Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Land Use Transformation: Exploring Private Small Holdings and Conservation Opportunities Along the Estuary in Tasman, New Zealand

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Environmental Management

at Massey University, Palmerston North, New Zealand

Katrina O’Connor

Abstract

This study looks at the historical land use change of an area on the Waimea Inlet, an area close to the cities of Richmond and Nelson, New Zealand. This is an area with high ecological value that supports many native and migratory bird species. The use of aerial photograph comparisons between the 1940s, 1980s and 2020s paints a picture of an area that has undergone a significant transformation from productive orchards and grasslands to higher density residential lifestyle properties. It also shows that native vegetation has become very fragmented over the peninsulas. The land cover change and interviews indicate that there is a lot of land that is not used for productive purposes on these smaller lifestyle blocks. To look at potential to utilise this unused land for conservation purposes this research developed an understanding of the perceived barriers to conservation of the current landowners of smaller lifestyle holdings in this area. The results indicated that many landowners value conservation and the amenity of the area but face barriers such as time constraints and varying levels of practical knowledge. The findings suggest that policies supporting coordinated efforts between private landowners, community volunteer groups and government agencies to connect fragmented areas of native vegetation are crucial for enhancing biodiversity. These vegetative connections are necessary to ensure ecological resilience in this area for species into the future.

Acknowledgements

This thesis marks the end of a challenging but rewarding journey, and I could not have reached this point without the incredible support of so many people.

First and foremost, I would like to thank my supervisor, Diane Pearson, for your steady guidance, patience, and belief in me. Your thoughtful feedback, clear direction, and encouragement have encouraged me to keep going and complete this project.

Most importantly, I wish to thank my family. Thank you for your patience, support and company. Your love and encouragement have been my anchor throughout this journey.

TABLE OF CONTENTS

TABLE OF CONTENTS 5

Chapter 1 - Introduction 9

1.1 Study Overview 9
1.2 Lifestyle Properties 9
1.3 The Study Area 10
1.4 Background 12
Definitions: 12
1.4.1 Land Use Change in New Zealand 12
1.4.2 Development in Coastal Areas 14
1.4.3 Biodiversity in New Zealand 16
1.4.4 GIS for Land Use Planning 18
1.5 The need for this research 18
1.6 Aim and objectives 19
1.6.1 Research Question 20
1.6.2 Research objectives 20
1.7 Focus of the study 20
1.8 Thesis Outline 21

Chapter 2 - Literature Review 23

2.1 Introduction 23
2.2 The need for Conservation on private land 23
2.3 Estuary Conservation 25
2.4 Land Use Change to Lifestyle Blocks 27
2.6 Land Use Change Modelling 29
2.7 Conservation on Private Small Landholdings 31
2.8 Summary 37

Chapter 3 - Case Study Description 39

3.1 Introduction to chapter 39
3.2 Location 39
3.3 History of the area 42
3.4 Study Area Land Use 47
3.5 Ecology 49
3.6 Conservation Initiatives 52
3.7 Summary 53

CHAPTER 4 - Methodology 55
4.1 Introduction 55
4.2 Context for Methodology 56
4.3 Aerial Land Use Comparison Methodology 57
4.3.1 Introduction 57
4.3.2 Visual Interpretation of Land Cover Using Aerial Photos 58
4.3.2.1 Historic Aerials Source 58
4.3.2.2 Land Use Categorisation 59
4.3.2.3 Segmentation of Land Use on the Aerials 60
4.3.2.4 Analysis of Differences in Land Coverage Over Time 62
4.3.2.5 Analysis of the Relationship Between Building Coverage and Land Cover Change Over Time 63
4.3.3 Assessment of past survey plans to assess the change in property boundaries and property sizes 63
4.3.3.1 Survey Plans 63
4.4 Social analysis Methodology 65
4.4.1 Introduction 65
4.4.2 Methodological Theory 66
4.4.3 Online Survey 67
4.4.3.1 Data Collection 67
4.4.3.2 Sample Selection 68
4.4.3.3 Survey Questions 69
4.4.3.4 Survey Ethics 70
4.4.3.5 Pilot Survey 71
4.4.3.6 Analysis 71
4.4.4 Phone Interviews 72
4.4.4.1 Initial Interview Questions 74
4.4.4.2 Sampling 74
4.4.4.3 Ethical Review 76
4.4.4.4 Pilot Interview 76
4.4.4.5 Analysis 77
4.4.5 Summary 78

CHAPTER 5 - Results 80
5.1 Introduction..... 80
5.2 Aerial Land Use Comparison..... 81
5.2.1 Tree/Bush Area..... 85
5.2.2 Grass/scrub..... 88
5.2.4 Orchard Land Use..... 92
5.3 Assessment of Past Survey Plans..... 93
5.4 Social Analysis Results..... 98
5.4.1 Online Survey..... 98
5.4.1.1 Introduction..... 98
5.4.1.2 Demographics of Online Survey..... 98
5.4.1.3 Motivations of Online Survey Participants..... 102
5.4.1.4 Pest and Weed Control..... 104
5.4.1.5 Knowledge..... 104
5.4.1.6 Barriers to Conservation..... 106
5.4.1.7 Interactions with Agencies..... 108
5.4.2 Phone Interviews..... 109
5.4.2.1 Introduction – Phone Interviews..... 109
5.4.2.2 Phone Interview Responses – Time..... 110
5.4.2.3 Phone Interview Responses - Money..... 112
5.4.2.4 Phone Interview Responses – Knowledge..... 112
5.4.2.5 Phone Interview Responses – Motivation..... 113
5.4.2.6 Interactions with government agencies..... 114
5.4.2.7 Interactions with Volunteer Groups..... 114
5.5 Summary of Results..... 115

Chapter 6 - Discussion 116
6.1 Introduction..... 116
6.2 Aerial Land Cover Comparison..... 117
6.3 Survey Title Comparison..... 119
6.4 Conservation..... 119
6.5 Landowner Motivations..... 124

Chapter 7 - Conclusion and Recommendations 132
7.1 Conclusion..... 132
7.2 Recommendations..... 138
7.2.1 Habitat Planting..... 139
7.2.2 Pest Control..... 141
7.2.3 Weed Control..... 142
7.2.4 Monetary Incentives..... 142
7.3 Evaluation of Research Methods..... 143
7.4 Recommendations for Future Research..... 144
7.5 Overall Summary..... 145

References 146

Appendix I: Private Land Conservation Survey 173

Appendix II – Phone Interview Questions.....192

Appendix III - Flyers.....195

Appendix IV – Site Photos 197

Chapter 1 - Introduction

1.1 Study Overview

This study looks at the potential of utilising privately owned lifestyle blocks as areas for future conservation in New Zealand. Effective conservation planning entails identifying the most suitable locations and methods for interventions to reach sustainable conservation outcomes (Luby et al, 2022). Attempts to conserve wildlife on private lands are characterised by a complex socio-ecological interplay between human practices and wildlife (Matthew et al, 2025). This study is unique in that it takes an interdisciplinary approach by integrating the use of historic aerial photo images and GIS analysis to quantify the land use changes in the study area, or change due to human use of the land as well as using sociological methods to assess the values of the landowners. This provides a picture of both land use change over time and the perceived motivations, barriers and enablers of the current landowners in the area. The use of this two-pronged approach fills an information gap in both the knowledge of land use changes in an area that has had high growth in lifestyle blocks, in conjunction with providing information on the values of the landowners of these small properties, which are under researched when compared with those of larger agricultural and horticultural farm owners who have been the subject of considerable environmental studies in New Zealand.

1.2 Lifestyle Properties

There are no official definitions of what a lifestyle block is in New Zealand. Statistics New Zealand uses residential development of land sized 2–8 hectares (lifestyle blocks are about 5 hectares on average) to describe lifestyle blocks (Statistics New Zealand, 2021). Land Information New Zealand (2010) (p. 60) defines a lifestyle block as being “generally, in a rural area, where the predominant use is for a residence and, if vacant, there is a right to build a dwelling. The land can be of variable size but must be larger than an ordinary residential allotment. The principal use of the land is non-economic in the traditional farming sense, and the value exceeds the value of comparable farmland”. Environment Canterbury (2025) defines lifestyle blocks as “between one and 20ha, with majority being in the 4-5ha range”. In 2019, 38%, 28% and 17% of highly productive land i.e Land Use Class 1, 2 and 3 land, respectively,

were occupied by medium sized parcels (under 40ha) or smaller with a dwelling (Curran-Cournane et al., 2021).

New Zealand, as with other parts of the world has seen an increase in lifestyle blocks (smallholdings) This is due, in part, to the intensification of agricultural land use, coupled with the expansion of urban land cover and the increase in populations within New Zealand's urban areas (Dudley et al., 2020). The increase in urban land cover has in part led to amenity migration, the movement of affluent individuals from suburban or urban areas to rural areas for lifestyle amenities (Abrams et al., 2012).

1.3 The Study Area

The study area is located at the top of the South Island of New Zealand along the Waimea Estuary in an area that has recently seen a large increase in lifestyle blocks from previous horticultural and agricultural land.



Figure 1.3.1 – Location of Study Area: (source: Topofthesouthmaps.co.nz)

Many estuaries worldwide have seen land use changes alongside them with nearly half of the world's estuaries globally having been directly altered by humans (Jung N et al, 2024). This site was chosen as it is an area that has seen land use change over the past 20 years from a largely rural horticultural use to smaller lifestyle use. The Bronte and Hoddy Peninsulas subject to this study are rolling hills that look out over the Waimea Inlet and are reasonably close to the nearest urban town of Richmond (a 5 to 10 minute drive away). It is also an area of ecological value in that it borders the Waimea Inlet, an estuary that has been largely modified at the eastern end but little modified at this western end where the study takes place.

The study area contains a history of being used over time by both Māori to access the Waimea Plains (a historic horticultural site) as well as being developed into apple orchards in the early 1900s for European settlers. The site currently contains a mixture of uses with a few orchards still operating but it is largely lifestyle blocks.

It is a location where conservation is likely to be beneficial as it is next to the sea and is at the bottom of a catchment area that includes agricultural and horticultural uses further up the catchment. The estuary has been identified as habitat for at least 3 threatened species of coastal birds (Black-billed Gull, White Heron, Black Fronted Tern) and 8 at risk species of coastal birds (Banded Rail, South Island Fernbird, Red-billed Gull, White-fronted Tern, Pied Shag, Black Shag, Little Black Shag and Royal Spoonbill) (Schuckard and Melville, 2019). It is also the location of existing volunteer efforts to restore ecological areas such as the “Battle for the Banded Rail” which includes volunteers planting in this area to provide habitat for the banded rail.

Given the above the study area provides a mixture of land use change, ecological importance and some existing conservation work making it an area where this study is relevant and can be put to practical use.

1.4 Background

Definitions:

The following definitions from Law et al, 2024 provide some clarity on the definitions used in this study:

Land cover refers to the physical surface of the earth, including various combinations of vegetation types, natural bare surfaces (e.g. exposed rock or gravel, permanent snow and ice), and water bodies, as well as anthropogenic elements, such as agriculture, transport infrastructure and built environments. Land-cover classes can usually be distinguished by characteristic patterns using remote sensing.

Land-use classification provides additional information on land cover and the types of human activity involved in land use. It may also facilitate the assessment of environmental impacts on, and potential or alternative uses of, land (United Nations 1997).

Land use means the purpose to which the land is committed, including the production of goods (such as crops, timber, and manufacturing) and services (such as defence, recreation, biodiversity, and natural resources protection).

1.4.1 Land Use Change in New Zealand

Land Use in New Zealand is undergoing significant changes, with urban sprawl resulting in the subdivision of previously agricultural land near cities into small rural residential blocks, locally known as lifestyle properties. The trend of subdividing land into lifestyle blocks is on the rise in New Zealand. In 2012 Andrew & Dymond estimated that lifestyle blocks (on all land use classes) occupied 873,000 ha, or about 5% of New Zealand's non-reserved land. Nationally, in 2002, 20,735 hectares of highly productive land (defined as land use classes 1, 2, and 3) were converted through subdivision to rural residential land (>0.4ha to 2 ha with a dwelling) (Statistics New Zealand, 2021). By 2019, this had increased to 43,252 hectares of highly productive land being converted to rural residential land. (Statistics New Zealand, 2021).

Curran-Cournane et al. (2021) conducted a study on land fragmentation on highly productive soils (land use classes 1 –3) and found that, in 2019, 38%, 28% and 17% of Land Use Class (LUC) 1, 2 and 3 land, respectively, were occupied by medium sized parcels (under 40ha) or smaller with a dwelling in 2019. They also noted a 73% increase in small parcels (>2.0 to ≤8.0ha) on LUC 1-3 land between 2002 and 2019. While these smaller parcels reduce the agricultural potential of private land, they also present a unique opportunity to protect indigenous biodiversity on land types that are not represented in New Zealand's conservation estates. Although 32% of New Zealand's land area is in public conservation estates, this land is biased towards high elevation vegetation types and the public conservation estates poorly represent lowland areas (Cieraad et al., 2015; Monks et al., 2019; Pannell et al., 2021). A quarter of the remaining indigenous vegetation in New Zealand is found on private land, including threatened and rare biodiversity, with some species existing only on private land. Therefore, the inclusion of private land in conservation is essential to conserve ecological areas that are distinct from publicly owned conservation land. The contribution of private land has been found to be critical to the integrity of ecological diversity in other studies. (Brown et al., 2015; Environment Guide, 2018; Holdaway et al., 2012; Monks et al., 2019; Pannell et al., 2021).

In New Zealand, incorporating private land in conservation management is crucial for biodiversity protection at a national level and for maintaining and conserving ecosystems that are not represented in public conservation lands. policies and programmes worldwide have been implemented to include private land in conservation efforts. It is increasingly evident that understanding landowners and their values is crucial for private land conservation participation (Selinske et al 2022). To effectively include private land in conservation management, understanding landowners' motivationslandowners, barriers and abilities to implement conservation practices is needed.

The management of private land has significant implications for biodiversity conservation nationally, with land managers having a critical role to play (Hanley et al. 2012, Thompson et al. 2015, Maseyk et al., 2021). Conservation policies on private land include National Policy

Statements such as the National Policy Statement for Fresh Water Management (2020) and regional rules, which vary by district, as well as national and regional incentive programs. Nationally, there is a lack of cohesiveness to these regional policies and there is a lack of incentives to support the protection of biodiversity on land outside of the public conservation estate. Where policies do exist, there is a lack of compliance and monitoring necessary to achieve objectives, with variations across regions (Brown et al., 2015; Norton & Cochrane, 2000).

Typically, owners of small lifestyle blocks do not necessarily purchase the land for productive purposes (Curran-Cournane et al 2021, Curran-Cournane 2018), leaving an opportunity to utilise land for conservation measures without impacting income. The use, experiences, and motivation of lifestyle block owners are not well understood, particularly in New Zealand. Previous international studies have found that land productivity, length of tenancy, motivations for ownership, off-farm income and rural experience are all highly variable (Fairweather 1996; Fairweather & Robertson 2000; Sanson et al. 2004; Isnard 2009; Property Economics 2009). Motivations and behaviours are influenced by personal values and perspectives (Davies & Hodge 2007), and social norms (Ajzen 1991; St John et al. 2010; Kuhfuss et al. 2016; Lute et al. 2018). There is a lack of research into the motivations and behaviours of the lifestyle block owners in New Zealand. Given the increase of lifestyle blocks in New Zealand, and the benefit of including privately owned land in conservation to ensure biodiversity across a range of ecosystems, knowing more about these landowners is imperative.

1.4.2 Development in Coastal Areas

Estuaries worldwide have been significantly impacted by both anthropogenic climate and non-climate drivers of changes (Kennish, 2021). Rapid urbanization has dramatically altered land-use patterns in many estuarine areas around the world. (Xu et al, 2022). Increasingly habitat loss and fragmentation alongside estuaries are, in part, due to land use changes for short-term economic gain, which result in long-term environmental and societal consequences; (Elliott, 2019). Disproportionate human population growth and development in

coastal watersheds have adversely affected the structure and function of many estuarine and coastal marine ecosystems. (Kennish, 2021).

Historically estuarine ecosystem have exhibited high natural variability in response to different human pressures within their catchments, including upstream rivers, and the estuaries themselves. The sustainability of these ecosystems depends on many variables, including population growth, cultural influences, historical changes, and community involvement. (Elliott et al, 2019). Despite their susceptibility to anthropogenic degradation, estuarine environments support numerous species of organisms and habitats of ecological importance, while also providing vital goods and services to society.(Kennish, 2022). Coastal ecosystems, including terrestrial coastal wetlands and shallow waters, play irreplaceable roles in material production, climate regulation, water conservation, pollutant removal, biodiversity maintenance and other factors, and are some of the most valuable natural ecosystems on Earth (Liu, 2020).

The ecosystem services derived from estuaries range from benefits from food production and recreational opportunities to containment processing and cultural identity (Thrush et al, 2014). Coastal ecosystems are crucially important for global carbon and nitrogen cycling and other ecosystem services (Thrush et al. 2021). However, the functional extinction of shellfish beds, coupled with elevated nutrient and sediment delivery to coasts may lead to rapid changes disproportional to nutrient loading, predisposing the ecosystem to a functional tipping point (Thrush et al, 2021). Consequently, management actions need to be based on an understanding of the complexities, including nonlinear interactions, of multiple stressors on overall ecosystem functioning.

Many estuaries are squeezed between sea-level rise, coastal hardening and adverse cumulative effects from unsustainable catchment activities. (Urlich and Hodder-Swain, 2022). Land use transformations provide direct economic benefits for human beings but can significantly alter or imbalance ecosystem services, affecting water resources, air quality, disaster prevention, biodiversity and other aspects, and they affect human well- being (Liu, 2020). Land use is a crucial way human activities impact ecosystems, by influencing ecosystem patterns and processes (Li et al., 2018).

Catchment land cover and estuary physical characteristics that control mixing are important environmental determinants of estuarine water quality in New Zealand. (Dudley et al, 2020). With sea level rises, estuary margins may need to be repurposed after a managed retreat, such as for the facilitation of saltmarsh expansion (Swales et al., 2020). However, there is currently no specific policy facilitating such estuary migration, and it is likely to be an expensive undertaking, especially for estuaries surrounded by housing, infrastructure and/or farms (Bell et al., 2015). Implementing existing legislation, such as the Resource Management Act (RMA) 1991, has largely failed to prevent or reverse the ongoing ecological degradation of many estuaries (NZ Government 2021a, Randerson et al., 2020). Estuaries should be at the centre of freshwater management, with estuary survival under sea level rise needing prominence under proposed government RMA reforms (Urlich el al., 2022).

Much of the nutrient load applied to agricultural soils eventually passes to waterways and coastal mixing zones (Dymond et al. 2013). Nutrients from agricultural and urban land alter New Zealand's freshwater quality (Larned et al. 2016), and contaminants in freshwater flows to the ocean alter coastal water quality (Rabalais et al. 2009).

Given the importance of estuaries and the increase in small holdings near estuaries from landholders looking for landscape values utilising these properties for conservation would be of a benefit both for the ecology of the land and the estuary itself.

1.4.3 Biodiversity in New Zealand

Historically in New Zealand at least three quarters of the natural environment has been significantly modified by humans (Leathwick et al, 2004). Currently, the greatest threats to native species are habitat loss and invasive mammalian predators (Diamond & Veitch, 1981; Towns & Daugherty, 1994). Although thirty-two percent of New Zealand's land area is in public conservation estate, this land is biased towards high elevation vegetation types and poorly represents lowland areas (Cieraad et al., 2015; Monks et al., 2019; Pannell et al., 2021). A quarter of the remaining indigenous vegetation in New Zealand is found on private land,

including threatened and rare biodiversity, with some species only being found on private land making the contribution of this land critical to the integrity of landscape-scale ecology (Brown et al., 2015; Environment Guide, 2018; Holdaway et al., 2012; Monks et al., 2019; Pannell et al., 2021).

New Zealand has a unique biodiversity due to its long isolation from other land masses and distinct geological history. It is home to a variety of endemic species, many of which are found nowhere else on Earth. This distinctive evolutionary history has resulted in the development of an intricate web of ecological relationships, making New Zealand a hotspot for scientific inquiry into the processes that drive speciation and adaptation in isolated ecosystems (Wardle, 2010).

Despite its relatively small landmass, New Zealand harbours an extraordinary diversity of ecosystems, ranging from alpine grasslands to dense temperate rainforests. However, the unique biodiversity of New Zealand faces numerous threats, including habitat loss, invasive species, and climate change, emphasizing the need for comprehensive conservation strategies that integrate ecological research and management practices (Dawson et al., 2015). The conservation of this rich biodiversity faces challenges, particularly on private land where human activities can have a significant impact.

Studies such as those conducted by Innes et al (2017) and Didham et al (2019) highlight the importance of private land in supporting unique species and ecosystems. Additionally, research by Norton et al (2020) emphasizes the role of private landowners as stewards of biodiversity and the need for effective conservation policies that encourage their active participation. Understanding the motivations and concerns of private landowners is essential for designing effective conservation measures that are both ecologically sound and socially acceptable.

