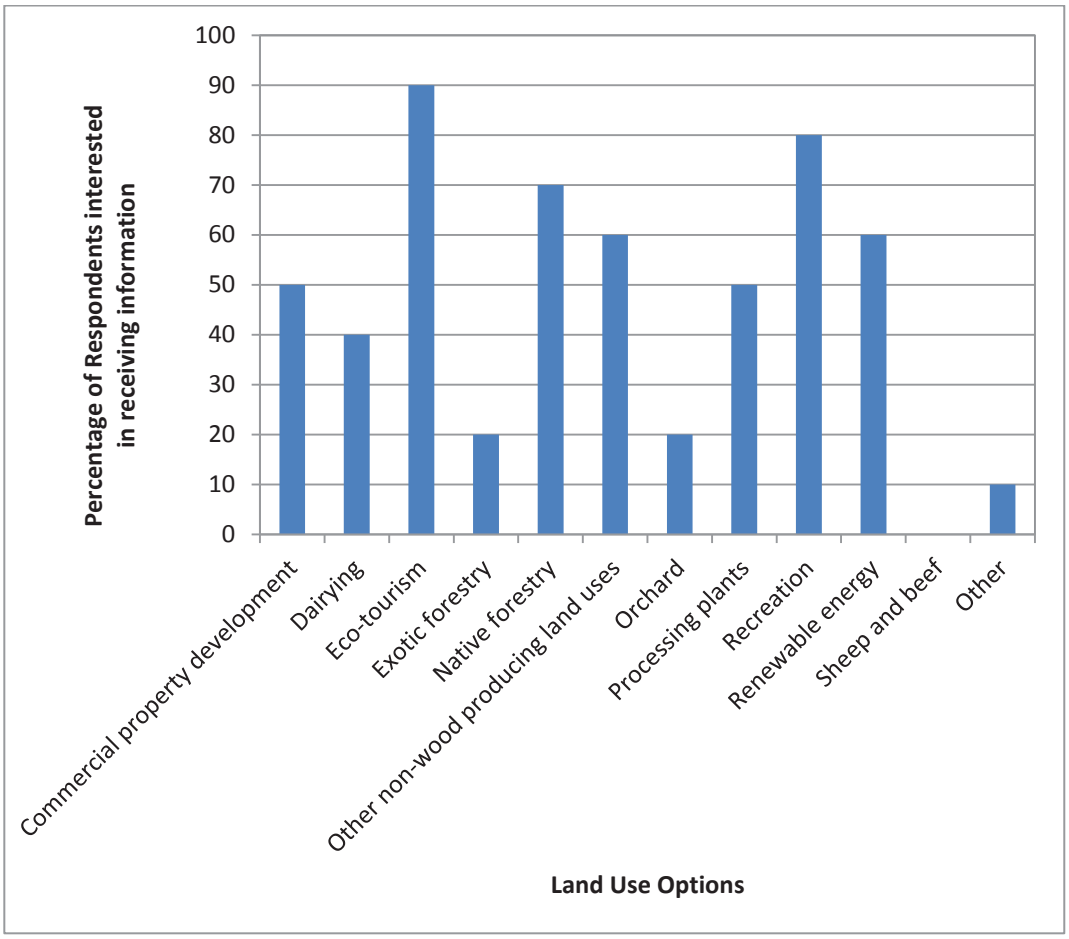

Figure 5.3: Land use options that respondents were interested in receiving information about as possible suitable land use options for their trust's/incorporation's land, expressed as a percentage of respondents.

With the exceptions of eco-tourism and orchards, Table 5.2 shows that for the remaining land use options there was a moderate to strong disparity between the information given to the all of the Māori groups and the information on land use options that they were interested in. In particular, the table shows that the respondents were more interested in native forestry as a land use option, compared to sheep and beef. In the cases of eco-tourism and orchards, the information received by respondents on these two land use options matched perfectly with the information sought.

Table 5.2: The percentage difference between the information received and the information sought by respondents regarding the different land use options, expressed as a percentage of respondents.

Land Use Option	Percentage Suggested	Percentage Interested	Percentage Difference
Native forestry	50	70	**-20**
Eco-tourism	90	90	**0**
Orchard	20	20	**0**
Renewable energy/Geothermal energy	70	60	**10**
Other non-wood producing land uses	70	60	**10**
Processing plants	60	50	**10**
Recreation	90	80	**10**
Commercial property development	70	50	**20**
Dairying	70	40	**30**
Exotic forestry	50	20	**30**
Other	40	10	**30**
Sheep and beef	40	0	**40**

However, upon closer inspection, different groups received different levels of information. Table 5.3 shows that Group D had the best match of information, where every land use option they sought information on they received, and vice versa. Group E sought information on three land use options that they did not receive information about, and Group B received information on five land use options that they did not seek. This shows that, with the exception of one group, the majority of the groups surveyed were not obtaining land use option information specific to their requirements.

Table 5.3: The difference between the information received and the information sought by each group regarding the different land use options. Green = perfect information match; Blue = information given, but not sought; and Red = information sought, but not given.

Land Use Option	Group A	Group B	Group C	Group D	Group E
Commercial property development					
Dairying					
Eco-tourism					
Exotic forestry					
Native forestry					
Other non-wood producing land uses					
Orchard					
Processing plants					
Recreation					
Renewable energy/Geothermal energy					
Sheep and beef					
Other					

5.3 Influences on the Decision Making Process

Questions six to eight examined the influences of values and social, economic and environmental considerations on the decision making process.

Values

As shown in Figure 5.4, at least 60% of the respondents gave answers of five (high influence) for each of the ten values listed. The remaining respondents only varied their answers for each value between three (neutral influence) and five. For five of the listed values, 10% of respondents chose not to assign an answer to each value (no answer given). For the value Arohatanga, two respondents (20%) chose not to score the value. This would indicate that all Māori values are of similar importance to Māori trustees/committee members. In the cases of the two respondents who gave no answer, one may have been trying to select only their top five values, while the other respondent may have accidentally missed one of the values when filling out the question.

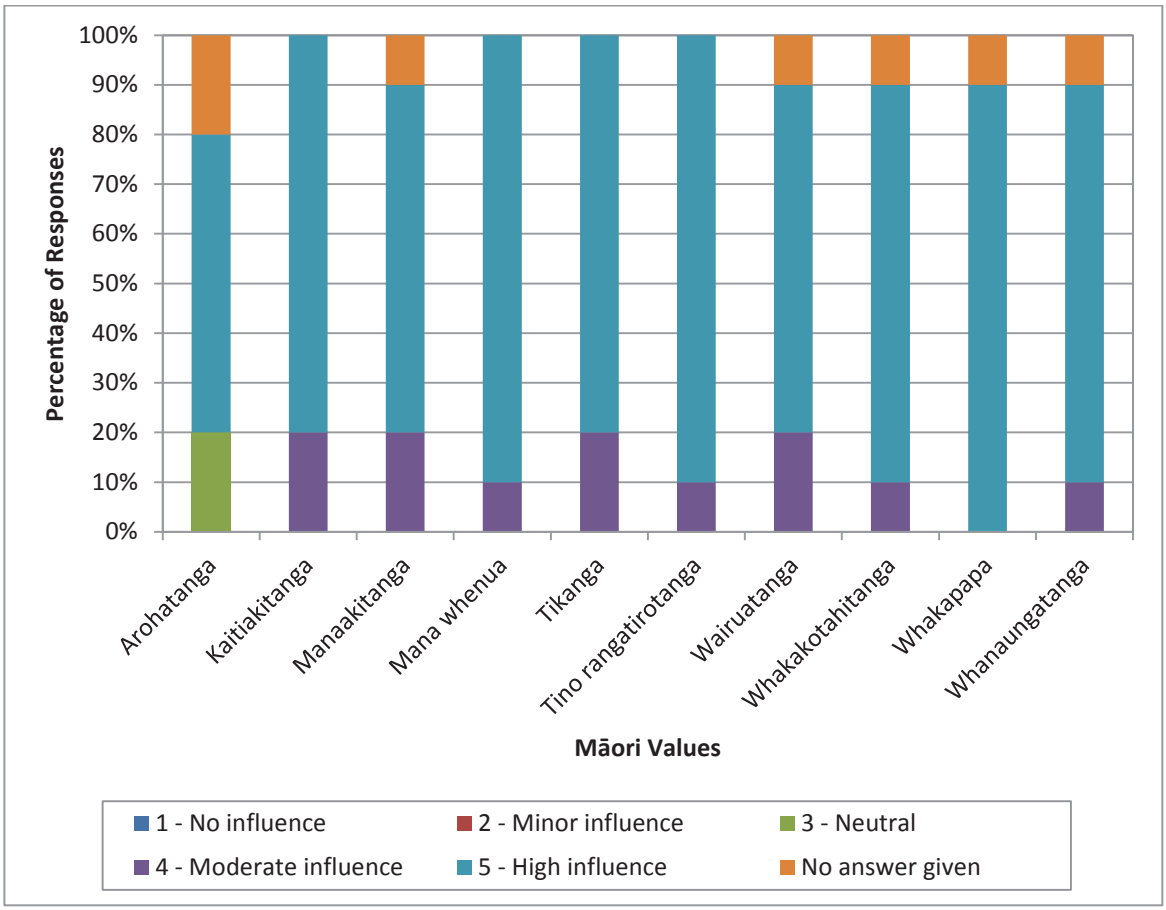

Figure 5.4: The influence Māori values have on the land use decision making process of Māori trusts/incorporations, expressed as a percentage of responses.