This study is also informed by the work of Kam et al (2019) and Pearson (2021). Kam et al (2019) looked at engaging absentee landowners in ecosystem delivery in South-eastern Australia. While their work looked at absentee landowners only, they used an approach to

understand the behaviours and values of the landholder group which is also relevant in this study. In addition, the work of Pearson (2021) explored the environmental stewardship, and potential barriers and motivators towards environmental management on lifestyle blocks in the Turitea Valley in the Manawatu Region of New Zealand.

1.4.4 GIS for Land Use Planning

Thematic maps of land use and land cover (LULC) help planners account for conservation, concurrent users, and land-use compressions by providing a reference for analysis, resource management, and prediction (Viddiraju et al., 2023). In order to plan and make better use of natural resources, it is crucial to identify and evaluate the effects of increasing land use and land cover change, which is primarily the result of human activities (Periyasamy et al 2021). Kerekes and Alexe (2019) found that the information obtained with remote sensing and GIS techniques are essential in order to understand the causes of land-use change. Furthermore, the information can be used for land planning strategies in order to have sustainable planning. In this study GIS is used to look at the historic land use change in the area in order to understand the changing land use. This information is analysed alongside sociological information of the landowners' values in order to gauge the potential opportunities that it brings for policies and programmes around conservation and to fill in the knowledge gap of land use change along with landowner values.

1.5 The need for this research

The effects of modified ecosystems and the continued effects of land use change are genuine issues that require investigating and a close look at policies to direct change to have a positive benefit to the environment is also necessary. Modification of coastal and estuarine shorelines through reclamation, dredging and in water structures can also affect ecosystem processes and as a result service delivery (Thrush et al, 2014). Being aware of long-term effects of modifications and land use on ecosystems means research can be undertaken and policies put in place to ensure land use changes do not take away from the available services of an estuarine ecosystem. In addition, incentivising land use alongside estuaries to include

ecological conservation can enhance the available services of the estuarine ecosystem. Mapping historic land cover patterns builds a picture of what has happened in the past due to changes in land use and gives us an idea of where there were previously patches of native vegetation that could possibly be reestablished in the future. It also demonstrates the change in this area from horticultural land use to largely recreational lifestyle blocks. This change in land use indicates that the landownerslandowners now (largely lifestyle blocks) will have different drivers from the historic landownerslandowners (mainly horticulture) who have cleared much of the native vegetation in the area for land use. However, replanting areas in native species cannot happen if landowners are not on board. The second part of this study looks at the current landowners and provides detail as to what would be required to get landowners on board for any future policies for planting on private land in this area.

While existing research has contributed valuable insights, there is a recognized gap in the understanding of how to encourage and support private landowners of lifestyle blocks in conservation efforts. Additional research is needed to explore motivations and barriers of these landowners. Studies by Robinson et al. (2022) suggest that financial incentives and educational programs can positively influence private landowners' conservation behaviour. Investigating factors that influence private landowners' decisions is crucial for developing policies that will work towards achieving conservation targets. This study looks to both quantify the change of land use alongside an estuary in New Zealand to demonstrate the change from horticultural land use to lifestyle blocks and investigates the motivation, barriers and enablers for landholders of the lifestyle blocks alongside the estuary to provide knowledge for future policy makers.

1.6 Aim and objectives

The aim of this research is to quantify the change in land use in a small case study estuarine area over the last eighty years and to determine the perceived motivators, barriers, and enablers of conservation on the lifestyle blocks (private land) that border an estuary using an example study area.

1.6.1 Research Question

This study was conducted to answer the following research question:

How has land use changed with increased demand for lifestyle properties over the past eighty years alongside the Waimea Inlet (Bronte and Hoddy Peninsulas) and what are the motivators, barriers and enablers of conservation measures on the small lifestyle blocks on the edge of the Waimea Estuary, New Zealand?

To answer the research question, three objectives were formulated:

1.6.2 Research objectives

1. To quantify the land use change over time on the Bronte and Hoddy Peninsulas on the edge of the Waimea Inlet using spatial and temporal analysis and past survey maps.

2. To identify attitudes and actions towards biodiversity conservation among lifestyle block landowners beside the Waimea Inlet.

3. Focusing on the perceived motivators, barriers, and enablers of biodiversity action to determine if more can be done to support private landowners to participate in management activities to protect biodiversity in the Waimea Inlet.

1.7 Focus of the study

The first part of this study quantifies the change in land cover using historical aerials from 1940s, 1980s and 2020s. These changes in land cover are used to indicate corresponding changes in land use. The change in land use cover is a crucial way in which human activities affect ecosystems (Lt et al 2018). Having accurate information on land use and land cover change is imperative for ecosystem monitoring and studying environmental change (Yu et al, 2016).

By quantifying both land cover changes and alterations in property size this research provides a basis for assessing land use patterns over time, important information to inform any future policies.

The second part of this study identifies the perceived values of the current landowners on lifestyle properties in the area. Conservation efforts on private land must be adaptable, responsive to changing conditions and values, and informed by the diverse motivations and capacities of landowners (Herse et al, 2020; Karimi & Hockings, 2018; Vigliano Relva & Jung 2021 as cited in Taylor et al, 2025). With an increase in lifestyle blocks in New Zealand knowing the motivations and values of landowners is imperative for effective conservation incorporating these properties. In New Zealand there is a lack of knowledge around lifestyle block owners' values with most research being done on larger agricultural and horticultural farmers. Pearson (2021) notes that despite lifestyle block properties occupying a significant amount of New Zealand land stock, research on this type of property has been limited to date. A lack of social knowledge about landholder management, values, attitudes, practices hampers effective and efficient conservation (Drescher and Brenner 2018, Fitzsimmons and Wescott 2007, Kamal et al 2015, Moon and Cocklin 2011, Messick et al 2021, Selinske et al 2015 in Taylor et al 2025). This study seeks to incorporate the values of the landowners with the land use change knowledge to provide a greater understanding to inform the design of conservation strategies incorporating these smaller lifestyle blocks.

1.8 Thesis Outline

Chapter One provides background information on conservation and estuaries in New Zealand, the problem statement for this research, aims and objectives.

Chapter Two uses a literature review to gather information on the importance of estuary conservation internationally and within New Zealand, the implications of enhanced conservation on estuary riparian margins. It then looks at the impacts of motivations, barriers, and willingness of private landowners of small holdings to undertaking conservation and how this affects policies.

Chapter Three describes the study area including demographical information and location details. It looks at the history of land use in the area and how this has changed over time.

Chapter Four describes the methodology and analysis used to investigate the motivations, barriers and enablers for conservation on private land in the case study area.

Chapter Five outlines the findings of this research including the results of both the mapping land use change analysis and the case study investigation into motivations, barriers and enablers for conservation in this area.

Chapter Six includes a discussion of the two research projects and the implications of the findings of the research projects.

Chapter Seven reflects on the research and makes recommendations based on both research projects including possible future research areas.

Chapter 2 - Literature Review

2.1 Introduction

This chapter reviews the existing literature on the intersection between lifestyle blocks and conservation measures. It also explores existing studies that have used GIS to map land use changes. Key themes of this chapter include studies on the history and current state of conservation in New Zealand, looking at conservation alongside estuaries. In addition literature of land use change to lifestyle blocks and lifestyle block trends in New Zealand was investigated. Existing studies on conservation taking place on smaller lifestyle size blocks are also summarized.

2.2 The need for Conservation on private land

In Aotearoa New Zealand the importance of biodiversity is recognised in Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy (Department of Conservation, 2020). This strategy document states "When nature is thriving, people are thriving. This has long been recognised in Māori culture, where nature and people are interwoven through whakapapa. People are kaitiaki (guardians) of nature, and nature is kaitiaki of people." (Hon Eugenie Sage, Page 4 Te Mana o te Taiao). The indigenous people of Aotearoa, Māori believe in Te Ao Māori (the Māori view of the world), people are the kaitiakitanga, the guardians of the land and of nature. Māori are considered tangata whenua (people of the land) and the enhancement of Aotearoa's natural ecosystems is of cultural importance. The Ngāti Rārua Ātiawa Iwi Trust (a trust made up of two of the iwi from the top of the South Island) summarises the importance of the sea as follows " *As the essence of all life, water holds great significance to Māori culture. Te moana (the sea) in particular is important as it allowed our tūpuna to make the journey to Te Tau Ihu as well as providing kai (food) and other resources. The moana around us is a taonga revered by our ancestors that brought our tūpuna and continues to bring us opportunities.*" (NRAIT, 2018). This shows that the moana, the sea has cultural importance in New Zealand and the conservation of areas like estuaries is a cultural priority to Iwi.

Aotearoa New Zealand estuaries provide habitat for many threatened species such as fernbird, white heron and inanga (DOC, 2024). However, many of these estuaries have been filled in,

drained or modified for farming and housing. Estuaries have been a preferred site for human settlement in New Zealand (NIWA, 2001).

Dudley et al (2020) found through multiple regression analyses of estuaries throughout New Zealand that land cover and salinity have significant effects on water quality in New Zealand's estuaries (Dudley et al, 2020). They found strong, negative effects of urban land cover on most water quality indicators measured, and negative effects of agricultural land cover on some water quality indicators (Dudley et al, 2020).Given this, if New Zealand is to sustain the full range of native biodiversity, then there is a need to prioritise biodiversity conservation on non-conservation (private) lands. (Norton et al. 2018), particularly in significant areas such as estuary edges. These types of private conservation or restoration activities can both improve the values of remnants on private land through buffering and enhancing connectivity and by increasing the overall extent of native habitat available. Restoration can also address a range of other environmental outcomes including enhanced water quality, reduced soil erosion and increased carbon sequestration. (Norton et al 2018).

Given that there are often small remnants of native bush on private land connectivity at landscape scale is critical, and individual restoration sites should be developed with consideration to how they can complement other restoration sites and remnant areas in order to enhance connectivity, including under future climate change. (Norton et al, 2018). Instead of haphazard individual plantings, new plantings need to be undertaken in a way that results in positive outcomes for biodiversity as well as meeting goals such as carbon sequestration. (Norton et al 2018). This would indicate that policies or strategies to coordinate plantings between lifestyle block owners would be preferable.

Private land conservation (PLC) is an increasingly recognized strategy to complement protected area networks (Bingham et al., 2017, Cortés-Capano et al., 2019, Kamal et al., 2015, Mitchell et al., 2018, Stolton et al., 2014). Integrating private land conservation with public conservation land is paramount to provide connectivity of native biodiversity, particularly across working productive landscapes. (Norton et al 2018). The voluntary nature of many PLC strategies implies that their success mainly depends on landowners' willingness to

participate (e.g. in terms of enrolment, permanence and security of conservation agreements) and on their management capabilities in terms of resources and knowledge (Farmer et al., 2017, Hardy et al., 2017, Knight et al., 2010, Selinske et al., 2015). Implementing PLC strategies successfully requires conservation organizations to understand how policy design might influence landowners' participation decisions (Clement et al., 2015, Clements and Cumming, 2017a, Clements and Cumming, 2017b, Epstein et al., 2015, Greiner, 2016, Hanley et al., 2012). From Cortes-Capano et al, 2021.

2.3 Estuary Conservation

Coastlines are the interface between the land and the sea. As such they are the point where the effects of land use cumulate before entering the ocean. As the interface between the land and sea, estuaries support an abundance of life and provide a range of ecosystem services for nature, which also benefits humans (Elliott and Whitfield 2011; Thrush et al. 2013; Urlich and Hodder-Swain, 2022). Despite the value of the ecosystem services provided by estuaries, most urban design planning takes little account for neighbouring estuarine waterways (Freeman et al, 2019) with urban centres tending to be on the edge of waterways including estuaries.

Due to the highly dynamic nature of estuaries, they are greatly affected by temporal and spatial anthropogenic pressures (Elliott and Whitfield, 2011). Studies internationally have found that along estuaries there is increasing habitat loss and fragmentation, not the least of which is because of land use changes for perhaps short-term economic gain but with long-term environmental and societal consequences; (Elliott, 2019). Around the world rapid urbanization has greatly changed land-use patterns in many estuarine areas (Xu et al, 2022). Fringing communities are the most productive areas of an estuary – they are also the most sheltered and shallow parts which makes them ideal targets for land reclamation and dredging. This may alter the entire balance of the food web. (NIWA, 2001).

There is a high natural variability in these ecosystems and in their responses to historical human pressures within their catchments, the river, and the estuary, and the potential for sustainability depends on many variables including population growth, the culture, historical

changes, and the involvement of the communities. (Elliott et al, 2019). Many estuaries are squeezed between sea-level rise, coastal hardening and adverse cumulative effects from unsustainable catchment activities. (Urlich and Hodder-Swain, 2022). Nearshore habitats are being degraded by multiple stressors. Shoreline armouring, land development, and invasive species threaten the economically and ecologically important species that depend on these habitats. (Prosser et al, 2018).

In addition, runoff of nitrogen (N) and phosphorus (P) from urban and agricultural watersheds (e.g., Jordan et al. 2003; Weller et al. 2003) threatens estuarine habitats worldwide through increased algal production, decreased water clarity, and increased occurrence of hypoxia (Doney 2010; Howarth et al. 2011). Management of land use to limit the anthropogenic component of catchment nutrient loads is an important issue in many countries (Daily et al. Citation1997; McDowell et al. Citation2015).

Land-use changes in coastal watersheds have become a concern because of escalating environmental pressures and the important roles these coastal watersheds play in coastal ecosystem services (Swaney et al., 2012; Zhou et al., 2014). Freeman et al, 2019 in their study found that urbanized coastlines had fundamentally changed the physical and chemical parameters of estuaries.

Intensification of land use in New Zealand over the last 20 years, in particular, dairy farming and urbanisation, has resulted in increases in catchment N and P loads (Parliamentary Commissioner for the Environment 2013). There is growing recognition that coastal water quality is interdependent with agricultural management in coastal catchments (Grieken et al, 2019). However, there are few studies looking at land use change on estuaries in New Zealand.

2.4 Land Use Change to Lifestyle Blocks

Land Information New Zealand defines a lifestyle block as being “generally, in a rural area, where the predominant use is for a residence and, if vacant, there is a right to build a dwelling. The land can be of variable size but must be larger than an ordinary residential allotment. The principal use of the land is non-economic in the traditional farming sense, and the value exceeds the value of comparable farmland” (LINZ Rating Valuation Rules, 2008 p. 60). The Ministry for Primary Industries has used in a study of lifestyle farming the definition “a lifestyle block has been defined as a small land holding of 50 hectares or less.” (MPI, 2022 - P.6).

Landscape changes including peri-urban sprawl creating rural lifestyle blocks is a trend in many countries including Europe (Spyra et al 2021), Australia (Kam et al. 2019) and America (Sorice et al. 2014). This sprawl can lead to landscape changes in the reduction of land previously used for agriculture and can also produce fragmentation in vegetation that has previously been used for habitat.

Small-acreage properties, also known as lifestyle blocks, can play a significant role in natural resource management (NRM) by promoting biodiversity and providing environmental and socio-economic benefits. These landowners are important stakeholders in Australian amenity landscapes due to their growing numbers and impact on the environment (Meadows et al., 2018), a situation that can also be applied in New Zealand.

Research by McAloon (2009) indicates that the number of land holdings below 40 hectares in New Zealand increased from 15,302 in 1972 to 35,701 in 1992. By 2021, the number of lifestyle blocks involved in running sheep, cattle, or deer surged from 23,000 in 2004 to over 70,000, with their average size remaining consistent at 5-6 hectares (Sise, 2023). This trend indicates that in New Zealand lifestyle block landowners are also becoming a big stakeholder in amenity landscapes. Additionally, with New Zealand’s population expected to grow to between 5.19 and 5.94 million by 2030 (StatsNZ, 2020), if the trend for lifestyle block ownership continues with this population growth the number of lifestyle block owners will likewise rise correspondingly.

Amenity migration, which involves affluent individuals moving from urban to rural areas for lifestyle reasons, contributes to changes in landownership and community fragmentation, leading to diverse values and motivations (Abrams et al., 2012; Kam et al., 2019). Despite lifestyle block properties occupying a significant amount of NZ land stock, research on this type of property has been relatively limited to date (Pearson, 2021).

There are limited studies on lifestyle blocks in New Zealand, particularly with regard to landowners' motivations with a lot of research being around larger farm blocks. It has been shown that landowners with lower resource dependency have different attitudes and motivations for landownership which affects their land management behaviours (Sorice et al., 2014). Understanding these motivations can aid social-ecological research and the development of interventions to promote conservation-oriented practices. Government agencies and environmental management bodies need to improve their engagement with lifestyle landowners, as they have traditionally struggled to connect with this group (Pannell & Wilkinson, 2009).

In Australia many rural lifestyle landowners have been found to be interested in forest management and biodiversity conservation. However, they often face challenges such as limited NRM experience, financial and physical constraints, and a lack of confidence (Hollier & Reid, 2007; Barr, 2009; Burnley & Murphy, 2004; Pannell & Wilkinson, 2009; Meadows et al., 2013, 2014). There is also a behavioural gap between their pro- environmental attitudes and the adoption of best practices, sometimes due to limited ecological understanding (Mendham & Curtis, 2010; Abrams et al., 2012).

Despite the possible barriers lifestyle block owners face, the reduction or cessation of extensive agricultural practices by new lifestyle landowners can lead to environmental improvements. Studies in Europe, North America, and Australia have documented positive changes in amenity landscapes due to new NRM practices (Kristensen, 1999; Erickson et al., 2002; Walker et al., 2003; Parkes et al., 2012). Additionally, the establishment of new gardens and forests by lifestyle landowners can benefit local biodiversity, depending on the specifics of planting and ongoing management (Gill et al., 2010; Cooke & Lane, 2015).

Given the large increase that has been seen in lifestyle block numbers it is possible that they could play a crucial role in ecological transformation and lifestyle block owners have potential to be recognized as an opportunity for private conservation policies. Research suggests they need better support to adopt conservation practices (Pearson, 2021). Meadows et al (2018) notes that support could come in the form of greater access to labour support, subsidized resources, and peer-mentoring programs. Such programs might involve guided tours of exemplary small-acreage forests and support for establishing native plant nurseries.

2.6 Land Use Change Modelling

Land use changes significantly affect ecosystem structure and functions (Foley et al., 2005; Lambin et al., 2001). The change in land use usually means a change of land cover and different habitats and ecosystem structures. Therefore, analyzing landscape

dynamics through time can be crucial for developing predictive models for ecosystem management and conservation (Luque, 2000).

Song (et al 2018) note that changes in land use and land cover considerably alter the Earth's energy balance and biogeochemical cycles, which contributes to climate change and—in turn—affects land surface properties and the provision of ecosystem services. Therefore, in order to provide effective conservation strategies, the pattern of land cover and land use change over time needs to be understood to know what changes have been made to an ecosystem. A system understanding of the patterns, causes, and trends of long-term land use and land cover (LULC) change at the regional scale is essential for policy makers to address the growing challenges of local sustainability and global climate change. (Jinquan et al, 2020). In addition, alongside estuaries quantifying the effects of land cover on coastal water quality is important because the degradation of water quality in coastal ecosystems impacts estuary health and ecosystem services. (Dudley et al, 2020).

Across most of the World's coastal zone there has been a geographic transition from naturally vegetated to human-altered land covers, both agricultural and urban (Valiela and Bowen, 2002). Previous studies have pointed out that changes in a landscape are most likely to be observed through changes in land use/ land cover (da Silva et al., 2015; Dadashpoor et al., 2019) in other words looking at landscape patterns (a spatial arrangement of various landscape elements of different sizes and shapes) (Liu et al., 2014).

Thus, a comprehensive and clear approach to understanding and measuring the changing intensity of the patterns and processes of land uses, landscapes, as well as the link to ecosystem service values, and the intricate relationships among them, is an important issue.

Hoque et al (2020) investigated the effects of different future land use scenarios on ecosystem service values using historic LULC maps and ESC coefficients along the Meghna River Estuary in Bangladesh. They found that agricultural and mangrove forest lands experienced the greatest decreases, while rural and urban settlement land had the greatest increases, leading to a total ESV decrease of US$105.34 million during 1988- 2018. Further they found that the business as usual model would decrease ESV by a further US$41.37 million (Hoque et al, 2020).

Understanding the effects of urbanization on ecosystem services (ESs) can provide scientific guidance for land use planning and the protection of ESs. Sun et al, (2020) established a framework to assess the spatial distributions of ESs based on land use changes in the Atlanta Metropolitan area (AMA) from 1985 to 2012. A new comprehensive ecosystem service (CES) index was developed to reflect the comprehensive level of ESs (Sun et al, 2018).