Social, Environmental and Economic Considerations

Respondents were asked to select five considerations from a provided list. The considerations were listed alphabetically, but could be categorised as social, environmental or economic, as shown in Table 5.4. Respondents could also list other considerations, but none chose to do so.

Table 5.4: The list of considerations presented to respondents, broken down into social, environmental or economic categories.

Social	Environmental	Economic
Access to land	Clean waterways	Infrastructure development
Connection to land	Environmental risks/benefits	Level of financial risk
Employment potential	Erosion control	Market expansion opportunities
Politics	GHG emissions	Production levels
Self-empowerment		Profit
Social risks/benefits		Upfront start-up costs

Having selected five considerations from the list, respondents were then asked to rank their answers from one (not important) to five (most important). Analysis for this section had to consider not only the ranking each respondent gave, but also the overall number of respondents selecting a given consideration.

Table 5.5 shows how the total percentage of respondents varied greatly across the different considerations from 0% up to 16.9% of respondents. Level of financial risk was selected by the most respondents (16.9%), and it was also deemed to be the most highly important consideration by respondents (9.2% of respondents ranked it as important or most important). Employment potential (15.4%), connection to land (12.3%) and social benefits and risks (10.8%) were also selected prominently overall by respondents. However, unlike level of financial risk, these considerations were rated as being of lower importance by respondents. For example, connection to land was ranked 3rd overall (selected by 12.3% of respondents), but 9.2% of those respondents believed this consideration to be of least important or of minor importance. Conversely, despite being the fourth most selected consideration overall, 7.7% of respondents said that social benefits and risks were important/most important.

Employment potential, profit and market expansion were ranked overall as 2nd, 5th and 6th equal respectively in the listed considerations. However, in each case, 6.2% of respondents scored each consideration as being important/most important. Overall, the considerations least selected were self-empowerment, upfront start-up costs and clean waterways, with 1.5%, 4.6% and 6.2% of respondents choosing those considerations respectively.

Table 5.5: Considerations that impact land use decision making, expressed as a percentage of respondents. The final two columns show the total percentage of respondents who selected each consideration and the total percentage of respondents for each of the three main categories.

Type	Consideration	1 Least Important	2 Minor Importance	3 Neutral	4 Important	5 Most Important	Total	Group Total
Social	Access to land	4.6	3.1	-	-	-	**7.7**	47.7%
	Connection to land	7.7	1.5	3.1	-	-	**12.3**	
	Employment potential	1.5	6.2	1.5	-	6.2	**15.4**	
	Politics	Not selected in top five considerations					**-**	
	Self-empowerment	-	-	1.5	-	-	**1.5**	
	Social risks/benefits	1.5	-	1.5	4.6	3.1	**10.8**	
Environmental	Clean waterways	-	3.1	3.1	-	-	**6.2**	13.8%
	Environmental risks/benefits	1.5	1.5	4.6	-	-	**7.7**	
	Erosion control	Not selected in top five considerations					**-**	
	GHG emissions	Not selected in top five considerations					**-**	
Economic	Infrastructure development	Not selected in top five considerations					**-**	38.5%
	Level of financial risk	3.1	3.1	1.5	7.7	1.5	**16.9**	
	Market expansion opportunities	-	-	1.5	4.6	1.5	**7.7**	
	Production levels	Not selected in top five considerations					**-**	
	Profit	-	1.5	1.5	1.5	4.6	**9.2**	
	Upfront start-up costs	-	-	-	1.5	3.1	**4.6**	

Politics, erosion control, greenhouse gas emissions, infrastructure development and production levels were the considerations not ranked by respondents. This suggests that they are seen as being even less important than those considerations ranked with a value of one. These answers also possibly reflect the landscape of the rohe. For example, a Māori land group on the East Coast may be more likely to select and rank erosion control as being of high importance because much of the land in that area is prone to major erosion problems. Overall, 48% respondents selected social considerations, compared to 38% selecting economic considerations and 14% selecting environmental considerations. Predominantly, the same considerations were selected by the five groups surveyed, indicating a strong similarity in the considerations that influence Māori land use decision making within the region.

5.4 EDDS Design

Questions nine to 15 examined the design of EDSS, including how the design of EDSS could be improved, the preferred mediums for EDSS and the preferred features.

New Zealand EDSS

Respondents were shown a list of New Zealand EDSS examples and asked if they have ever used them. As shown in Table 5.6, the most used EDSS was the Land Use Capability tool, with four respondents (40%) using the EDSS moderately or frequently. Only one respondent (10%) had never heard of the LUC tool. Of the EDSS listed the Māori Wetlands Model was the least well known; six respondents (60%) had never heard of it, and of the remaining four respondents only two had used it (10% sometimes and 10% frequently). Whenua Viz was another EDSS that was not used by the respondents, with four respondents never having heard of this EDSS and another three respondents having never used it.

Table 5.6: Examples of New Zealand EDSS that are used by Māori trusts/incorporations, expressed as a percentage of respondents.

New Zealand EDSS Examples	1 Never Used	2 Sometimes Used	3 Neutral	4 Moderately Used	5 Frequently Used	Never heard of EDSS
Land Use Capability	20	10	20	20	20	10
Mauri Model	20	10	10	20	10	30
Mauri-o-meter	10	0	20	10	10	50
Cultural Health Index	10	20	10	10	10	40
Māori Wetlands Model	20	10	0	0	10	60
Whenua Viz	30	0	20	10	0	40

Respondents were then asked how useful they found the EDSS that they used (Table 5.7). If a respondent had not used one of the EDSS listed before (as shown in Table 5.6 – categories

'never heard of the EDSS' or 'never used'), then their responses were listed as 'not applicable' for this section. Therefore, Table 5.7 represents only views of those currently using each EDSS. None of the respondents gave any of the listed EDSS a value of 1 (very unhelpful). However, reflecting the results from Table 5.6, six respondents (60%) found the LUC EDSS to be either helpful or very helpful, while only two of respondents found the Māori Wetlands Model to be either helpful or very helpful.

Table 5.7: The ease with which the New Zealand examples of EDSS are used by trustees/committee members, expressed as a percentage of respondents.

New Zealand EDSS Examples	1 Very Unhelpful	2 Unhelpful	3 Neutral	4 Helpful	5 Very Helpful	Not Applicable
Land Use Capability	0	0	20	40	20	20
Mauri Model	0	10	10	20	10	50
Mauri-o-meter	0	10	0	20	10	60
Cultural Health Index	0	0	30	10	10	50
Māori Wetlands Model	0	10	0	10	10	70
Whenua Viz	0	10	30	10	0	60

Respondents were then asked what they thought made the listed EDSS unhelpful, and what could be done to improve them. All five groups provided comments which could be generally summarised as follows:

- Users require more training in the tools – what the tools offer, how to use them and what tools are available;
- Cultural aspects not always framed appropriately for a given group (e.g. Mauri can be an emotional/spiritual concept for one group, while for another group Mauri is a physical thing); and
- Simple explanations/concise summaries are important especially for sharing and understanding the information.

These comments will be discussed in further detail in Section 6.3 (Limitations of current New Zealand EDSS).

Preferred EDSS mediums

Figure 5.5a shows that 45% of respondents would prefer future EDSS to be developed as computer software, with others preferring either a web-based tool or a paper-based tool (22% of respondents each). Only 11% of respondents wanted EDSS to be developed as a macro tool,

while none wanted a spreadsheet based tool. Respondents were then asked to select their preferred electronic medium for future EDSS from a choice of computer, smart phone or tablets (Figure 5.5b). Fifty percent of respondents selected computer, 27% selected tablet, while 23% preferred smart phone applications. Again, as for all of the above answers, the results here would need validating against Māori land groups in other rohe.