Viela et al (2016) note that coastal zones, subject to reasonably rapid changes in global and local driver variables, will require that assessment and management of eutrophication include adaptive strategies that capture effects of changing baselines. Management initiatives will be constrained by spatial scale of driver variables: local efforts may address wastewater and fertilizer N sources, but atmospheric sources require national or international attention. Wastewater and fertilizer nitrogen derive from within the watershed, which means local measures may effectively be used to partly control eutrophication of receiving waters (Valiela and Bowen, 2002).

A second possible reason for weak correlations between catchment agricultural land cover and estuarine nutrient concentrations is that land cover itself may be a poor proxy for contaminant loss from the land if rates of contaminant loss vary greatly within land cover classes. This is likely to be the case because land-use intensity can have marked effects on nutrient losses from land (Mander et al. Citation2000; Dymond et al. Citation2013). For this reason alone, models that consider land-use intensity (e.g. equivalent stocking densities) as explanatory variables that relate directly to contaminant loss from agricultural land may be preferable for predicting impacts to estuaries (Snelder et al. Citation2018).

2.7 Conservation on Private Small Landholdings

Protected areas play a crucial role in biodiversity conservation; however, it is becoming increasingly evident that addressing threats beyond public protected area boundaries is also essential (Kearney el al 2022). Understanding what motivates private landowners to

engage in land stewardship is vital for land conservation goals to include private land (Drescher et al, 2022). Taking the social complexity of private land relations seriously can help point towards conservation pathways in which private land relations may enable conservation (Taylor et al, 2025). Drescher (2014) found that non-farm private land owners

are less likely to respond to tradition motivators for environmental conservation and little is known about the conservation attitudes and values of this group. Land ownership patterns and property rights significantly influence land management practices and the protection of ecosystem services (Abbasnezhad & Abrams, 2025).

Designing and implementing incentive programs and other policy measures to encourage landholders to plant trees on their land requires a thorough understanding of the factors influencing their decisions and to what extent (Tedesco et al., 2023). Designing private landholder programs and policies needs to account for landowners preferences including motivations and barriers to conservation on their land. Williams et al (2024) found that the performance of optimal private land conservation is largely dependent on landholder preferences. They found that conservation benefits were more than 2.59 times higher for approaches that took into account landholder preferences then when they were ignored.

Between 2002 and 2019, the total area of small-sized (>2 to ≤8 hectares) land parcels in New Zealand increased by 5,383 hectares, from 280,557 hectares to 285,940 hectares. There was also a 59 percent increase in small-sized parcels with a dwelling, from 109,635 hectares to 173,800 hectares (Stats NZ, 2023). In 2012, Andrew & Dymond estimated that lifestyle blocks occupied 873,000 hectares, about 5% of New Zealand's non-reserved land.

Although 32% of New Zealand's land area is in public conservation estates, this land is biased towards high elevation vegetation types and poorly represents lowland areas (Cieraad et al., 2015; Monks et al., 2019; Pannell et al., 2021). A quarter of the remaining indigenous vegetation in New Zealand is found on private land, including threatened and rare

biodiversity, with some species found only on private land. This highlights the critical contribution of private land to the integrity of landscape-scale ecology (Brown et al., 2015; Environment Guide, 2018; Holdaway et al., 2012; Monks et al., 2019; Pannell et al., 2021).

Relying solely on public conservation lands for habitat provision will be inadequate for achieving national conservation goals. Designing incentive programmes to encourage rural landholders to plant native trees on their land requires knowing what factors influence their decisions (Polyakov et al, 2023). The management of private land has major implications for biodiversity conservation nationally, and land managers play a critical role (Hanley et al., 2012; Thompson et al., 2015; Maseyk et al., 2021). Policies for conservation on private land include National Policy Statements and regional rules that vary by district. However, there is a lack of cohesiveness in these policies and insufficient incentives to support biodiversity protection on private land. Where policies do exist, there is often a lack of compliance and monitoring necessary to achieve objectives, and this varies by region (Brown et al., 2015; Norton & Cochrane, 2000).

The use of small land parcels and the experiences and motivations of landowners are not well understood, especially in New Zealand. International studies have found that land productivity, length of tenancy, ownership motivations, off-farm income, and rural experience are highly variable (Fairweather, 1996; Fairweather & Robertson, 2000; Sanson et al., 2004; Isnard, 2009; Property Economics, 2009). Motivations and behaviours are influenced by personal values and perspectives (Davies & Hodge, 2007) and social norms (Ajzen, 1991; St John et al., 2010; Kuhfuss et al., 2016; Lute et al., 2018). There is a lack of research into the motivations and behaviours of small landholders in New

Zealand. Understanding these factors to inform policy could enhance conservation on land that often differs from conservation estates, is often underutilized, and is increasingly popular among lifestyle block owners.

The intensification of agricultural land use, coupled with the expansion of urban land cover and populations within New Zealand's urban areas, has significantly increased in the late twentieth and early twenty-first centuries (Dudley et al., 2020). Amenity migration, the movement of affluent individuals from suburban or urban areas to rural areas for lifestyle amenities, has been identified as a key driver of land use changes (Abrams et al., 2012).

In South Australia, recreation and amenity related to private cultural services are the main drivers of land acquisition and land use motivations among absentee landholders (Kam et al., 2019). Similarly, in Australia, many new immigrants to rural amenity landscapes have acquired small-acreage properties containing native forest patches or ex-grazing and cropping lands. These properties are often degraded but available for ecosystem restoration, generating important biodiversity and socio-economic benefits at various scales (Meadows et al., 2018).

Many Australian rural lifestyle landowners express strong interests in biodiversity conservation due to a sense of environmental stewardship (Hollier & Reid, 2007; Barr, 2009). However, capacity-related constraints, including minimal practical experience, limited time, finances, and physical capabilities, often reduce their involvement (Burnley & Murphy, 2004; Pannell & Wilkinson, 2009; Meadows et al., 2013, 2014). A behavioural gap, where there is a disconnect between pro-environmental attitudes and the adoption of improved practices, can also hinder best-practice natural resource management (NRM) by

these landowners (Mendham & Curtis, 2010). This gap may sometimes result from limited ecological understanding (Abrams et al., 2012).

Pannell (2008) categorizes policy mechanisms for pollution mitigation into several approaches:

Positive incentives: Financial or regulatory instruments to encourage change.

Negative incentives: Financial or regulatory instruments to inhibit change.

Extension: Methods such as technology transfer and education.

Technology development: Strategic or participatory research and development to generate improved technologies.

No action: Informed inaction.

Pannell and Wilkinson (2009) build on this framework to account for the differences between lifestyle landholders and commercial farmers. These differences, such as smaller properties, lack of management skills, and lack of time for land-management activities, likely change the private and public net benefits and, hence, the choice of effective policy instruments. This demonstrates the importance of understanding the perceptions of lifestyle block owners and not assuming they have the same motivators, barriers and enablers as agricultural and horticultural landowners. In order for policies and

conservation actions to be effective they must take into account the landowners themselves.

Understanding landownership changes and motivations is crucial for informing policy and promoting conservation-oriented practices. Government agencies and publicly funded environmental management bodies must recognize the importance of engaging with lifestyle landowners and provide greater access to labour support and subsidized

resources (Pannell & Wilkinson, 2009). Peer-mentoring programs, guided tours of model small-acreage forests, and support for establishing native plant nurseries could increase landowners' interest, knowledge, skills, and activity in forest management (Meadows et al., 2018). Lifestyle-oriented landowners were found to be less likely to use conservation practices compared to production-oriented landowners, highlighting the need for targeted interventions (Sorice et al., 2014).

To the degree that these values and attitudes are shared by community members, a culture of land use behaviour can develop (Sorice et al., 2014). Cortes-Capano et al.

(2021) found that facilitative incentives such as access to training and technical support were preferred by landowners in Uruguay, suggesting that similar approaches might be effective in other contexts.

Addressing the gap between pro-environmental attitudes and practical engagement in conservation practices among rural lifestyle landowners requires a multifaceted approach. By understanding the unique needs and constraints of these landowners and implementing targeted policy mechanisms, it is possible to foster greater participation in biodiversity conservation and sustainable land management practices.

2.8 Summary

New Zealand conservation strategies face multiple challenges with habitat loss, land use changes, land modifications and much of public conservation land being on high unproductive land of a similar ecosystem. Historically New Zealand has faced large scale habitat loss with human development. Government owned conservation lands cover limited habitats due to mainly being on what was seen as the non-agricultural land. Therefore, public conservation strategies are also needed in order to maintain more diverse ecosystems and differing habitats.

As with elsewhere in the world here has been a recent trend towards a change in land use to lifestyle blocks and the ecosystem services they provide in New Zealand. This study looks at this trend alongside an estuary in the Tasman district of New Zealand.

In order for conservation strategies to be successful the motivators, and barriers of the private landowners needs to be understood. Currently, there has been a focus on conservation on agricultural land in New Zealand with little information about lifestyle block owners known. The knowledge, motivation and barriers of agricultural landowners are likely to be somewhat

different from that of lifestyle block owners (Drescher, 2014). Given that lifestyle blocks are increasing in many parts of New Zealand studies that provide this understanding will aid in future policies to provide more opportunities for private land conservation.

Chapter 3 - Case Study Description

3.1 Introduction to chapter

This chapter provides a description of the case study area and its location in Aotearoa New Zealand. Current and historical land uses are described along with a social history of the area and how it has been developed over time. The changes in biodiversity over time and conservation measures within the catchment will be detailed along with population changes over time.

3.2 Location

The study area for this thesis is the Waimea Inlet, which is located at the top of the South Island of New Zealand. According to *"Waimea Inlet Management Strategy"* (n.d.) it is the largest enclosed estuary in the South Island, at 3,455 hectares in area and it has an internal coastline of 65 kilometres between Tahunanui and Mapua. The inlet itself is separated from the Tasman Bay by Rabbit and Best Islands to the west and by the Monaco peninsula to the east (see Figure 3.2.2). It is on the edge of the Tasman Bay bordering the town of Richmond and the city of Nelson (see Figure 3.2.1).

Nelson is now a city of approximately 52900 people and the town of Richmond, a town of approximately 18000 people. Both towns support the surrounding agriculture and horticultural industries as well as having an active arts scene. The development of these nearby towns and associated agricultural and industrial land has led to modifications to the inlet, particularly to the Eastern end near the townships which has been subject to reclamation for industrial, township and agricultural uses. The western end in contrast has not been modified as much as shown in figure 3.2.2 below. This study looks at peninsulas on the western and less modified end of the inlet as shown in Figure 3.2.3.

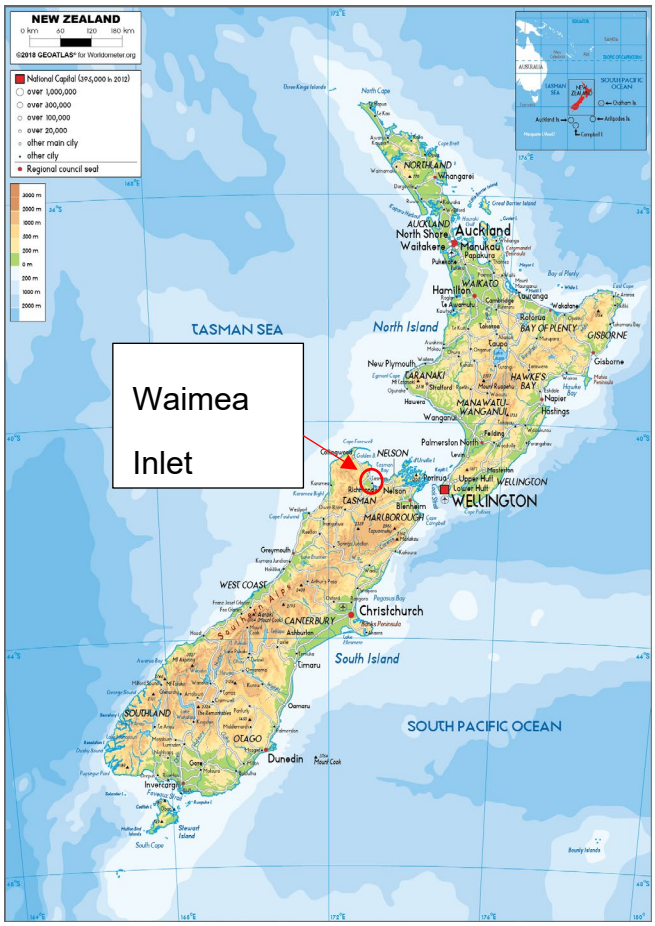


Figure 3.2.1 – Location of the Waimea Inlet



Figure 3.2.2 Waimea Inlet

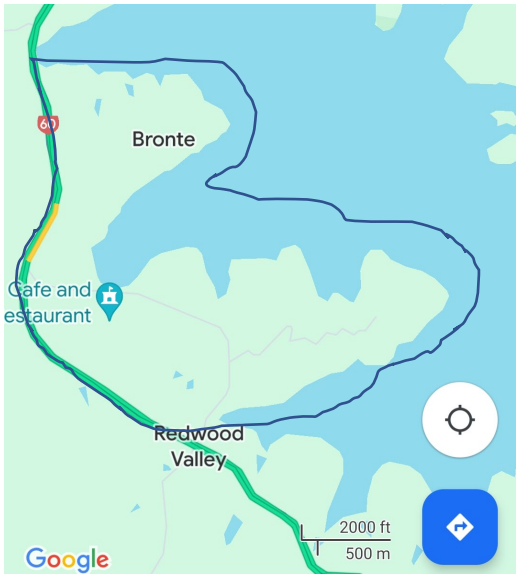


Figure 3.2.3 - Case Study Area

This case study area of the Bronte and Hoddy Road peninsulas border the western end of the Waimea Inlet (see Figure 3.2.3 above). The two small peninsulas are in the Moutere-Waimea ward and jut out into the Waimea Inlet. The study area ranges from State Highway 60 out onto the two peninsulas. The first peninsula includes Westdale and Hoddys Road, along with other smaller roads. The second peninsula includes Bronte Road, along with other smaller roads. Both peninsulas are located off the State Highway between the towns of Richmond and Mapua.

The study site is framed on the inland part by State Highway 60 between Nelson and Motueka. This became the state highway route in the 1980s. For many years the roading in the area was gravel with the state highway and main road to Motueka being the inland Moutere Highway (not going past this area). In approximately 2009 the road was further upgraded to the current route which forms the edge of the study area. This means access to Richmond and Nelson is expedient, being around 15 minutes to the centre of Richmond and 30 minutes to downtown Nelson. The short commute, along with the natural beauty of the Waimea Inlet, makes the area a popular place for lifestyle sections. Appendix III includes photos of the area along the peninsulas.

3.3 History of the area

The Waimea River flows across the Waimea Plains and into the inlet. The flat land close to the bay made this a favoured growing spot for horticulture crops for Māori who supplemented the soil with wood ash, sand and gravel (Theprow, 2024). As such the area has a long history of horticultural use, both by Māori (the first settler of New Zealand) and later

European settlers. The Waimea plains were an important growing area for Maori of Te Tai Ihu (the top of the South Island). Organic materials found in a pit on the Waimea plains in the Appleby area been radiocarbon dated at between 1460 and 1650 AD indicating that this area was used for horticulture at least at that time, if not earlier (Mitchell and Mitchell, 2004). The Waimea Plains are still used for horticultural practice today, with high fertile soils mainly located on the flatter river plains where the soils are predominantly deep soils with heavy silt loam to clay loam subsoil textures passing into coarser texture or gravel at greater depth. The upper parts of the catchment have a mixture of land uses including forestry, agriculture and non-productive lifestyle blocks.

During early Pakeha settlement a pier was built at the end of the Bronte Road peninsula and German immigrants living up the Moutere Valley would use this as a landing site to bring supplies from Nelson. It was quicker and easier to go by boat across the inlet than inland and over the Waimea River. Around 1910 Arthur McKee an English immigrant entrepreneur bought up a large portion of land including the Bronte Road area, subdivided it, planted apples on it and sold the orchards sight unseen to absent owners with the provision that his business would run them. Many orchards were uneconomical due to the small trees not yielding many apples (Stephens, 2011). This saw a few owners buying out the majority of the orchards and running them as larger orcharding operations.



BIG MONEY
IN
APPLE GROWING

From between £80 to £200 net per annum, per acre, is being made by the fruit grower to-day. That is fact. It is easy to calculate what can be done with a modest orchard of from 10 to 20 acres. When these earnings are taken into consideration with the light pleasurable kind of work involved, it must be admitted that fruit growing is worth while. The market can never become glutted, millions of cases are wanted in England alone. There is a big demand for New Zealand apples which the production can never exceed. There's too little land of the right kind for one thing. Last year we imported £147,000 worth of apples, and we had orders from Covent Garden and South American buyers alone for over 500,000 cases. We supplied a paltry 30,000 cases. It has been satisfactorily demonstrated time and again that N.Z. apples can be delivered at the other side of the world in perfect condition. Experts say that the apples grown in the Nelson District are the finest in the world.

WHATEVER YOU DO, SEE A PROPERTY BEFORE BUYING. DON'T BUY BLIND!

THE CHAIRMAN OF THE BANK OF N.Z. in his speech at the Annual Meeting of Shareholders in Wellington on the 26th June, 1913, said:

READ WHAT THE POLITICAL HEAD OF NEW ZEALAND SAYS ABOUT APPLE GROWING. THE GOVERNMENT HAS GREAT FAITH IN IT.

Extract from statement made by the Premier, Mr. Massey, on 14th July, 1913: "The fruit-growing industry was going to be a most important one, and the State was going to do all it could to assist the industry. The Government hoped to be able to put through legislation enabling one of the Departments, probably the Public Trust, to make advances to Associations for providing storage and canneries, and helping the industry generally. It had helped the dairying industry, and it hoped to be able to help the fruit industry."

"Although the industry is still very much in its infancy giant strides have been made during the past few years . . . I am optimistic enough to believe that New Zealand will, in the near future, take a very prominent place as an exporter of apples and other fruits"

WHY YOU SHOULD GROW APPLES!

Because it pays handsomely, very small capital is required. You are your own master and independent. The life is ideal, the work is easy and does not entail the daily drudgery and ceaseless toil that other forms of farming do. Every man looks forward to the day when he will be able to relinquish strenuous work, either as an employer or an employee and be able to lead a comfortable healthy life under ideal conditions. The strain of commercial life is too great, compatible is been, and for many there is not much possibility of retirement; it's drudgery all their days. Now to all these people the present opportunity should make a very strong appeal. Their intelligence will make them feel that the possibilities of Apple Growing are sure and great: that the means of acquiring an orchard are easy. The only drawback is the disinclination to make a start. How foolish dalliance is, will be best known in the near future when there will be many regrets at the opportunity lost.

RUBY BAY ORCHARDS

10 per cent. DEPOSIT. BALANCE 5 per cent. IN 5 YEARS.

THOSE ARE THE EASY TERMS. Mr. STAFFORD IS SELLING THE VERY PICK OF THE BEST APPLE GROWING DISTRICT IN N.Z., PERHAPS EVEN IN THE WORLD. Ruby Bay is 8 miles from Nelson, and is where the fruit experts—men who DO know, have been buying land. Such well-known men as Mr. T. W. Kirk (Head of the Agricultural Dept.), Mr. Justice Chapman, Dr. Deck, Dr. Paxton, Messrs. Brown, Austin, Boulton, Trevethin, McKee, Hallam, Andrews, Harris, have already purchased orchard land in part of the original Ruby Bay Estate. These people evidently consider Ruby Bay the best. Ruby Bay has an average annual sunshine of 8½ hours a day. Suffers from no high winds. As a beauty and healthful spot it is incomparable.

Arrangements can be made for planting and supervising. This work will be under the direction of Mr. Stafford who is himself an experienced orchardist of many years standing. Purchasers will be certain of getting everything right and at the lowest possible cost.

PRICE AND FULL PARTICULARS from Mr. W. Stafford, Ruby Bay, Nelson, or from his Accredited Agents, Messrs. H. F. McNeill & Co., 155 Featherston St., Wellington, or Bright's Buildings, Otaki. Arrangements to view property.

Figure 3.3.1: An advertisement for apple orchards from a 1940s newspaper.

(copyright: Stuff. -https://paperspast.natlib.govt.nz/newspapers/NZTIM19130812.2.106.1)

The area has largely been used for orcharding since then, however rocky apple prices in the 1990s and 2000s and the deregulation of the apple industry in 1999 saw some orchards change use and some subdivide (McKenna 1998). Between 1997 and 2019 in the Waimea Inlet area (encompassing the study area and other land around the inlet) the number of allotments between 0.2 and 2 ha went from 28 to 104. The number of 2 to 6 ha allotments went from 8 to 35, while allotments between 12 and 50 ha went from 12 to 0 in the area (Butler, 2020).



Figure 3.3.2: Hoddy Peninsula from the inland end in the 1970s with Bronte Peninsula in the background.

As with many areas of New Zealand there has been an increase of subdivision and small holdings to respond to a growing population and a growing desire for people to escape urban pressures and live on larger blocks where they can be more self-sufficient. The Tasman District experienced 11% growth in population between the 2013 and 2018 census (Tasman District Council, 2022), with the Moutere-Waimea ward increasing from 14500 people to 15600 between 2018 and 2021. In the Tasman Region the number of subdivisions creating lifestyle blocks of >0.4 ha to ≤2 ha with a dwelling from highly productive land (LUC classes 1, 2 and 3) was 200 ha in 2002. This increased to 912 ha in 2008, 976ha in 2012 and 1119ha converted in 2019 (Statistics New Zealand, 2021).

A report by the Department of Conservation in 1990 (Davidson & Moffat, 1990) notes that much of the Waimea Estuary has been filled in from its margins and made into a receptacle for waste. It goes on to estimate that approximately 200 hectares of the original estuary has been lost, mostly marginal vegetation which is the base of the estuarine food chain.

The Department of Conservation Report gives a detailed analysis of the state of the estuary in 1990, particularly in terms of aquatic indicators for estuarine health (Davidson & Moffat, 1990). This report found that habitats in the estuary were threatened by development, pollution, infilling or recreational misuse. The western area of the Waimea Inlet, which is where my study takes place, was considered to be an important ecological unit (Davidson & Moffat, 1990, P115).

3.4 Study Area Land Use

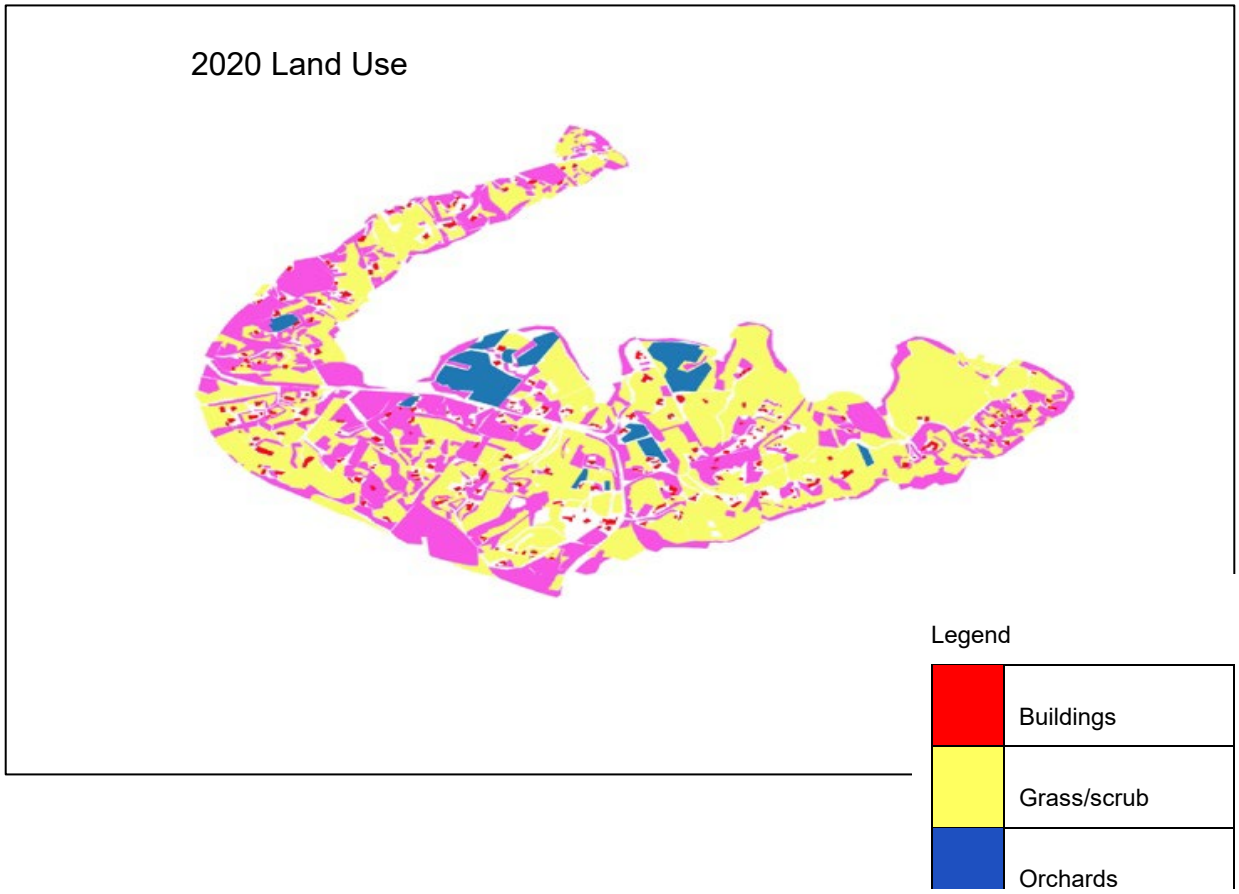


Figure 3.4.1: Land Use in the Study Area 2020

Figure 3.4.1 shows that there is a lot of land cover fragmentation in the study area with grass/scrub being the predominant land cover. This agrees with the predominant land use from the Ministry for the Environment's LUCAS land use map (MfE, 2020) which contains 12 land use classes and shows grasses as the predominant land use in the study area (see figure 3.4.2 below).

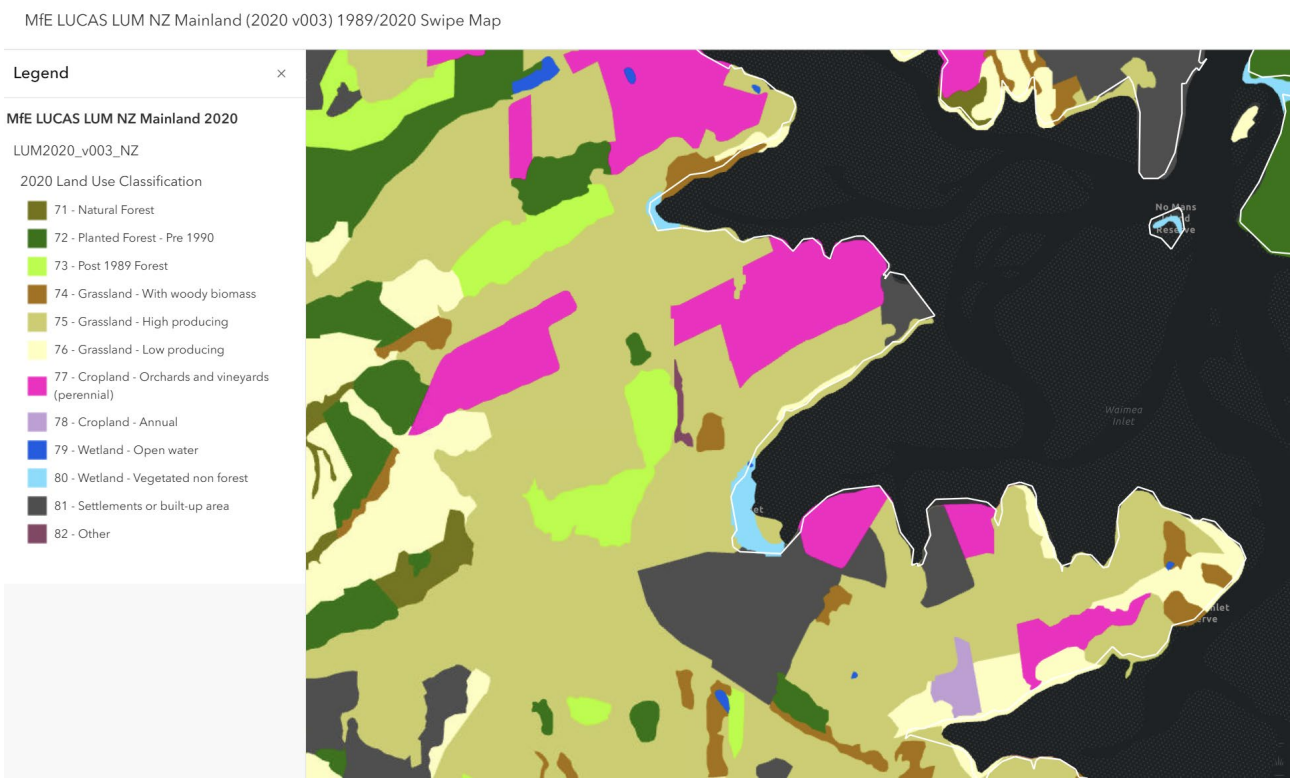


Figure 3.4.2: 2020 LUCAS Land Use Map of the study area – www.environment.govt.nz

There are still a few productive orchards shown as blue on maps produced by myself (figure 3.4.1) and pink on the LUCAS land use map (figure 3.4.2). The LUCAS land use map shows the small amount of planted forestry, while figure 3.4.1 shows there is a number of larger trees and bush in the area (it is noted that this map does not distinguish between forestry, garden or native bush). The study area is on low hill country bordering the Waimea Inlet with many private properties having land that goes right down to the sea. Many sections afford a view out across the inlet, this combined with the close vicinity to Richmond and Nelson have made the area a desirable place to live with many large dwellings occupying the lifestyle blocks.

3.5 Ecology

It is likely that the original ecological state of the Waimea Inlet included saltmarshes with ribbonwood, sea rush and oioi merging into glasswort, sea primrose and remuremu. Coastal scrub would also have been present including manuka and ngaio (North, M and Vaughn, L 2015). A lot of land clearance around the inlet took place after Europeans arrived to utilise the land for horticultural purposes. This included clearing right down to the waterfront.

Monitoring has been undertaken of the estuary by the Tasman District Council as part of their State of the Environment Programme since 1999. The latest review by Salt Ecology (2021) notes that significant changes have occurred to the estuary over time with widespread historical losses of seagrass and salt marsh habitat, and sandy substrates becoming increasingly impacted by muds. The report goes on to note that a densely vegetated terrestrial margin helps protect the estuary from terrestrial weed invasions, provides food, shelter, and habitat for a variety of species, reduces the risk of shoreline erosion, and removes carbon from the atmosphere and stores it not only in this margin, but also in the estuary and seabed of Tasman Bay to provide food and habitat and mitigate climate change.

The estuary is habitat to a range of species in the water and also a number of bird species. The western end of the Waimea Inlet, where my study location is, has been identified as habitat for at least 3 threatened species of coastal birds (Black-billed Gull, White Heron, Black Fronted Tern) and 8 at risk species of coastal birds (Banded Rail, South Island Fernbird, Red-billed Gull, White-fronted Tern, Pied Shag, Black Shag, Little Black Shag and

Royal Spoonbill) (Schuckard and Melville, 2019). One volunteer group the Tasman Environment Trust has ‘adopted’ the Banded Rail for its platform “Battle for the Banded Rail” which includes planting in this area.

The Banded Rail is a shy bird and mainly lives around saltmarshes. In the Nelson area it is estimated there is around 200 birds with a home range of approximately 1.5ha per pair (NZ Birds Online, n.d.). Banded rail breed in spring and summer, constructing a rough platform of rush and reed fragments, usually in jointed rush thickets between 10 and 50 cm above ground or water. Land use change in the forest area included the clearing of existing bush for orchards, often right down to the water line.

According to Scharkard and Melville, 2019 less than 0.25% of native terrestrial forest remains within 700 metres of the inlet, in nine remnant sites totalling less than 10 hectares.



Figure 3.5.1: - Bronte Peninsula 1930s showing little vegetation to the water after being cleared to sell as apple orchards and used as a landing for small vessels bringing goods from Nelson.

3.6 Conservation Initiatives

There are a number of conservation initiatives in action around the Waimea Inlet. These include initiatives by government agencies such as the Department of Conservation and Tasman District Council. There are also volunteer groups working such as the Battle for the Banded Rail and Forest and Bird New Zealand. In addition, the Waimea Inlet Forum is a hybrid forum with contributions from both government agencies and the private stakeholders.

As discussed above the Department of Conservation commissioned a detailed assessment of the estuary in 1990 and the Tasman District Council has been monitoring the inlet as part of its State of the Environment reporting since 1999.

In between 2006 and 2009 requests were made for a management strategy for the Waimea Inlet both to the Department of Conservation Community Forum and to the Nelson Biodiversity Forum and to both the Tasman District Council and Nelson City Council Annual Plans. In 2009 the two Councils agreed to undertake a Waimea Estuary Management Strategy (WIMS, n.d.). In 2009 representatives from both Councils and from Tiakina te Taiao (a combined iwi committee for environmental matters in the Nelson/Tasman area) launched the project. From this a Waimea Inlet Forum was proposed as a platform for "connecting individuals, groups and agencies and integrating activities around the inlet." (Page 7, WIMS, n.d.).

The Waimea Inlet Forum meets twice a year and meetings are open to the public. They currently coordinate planting on public land and have established a network of predator traps. In addition, in 2016 they ran a pilot programme trapping feral cats while protecting domestic cats and advocating responsible cat ownership. The Waimea Inlet Forum has a website - www.waimeainlet.wordpress.com, although the last update seems to have been in April 2021.

The Tasman Environment Trust (TET) is a trust established in 2000 by representatives from Nelson Marlborough Conservation Board, Federated Farmers, Queen Elizabeth II Trust and the Tasman District Council as well as members of the public. The TET was originally established to administer funds in the Cobb valley but has extended to projects throughout the Tasman area. One of these includes the Battle for the Banded Rail which is focused on the edges of the Waimea Inlet and replanting to encourage roosting for the Banded Rail.

3.7 Summary

The study area used in this research holds particular significance due to the substantial number of subdivisions that have occured over the past 20 years. These subdivisions have transformed the land use from predominantly horticultural land to lifestyle blocks, especially within the Hoddy and Bronte Peninsulas in the Tasman district of New Zealand. This is reflective of a broader trend observed across New Zealand.

Importantly, this abundance of lifestyle blocks presents a unique opportunity for conservation. Situated on the edge of an estuary, which creates an interface between land use and marine ecosystems. Estuaries worldwide are often subject to extensive modifications and development, necessitating ongoing research to understand the intricate connections between land use and the marine environment. The change of land use in this area could have significant consequences for the estuary ecosystem.

The use of these lifestyle blocks for conservation plantings could mitigate adverse environmental effects and support the health of the estuary ecosystem. Since 1990 the ecological characteristics of the estuary have been documented in detail, providing a comprehensive foundation for analysing the impacts of land use changes in this area. Additionally, existing conservation measures within the area offer a basis for evaluating the effectiveness of any initiatives. As land use continues to evolve and urban sprawl continues to increase, it is imperative to explore the potential for these lifestyle blocks to contribute to conservation efforts.

CHAPTER 4 - Methodology

4.1 Introduction

The methods used in this study were designed to achieve the objectives stated in Chapter 1 in a scientific manner. As discussed in Chapter 1, the aim was to quantify the change in land use in a small case study estuarine area over the last 80 years and to determine the perceived motivators, barriers, and enablers of conservation on the private land that now dominates the area. A range of literature was reviewed to determine appropriate research methods in order to achieve these aims. This chapter gives an outline of the research design, the spatial analysis procedures, survey sampling procedures, data collection and analysis processes used. Ethical considerations undertaken as part of this research will also be described.

The study was done in two parts, a spatial analysis of land changes over time and a social analysis of private landowners, and each has its own methodology explained below. Firstly, the methodology for the aerial photograph spatial analysis which was used to quantify the change in land use in the study area is explained. Then the methodology for the survey and social analysis that was used to determine the perceived motivators, barriers, and enablers of conservation on the private land that now dominates the area.

4.2 Context for Methodology

The methodology selected in this study was shaped by many things including the nature of the research question, information available on the topic and the geographical area, existing research on the topic and the philosophical worldview of the author, all of which are explored further below. Some of the research was undertaken during Covid lockdowns which meant slight changes to the methodology such as surveys being conducted by phone interviews rather than face to face.

The study brings together spatial analysis to provide a picture of historical land use showing the change from largely horticultural land use to lifestyle blocks which indicates landowner drivers will be different from those in the past where native vegetation has been removed. The second part of the study involves finding out the drivers and barriers of the current landowners towards increasing native vegetation in the area. In order to gain the most information possible to inform future policy decisions both qualitative and quantitative approaches are used. This allowed me to further develop themes that were identified and understand the landowners more. Due to the different aspects of this study and the use of qualitative and quantitative questions in the interviews a mixed method approach is most appropriate for this study.

This study looks at the role of private landowners in the restoration of ecology and biodiversity of a small geographical area on the edge of an estuary, the Waimea Inlet, in Tasman, New Zealand. The area around the inlet has historically been used for agriculture

and horticultural practices but has over the past twenty years been subdivided into small landholdings known as lifestyle blocks in New Zealand.

The Waimea Inlet is also recognised as a significantly important ecological area in New Zealand (Davidson, R and Moffat C, 1990). As such there are a number of environmental programmes in action around the inlet, both through government and volunteer agencies, which are detailed in the subsequent chapter.

4.3 Aerial Land Use Comparison Methodology

4.3.1 Introduction

This section gives details of the methodology used for the aerial photograph analysis that looks at quantifying the land use change in this area over the past 80 years. Genneratti et al (2011) proposed a methodology for land cover change analysis using historical aerial photos and appropriate parts of this methodology was used for this study. In addition, the methodology of Andrew & Dymond (2012) who researched the expansion of lifestyle blocks onto high class soils in New Zealand, was also used to inform this methodology.

The study explored land cover change in order to determine the change in land use and different vegetation over time in the study area. This gives an indication of ecological changes, in particular habitat changes and available habitat for species living in the area. There were four stages to this part of the study:

1) the visual interpretation of land cover using aerial photos to map changes in tree/bush cover,

2) the analysis of differences in land coverage over time,

3) the analysis of the relationship between building coverage and land cover change over time.

4) the assessment of past survey plans to assess the change in property boundaries and property sizes over time

4.3.2 Visual Interpretation of Land Cover Using Aerial Photos

4.3.2.1 Historic Aerials Source

Historic aerial photographs of the site were first flown in the 1945 – 1948 (note that as they are part of a larger set for the district the exact year is unknown) above the study area. The next available aerial photos were in the 1980s. These aerial photographs were already digitized and mapped into GIS format and available as part of the Top of the South Maps website (TOTSM, 2022), a joint GIS initiative between the two regional authorities of Nelson and Tasman. The most recent aerials were acquired from Land Information New Zealand and were taken in 2020. Genneratti et al (2011) outline as first steps in their proposed methodology orthorectification and radiometric correction of aerial photos. In this case this was already done as part of adapting the aerial photos for the Top of the South Maps website

and making the aerials available for public use. The aerials were already georeferenced to EPSG:4326 - WGS 84.

4.3.2.2 Land Use Categorisation

A visual interpretation of the aerial photos was used to categorise the land on each aerial into different uses using the QGIS software. Skalos et al (2011) found that visual interpretation of the digital data record was identified as an optimal method, because of the possibility of zooming in and out on the monitor screen.

The quality of the photos varied which meant that in some cases the land use category could only be determined to a higher level. For instance the category trees/bush is used but it cannot be distinguished between native and non-native trees and often the height of the trees/bush cannot be determined. The category orchards is used as the orchards can be identified by uniform planting but the type of orchard is unable to be determined. However, given historic accounts orchards in this area were planted in the 1930s and 1940s were all apple orchards. The variability of the aerial photo quality and the inability to distinguish between types of trees and/or shrubs informed the land use categories.

Four categories were used to classify the land as below:

Bush/trees – Areas with larger trees, this included gardens with trees.

Grass/scrub – pasture areas that could contain smaller ‘scrub’ but not larger trees.

Building areas – All buildings were outlined in this area including dwellings as it was not possible to tell whether a building was a dwelling or not on older aerial photographs.

Orchard – Orchards were distinguished by the uniform planting in straight lines of trees.

4.3.2.3 Segmentation of Land Use on the Aerials

The QGIS™ software programme was used for the digital mapping and analysis. The aerial photographs were placed onto QGIS and then the study area was identified for each aerial using landmarks. The majority of the edge of the study area is the land to ocean interface, which has changed little in this area over the past 80 years. The inland boundary is defined by what is now State Highway 60.

The study area is geographically defined by the sea and by the main road, State Highway 60. As State Highway 60 was moved to its current position in 2010 the older 1940 and 1980s aerials do not show the State Highway limit. Therefore to ensure the same area was mapped on each of the aerials a shapefile showing the study area outline was created. In addition the recent aerials were overlapped with historic aerials to ensure the same delineation occurred on the landward side where the current state highway is. To further ensure this the vegetation layers were overlapped with each other and the historic photos to ensure no historic vegetation was missed. This updating/backdating approach also helps maintain the consistency of the features with on changes, and largely reduce "false changes" (Xian et al., 2009). Updating/backdating means looking at previous years categorisation to see if the land use is the same or has changed and to ensure changes are actual changes

and not due to different interpretation of the different aerial photos. This was particularly useful as the resolution of the 1980s photos was lower in some areas that that of the other pictures used.

The next step was to manually create polygons around each land use classification category as described above. This was done on each aerial photograph. Each category then became a shapefile.