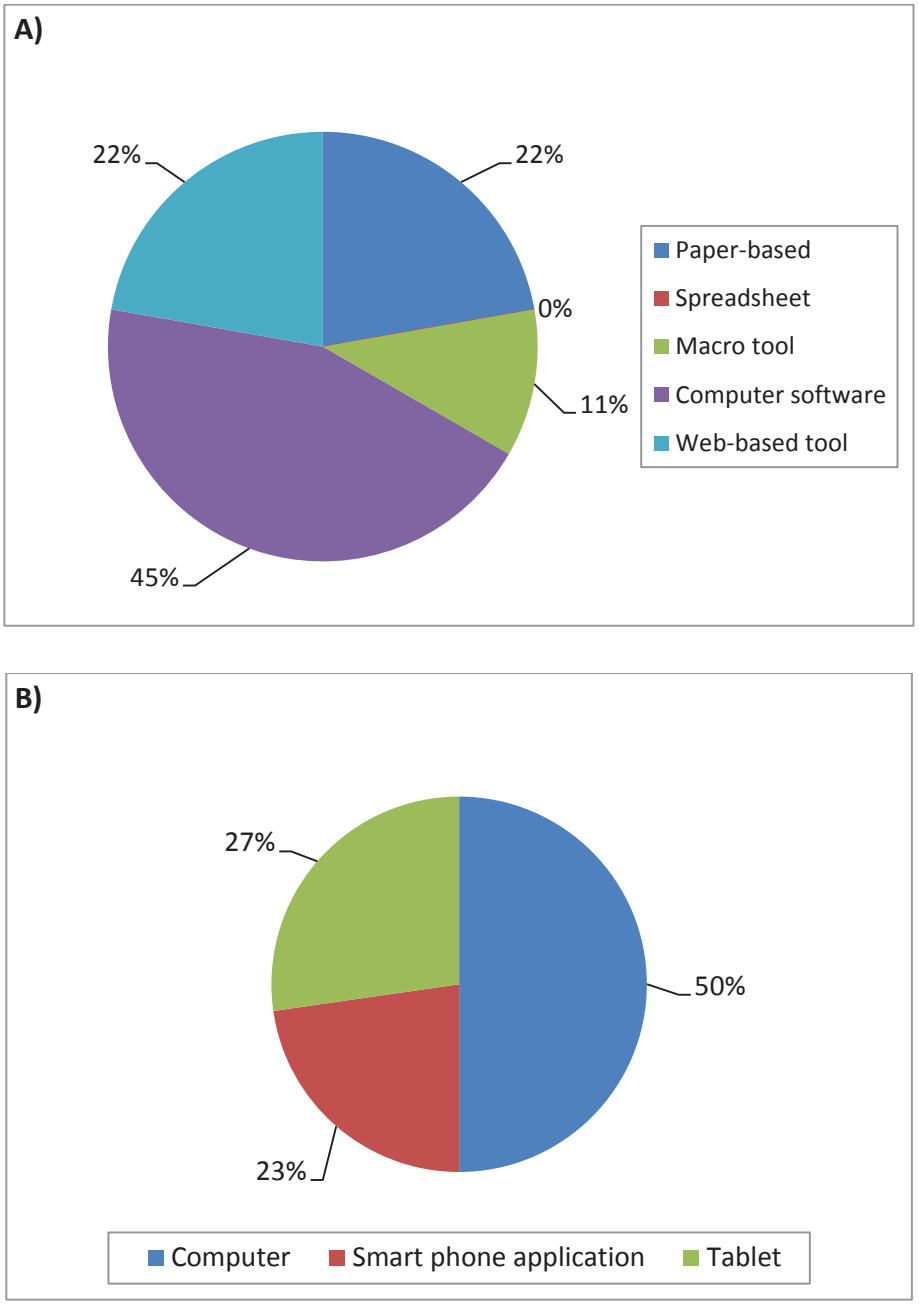

Figure 5.5: a) Respondents preferred style for EDSS developed in the future, and b) Respondents preferred electronic medium for future EDSS, both expressed as a percentage of responses.

Finally, respondents were asked about the importance of different features that could appear in an EDSS. Each respondent scored each feature from one (low importance) to five (high importance), with the option of selecting 'not sure'. Respondents were also able to submit other features and score them.

Table 5.8 shows that "Visualisation of my own land" was the feature most respondents ranked as important, with 85.7% selecting it as important or of high importance. Respondents also highly ranked the features "Ability to connect with experts", "Ability to share information with others", "Associated Trust/Incorporation information" and "Ease of use". "Translation in Te Reo Māori" was the feature least highly ranked by respondents (85.7% of respondents ranked it as of neutral importance or lower). "Ability to play with scenarios", "Graph forms" and a "Free tool" were also less important EDSS features for respondents.

Table 5.8: Preferred features for future EDSS for Māori respondents.

EDSS Features	Low – Some Importance	Neutral	Important – Highly Important	Not Sure
Visualisation of my own land	0.0	14.3	85.7	0.0
Ability to share information with others	0.0	14.3	78.6	7.1
Ability to connect with experts	0.0	7.1	78.6	14.3
Easy to use	0.0	7.1	78.6	14.3
Access through the internet	0.0	14.3	71.4	14.3
Associated Trust information	0.0	0.0	78.6	21.4
Plain figures	0.0	14.3	57.1	28.6
Map form	0.0	21.4	71.4	7.1
Free	7.1	35.7	42.9	14.3
Ability to 'play' with data/scenarios	0.0	57.1	28.6	14.3
Graph form	0.0	57.1	35.7	7.1
Separate software program	21.4	7.1	35.7	28.6
Translation in Te Reo Māori	21.4	64.3	7.1	7.1

5.5 Demographics

Despite having only 14 surveys returned the results represent the thoughts and opinions of 29 Māori trustees and committee members from five groups in the Waiariki rohe. Table 5.9 shows that across the five groups there is a good mixture of male and female respondents with a range of levels of education. The average age of the trustees and committee members is between 41 to 60 years. The five groups also represent the following range of iwi/hapū:

- Ngāti Kahungunu
- Ngāti Makino

- Ngāti Pikiao te Iwi
- Ngāti Rangiwewehi
- Ngāti Rongomai
- Ngāti Tamateatutahi-Kawiti
- Ngāti Tarawhai
- Ngāti Te Takinga te Hapū
- Tapuika
- Te Arawa Waka

Table 5.9: Demographic summary of the five Māori Groups who participated in this survey.

Group	Trustees/Committee Members		No. Surveys returned	No. people who helped fill out the survey	Level of Education	Average Age Range of Group Members
	Male	Female				
Group A	3	2	5[5]	4	Primary Secondary	51 – 60 years
Group B	6		1	1	University	41 – 50 years
Group C	6		1	1	University	51 – 60 years
Group D	4	3	6	6	Secondary University	51 – 60 years
Group E	3	2	1[6]	5	University	41 – 50 years

[5] Five surveys were returned for Group A because for some questions they answered as individuals (accounting for four of the surveys) and some questions they answered as a group. These group or collated answers were recorded in the fifth survey.
[5] Likewise, Group E submitted one survey which was the collated answers of the five Trustees.

6 DISCUSSION

This chapter consists of three sections. Section 6.1 examines the process of working with Māori landowners, and in particular the reasons respondents did not participate in this study and the length of time required to gather the data. Section 6.2 addresses issues that were raised during conversations with respondents, primarily barriers for smaller Māori landowners and the fear of these findings having a negative impact upon the participating groups. Finally, Section 6.3 discusses the major points raised by the analysis of the results. These points include the limitations of current EDSS, preferred land use options, the importance of social considerations over economic and environmental considerations, the importance of Māori values, and future development of New Zealand EDSS.

For all three sections, comments from respondents have been included as supporting evidence.

6.1 Working with Māori Landowners

When undertaking the data collection and analysis, it became apparent that working with Māori landowners was going to pose a unique challenge. It is hoped that this section will help future researchers better understand Māori landowners and how to work with them.

Kaupapa Māori Research Methodology – how it informed this work

While the researcher was unable to follow the reality of Kaupapa Māori research because she is not of Māori descent, she still tried to follow its principles when carrying out her cross-cultural work. Below are some of the insights she has gained as a result of carrying out this piece of work in relation to Kaupapa Māori research methodology.

In retrospect, using a survey was probably not the best tool for gathering information from Māori Trusts and Incorporations. However, when originally designing the methodology, the initial plan was to approach groups from Northland, Bay of Plenty and the East Coast Māori communities. Given this initial spread of participants, and given time and budget constraints, it was believed that a survey would be the best mechanism for yielding results. The survey questions and design were checked for appropriateness by the project's cultural advisor, and the researcher's supervisors.

Once it became apparent that the study was too ambitious for the research time frame, the survey remained as the chosen mode of data collection. This was partly because it was believed that too much time would have been lost trying to establish another method. Also, some trusts and incorporations had already been approached about participating in the study.

The survey had been included as part of that initial communication so that the groups could look over the questions to see if they had any questions or objections. It was felt that confusion would occur if the survey was suddenly removed from the study and a new methodology established, potentially resulting in reduced participant confidence and engagement. Both of these reasons were strong drivers for continuing with the survey.

In keeping with the underlying principles of Kaupapa Māori research the following actions were followed:

- The researcher introduced her own whakapapa, and told her story as to why she was undertaking the research. This allowed the Trusts and Incorporations involved a chance to question her motives, and understand her background, before they decided to engage any further;
- Participating groups were allowed to determine who answered the survey and how they answered it (as a group, as individuals, or as an individual on behalf of the group);
- The researcher offered to meet all participants face-to-face if they wanted to;
- Where points were unclear the researcher returned to the individual or group and asked for clarity around their response; and
- Koha in the form of a copy of the research and a summary will be provided to each participating group upon completion of this work (Barnes, 2000; Cram & Kennedy, 2010; Hutchings, 2002; Jones et al., 2010).

One of this things the author could have done better was to undertake face-to-face meetings with all participants at the beginning. This could have helped to establish a better working relationship throughout the project. Likewise, establishing an ongoing schedule of regular meetings with participants to keep them informed about the work and how it was progressing would also have helped with maintaining the relationships (Barnes, 2000; Cram & Kennedy, 2010; Hutchings, 2002; Jones et al., 2010). As a researcher, it is very easy to get pulled into the research, until perspective is lost regarding the relationships that supported the research. Therefore, researchers should establish regular hui and opportunities to kōrero with participants, in order to keep them informed about the works progress (Barnes, 2000; Cram & Kennedy, 2010; Hutchings, 2002; Jones et al., 2010). This will help to enhance the relationships, but should also increase the feeling of Māori ownership of the work (Barnes, 2000; Cram & Kennedy, 2010; Hutchings, 2002; Jones et al., 2010).