This had limits in the accuracy as it was dependent on the researcher creating accurate polygons. However, it also had benefits as there was the ability to zoom in and identify land use more accurately before drawing a polygon. The small study area made this possible but it would be difficult and time consuming to hand draw shape files to replicate this for a larger study area.

The patch edges were created where there were natural boundaries such as roads, driveways, streams or change of categories. The property boundaries were not used for patch boundaries. This allowed for an analysis of the change in size of patches for each land use category over time with land size changes being able to be analysed by survey plans. Roads, driveways and streams were not mapped and are shown as gaps between the patches on the maps.

As the older aerial photos were in black and white no distinction has been made between exotic and native species in the forest category as there was no way to distinguish between

the two. Given that the study site was subject to large scale vegetation clearance in the 1930s for the creations of orchards, the vegetation could be either left over native or exotic trees planted for shelter.

4.3.2.4 Analysis of Differences in Land Coverage Over Time

The Lecos extension on QGIS was used for analysis of the different land categories in each aerial. This was run for each land use category. The calculations used were:

Number of patches – gives the total number of patches of each category of land coverage as described above for each aerial.

Mean Patch Area – gives the mean area of patches for each category of land use for each aerial.

Overall Core Area – gives the overall area of land for each category of land use on each aerial.

Patch Density – gives the number of patches for each land use divided by the total area of the study area on each aerial.

This was done by visually comparing coloured maps of the study area with each land use category given a colour. The percentage change in each land use area was compared over time and graphs were used to analyse the change in the different land use categories over time. Graphs were created to show the change in each land use category over time using each of the calculations as appropriate.

4.3.2.5 Analysis of the Relationship Between Building Coverage and Land Cover Change Over Time

The building coverage in comparison to land cover (all other land use categories) was compared over time. The overall core area of buildings was divided by the study area to calculate the percentage of the study area that was in buildings. This was compared between the 1940s, 1980s and 2020. The overall core area of each other land use category was also calculated as a percentage of the total study area for each of the times.

4.3.3 Assessment of past survey plans to assess the change in property boundaries and property sizes

4.3.3.1 Survey Plans

Survey plans from 1898, 1928, 1954, 1981 were obtained from the National Library of New Zealand (NLNZ, 2022). These were jpg files and not digitised. A survey plan for 2022 was obtained from the Top of the South Maps website (TOTSM, 2022).

Past survey plans were found online from Archives New Zealand (Archives NZ, 2024) and Land Information New Zealand (LINZ, 2024) for the area. A raw count of the change in the

number of legal properties in the study area was undertaken based on these survey plans. The survey plan from 1898 only showed Hoddy Road peninsula so while this was included in the results for interest, it was not included in statistical analysis. The survey plans show title boundaries and in some instances these are hard to distinguish, an example of this is shown in Figure 4.3.1 below.

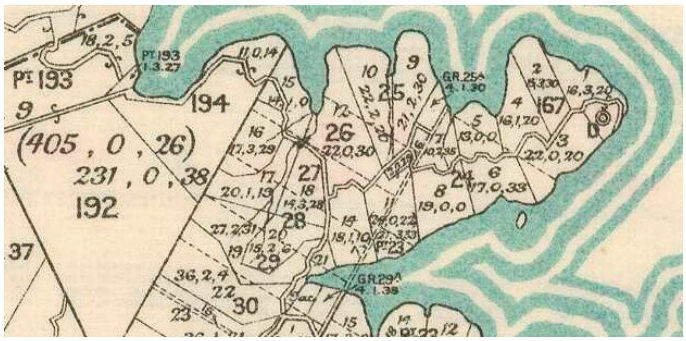


Figure 4.3.1: – The 1928 survey plan of Hoddy Peninsula showing some indeterminable lines.

My background in subdivision planning was used to make the best judgement on some of the older plans where it was not clear what parcels were included in a title. It is noted that titles do not necessarily correspond to landowners as a landowner may own more than one title but gives a good idea of the likely size of an allotment and potential likely land use. The number of titles was compared through the years using a basic count from each survey plan.

4.4 Social analysis Methodology

4.4.1 Introduction

This section gives details of the methodology used for the social analysis part of the research. The social analysis included a mailbox survey to the case study area with voluntary participation and an interview survey, again with voluntary participation. The theory behind the method of social analysis and why it was chosen is explained below, followed by the methodology of the mailbox survey and analysis and then the phone survey methodology and analysis.

An initial web-based survey using the Qualtrics software (Qualtrics, Provo, UT) was undertaken. This was then analysed and the results of the web survey were used to form the basis for the qualitative phase which took the form of semi-structured interviews. The semi-structured interviews were used in order to elicit the detail of information in the qualitative phase to explain or give further detail with regard to the results of the quantitative web survey (Young et al, 2017).

The initial survey allowed a broad overview of the views and feelings of landowners and occupiers, which was complemented by the subsequent interviews that allowed the issues to be explored in more depth. The interviews also allowed participants to go into more detail and explanation of their viewpoints.

4.4.2 Methodological Theory

This research uses an explanatory case study methodology as outlined by Yin (2018 p.355). Yin (2018) writes that there are three conditions that differentiate between which of the five social science research methods to use. These three conditions are the form of question posed, the control a researcher has over behavioural events and the degree of focus on contemporary. In this case the form of the questions posed were to allow discussion around how and why landowners were currently using their land, which was expected to help explain why there are different levels of conservation on private lifestyle properties and what the different factors are that can influence this. In this research the researcher did not have control over behavioural events and the focus was on the contemporary situation. A case study was therefore the appropriate method according to Yin (2018).

In this case we specifically explore the attitudes, motivators and barriers of private lifestyle block owners towards using conservation management on their property. Creswell and Creswell (2018) note that explanatory case studies may be undertaken to investigate causal relationships; hence, they are mainly used for theory testing. Here we are exploring the theories behind possible barriers and motivations towards conservation on private land.

Both qualitative and quantitative approaches were used to answer the research question. More insight into a problem is to be gained from mixing or integration of the quantitative and

qualitative data (Creswell & Creswell (2018). An explanatory sequential mixed method design as described by Creswell & Creswell (date p355) was used.

4.4.3 Online Survey

4.4.3.1 Data Collection

A web survey was conducted using the Qualtrics software. Qualtrics is a software platform for creating surveys that can be accessed via the web or by phone. The programme also tracks participation making it easy to monitor participation rates and mitigating potential biases. The programme also provides tools to analyse the data and can be used to create reports, charts and graphs to understand patterns in the data.

A web based survey was chosen as trade-offs need to be made between the quality and cost, and internet questionnaires have been identified as easy to get blanket coverage by random delivery (Walliman, 2022). In this case the low cost of a web-based survey also factored into the decision. In addition, this ensures anonymity of the research and respondents which can encourage frankness in responses and eliminate bias due to sex, age, nationality etc. (Walliman, 2022). And finally, the research took place during differing Covid restrictions in New Zealand, including full lock down. A web-based survey ensured accessibility during the various Covid restrictions.

4.4.3.2 Sample Selection

Initial invitations to complete this survey were distributed to approximately 86 mailboxes in the case study area in August 2021. The reasons behind the mailbox sample size were mainly that the geographical constraints of the area gave a clear set sample area. Also taken into consideration were costs, timeliness and accessibility in the given climate. The study area is located geographically close to the researcher so personal delivery only took a few hours of the researcher's time and ensured that all mailboxes in the area were delivered to rather than relying on a third person delivery such as post.

The survey invitation was distributed initially along Hoddy Road Peninsula and Westdale Road up to the State Highway in August of 2021 (see figure 4.4.1 below). Following a lack of responses a follow up mailbox drop was repeated two weeks after the initial drop. Due to a still small response the subject area was increased with a similar mailbox drop one month after the initial drop to include the neighbouring peninsula along one side of the Bronte Road Peninsula as indicated on Figure 4.4.1 below. This was a further 14 mailboxes included in the invitational drop. Bronte Road peninsula has had a similar history of land use, with orchards developed by the same developer in the 1910s and has lifestyle development pressures the same as the Hoddy Road peninsula and was therefore a logical inclusion into the case study. In total 100 invitations were distributed. This was all the mailboxes along the Hoddy Peninsula and the eastern side of the Bronte Peninsula. The invitation flyer drop was used in order to give an equal opportunity to the population of the case study to be involved and also allowed anonymity to be maintained.

4.4.3.3 *Survey Questions*

The survey contained questions about the participants values, knowledge and experience of conservation practices, and possible barriers towards conservation management. In addition, basic population data such as the number of people in the household and income were obtained in order to be able to analyse for any demographic trends.

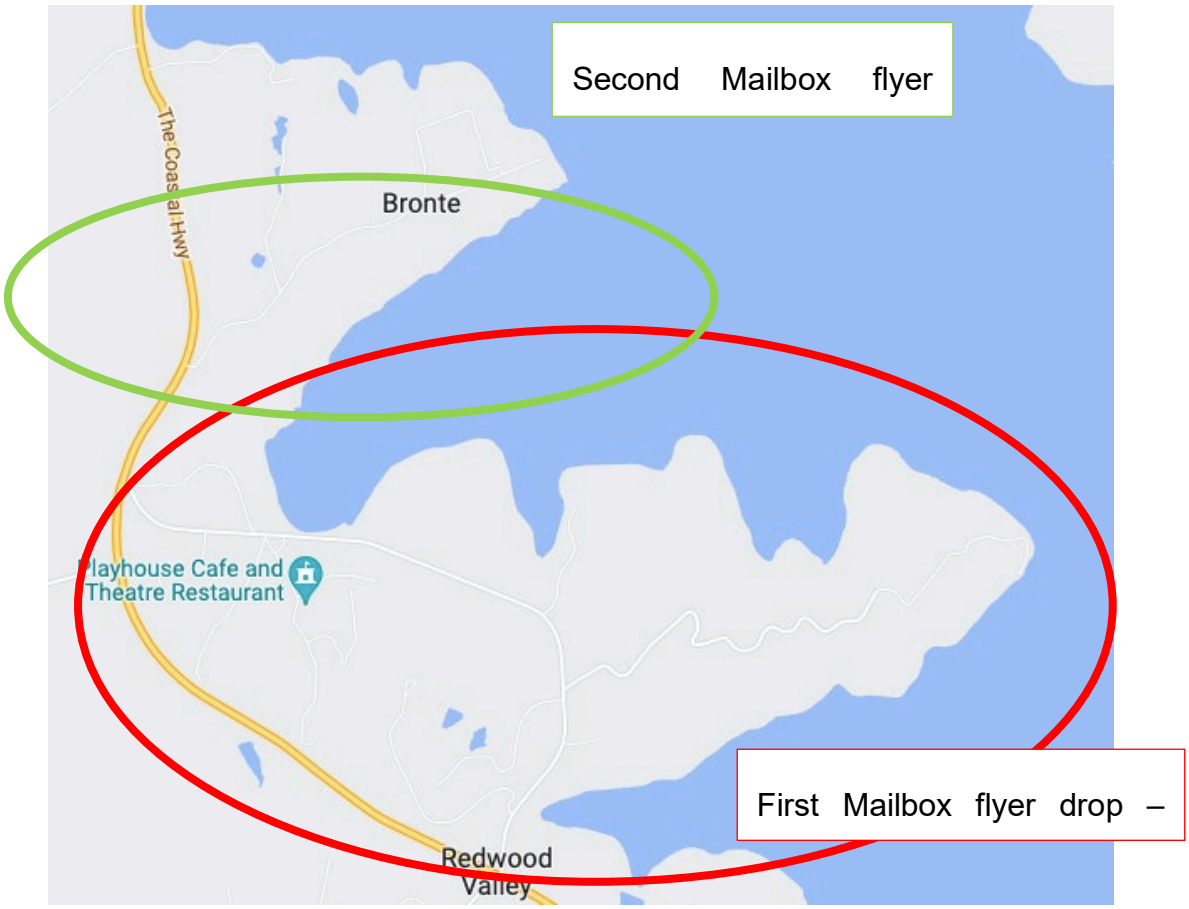


Figure 4.4.1: Map of flyer distribution – note: not included were residents to the west of the State Highway or whose mailboxes front onto the State Highway.

The online survey contained 30 questions and was open for a month after the last mail drop for respondents to answer. A copy of the survey questions is contained in Appendix A of this report. There were 21 respondents to the web-based survey. It is noted that some respondents did not answer some questions and therefore the total number of respondents for each question does vary.

The online survey was split into components. The first questions gathered demographic information about the respondent and the land itself such as income levels, number of people living on the property and property size. The next section was entitled 'location' and contained questions about why the respondent moved to the Waimea Inlet. This gives some insight as to the values the respondents have towards the conservation of the inlet. The next section was about land management and contained questions pertaining what land management was currently taking place including weeding, planting and other pest control. The final section addressed knowledge and contained questions about the level of knowledge the respondent had around planting, weeding and pest control. Questions were also included in each section about possible barriers that could be preventing landowners from conservation work on their land.

4.4.3.4 Survey Ethics

The proposed interviews were considered under the Massey University Ethics Approval process and were seen to be low risk under this process. All submissions were anonymous and the survey was designed to maintain the participants anonymity. A letter was given at the beginning of the survey to explain the use of the survey data and a copy of this is

contained in Appendix B. The survey gathered general data about the persons living on the property and the property itself as well as qualitative data about values, views and experiences in relation to conservation on their land but no data that could be used to identify individuals. It is noted that the survey asked for the number of people living at each property and their age including under 16s. No under 16 year olds participated in the study, this was information provided by the adult on site as to the age of people living on site.

4.4.3.5 Pilot Survey

The draft survey was piloted with owners of similar sized land parcels known to the author who live in a different part of New Zealand. Small changes were made to the survey in response to feedback from the pilot web survey. These changes were to make questions and instructions clearer to the participants.

4.4.3.6 Analysis

The Qualtrics software was used to generate summary statistics. These included percentage statistics for each question. For questions using the Likert scale the percentage of response to each point on the scale was used rather than the mean. This was due to the small sample size, as the percentage response gave a more accurate picture whereas the means generated tended to have relatively large standard deviations.

4.4.4 Phone Interviews

This study looks at what the barriers are for landowners to participate in conservation initiatives on private land in the study area. After the initial web based interview was completed it became apparent that there were some answers that did not give enough information to understand the view of the participants. Sutherland et al (2018) notes that understanding human attitudes, knowledge and behaviour are central to conservation research and practice. A semi-structured interview approach was used to allow a deeper understanding of attitudes, knowledge and behaviour. Young et al, (2017) note that semi-structured qualitative interviews allow the interviewer to ask additional questions if an interesting or new line of enquiry develops in the interview.

Therefore I used a semi informal interview approach using a sample of the participants from the web based study group and snowballing (Patton, 2002) onto any other volunteer participants from the study area would allow for a deeper understanding of people's attitudes and knowledge particularly with regard to priorities and intrinsic values in terms of the conservation of the area they live in. According to Creswell and Creswell (2018) the overall intent of this design is to have the qualitative data help explain in more detail the initial quantitative results, thus it is important to tie together or to connect the quantitative results to the qualitative data collection.

Qualitative methods can provide detailed data about first-hand experiences using insider viewpoints that could be easily missed using predesigned, structured surveys based on outsider perspectives. (Rust et al, 2017)

Semi-structured interviews would enable me to develop further understanding of the attitudes, knowledge and behaviour of the private landowners in this area. Whilst a structured interview allows for more direct comparative analysis (Young et al, 2017) semi-structured interviews would give participants a chance to add their own opinions and information thus giving a deeper understanding of their viewpoints.

Young et al (2017) advises to consider at this stage include whether interviews can provide the right kind of data for envisaged outputs or whether other research techniques might be more suitable. In this case I believe the semi-structured interview would provide the envisaged output of understanding intrinsic values of the participants and also understanding their existing views of both where they live and working with other stakeholders (such as Council and volunteer groups).

A mixed method approach including semi structured interviews was used by Kam et al (2019) when looking at engaged absentee landowners in private conservation in the Sydney area. They found that the collection of quantitative data enabled a broad and general insight into the views of absentee landholders. I have employed semi structured interviews in this study to allow for that broader view and insight into the drivers behind private landowners in this area. The area has undergone a variety of development in the past twenty to thirty years that has seen it change from mainly apple orchards to a variety of sized blocks with a mixture from no productivity to still be used as orchard. Therefore the owners are likely to be bringing a varied background of agriculture experience, time in the area and awareness or interaction with local conservation schemes and the semi structured interview allowed the ability to give a deeper insight that the web based interviews and structured personal interviews would not.

Rust (et al, 2017) summarises this nicely by noting that qualitative methods may be preferred when deeply exploring a topic while trying to preserve the context.

4.4.4.1 Initial Interview Questions

A full copy of the phone interview questions is contained in Appendix C. The initial interview questions started with questions to make the participant feel comfortable and also to provide some basic information and to gain an insight into the point of view the participant is coming from. In particular asking how long the participant had lived there and where they had lived both provided easy to answer questions for the participant and provided background information that was relevant to know what type of experience the participant had with rural environments and the Waimea Inlet in particular.

4.4.4.2 Sampling

The sample was taken from the participants of the web based survey. The web based survey contained a section at the end that provided a place for participants to express interest in participating in a phone or face to face interview. Due to Covid the majority of these became phone interviews. Those who provided their details to participate in the interviews were emailed to arrange a time for the interview. In addition the snowball method was applied where those who put their name down for an interview were asked to provide details of any other participants who lived in the appropriate area and may wish to be interviewed.

Overall, my semi structured interviews included ten people. This is a small sample size however, smaller sample sizes are common in qualitative studies, as the emphasis is on quality and depth of findings over quantity and generalizability (Rust et al, 2017). In this case the smaller sample size was considered to be enough to give some quality information to supplement the quantitative web survey. This decision was made taking into consideration the timing of the research during the Covid pandemic and the variable Covid lock downs in New Zealand.

Moon & Blackman (2014) note that natural scientists often attempt to explain patterns at the population level by extrapolating results obtained from a subset of the population.

In this case the sample interviewed was small however I believe that it is suitable for the exploratory purposes used here as it contains a diversity of participants and the demographic of the participants was similar to what could be expected from the larger population sample from relevant statistics. The sample contained participants who had been involved with various agencies with a variety of interactions including no interactions at all. Therefore it is unlikely that any bias was present in terms of the sample only containing those already involved in conservation projects in the area. The results of the semi structured interviews therefore should be interpreted with caution, knowing that it is a small sample size and are perhaps more powerful when combined with the results of the web-based survey.

4.4.4.3 Ethical Review

The proposed interviews were considered under the Massey University Ethics Approval process and were seen to be low risk under this process. Interviewees were given information at the beginning of the interview outlining the interview process and the use of the data. It was also explained that answers would be coded and become anonymous when being analysed. Responses to the interviews were analysed anonymously with each respondent being given a code when inputted into the software.

4.4.4.4 Pilot Interview

The semi structured interview process was trialled on four persons known to the researcher who live on lifestyle properties in areas of the North Island (well outside of the study area). Some base questions were adjusted as appropriate to fit the fact that the pilot participants were not near the Waimea Inlet. For example instead of asking about their knowledge of the Waimea Inlet general conservation questions about the area they lived in were asked.

Whilst the four people who participated in the pilot trial were known to me it is unlikely that there was any bias introduced here as they were not instructed by me to answer in any particular way. They also did not know the particulars of my study and are not overly familiar with the Waimea Inlet area.

4.4.4.5 Analysis

The interviews were recorded and typed as the interview progressed. Interviews were either recorded via a phone application and/or also typed directly into word during the interview. The recordings were typed verbatim into the Lumivero (2023) Nvivo software ((Version 14) www.lumivero.com) and the typed interviews were transferred straight into the Nvivo programme. Nvivo is qualitative data analysis software that assists in managing, analysing and finding patterns in unstructured data such as phone interviews.

Thematic analysis was undertaken following a six step process:

1. Familiarization
2. Coding
3. Generating Themes
4. Reviewing Themes
5. Defining and Naming Themes
6. Writing Up

First, I read through the interview response to become familiar with the data gathered through the interview process. This also indicated any typos that may have occurred.

Next, parts of the text with key words were highlighted and codes were used to describe the different contents of the highlighted text.

Patterns were found from the similar codes throughout the interviews and these were used to create themes.

The themes were reviewed to make sure they accurately represented the data.

Once themes were reviewed they were defined and named as demonstrated in the figure below.

After this the themes were analysed and written up. If a single response covered a number of topics it was coded separately for each code with different contextual segments as appropriate.

4.4.5 Summary

This research used a two-pronged approach to build a picture of land use change and landowner perspectives in the study area. This included spatial analysis and analysis of past maps as well as sociological interviews to gauge the perspectives of current landowners.

spatial maps of land cover changes from the 1940s, 1980s and 2020s were created from aerial photos and analysed to quantify the change in land use in the study area of time. Additionally, analysis of past survey plans was used to give a fuller picture further back in history to the development of this area and the change in property size.