Another way in which this research could have improved this work would have been by working alongside a Māori researcher, or by getting one group of participants to trial the survey first and submit feedback. While the project advisor was of Māori descent and provided good advice, they were not involved in the research at a working level. Working alongside a Māori researcher could have provided greater access to the details and the knowledge required for a solid piece of Kaupapa Māori research (such as know appropriate terms to use for literature review searches, and correct protocol for remaining engaged with participants). Likewise, getting feedback from one group about the survey method and questions could also have better informed the project, as well as providing the opportunity for greater Māori input and ownership in the research (Barnes, 2000; Cram & Kennedy, 2010; Hutchings, 2002; Jones et al., 2010).

Reasons respondents gave for not participating in survey

Overall, 50 Māori trusts and incorporations in the Waiariki rohe were approached to take part in this study. The majority of these groups did not respond to the request for their assistance with the research. Of those groups who did respond, but who declined to participate in the survey, a few key reasons were given[7]:

> "*The trust doesn't have any Māori land*";
>
> "*The trust technically holds land interests on behalf of the iwi as a result of the [our] Settlement. However the land that sits within our realm is either cultural redress property or commercial property.*
>
> *The cultural redress properties are returned from the Crown directly to the respective hapū that hold mana whenua over that land. Our only function is to advise who that land belongs to and to ensure that title is transferred to the correct entity.*
>
> *Our commercial properties have been assigned to our commercial entity. The Deed of Assignment over our commercial properties allows [our commercial entity] to utilise our properties 'as if it was their own'. Therefore we don't have any day to day management as a result of this Deed*";
>
> *"The trust is a transfer group, designed to help the hapū take over the management of the land (this has not happened yet)"*; and

[7] Note: In order to prevent the identification of the group who provided these comments, group details have been removed from the quotes.

> "*I placed your data on our agenda for the Board to consider. Unfortunately they have declined their support at this time. Primarily due to the fact that this survey impresses as an initiative conducted via SCION with whom we do not have a professional working relationship*".

Given that the majority of groups approached did not respond at all, this is a key area for future researchers to focus on. This piece of research followed Dillman's (2000) method for contacting potential participants; a methodology that focused on contact through the written form (emails and letters). In very few instances, follow up phone calls were used. This approach was followed as written conversations are easier to look back on, rather than trying to recall the exact words used in a conversation held over the phone, for both the participants and the researcher (Dillman, 2000). However, some of the groups who gave no response may have responded differently if contact had been made through a phone conversation, as this could be seen as being more personal. Even if the respondents chose to decline to partake in the study at least the researcher would be able to ask them why they are declining to participate.

For the Māori land groups recommended by the project advisor, the initial email included a comment linking the project advisor and his support to my project. With three of the five partaking groups coming from the project advisors list, this would suggest that having a personal connection could increase the likelihood of a Māori land group choosing to participate. If future researchers can better understand why potential respondents are not taking the time to respond, even to decline participating, then this could help to achieve a greater sample size and contribute to more robust research.

Time requirement for data collection

One factor of this project was the time required to undertake interviews and meetings and to collect the data. Many of the groups who were eventually interviewed required considerable discussion and questioning about the project before they were prepared to commit to being involved in the survey. In each case the potential participants were trustees and committee members who represent their people, and who wished to make the best possible decisions for their group, so they wanted to understand the survey and how it might impact upon them.

In this regard it is important to build a strong relationship with Māori participants, especially if the research team is of non-Māori descent, and appropriate time should be set aside for this process (Hayes, 2003; King, 1997). By taking the time to build that relationship, potential candidates are more likely to participate in a survey, and are more likely to support any EDSS

that is developed (Hayes, 2003; King, 1996; Reed, 2008). From another perspective, once a relationship is established, being of non-Māori descent may provide an advantage to the research team, as they have the potential to provide an unbiased view not representative of any other iwi or hapū.

6.2 Respondent Conversations

Before respondents completed the surveys, conversations were had with each group in order to answer questions or concerns that they might have. From those conversations arose discussion points regarding help for smaller Māori groups and concern about how the results might be interpreted by others.

Help for smaller Māori Trusts/Incorporations

There are many Māori trusts and incorporations in New Zealand; the Te Puni Kōkiri database lists 141 such groups (Te Puni Kōkiri, 2015b). The project advisor suggested that contacting the very small groups would not be beneficial to the project as often they did not have a clear governing group, clear strategic plan for their land and/or the resources to implement their plan.

While it was important for this study to get groups that had made or were in the process of making decisions about their land and its use in order to get results, it was pointed out by Group A (personal communication, November 1, 2014) that many of the smaller groups were forced to make no decision about their land because of various barriers (Controller and Auditor-General, 2004). In all cases such groups have land, but they:

- May not be able to find enough people to form a Trust/Incorporation;
- May struggle to fill in the paperwork to form a Trust/Incorporation;
- May not know where their land is;
- May not know who all the stakeholders are, and therefore, cannot make any decisions without their consent;
- May not know how to or cannot access the various resources that will help them to make land use decisions (e.g. consultants, local councils etc); and
- May not have the resources to implement their land use decisions (Controller and Auditor-General, 2015; Group A, personal communication, November 1, 2014; Group D, personal communication, February 3, 2015).

As a result, there are blocks of land all around New Zealand that have been handed back to Māori, but which are unused and reverting to blackberry, gorse and scrub (Controller and

Auditor-General, 2004; Group A, personal communication, November 1, 2014). When queried if different groups could work together, as a collective to share resources and knowledge, Group A acknowledged that some groups are already doing that, and very successfully (personal communication, November 1, 2014). However, it was also suggested that Māori can be their "own worst enemy" and if even one stakeholder refuses to work with another trust/incorporation that can effectively stop all collaboration and resource sharing (Controller and Auditor General, 2015; Group A, personal communication, November 1, 2014).

This has significant implications for researchers, as they will need to make sure that their work is not only easy to understand, but also easily accessed, especially by those who are currently struggling to find land use and land management resources. By creating a marketing strategy for their EDSS researchers would help to ensure that users know about their tool. This engagement may prevent future EDSS from being unfamiliar to Māori groups; unlike the Cultural Health Index, Māori Wetlands model and the Mauri-o-meter, EDSS which few survey respondents knew about. Tools that facilitate the sharing of information and resources between Māori land groups, and that offer support and guidance to groups going through the land use decision making process, could also help to remove some of these barriers.

This could also appear to be a niche market opportunity for consultants. By working with the smaller Māori groups to create a collective with bargaining power and access to combined resources, consultants could help to remove barriers to Māori land development, as well as creating new job opportunities for the consultants.

Concern that findings may be discredited because respondents are Māori

One of the groups was concerned about taking part in this study, as in the past they had helped Kepa Morgan to determine the underlying concepts of the Mauri Model[8]. Once the model was developed, and starting to be used, the group received unanticipated criticism as many non-Māori people did not understand the concepts contained in the Mauri Model and dismissed it and its work. Some people even went to the extent of refusing to accept any analysis that involved the Mauri Model, due to its "lack of scientific basis".

Such attitudes do not aid the incorporation of Māori values into decision making tools. In the first instance it can marginalise those who have contributed their knowledge to the tool, making them less likely to share their knowledge in the future (Arquette et al., 2002; Hayes, 2003; Stevenson, 1996). It is therefore critically important for researchers working with Māori

[8] Note: In order to prevent the identification of the group who provided these comments, all personal communication references have been removed from this section.

to a) show scientific rigour, as the methods used will be under greater scrutiny; b) acknowledge that a wider cultural viewpoint is valid and necessary and c) not to be perturbed by such criticism (Arquette et al., 2002; Hayes, 2003; Stevenson, 1996). More robust thinking and critical analysis can occur when indigenous knowledge is acknowledged, and incorporated alongside Western scientific, knowledge into a tool (Arquette et al., 2002; Colchester, 2004; Raymond et al., 2010; Rizzoli & Young, 1997; Stevenson, 1996).

6.3 Analysis Discussion Points

Several key discussion points arose from the analysis of the survey results, including: the limitations of current New Zealand EDSS, preferred land use options, the importance of social considerations, how Māori values are interlinked, and key features for future New Zealand EDSS.

Limitations of current New Zealand EDSS

In the survey, questions nine to twelve looked at examples of New Zealand EDSS, their limitations and how they could be improved. Of the listed New Zealand examples of EDSS, the Māori Wetlands Model was the least well known. This is not surprising as over 90% of New Zealand wetlands have been drained or filled (National Wetland Trust of New Zealand, 2015). With only around 10% of New Zealand's wetlands remaining, few Māori groups have wetlands on their land giving them no reason to access or use the Māori Wetland Model[9].

The other four examples of New Zealand EDSS were used to varying degrees by respondents. This variability amongst the answers appears to relate more to individuals rather than the groups. For example, some respondents had not heard of any of the listed EDSS, while other respondents had heard of the majority of them. This could suggest that EDSS use depends upon a respondent's position within their trust/incorporation, or upon their normal day job. If a respondent works more with technology, or their position requires them to look for tools to help them make land use decisions, then they are likely to be more familiar with the listed EDSS. Respondents may also be familiar with the listed EDSS because their consultants use the tools, and discuss the tool's results with the group (Group A, personal communication, November 1, 2014).