A targeted online survey was used to collect the perspectives of current landowners towards conservation and to collect more detailed basic data for the study area. This was followed

up by in-depth interviews that were analysed to further understand perceived barriers from current landowners towards conservation on their properties.

The methods used in this study were designed to achieve the objectives stated in Chapter 1 in a scientific manner, with ethical considerations for each part of the process.

CHAPTER 5 - Results

5.1 Introduction

This Chapter presents the results and identifies changes in land cover since European settlement. It also presents results of the social analysis and describes factors that influence biodiversity protection and management on privately owned rural land beside the Waimea Inlet. This Chapter includes results from the spatial analysis of land cover and survey plans along with results from the survey and interview data complemented by descriptive characteristics. This Chapter will follow a similar pattern to previous chapters by starting with the spatial analysis results firstly, presenting the results of the visual interpretation of land cover, then the assessment of past survey plans, followed by the analysis of differences in forested vegetation over time and the analysis of the relationship between building coverage and land cover over time. Then the chapter will present results of the social analysis firstly by describing the participants and their backgrounds, followed by the influencing factors of the motivators, barriers and enablers.

5.2 Aerial Land Use Comparison

This section compares different land use over time from the analysis of the historic aerial photographs. Figure 5.2.1 shows the maps produced by the digital analysis of the historic aerials. Each area of land use was mapped and is shown as patches on the maps below.

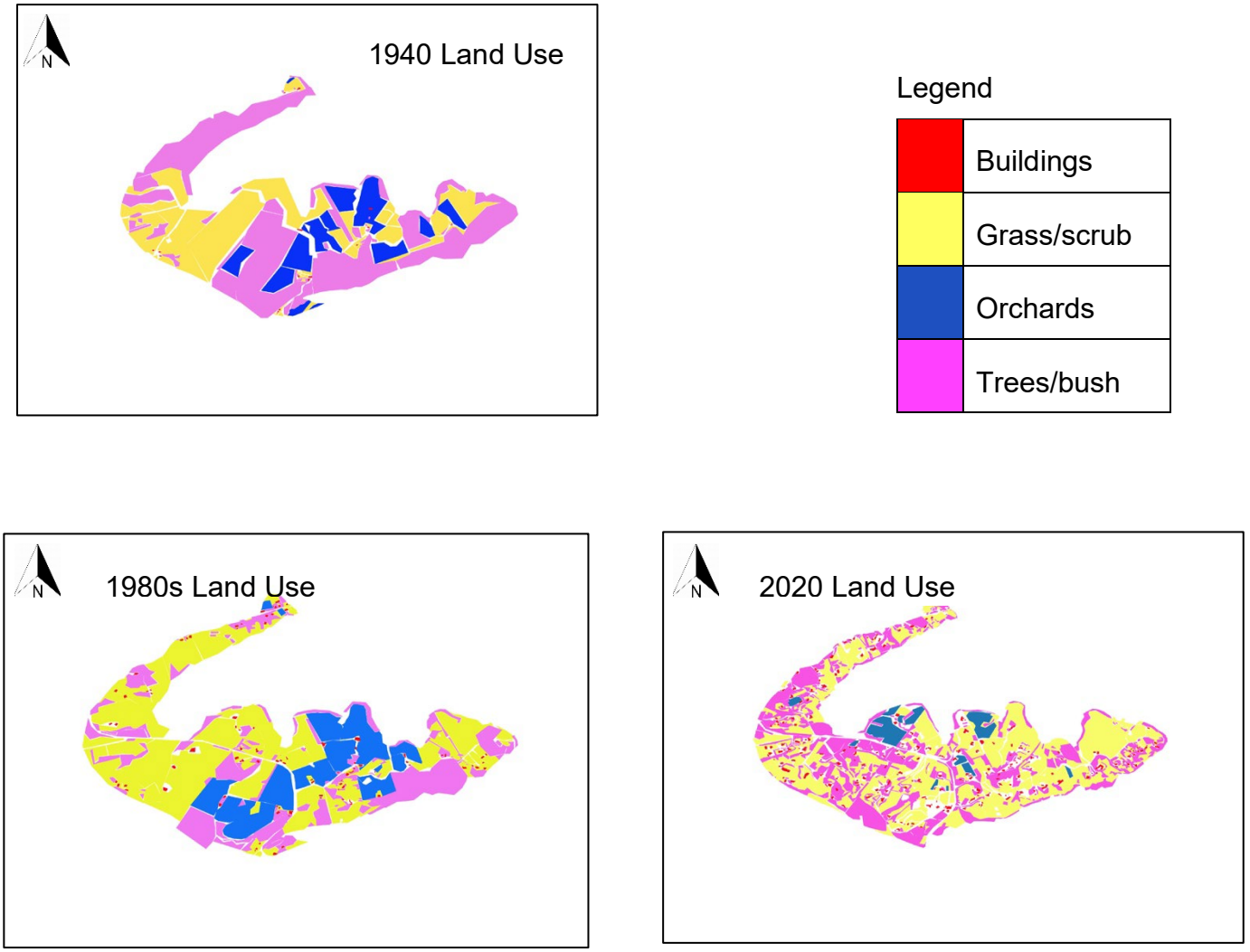


Figure 5.2.1: Mapping of the change in land cover from historic aerials.

Statistics from the maps were extracted using the Lecos extension to QGIS. Table 5.2.1 is produced directly from those statistics and Table 5.2.2 was produced using the statistics placed into Excel.

Land Use Patch Density		
	Number of Patches	Patch Density
Trees/Bush		
1940s	25	0.000771
1980s	107	2.21E-05
2020s	250	4.0078
Grass		
1940s	39	6.62E-06
1980s	70	7.30E-06
2020s	170	2.03E-05
Buildings		
1940s	25	7.71E-04
1980s	94	4.72E-04
2020s	280	5.16E-04
Orchards		
1940s	14	5.13E-06
1980s	8	2.17E-06
2020s	12	1.43E-05

Table 5.1: *Land Cover Statistics for the layers calculated using the Lecos extension to QGIS.*

Percentage Change in Land Use Over Time			
	Change from 1940 to 1980	Change from 1980 to 2020	Change from 1940 to 2020
Trees/Bush	-48.14%	26.59%	-34.35%
Grass	60.30%	-12.88%	39.65%
Buildings	529.09%	170.24%	1600.04%
Orchards	35.37%	-77.38%	-69.39%

Table 5.2: The percentage of change in each land cover over time.

Figure 5.2 shows the change in land cover between the aerial photos in the 1940s, 1980s and 2020s. As discussed above the overall bush/tree cover has reduced (by 48%) between the 1940s and 1980s and then increased to the 2020s by 27%. The bush/tree cover in the 2020s is made up of many smaller patches (250 patches as seen in Table 5.1) dispersed throughout the study area, giving a patch density of over 4 (the number of patches per hectare).

The area in orchard increased between the 1940s and 1980s by 35% and then decreased in the 2020s by 77%. The number of buildings increased between the 1940s and 1980s by 529% and then increased by another 170% between the 1980s and the 2020s to give an increase from the 1940s to the 2020s of 1600%.

The grass/scrub land increased between the 1940s and 1980s by 60% and has become more dispersed in smaller patches in the 2020s as can be seen by the number of patches increasing from 39 to 170 in figure 5.1.

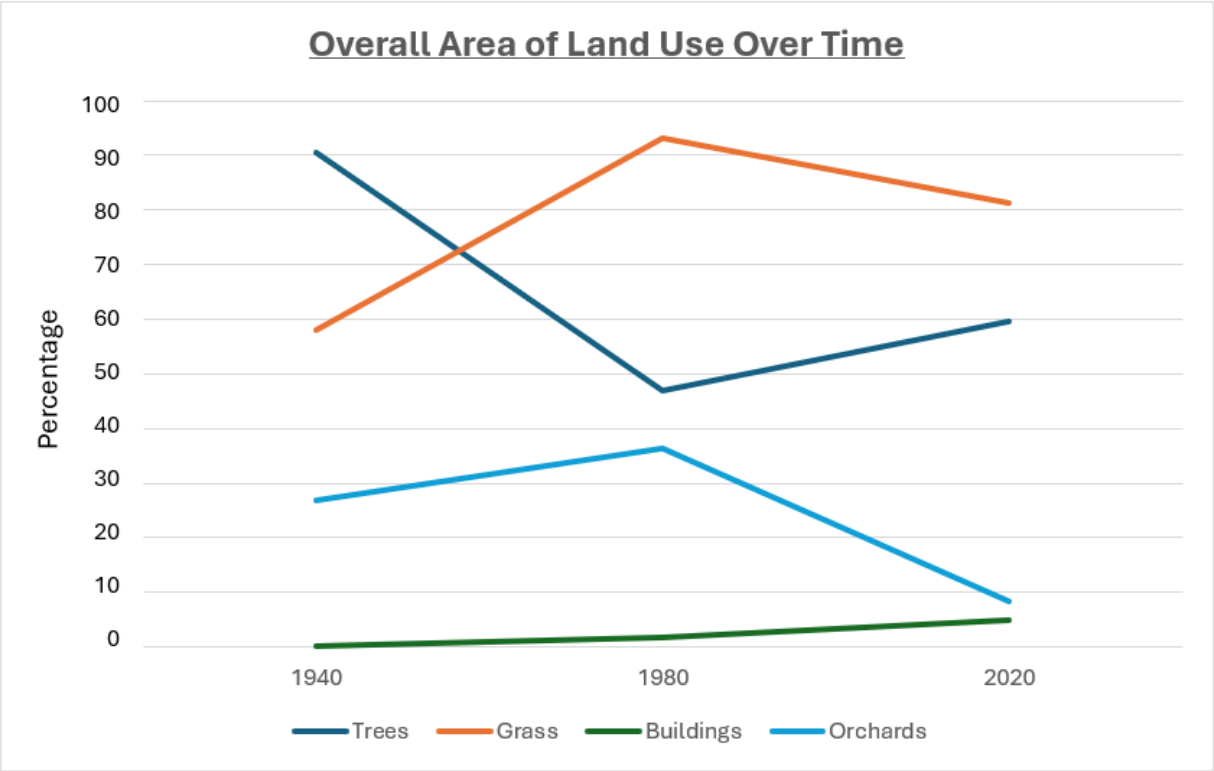


Figure 5.2.2: Graph Showing Area of Land Use Over Time

Figure 5.2.2 shows the overall area of bush/tree decreasing between the 1940s and 1980s and then increasing slightly to 2020s. It is still lower in the 2020s than in the 1940s. The grass area is shown to increase between the 1940s and 1980s and then decreases to the 2020s, although it is still higher in the 2020s than in the 1940s. The orchard area increases

between the 1940s and 1980s and decreases in the 2020s below the 1940s level. Overall building area increases between the 1940s and the 1980s and increases more in the 2020s.

5.2.1 Tree/Bush Area

When looking at the number of patches of bush/tree cover the number of patches increases over time from 25 patches in the 1940s aerials to 250 patches in the 2020 aerials. This increase in patch numbers is visually evident in Figure 5.2.1 which shows bush/trees in pink. Figure 5.2.1 clearly shows the fragmentation of the tree/bush areas.

The mean patch area decreases between 1940 and 1980 from 269302 to 45156 and then decreases further from 1980 to 2020 to 24950 as shown in Table 5.1. This is also evident in Figure 5.2.1 where the pink patch areas can be seen to be getting smaller over time.

Table 5.2 shows the overall percentage of change in trees over time decreasing by 48.14% between 1940 and 1980 and by 34.35% from 1940 to 2020.

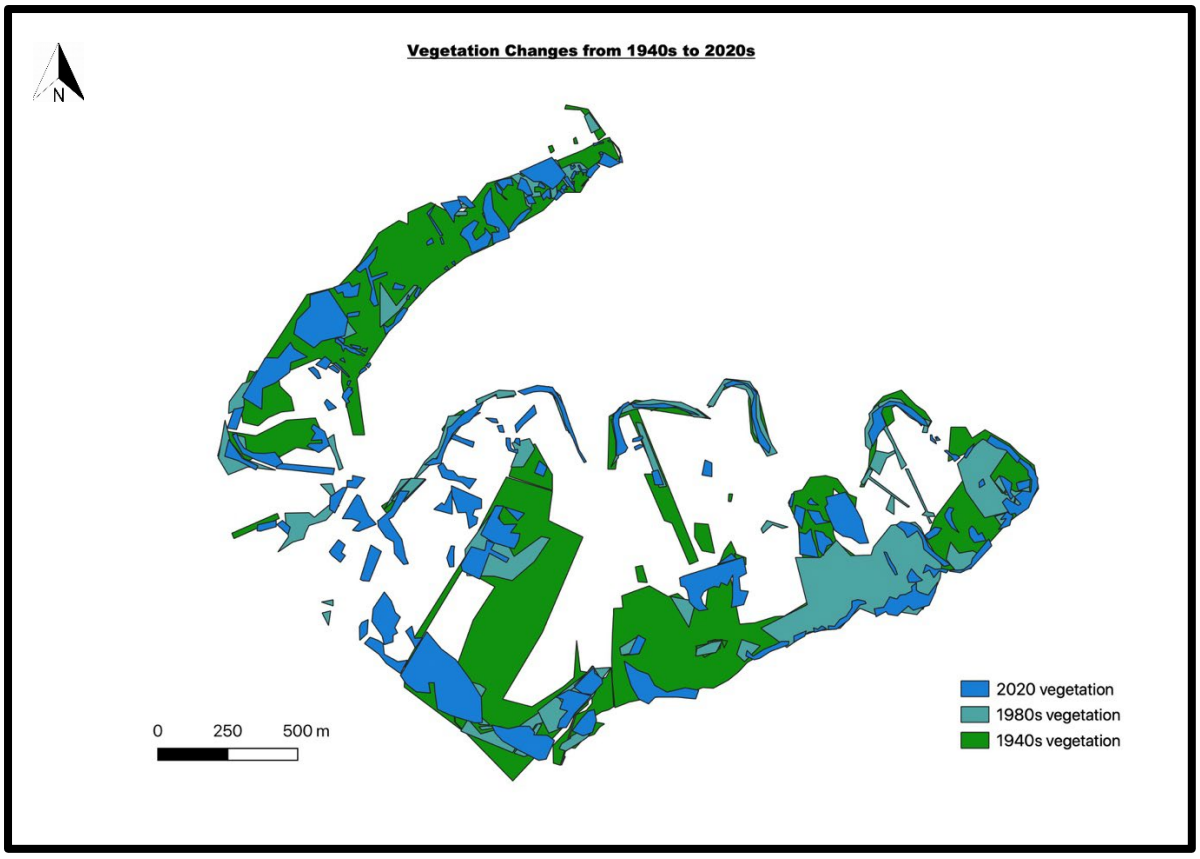


Figure 5.2.3: Map showing the change in bush/forest area over the 1940s, 1980s and 2020s aerials.

Figure 5.2.3 shows the areas of bush/tree cover in the 1940s have been reduced to the 1980s and then slightly increased by the 2020s. Even though there was an overall increase in bush/tree cover between the 1980s and 2020s Figure 5.2.3 shows the fragmentation of

the bush/tree area by the 2020s with a lot of small patches compared to the larger cohesive patches in the 1940s.

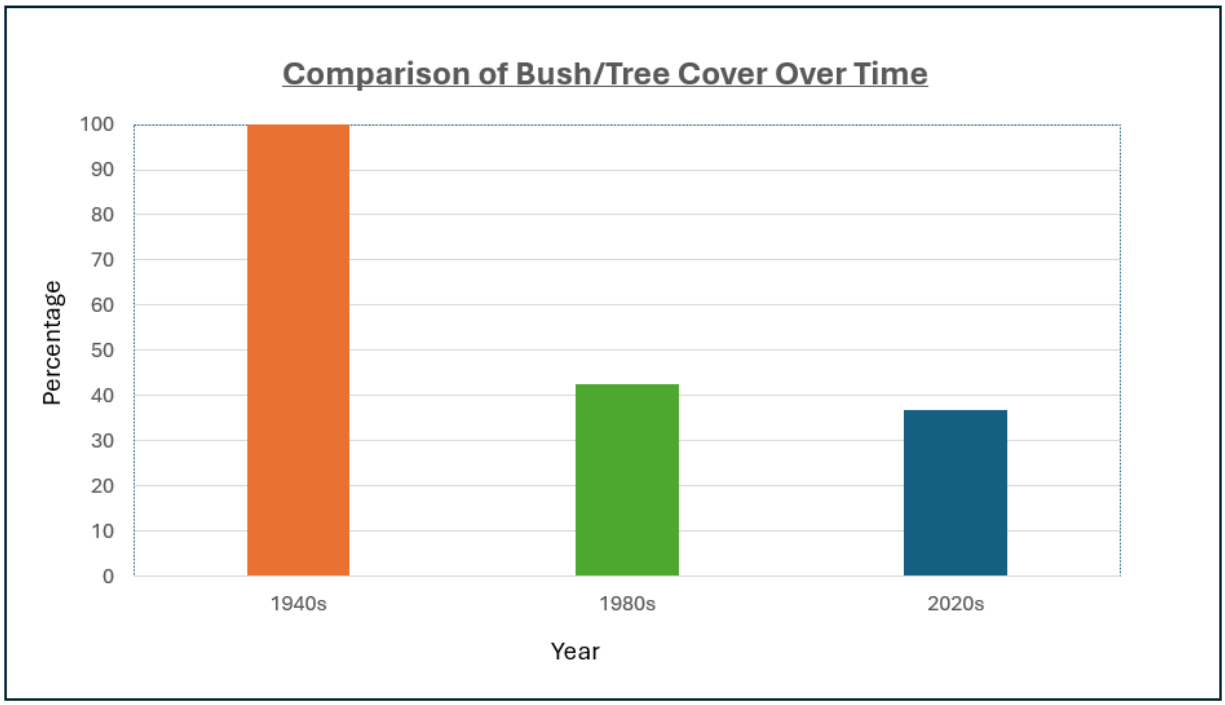


Figure 5.2.4: Bush/Tree cover area comparison between aerials

It can be seen in Figure 5.4.2 that the bush/tree cover reduced by approximately 58% between the 1940s aerials and the 1980s aerials. The cover reduced by approximately another 5% between the 1980s aerials and the 2020s aerials. Between the 1940s and the 2020s there is approximately a 64% reduction in bush/tree cover.

5.2.2 Grass/scrub

Figure 5.2.5 shows that the amount of grass/scrub increased by approximately 60% from the 1940s to the 1980s. There was then a decrease to the 2020s, but the 2020s still saw more area in grass/scrub than in the 1940s.

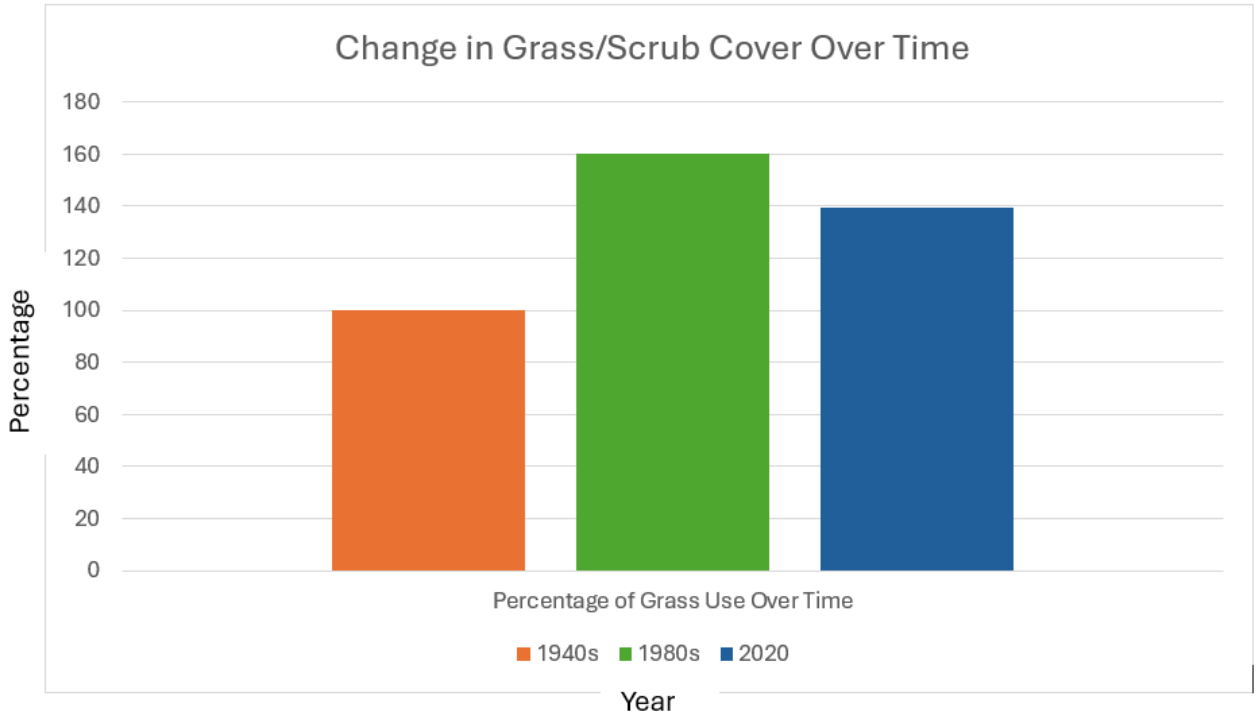


Figure 5.2.5: Percentage of grass/scrub cover over time

5.2.3 Building Land Use

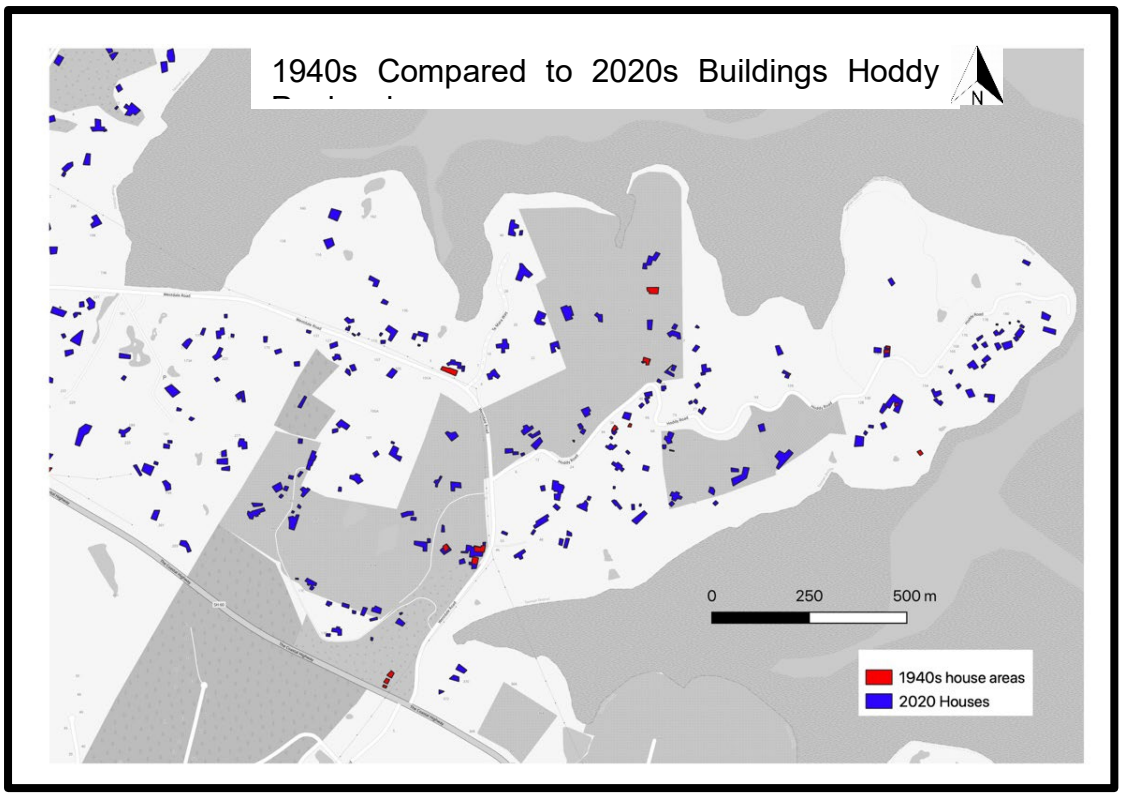


Figure 5.2.6: Map showing the comparison of the building coverage between the 1940s and the 2020s on the Hoddy Peninsula.

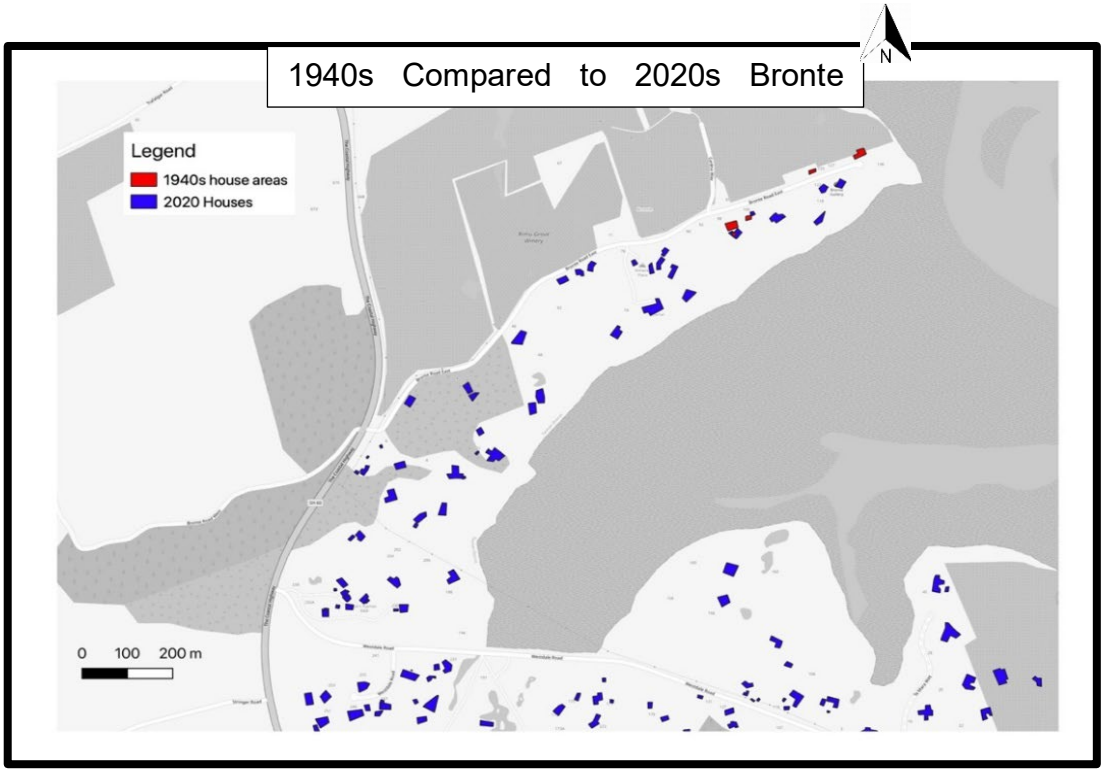


Figure 5.2.7: Map showing the comparison of the building coverage between the 1940s and the 2020s on the Bronte Peninsula.

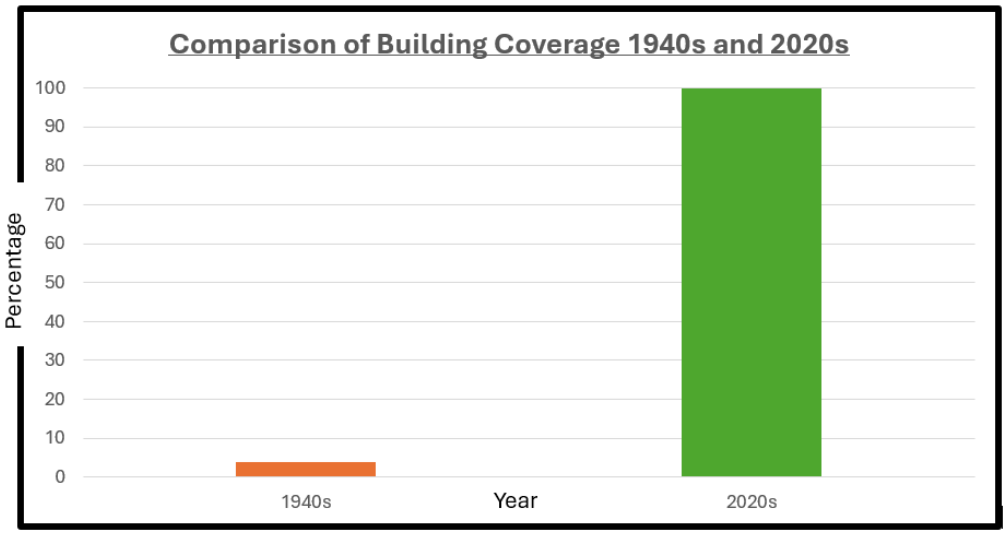


Figure 5.2.8: A graph of the building coverage from the 1940s aerials compared to the building coverage from the 2020s aerials.

The increase in buildings from the 1940s to the 2020s can be seen in Figures 5.2.6 to 5.2.8. Buildings have increased in all parts of the study area. This coincides with the increase in titles shown in section 5.3 of this report. There has been an increase in buildings by approximately 97% from the 1940s to the 2020s as shown in Figure 5.2.8.



Figure 5.2.9: 2020 Buildings overlaid on the 1940s aerials.

5.2.4 Orchard Land Use

The area used for orchards increased approximately 38% between the 1940s and the 1980s. There was then a steep decrease between the 1980s and 2020 with there being approximately 70% less land used for orchards in the 2020s compared to the 1940s.

5.3 Assessment of Past Survey Plans

The following are historic survey plans of the study area showing the division of the land since 1898. These survey plans were accessed from the National Library of New Zealand Cartographic Collection (National Library of N.Z., n.d.).

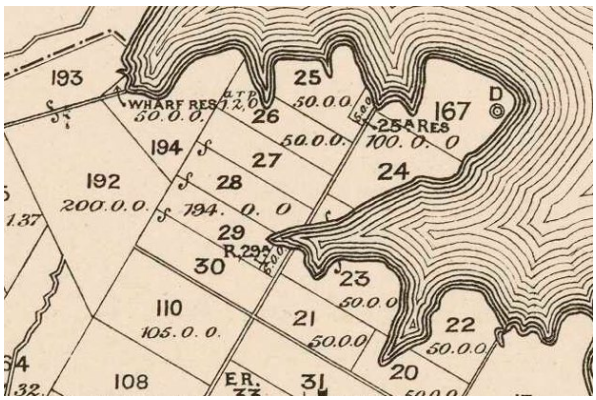


Figure 5.3.1: 1898 Survey Plan of Hoddy Road peninsula.

This survey plan shows only a part of the study area – Hoddy Road, with the Bronte Peninsular missing. No survey plan this old was found for the Bronte Peninsula. The plan shows approximately ten titles surveyed along Hoddy Road.

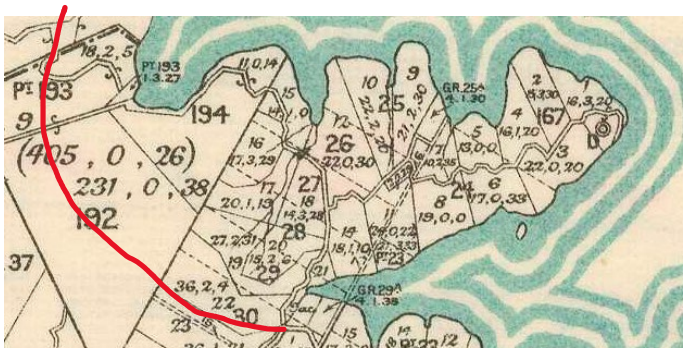


Figure 5.3.2: 1928 survey plan Hoddy Road Peninsula with the study area shown by the red line.



Figure 5.3.3: 1928 survey plan Bronte Peninsula with the study area shown by the red line.

In Figure 5.3.1 above Hoddy Road is shown to have 24 titles and is showing the current roading system with the exception of the State Highway. Figure 5.3.2 is showing the Bronte Peninsula which is shown to have 5 titles in the study area. The survey plan shows the 'town of Bronte' which was a planned town that never eventuated and the land shown to be surveyed for this 'town' remained in one title.

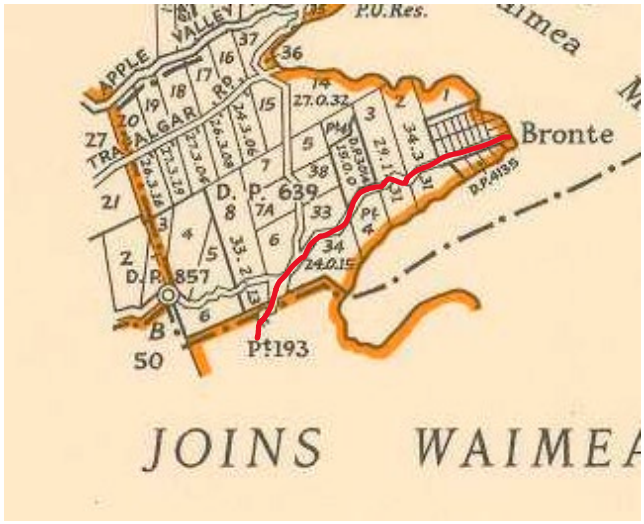


Figure 5.3.4:1954 Survey Plan on the Bronte Peninsula with the study area delineated by the red line.

The 1954 survey of the Bronte peninsula shown in Figure 5.3.4 shows no change from the 1928 survey plan.

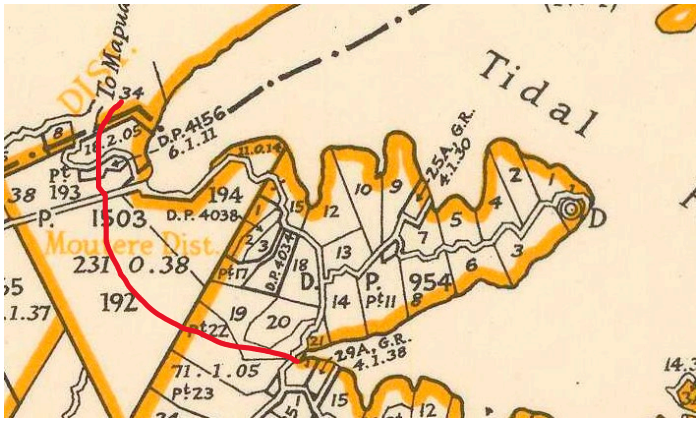


Figure 5.3.5: 1954 Survey plan of the Hoddy Peninsula (24 titles)

The Hoddy Peninsula survey plan shown in figure 5.3.4 is from 1954 and shows little change from the 1928 survey plan.

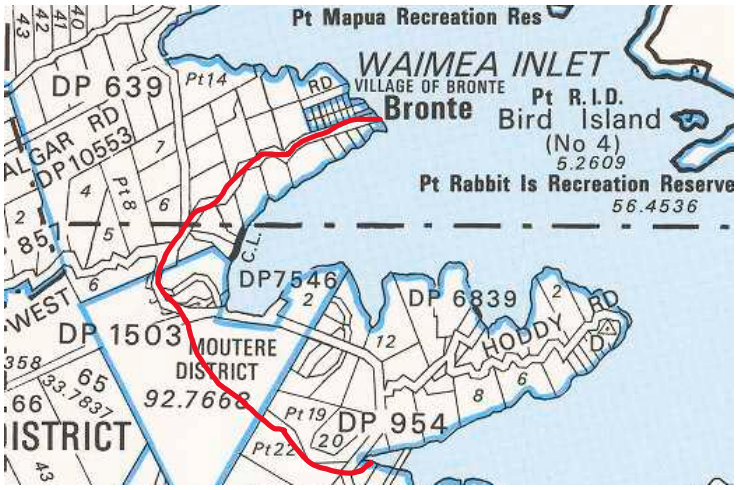


Figure 5.3.6: 1981Survey Map of Bronte (7 titles) and Hoddy Road (24 titles) Peninsulas

The 1981 survey plan shows both peninsulas with a similar number of titles as the 1954 and 1928 plans.

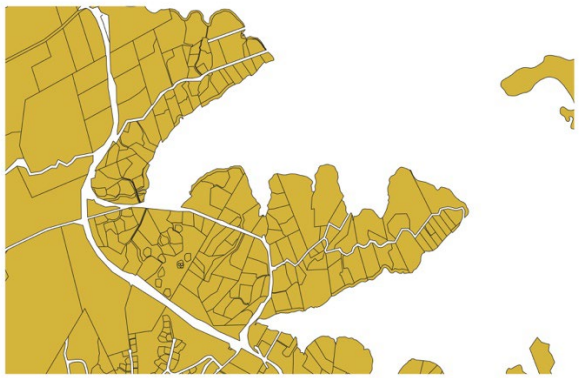


Figure 5.3.7: 2022 Survey Plan of Bronte (26 titles) and Hoddy Road (104 titles)

The 2022 survey plan shows a change from 7 titles to 26 title on the Bronte peninsula part of the study area and a change from 24 titles in 1981 to 104 titles in 2022 on the Hoddy Road peninsula part of the study area.

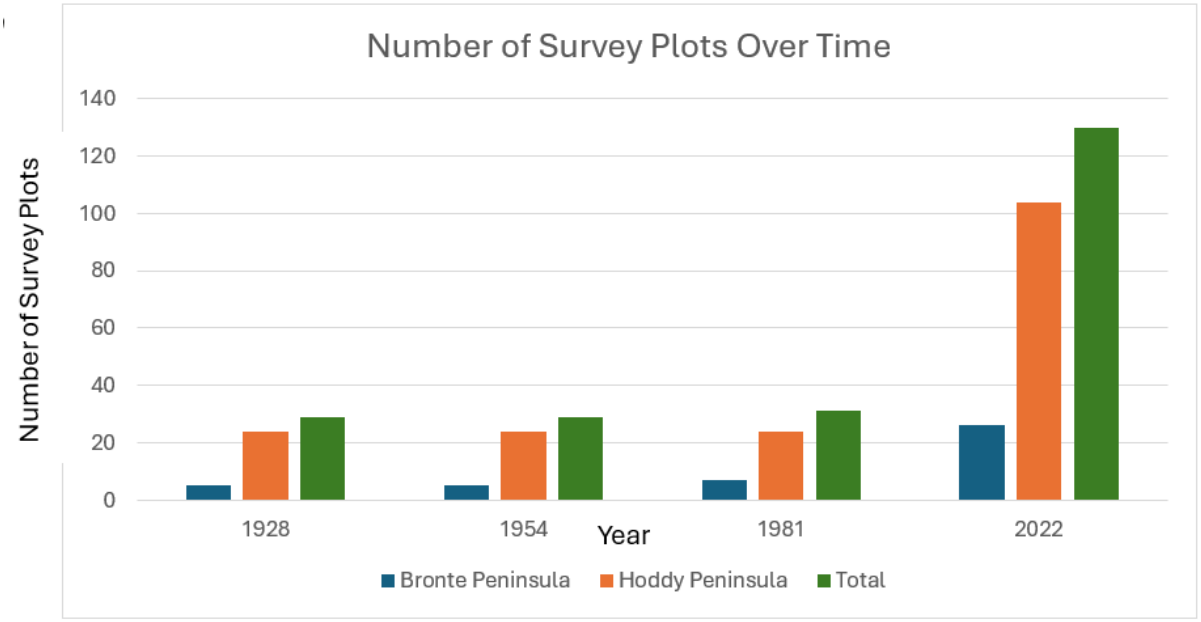


Figure 5.3.8: The number of titles shown on survey plans throughout the years.

As can be seen in Figure 5.3.8 the number of titles remained reasonably constant between 1928 and 1981 with a large increase in the number of titles on both peninsulas between 1981 and 2022.

5.4 Social Analysis Results

5.4.1 Online Survey

5.4.1.1 Introduction

The survey used probability based sampling by hand dropping a flyer into every mailbox in the subject area. The flyer contained a QR code it also had a website link and an email address to contact if the QR code was not able to be used. Therefore unless someone was missing a mailbox all residents had the opportunity to participate. Nonresponse error can be minimised by making strategic repeated contacts (Feilding et al, 2017) and in this case there was a repeat maildrop with a reminder notice two weeks after the initial drop further reduced A total of 21 responses were received for the survey. The small sample size is a limit to this survey however as the sample does somewhat match the demographics of the population the results may still give a good indication of some motivations and barriers to lifestyle block owners.

5.4.1.2 Demographics of Online Survey

The demographics of the case study area are discussed below and comparisons made between the larger population of the area and the respondents to the online survey. Due to restraints such as time and limited personal communication during Covid lockdowns the survey resulted in a small sample size. In order to have more confidence in the results the

comparison of the respondents to the demographics of the larger population of the case study area was undertaken. As shown in Figure 5.4.1 the residents who completed the survey include households with a variety of ages, with two thirds being over 50 years of age. This is consistent with the demographics from the 2018 census shown in Figure 5.4.2 which had an average age of 48.6 years for the Moutere Hills area, which the study area is a part of. The 2018 census count had 66 of the 114 or 57.8% residents of the Hoddy Road Peninsula aged over 50. It is also consistent with the Tasman District Council's growth modelling for this area and would indicate that while the survey was small it did have a demographic similar to the whole population of the study area.