The Land Use Capability (LUC) EDSS was the most recognised tool and was also the EDSS deemed most helpful with 60% of respondents finding the LUC to be helpful or very helpful. The majority of the respondents had also heard of and used at least one of the listed EDSS.

[9] In retrospect, it would have been useful to ask survey participants whether they have any wetlands as part of their land matrix, as this would support their use, or lack thereof, of the Māori Wetlands Model.

However, the majority of respondents also found the listed examples of New Zealand EDSS to be less than helpful, primarily because they found the tools hard to use, the outputs hard to understand and the EDSS did not incorporate features they required. The listed examples of New Zealand EDSS lacked extensive stakeholder participation (e.g. the Cultural Health Index is only based on information from two Māori groups (Tipa & Teirney, 2006)), and perhaps as a result, do not meet the needs of the users (Reed, 2008). This lack of usefulness across the listed examples would indicate that that there is room for improvement when it comes to creating EDSS for Māori (Fa'aui & Morgan, 2014; Robb, 2014; Waikato River Authority, 2014).

When asked how the current tools could be made more effective for users respondents made the following comments:

> *"Generally not frequent users of models. The LUC model is appropriate for assessing slope type, soil type etc that we have applied in recent research on the capability of our whenua. We are now at a stage where we need to do a feasibility study on the options that the LUC research has revealed. We have no problems with the LUC model as a tool to provide an initial assessment of our land capability. The other models may have some utility during the feasibility phase but we are generally unaware of these models".*
>
> Group B
>
> *"Providing the ability to coordinate responses from other management structures (i.e. trusts and incorporations). We're not making good use of economies of scale and bargaining power because we do not know what our neighbours are doing. There is also a lack of connection and understanding of what other groups are doing (e.g. Māori land trusts, regional and district councils).*
>
> *Simple explanations and concise summaries are also helpful – sometimes you feel like you're getting lost in all of the detail".*
>
> Group D
>
> *"All of the tools are helpful, but we need more training in them. We lack technical information, and are very dependent on consultants when we should be building our own capabilities.*
>
> *Mauri models sometimes lack the economic aspects of the Kaupapa. Cultural health aspects are not always framed for a Māori context. You kind of need bits of each.*

There is a lack of connection between Māori aspirations/goals and commercial goals."

Group E

Based upon the above comments, respondents were looking for EDSS that were simple to use, came with training material and allowed them to connect with other groups and experts. Training materials and ease of use will be crucial for EDSS success, as the respondents want to extract the most benefit possible from the tools. This is not just for their own personal benefit and enrichment, but could also help them reduce their dependency on consultants, and possibly enable better understanding of technical reports (if the consultant is using the same EDSS as the group). Better understanding of the tools available and how those tools work should also allow groups to make better decisions for their land.

Respondents also believed that better integration of Māori values and goals with other features, like economic features, would be beneficial. Developers and researchers need to understand the context of Māori concepts, and how that context can be different for different Māori groups. For example, for Group A Mauri was a physical heart of their property, but for Group D Mauri was non-physical and more based on the spiritual (Group A, personal communication, November 1, 2014; Group D, personal communication, November 19, 2014).

Finally, having the ability to communicate with other groups (Māori groups, councils, Department of Conservation) through the EDSS would provide users with a better understanding of adjacent or local land use decision making. If such decision making is complementary, then the EDSS should support the group's ability to work with other groups, so that they can achieve good economies of scale and bargaining power. The EDSS should also provide the ability for users to give feedback on the land use decision making processes; either stakeholder to governing group, or Māori land group to Māori land group. Through effectively engaging with and understanding future stakeholders, researchers and developers should see an improved uptake in future EDSS (Cox, 1996; Reed, 2008; Rizzoli & Young, 1997).

Preferred land use options

Given the prominence of exotic forestry, dairying and sheep and beef as land use options in New Zealand (Ewers et al., 2006; MacLeod & Moller, 2006; New Zealand Government, 2014), it was believed that Māori trusts and incorporations would only receive information on those land use options. These are land use options that have long been employed on New Zealand land, with forestry alone contributing 1.1% to the gross domestic product (GDP) in 2013 (New Zealand Government, 2014). Similarly, agriculture and horticulture contributed 4.5% to the 2013 GDP, with dairying being the predominant agricultural activity for the sector earning

$10,386 million (New Zealand Government, 2014). With those returns, it was believed that consultants especially would persist in marketing these three mainstream land use options.

However, the five groups surveyed reported that a diverse range of land use options had been presented to them. In particular, eco-tourism and recreation were the two possibilities reported as potential land use options by the majority of respondents. This diversity could be accounted for in two possible ways. Firstly, consultants are keeping abreast of the variety of land use options available for land in New Zealand, and are making their clients aware of the possibilities. Secondly, the Māori groups are doing research on potential land use options before seeking the advice of experts (Group D, personal communication, February 3, 2015). By looking at other Māori land organisations, as well as land use options being implemented within their area, and using the internet, current Māori land groups have a wealth of sources to draw land use information from (Group D, personal communication, February 3, 2015).

This prior research may also explain the match between the information respondents received and the information respondents sought on land use options. Certainly, eco-tourism and recreation were the top two land use options that respondents wanted to receive information on. This could indicate that the groups had undertaken land use option research prior to engaging with consultants. Interestingly, for question five, the more traditional land use options (sheep and beef, exotic forestry, orchard and dairying) were the options respondents least wanted to receive information on. A Group D respondent clarified these results explaining that:

> *"Māori land groups are typically overwhelmed with information about the more typical land use options. Indeed most groups already have a good understanding of those land use options either because their land is currently under a traditional option, or they know another Māori group with that land use option, and so gain information that way. For them, the more recent land use options, such as eco-tourism, are less well known, and so are more potentially exciting, with Māori groups wanting to receive information on those land use options instead"* (Group D, personal communication, February 3, 2015).

This has important implications for both consultants and researchers and developers of EDSS. Consultants need to be aware of the range of land use options available nowadays, and need to be able to provide their clients with information on that diverse range of options. While the traditional land use options should not be ignored as potential options, this study has shown that many Māori landowners are open to exploring diverse options for their land. In addition,

researchers and developers of future EDSS need to incorporate a diverse range of land use options into their tools. This could lead to researchers and developers from different organisations working together to create a comprehensive EDSS containing information on a variety of land use options.

The importance of social considerations

First impressions gained from groups responses were that profit is the most important factor that drives all decision making processes. For example, Group A stated that they chose dairying over forestry because dairying gave them an instant annual return for their stakeholders, while planting the land in trees would have seen them waiting around 30 years before they received a return on their investment (personal communication, November 1, 2014). Thus, on the surface, it would seem like profitability drives Māori land use decision making (Group D, personal communication, February 3, 2015).

However, while profit is important to Māori trusts and incorporations when making land use decisions, it is not the driving factor. This study found that overall 48% of respondents selected social considerations, while only 38% of respondents selected economic considerations and 14% selected environmental considerations. However, economic considerations generally scored higher than social and environmental considerations. This response is supported by the Office of the Auditor General who states "we acknowledge that cultural and spiritual ties to the land are often more important to Māori landowners than the ability to profit from the land" (Controller and Auditor General, 2015, Part 2). This indicates that it is crucial for future EDSS to include social and environmental considerations in their design, but these must also be economically sound in the long term.

This is supported by comments made by the respondents. When making land use decisions the groups are considering many different details. Not only are they working to uphold their group's vision statement, but they are also considering how best to use the land.

> *"The land is worth more to us than its dollar value. We want to keep it as it took so long for us to get it back. We have a love for our land, and it is important to bring in the next generation for continuity of management".*
>
> Group A, personal communication, November 1, 2014

> *"We're only there for the now – we're ultimately trying to create something sustainable (50 plus years) that our children and grandchildren can take over. Only the land and future generations remain. Therefore, we don't want to stuff things up; we*

need to do things properly and that means taking care of the social (employment potential and scholarship and education opportunities) and the environmental considerations. Yes, we carry out due diligence on all options and weigh up the risk, but the economic returns are not the drivers of our decisions".

Group D, personal communication, February 3, 2015

The two comments above clearly reflect the strong linkages and commitment of Māori groups to the land. While money does provide many benefits, both Group A and Group D are more concerned with their connection and love for the land, as well as the ability to manage it in such a way as so that it will continue to provide for their future generations (Rotarangi & Thorp, 2009). This means making decisions that will ensure sustainable use, but also support the social and environmental. By selecting a land use option that provides employment potential or education opportunities for family members, Māori land groups are ensuring that social connection to the land (Rotarangi & Thorp, 2009). Future EDSS tools need to support those connections, and need to understand the importance of long term social and environmental land use decision making (Stevenson, 1996).

Supporting the above comments, of the social considerations listed in the survey, 15.4% of respondents selected employment potential. Employment potential could be categorised as an economic consideration, but for the groups surveyed it is more about supporting whānau (family) and bringing them together, helping them to connect to the land (Controller and Auditor-General, 2015; Group D, personal communication, February 3, 2015; Rotarangi & Thorp, 2009). As such, any future EDSS should consider ways of calculating the employment potential of different land use options.

Connection to the land was another social consideration selected by many respondents (12.3%). Since the arrival of European settlers to New Zealand through to the end of recent Treaty of Waitangi settlements, many Māori have been alienated from their land. With many of the Treaty settlement packages containing land deals, many Māori groups are now in a position to utilise and administer their land, re-establishing that important connection to the land. An EDSS that can foster this connection to the land, by keeping stakeholders abreast of developments or allowing people to share stories relating to the land, should aid the tool's uptake by users (Reed et al., 2009; Stevenson, 1996).

Level of financial risk was the economic feature that was deemed to be most important by respondents. Over 16.9% of all respondents selected this consideration, with 9.2% of

respondents saying it was important or highly important. Because trustees/committee members are answerable to all of their stakeholders they need to fully understand all of the financial risks involved in every land use option (Group D, personal communication, February 3, 2015). Researchers and developers need to consider how future EDSS will show the levels of financial risk associated with different land use options to users. If users have a better understanding of the levels of financial risks for each land use option, they can make more informed decisions, and it will also be easier to pass this information on to their stakeholders.

Māori values are interlinked

The responses to question six deviated the most from the expected responses. Because the respondents were asked to give each value a score from one (no influence) to five, (high influence) it was expected that respondents would score each value independently, with each value receiving a range of scores (this is how respondents had answered previous questions in the survey). In reality, almost every respondent scored each value as a five, with the occasional four and three. Possibly a better way to ask the question would have been to get the respondents to rank their top five values. However, two groups added the following comments to explain their response to this question:

> *"All of the values are very important to us, and have a high influence on our decision making"*.
>
> Group A

> "*All of the values that you had on the sheet are a 5-high influence to our decision making processes. I don't want to order the 'Top 3' as they are all inter-connected and without one, the others don't quite make sense to us as Māori. So it is difficult to find a 'top 3' as such*."
>
> Group E

These two comments provide great insight into the way respondents have answered question six. For both Group A and Group E, because the values are interlinked, all values have the same level of influence on their decision making and must be scored the same. Given the above comments, asking the respondents to rank their top five values may still have resulted in the same overall response to the question.

It is also worth noting here, the contrast between this result, which says that all values are of equal influence, and the results surrounding the different social, economic and environmental

considerations. In particular, the environmental considerations were ranked of least importance overall, yet values like kaitiakitanga (see Section 2.9), were seen as being of equal importance with the other values. This mismatch in the results suggests that researchers not only need to understand how the values are interlinked, but also how they underpin social, economic and environmental decision making considerations. Further research is required in this area to understand how social, economic and environmental considerations are influenced by Māori values and vice versa, as well as how the combination of values and considerations influences land use decision making by Māori.

While much work has already been done on Māori values (Harmsworth, 1998; Harmsworth, 2002b; Harmsworth & Awatere, 2013; Jollands & Harmsworth, 2007; Roberts et al., 1995; Taiepa et al., 1997), this is still a key area for future research. Working with Māori landowners specifically on values to understand how they interlink and impact upon land use decision making would provide valuable information for future researchers and developers of EDSS tools (Harmsworth & Awatere, 2013; Jollands & Harmsworth, 2007). If those linkages are not understood, then they cannot be implemented into future EDSS. And if they are poorly incorporated into future EDSS, then Māori may lose faith in the tools and be less likely to use them.

Incorporating Māori values into an EDSS may be challenging, and may not be successfully achieved on the first, second or subsequent attempts. Therefore, researchers and developers should not be despondent if it takes time to get this area of their EDSS correct. One possible idea is to have the users select indicators and upper and lower limits of acceptability for each value. Using this information, and by incorporating prior understanding of the linkages and areas of impact, the EDSS can prevent landowners from selecting land use decisions that are detrimental to their selected values (outside of their acceptability limits). As long as a genuine attempt is made by developers and researchers to understand and incorporate the values and their linkages, then support for the EDSS is more likely.

Features of future New Zealand EDSS

Questions 13 to 15 of the survey examined how future EDSS could be developed to improve uptake by users. This included the preferred medium for future EDSS and the features respondents placed a priority on for inclusion in the tools.

It was expected that a paper-based medium would be the most popular choice, as older generations can feel less comfortable using modern technology. However, in general the respondents preferred a computer based EDSS over paper-based tools, with smart phone

applications and tablets also receiving a reasonable level of support. This preference for electronic mediums indicates that current trustees/committee members have reasonable skills in this area[10]. By seriously considering tablets and smart phone applications, they are also aware of the direction future development is likely to take. Group B also indicated that they are trying to encourage younger people to take up positions as trustees/committee members, and use of smart phones and tablets are a good way of fostering this encouragement.

For researchers and developers of future EDSS, this information is very important. If they can create a tool that is computer based, but translates easily to a paper-based form, then the tool can cater for people who prefer paper (Gough & Ward, 1996; Rizzoli & Young, 1997; Shin et al., 2002). Likewise, if the EDSS can also be adapted for smart phone or tablet mediums, then it is putting it into a form that younger people are more familiar with, which may increase the lifespan of the tool. An EDSS that is flexible in its presentation medium will ultimately cater for more people's needs, which can only increase its usability and uptake (Gough & Ward, 1996; Rizzoli & Young, 1997; Shin et al., 2002).

Respondents were then asked to rank from one (low importance) to five (high importance) features that could appear in future EDSS. Respondents were supplied with a list of potential features, which they could add to, although none did so. From the results of this ranking, a picture was built up regarding the important and least important features for the respondents; many of those features selected by respondents coincided with Rizzoli and Young's (1997) list of six desirable features (Section 3.2) that should be incorporated into all EDSS.

Of the listed features, a free EDSS and translation into Te Reo were the features considered least important for inclusion by respondents. It was interesting that respondents did not rank a free EDSS more highly. However, as a respondent from Group D explained:

> "*[We]* d*on't mind paying for products and services provided they add value to our business".*

This will be appreciated by researchers and developers, particularly those in government sectors, who often feel obliged to develop EDSS for little or no return (Jordan, 2010).

It was interesting that translation into Te Reo Māori ranked so low on the list of preferred EDSS features. The researcher believed that the ability to switch between Te Reo and English

[10] In hindsight, this finding could have been confirmed by asking the respondents about their current usage of such devices. This is an area future researchers could examine by asking future respondents about their familiarity with and use of existing electronic mediums, such as smart phones and tablets.

would be an easy and distinct way of customising an EDSS for Māori. However, a member of Group D suggested several reasons for why translation into Te Reo was ranked low:

- Translation between Te Reo and English does not really add any usability to the tool;
- Users now and in the future may not be fluent in Te Reo;
- Users are more familiar with the English language so there is no confusion about what is being said;
- Te Reo is an evolving language, with modern Te Reo containing different words and phrases compared to traditional Te Reo (e.g. words for Facebook, cell phones and Twitter); and
- The spelling and meanings of Māori words can change depending upon an iwi/hapū's geographic location within New Zealand. Such differences could cause confusion for users (Group D, personal communication, February 3, 2015).

In contrast, respondents thought the ability to visualise their own land was of highest importance. This was the only feature that all respondents provided an importance rating for, with 86% of those respondents declaring this feature to be important or highly important. The remaining 14% of respondents believed this feature to be of neutral importance. The ability to be able to visually see land blocks, the boundaries, any waterways and infrastructure provides a powerful tool for making land use decisions. By utilising existing national and regional public domain GIS datasets like cadastral data, aerial photography, LRI (Land Resource Inventory), LUC and S-Map in future EDSS, developers will be able to create an EDSS with access to information that will help landowners understand their land and its capabilities better. The inclusion of QEII National Trust and Ngā Whenua Rāhui covenants could also be helpful, as they will give an indication of any limitations placed on the land.

By providing Māori landowners with the ability to visualise their land, researchers and developers of EDSS are also providing Māori with another way of connecting to the land. Any tool that can support that connection to land will be of value to Māori landowners (as shown by the emphasis survey respondents placed upon this consideration). This is also one of Rizzoli and Young's (1997) six desirable features for inclusion in an EDSS.

Respondents also scored the following features as being very important:

- Ability to connect with experts (Rizzoli & Young, 1997);
- Ability to share information with others;
- Associated Trust/Incorporation information; and

- Easy to use.

A member of Group D (personal communication, February 3, 2015) commented that one of the main impediments for the group was the ability to source the best information from the correct source, as they often did not know who they should be talking to. By creating an EDSS that links users to experts then researchers and developers will be reducing, if not removing, one of the impediments for Māori groups making land use decisions. A directory of consultants, or a list of places where users can access key information, grouped by land use category (e.g. forestry consultants or wetland information) would provide a valuable resource for Māori groups (Rizzoli & Young, 1997).

Allowing users to share information stored in the EDSS easily with others would also provide great value for users. This information sharing flows two ways. Māori groups want to be able to pass information onto their stakeholders, in order to keep them informed with what is happening with their land (Group D, personal communication, February 3, 2015). The ability to share trust/incorporation information with other Māori groups or interested parties (e.g. District Councils) is also important (Group D, personal communication, February 3, 2015); this type of information sharing needs to be more restricted, letting interested parties only see the high level information associated with a group and their land use plans. While individual groups must do what is best for their own land and stakeholders, having access to this high level information for neighbouring groups could allow groups to work together and increase their bargaining power/improve their economies of scale.

A tool that is easy to use was the final feature believed to be very important by respondents. This is a vital area for researchers/developers to get right. If an EDSS is not easy to use, then users will not adopt it (McIntosh et al., 2011). Several of the respondents commented that current EDSS are often difficult to use and lack training material. An easy to use tool may not always be intuitive (although an effective EDSS should be). Therefore it is important to have instructions that are easy to understand and follow as well (McIntosh et al., 2011). This information needs to be placed in a location that is accessible, such as the home page of a website or the main user interface of an EDSS. Having the instructions in different forms could also be helpful for users as different people learn and understand in different ways (e.g. a video versus a written document).

Both the existing literature on stakeholder participation and Kaupapa Māori research have shown the importance of stakeholder participation. Had this study engaged more frequently with its participants then the outcomes might have been more widely applicable. Without

stakeholder participation researchers and developers run the risk of designing EDSS that fail to meet stakeholder requirements. In particular, this study has shown the need for researchers and developers to understand the underlying drivers of Māori land use decision making processes, including Māori values and social, economic and environmental considerations. The ability for users to visualise their land, to access consultants or experts, and to share information with other groups and their stakeholders were deemed by this study's participants to be the most important features for a future EDSS.

7 CONCLUSIONS AND RECOMMENDATIONS

With the arrival of European settlers to New Zealand in the early part of the 19th Century, Māori were alienated from their land. Today, Treaty of Waitangi settlements have helped many Māori to regain access to the land. However, many Māori landowners face barriers to the development of their land associated with access, finance and multiple ownership. Even when these barriers are overcome, Māori land trusts and incorporations still face problems when trying to administer and utilise their land. It is hoped that through the process of stakeholder participation and Kaupapa Māori research, researchers and developers will be able to develop Environmental Decision Support Systems (EDSS) as a way of transferring science, and thus aiding the land use decision making processes of Māori landowners.

As such, the overall aim of this thesis was to address "how Environmental Decision Support Systems can be improved to better meet the stated needs of Māori landowners". To answer the research question a good understanding regarding the background to Māori landownership issues, and how best to engage and research with Māori, was needed (Barnes, 2000; Cram & Kennedy, 2010; Durie, 2004; Hutchings, 2002; Jones et al., 2010; Thompson & Barnett, 2008; Walker et al., 2006. In addition, current EDSS needed to be reviewed, including New Zealand EDSS examples. With a better understanding of the background issues, a method was then developed to determine the needs of Māori landowners, data collected and recommendations made that would aid the development of future EDSS.

The literature review on EDSS had universally commented on the importance of stakeholder participation (Hansen & Prosperi, 2005; Kingston et al., 2000; Reed, 2008; Reed et al., 2009). This is something that has not always been done well in the past and so the primary purpose was to talk to Māori landowners to determine their needs for EDSS. A survey of local Māori landowners from Māori land trusts and incorporations was determined to be the best way to gather information about land use decision making requirements. Between the project's advisor and the Te Puni Kōkiri database a list of Māori land trusts and incorporations was assembled. Dillman's (2000) approach was used to shape the survey and cover letter that was sent out to the groups. At all points of contact, confidentiality and the desire to meet with respondents were emphasised. Respondents were free to fill out the surveys in the manner that worked best for them, in order to increase the rate of return, but also in keeping with Kaupapa Māori research principles. Once the surveys had been returned, the results for each question were examined and analysis carried out.

The key findings from this work are as follows:

- The key driver of land use decisions in the groups surveyed are social considerations, followed by economic considerations and then environmental considerations. Any EDSS that is developed for Te Arawa entities should include all three factors, as these constructs underpin most concepts of sustainability and of generating benefits for future generations.
- According to the groups surveyed, Māori values are interlinked, with any one value being of equal importance to all other values. These values underpin the decision making process of Māori trusts and incorporations. As such, researchers and developers will need to understand the linkages between values, so that they can incorporate them into future EDSS. Failure to understand the linkages or to incorporate Māori values could undermine the usefulness and uptake of any tool that tries to aid Māori landowners in their land use decision making.
- The data from this survey show a mismatch between the expressed balance of values, and the considerations that impact on decision making. The reasons for this, and how it could/should be incorporated into any decision making system requires further study.
- Visualisation of the land to aid understanding of its various features and to help make informed long term, sustainable decisions was an important EDSS feature for the groups surveyed. The ability to share information with others, to connect to experts and to access associated group information were also features that were highly desired by the respondents to this survey. In addition, any future EDSS must be easy to use.

Developers and researchers need to examine how they can create an EDSS that not only incorporates social, economic and environmental considerations, values and desired features, but also help Māori groups to remove barriers to land use decision making. The development of an effective EDSS for use by Māori groups should also be underpinned by the development of a strong relationship between the researcher and user groups. Such relationship building is likely to require some time input and this should be incorporated into project planning. Kaupapa Māori research principles should also be upheld where possible, including Māori involvement in the research process from start to finish. While any future EDSS design should include features and information specific to that project, piece of research and stakeholders, it is hoped that these findings will provide a starting point for future EDSS development for Māori landowners.

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Ehara taku toa, he takitahi, he toa takitini

My success should not be bestowed onto me alone, as it was not individual success but success of a collective

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10 APPENDICES

Appendix 1: Declaration Confirming Content of Digital Version of Thesis

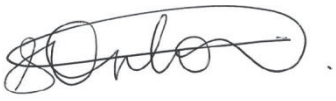
I confirm that the content of the digital version of this thesis

Environmental Decision Support Systems for Māori Landowners

is the final amended version following the examination process and is identical to this hard-bound paper copy.

Have you published articles/material from your thesis?	No
If yes, have you received copyright permission from the copyright holder, (usually the publisher), to include this material with your thesis?	N/A

Sarah Louise Orton



24th February 2014

APPENDIX 2: Māori Land Use Decision Making Survey - Māori Land Trust Version

Māori Land Use Decision Making

Figure 1 Lake Brunner (©Roger Bawden)

Sarah Orton
Scion
49 Sala Street
Whakarewarewa
Rotorua 3010
Phone: 07 343 5584

1. **As a Trustee, do you contribute to making decisions regarding the land use options for the Trust's land?**

   ☐ Yes
   ☐ No
   ☐ I don't know

2. **At what stage is the Trust in making decisions about land use options? Please tick all options that are relevant.**

   ☐ Learning about the different available options
   ☐ Implementing decisions
   ☐ Managing land use options

3. **To what extent are the following resources used by the Trust to help with making land use decisions? Please tick your answer, where 1 is never used by the Trust and 5 is frequently used by the Trust.**

Resource Types	Never		Sometimes		Frequently
	1	2	3	4	5
Computer software	☐	☐	☐	☐	☐
External consultant	☐	☐	☐	☐	☐
Field days	☐	☐	☐	☐	☐
Friends	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Library	☐	☐	☐	☐	☐
Mātauranga Māori	☐	☐	☐	☐	☐
Other Trusts	☐	☐	☐	☐	☐
Personal experience	☐	☐	☐	☐	☐
Regional Council	☐	☐	☐	☐	☐
Technical documents	☐	☐	☐	☐	☐
Whānau	☐	☐	☐	☐	☐
Workshops	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

4. **Have any of the following options been suggested as suitable land use options for your land? Please tick as many as are applicable.**

- ☐ Commercial property development
- ☐ Dairying
- ☐ Eco-tourism
- ☐ Exotic forestry
- ☐ Geothermal energy
- ☐ Native forestry
- ☐ Other non-wood producing land uses (e.g. Mānuka honey, ginseng or flax fibres)
- ☐ Orchard (e.g. Kiwifruit)
- ☐ Processing plants (e.g. Sawmills, biofuel or dairy processing)
- ☐ Recreation (e.g. Hunting, bush walks, mountain bike tracks)
- ☐ Sheep and beef
- ☐ Other(s)_____
- ☐ Other(s)_____
- ☐ Other(s)_____

5. **Please select five of the following options that you would have liked to receive information about as land use options for your land?**

- ☐ Commercial property development
- ☐ Dairying
- ☐ Eco-tourism
- ☐ Exotic forestry
- ☐ Native forestry
- ☐ Other non-wood producing land uses (e.g. Mānuka honey, ginseng or flax fibres)
- ☐ Orchard (e.g. Kiwifruit)
- ☐ Processing plants (e.g. Sawmills, biofuel or dairy processing)
- ☐ Recreation (e.g. Hunting, bush walks, mountain bike tracks)
- ☐ Renewable energy (e.g. geothermal, wind)
- ☐ Sheep and beef
- ☐ Other(s) _____
- ☐ Other(s)_____
- ☐ Other(s)_____

6. **How much influence do the following values have on your land use decision making process? Please circle your answer, where 1 no influence and 5 is high influence.**

Value	No Influence 1	2	Neutral 3	4	High Influence 5
Arohatanga (love)	☐	☐	☐	☐	☐
Kaitiakitanga (guardianship, stewardship)	☐	☐	☐	☐	☐
Manaakitanga (showing respect, generosity and care for others)	☐	☐	☐	☐	☐
Mana whenua (power from and over the land)	☐	☐	☐	☐	☐
Tikanga (custom, practice, way of life)	☐	☐	☐	☐	☐
Tino rangatiratanga (sovereignty, power, rule)	☐	☐	☐	☐	☐
Wairuatanga (spirituality)	☐	☐	☐	☐	☐
Whakakotahitanga (unity)	☐	☐	☐	☐	☐
Whakapapa (genealogy, lineage, descent)	☐	☐	☐	☐	☐
Whānaungatanga (relationship, sense of family connection, sense of belonging)	☐	☐	☐	☐	☐

7. **When making land use decisions, as a Trustee, please select your top five considerations that effect your final decision?**

- ☐ Access to land
- ☐ Clean waterways
- ☐ Connection to the land
- ☐ Employment potential
- ☐ Environmental benefits and risks
- ☐ Erosion control
- ☐ Greenhouse gas (GHG) emissions
- ☐ Infrastructure development
- ☐ Level of financial risk
- ☐ Market expansion opportunities
- ☐ Politics
- ☐ Production levels
- ☐ Profit
- ☐ Self-empowerment
- ☐ Social benefits and risks
- ☐ Upfront start-up costs
- ☐ Other: _____

8. **Using your top five considerations from question 7 (above) please rank your answers from 1 (most important) to 5 (least important).**

1) _____
2) _____
3) _____
4) _____
5) _____

9. As a Trust have you ever used the following decision support tools? Please circle your answer, where 1 is never used by the Trust and 5 is frequently used by the Trust.

Tool	Never		Sometimes		Frequently	Never heard of the tool
	1	2	3	4	5	
Cultural Health Index	☐	☐	☐	☐	☐	☐
Land Use Capability	☐	☐	☐	☐	☐	☐
Maori Wetlands model	☐	☐	☐	☐	☐	☐
Mauri Model	☐	☐	☐	☐	☐	☐
Mauri-o-meter	☐	☐	☐	☐	☐	☐
Whenua Viz	☐	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐	☐

10. Using your answers from question 9 (above), as a Trust did you find the following decision support tools useful? Please circle your answer, where 1 is very unhelpful and 5 is very helpful.

Tool	Very Unhelpful		Neither helpful or unhelpful		Very Helpful
	1	2	3	4	5
Cultural Health Index	☐	☐	☐	☐	☐
Land Use Capability	☐	☐	☐	☐	☐
Maori Wetlands model	☐	☐	☐	☐	☐
Mauri Model	☐	☐	☐	☐	☐
Mauri-o-meter	☐	☐	☐	☐	☐
Whenua Viz	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

11. Thinking about the tools you do use to make land use decisions, what is lacking, missing or unhelpful about those tools? Please use the space provided on the back page if you require more space to write.

12. Thinking about the tools you do use to make land use decisions, what would make them more helpful / easier to use / better suited your needs? Please use the space provided on the back page if you require more space to write.

13. If you were to use a decision support tool, what style would work best for you?

- ☐ Paper-based
- ☐ Spreadsheet
- ☐ Macro tool
- ☐ Computer software
- ☐ Web-based tool

14. Presuming an electronic based medium was selected, what kind of set up do you prefer to use?

- ☐ Computer (desktop or laptop)
- ☐ Smart phone application
- ☐ Tablet

15. What features would you prefer to have when accessing land use information? Please circle your answer, where 1 is of low importance and 5 is of high importance.

	Low		Neutral		High	Not Sure
	1	2	3	4	5	
Ability to connect with experts	☐	☐	☐	☐	☐	☐
Ability to share information with others	☐	☐	☐	☐	☐	☐
Ability to 'play' with data/scenarios	☐	☐	☐	☐	☐	☐
Access through the internet	☐	☐	☐	☐	☐	☐
Associated Trust information	☐	☐	☐	☐	☐	☐
Easy to use	☐	☐	☐	☐	☐	☐
Free	☐	☐	☐	☐	☐	☐
Graph form	☐	☐	☐	☐	☐	☐
Map form	☐	☐	☐	☐	☐	☐
Plain figures	☐	☐	☐	☐	☐	☐
Separate software program	☐	☐	☐	☐	☐	☐
Translation in Te Reo Māori	☐	☐	☐	☐	☐	☐
Visualisation of my own land	☐	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐	☐

16. What is the name of the Trust that you are a Trustee on?

_____

_____

17. How many Trustees are on your Trust?_____

18. What is the average age of those Trustees?

- ☐ ≤ 20 years
- ☐ 21 – 30 years
- ☐ 31 – 40 years
- ☐ 41 – 50 years
- ☐ 51 – 60 years
- ☐ ≥ 61 years
- ☐ I prefer not to answer

19. What is your gender?

☐ Male ☐ Female ☐ I prefer not to answer

20. What is the highest level of education that you have obtained?

- ☐ Primary School
- ☐ Secondary School
- ☐ Polytechnic
- ☐ University
- ☐ I prefer not to answer
- ☐ Other: _____

21. Which Hapu / Iwi do you belong to?

_____

_____

_____

☐ I do not belong to a hapu / iwi

22. Would you like a summary of the findings after this report is completed?

- ☐ Yes (Please leave your contact details below)
- ☐ No

_____

Thank you for taking time to complete this survey on Māori land use decision making. Your assistance in providing this information is very much appreciated. If there is anything else that you would like to tell me about this survey, please do so in the space provided below.

Please return this survey to:

Scion
C/O Sarah Orton
49 Sala Street
Whakarewarewa
Rotorua 3010

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

SCION
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Confidentiality
These survey results will be used in such a way that individual responses cannot be identified and only aggregated results will be published. Completed forms will be kept by the University and will not be released to third parties.

Participant Rights
You have the right to:

- Decline to answer any question
- Ask any questions about the study at any time during participation

Contacts
If you have any questions, please contact either myself or my supervisors.

Researcher	Supervisors	
Sarah Orton	Karen Hytten	Lisa Berndt
MSc Candidate	Institute of Agriculture	Forestry Informatics
Massey University	& Environment	Scion
Email:	Massey University	Email:
Sarah.Orton@scionresearch.com	Email:	Karen.Byane@scionresearch.com
Tel: +64 7 343 5584	K.Hytten@massey.ac.nz	Tel: +64 3 364 2987 etxn. 7280
	Tel: +64 6 356 9099	

Ethics Statement

Massey University requires that ethics approval be obtained for research involving human participants. This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 9099, email humanethics@massey.ac.nz.

APPENDIX 3: Cover Letter sent with the Survey

Te Papa Tipu Innovation Park
49 Sala Street, Private Bag 3020, Rotorua 3046, New Zealand
Telephone +64 7 343 5899 | Facsimile +64 7 348 0952
E mail enquiries@scionresearch.com | www.scionresearch.com

SCION
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29th September 2014

Attention:

Tēnā koe

I am writing to ask for your help in a study looking at who makes decisions about land use options for the Māori land. This study forms part of my Master's in Environmental Management and it is trying to determine whether Māori Trustees and Incorporations have different needs and values that influence their choices and that should be incorporated into land use decision making tools.

It is my understanding that you are a Maori Incorporation involved with making land use decisions. I am conducting the enclosed survey to find out;

a) What tools Committee/Management Members currently use for making land use decisions;
b) If they are aware of all of the land use options available to them;
c) Whether their underlying values affect their decision making process; and
d) If current tools allow for the incorporation of those values into the decision making process.

In order to collect this information I have designed a survey (please see attached) which I would appreciate if all Committee/Management Members could take the time to complete. I would prefer to come and join you all for this undertaking so that I can meet you all and to address any questions or comments that you may have about my questions directly. Please let me know if there is a suitable time/date for this to occur (e.g. a monthly meeting). If this is not possible then I am happy to provide you with enough paper based copies of the survey for you to complete, or I can provide a link to an online version of the survey.

The results from this survey will be used to help research organisations, such as Scion, to create better decision making tools for Māori in the future. By understanding if there are any differences between Māori and non- Māori regarding the their values and land use choices, and how those values and choices affect the decision making process, developers and researchers can create decision making tools that better suit Māori needs.

Please be assured that your answers are completely confidential and will only be released as summaries in which no individual's answers will be able to be identified. While this survey is voluntary, it would be greatly appreciated if you would take a few minutes to share your experiences and opinions about how you make land use decisions on behalf of the Incorporation. If you prefer that your Incorporation not take part in this study then please let me know.

If you have any questions or comments about this study, I would be happy to talk with you. My phone number is 07 343 5584 or you can email me at sarah.orton@scionresearch.com.

Thank you very much for helping me with my study. I look forward to hearing your response.

Noho ora mai

Sarah Orton

APPENDIX 4: Low Risk Notification Ethics Approval

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

17 September 2014

Sarah Orton
5 Cedar Place
Owhata
ROTORUA 3010

Dear Sarah

Re: Environmental Decision Support Systems for Māori Landowners

Thank you for your Low Risk Notification which was received on 5 September 2014.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J. O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)

cc Dr Karen Hytten
Institute of Agriculture and Environment
PN433

Prof Peter Kemp, HoI
Institute of Agriculture and Environment
PN433

Massey University Human Ethics Committee
Accredited by the Health Research Council

Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11222, Palmerston North 4442, New Zealand T 06 3505573; 06 3505575 F 06 350 5622
E humanethics@massey.ac.nz; animalethics@massey.ac.nz; gtc@massey.ac.nz www.massey.ac.nz