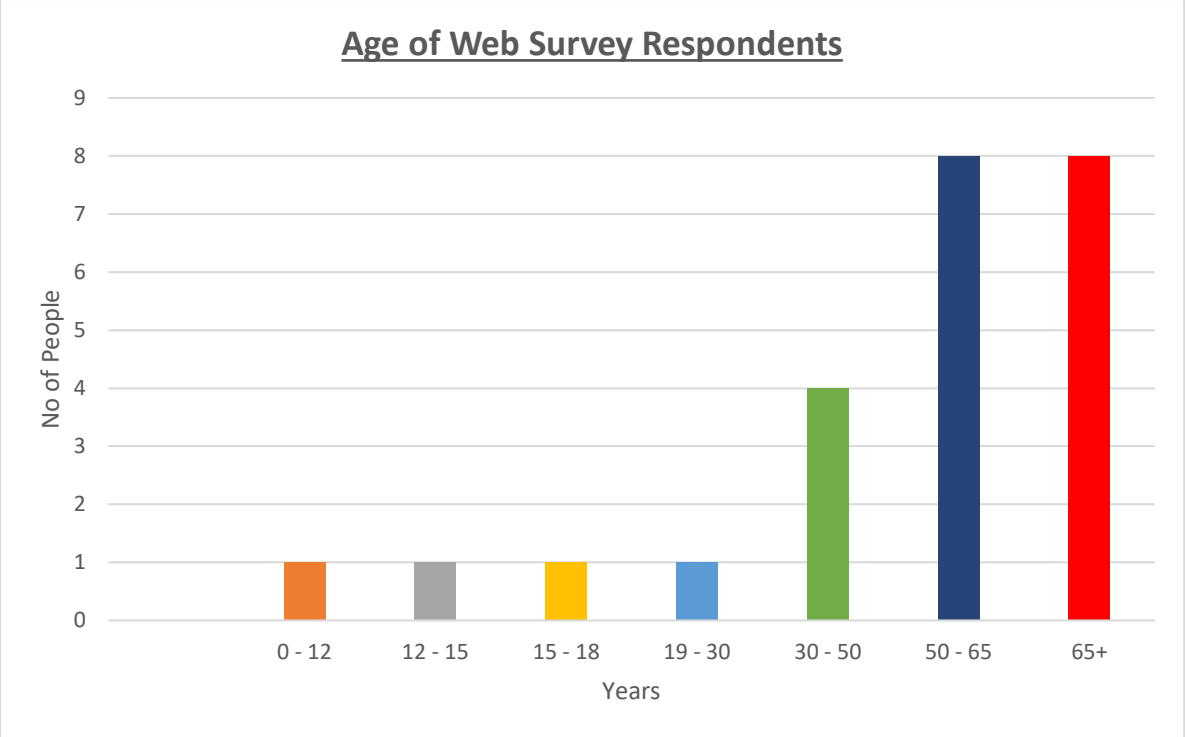


Figure 5.4.1: Graph showing the age distribution of the online survey participants

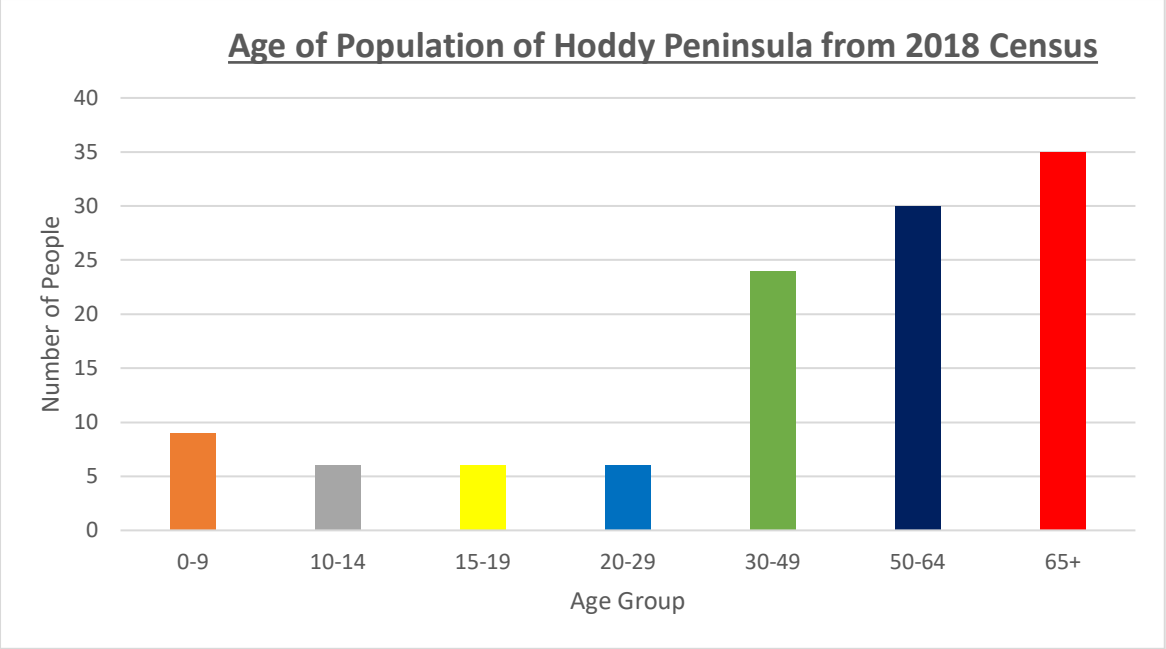


Figure 5.4.2: Graph showing the age distribution of the population of the Hoddy Peninsula from the 2018 census – this is a large part of the case study area.

Responses to the number of people living at the residence show that only three properties had over two people living there, with the majority being one or two person properties.

The respondents show a range of time that they have lived in the study area, with 9 respondents having lived there for over 10 years and 4 having lived there for under 2 years.

Overall, the population of the sample appears to be made up of people over 50 with some stating retirement and hobby farming as their occupation, while others indicated they work at a variety of occupations such as Company Directors and Chief Financial Officers.

The properties whose owners participated in this survey ranged from under 0.5ha (3 properties) to over 20ha (3 properties) with 7 properties being between 5000 and 10000m^2.

The amount of land use for productive purposes also varied with 8 respondents utilising under 40% of their property for productive purposes as shown in Figure 5.4.3. The productive purpose was not disclosed in the survey. This would indicate that they are largely lifestyle properties rather than farms. One respondent indicated they used at least 80% of their property for productive use. It was noted that “When we moved here it was a bit out of the way, it was very rural, it was very quiet. There were orchards and next door was a big plantation of pine trees that hadn't been looked after very well and now it's all marked cars and posh houses.”

40% of respondents indicate that over 40% of their property is in grass and half of the respondents indicated that they had less than 20% of their property in native shrubs.

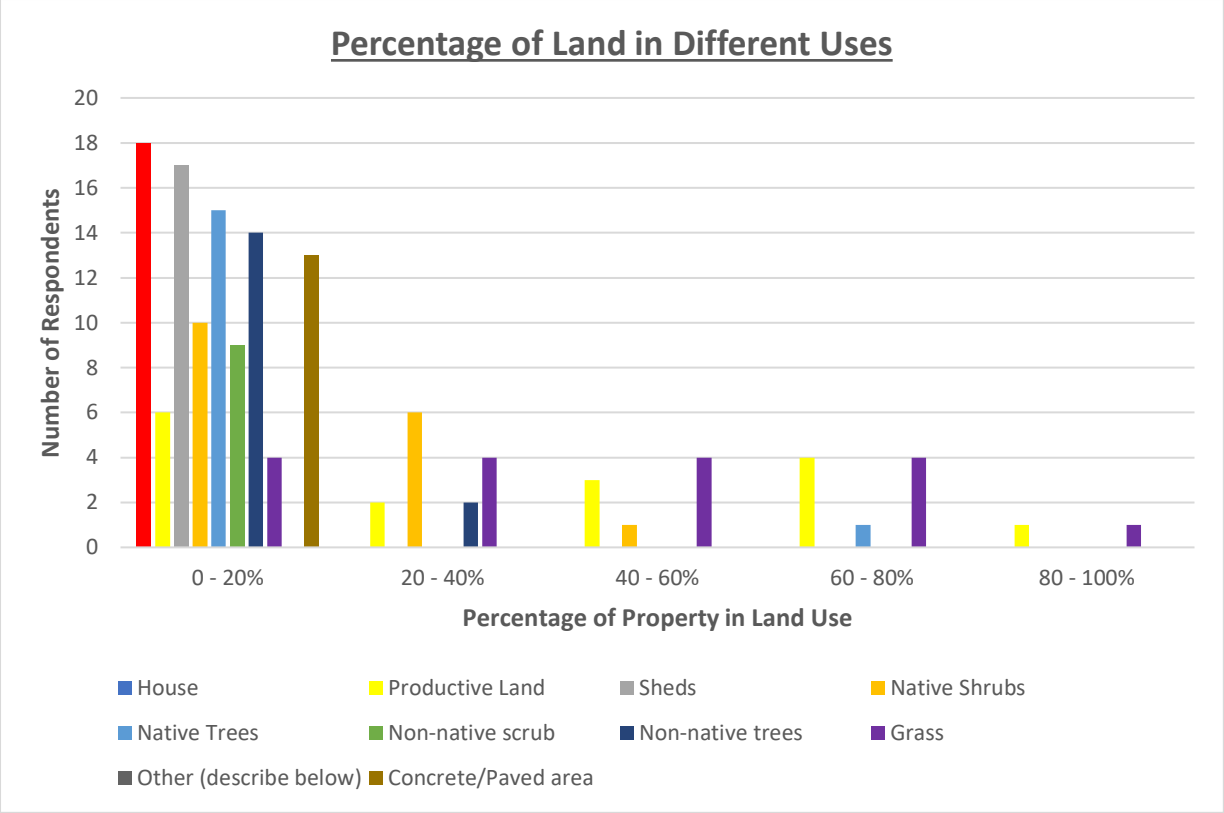


Figure 5.4.3: The percentages of the different uses of land in the case study area from the online survey.

5.4.1.3 Motivations of Online Survey Participants

A five point Likert scale was used for the participants of the web survey to order what they thought was the best thing about living by the Waimea Inlet, utilising a scale where 1 was the best reason and 9 the least reason. The 'views onto the inlet' and 'the wildlife' were equally rated amongst the participants as the best reason for living in the study area. This indicates that the area is chosen as a place to live for the location, not particularly for the

productivity of the land. Only two other options received a 1 rating as the best reason to live there. These were 'the nature around the inlet' (which two people rated as the best) and 'the property suits my business' (which one person put as the best).

Participants also had the option to give reasons other than those on the Likert scale for what is the best reason for living by the Inlet through an open-ended question. The reasons given included the community, the capacity to help the ecosystem, the walks, quietness, and the sense of space. When asked what the worst part of the living near the Waimea Inlet participants said distance of travel to get goods, lack of public transport, coastal highway is too busy, sediment going into the water, pollution affecting the water, too many expensive properties with landowners not interested in the ecology of the inlet, noisy water vehicles, people with helicopters and Rabbit Island stench.

When asked to rate the most important values of the Waimea Inlet 90.48% of respondents listed the visual beauty as the most important value with unique wildlife listed as the second most important.

There was motivation for the intrinsic values of the estuary and respondents in general indicated they lived there due to the natural beauty of the area. All respondents indicated that they were motivated to do something on their property and no respondents indicated that they didn't want to improve the conservation values of the area.

5.4.1.4 Pest and Weed Control

The web survey included questions pertaining to how regularly the participants performed different tasks on their property in terms of pest and weed control. The participants were asked to use a scale to indicate how often they did pest or weed control or how often they paid contractors to perform these tasks. The scale went from 0 for many times a year, 1 once a year, 2 sometimes, every 2-3 years, 3 rarely, every 3+ years and 4 never. Over 90% of respondents said they trapped for pest control most of the time (a 0 or 1 on the scale). In addition, 87.5 % pulled weeds most of the time (a 0 or 1 on the scale) and 71.43% sprayed for weeds most of the time. Indicating that the participants are motivated to control pests, both animal and plant in the area.

5.4.1.5 Knowledge

The participants were asked to rank their knowledge of certain areas of conservation from 0 – I know nothing to 5 - I am an expert. The results of this are seen in Figure 5.4.4 on the next page. There was a variety of responses to this question showing that the respondents felt a range of knowledge for various conservation measures. Three respondents felt they knew nothing about invasive species in the area, soils and where to plant for biodiversity. Whereas at the other end of the scale two respondents felt that they were experts on wildlife on their property and one respondent felt that they were expert on native plants, and which

native plants are appropriate for their property. A different respondent also felt they were an expert on pest control. The respondents who put the 5 for an area had 3 or 4s for the other areas. All of the respondents that put a 0 response also put 1 or 2 for the rest of the areas with the exception of one respondent who also put a 3.

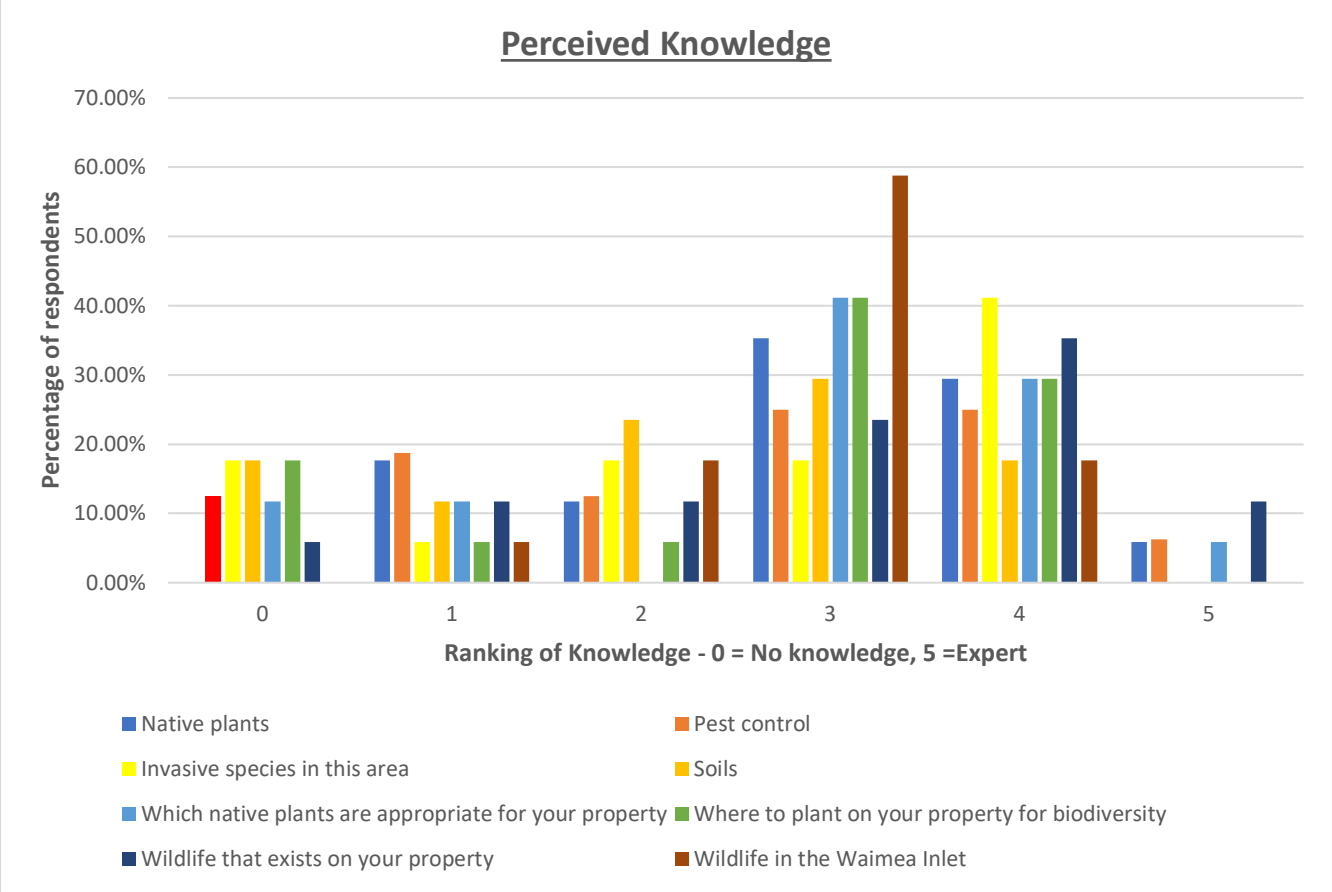


Figure 5.4.4: The ranking of perceived knowledge of the participants of the online survey where 5 is a high knowledge and 0 is little to no knowledge.

Limits to their own knowledge was a large reason for not doing conservation work on their properties. This was further divided into knowledge of where to get plants, which came up 6 times and own knowledge (or knowing what to do) which came up 11 times. One applicant repeatedly said that they would have appreciated more information since they bought there on what to plant and where to source good quality plants at reasonable prices. This respondent had also had interactions with volunteer groups and TDC but still felt their knowledge in this area was lacking.

The knowledge discussed included knowledge of where to put pest traps, what plants to plant, how to fence the planted area, and frequently how to keep weeds down around the plants. These comments came from property owners who had been there for twenty years and those who had recently bought.

5.4.1.6 Barriers to Conservation

The respondents were asked to rank possible barriers to conservation work with 0 being not a problem and 5 being a major problem (Figure 5.4.5 on the next page). The results show the need of the land for productive purposes was not a problem for 72.72% of respondents. In addition, 60% of respondents put knowing what to plant as not being a barrier. 35.72% put the financial cost of labour as a 4 or 5 (5 being major problem). A follow up question asked participants what would help them achieve more conservation work on their property. Eleven participants answered this question and six of these specified physical help. “I am 78 years old, just need some fit person to help”.

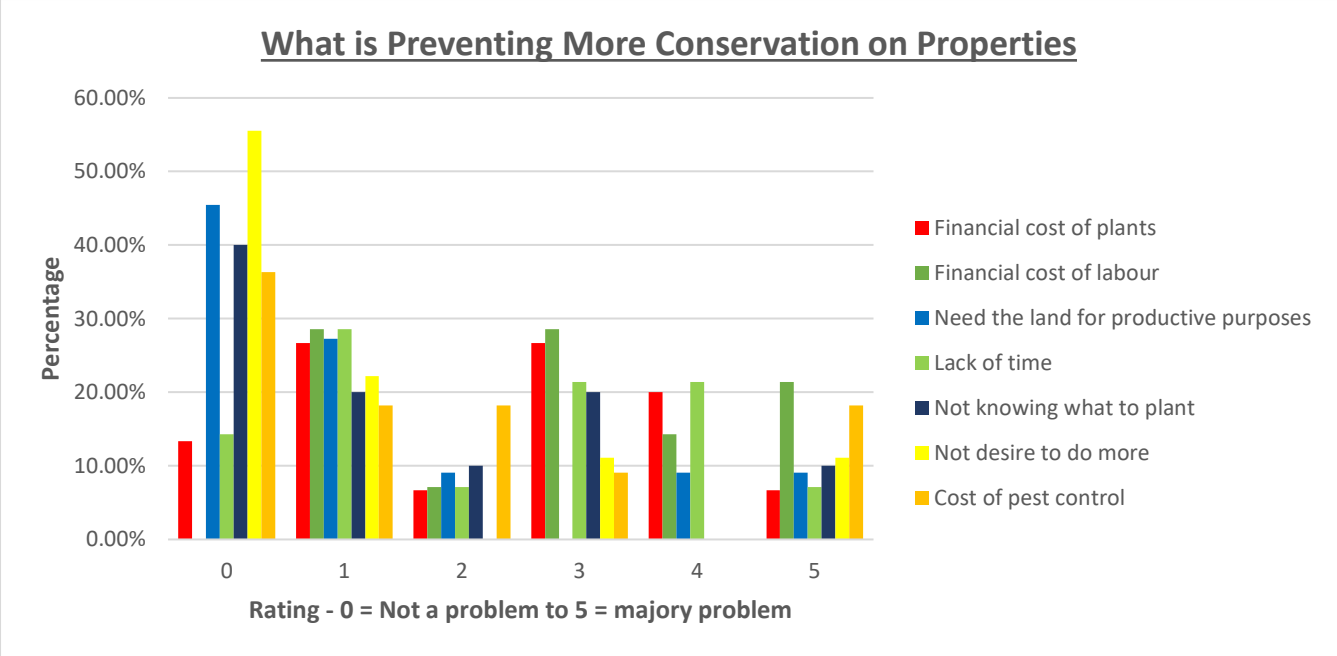


Figure 5.4.5: Rating from participants of the online survey of what is preventing more conservation on their properties with 0 showing things they are perceived to not being a preventative and 5 being things that are a major preventative of further conservation.

Money only came up twice in the interviews. Once the interviewee directly stated that they would like to plant natives but could not afford to do it themselves. The other time was part of a discussion about the respondents' interactions with Tasman District Council (TDC) during the subdivision process. The respondent believed TDC wanted them to plant up the riparian strip that TDC had taken as part of the subdivision process but when they asked TDC for money for this they were told there was none.

5.4.1.7 Interactions with Agencies

Eight respondents said they had taken part in an environmental program on their property and listed Battle for the Banded Rail, Tasman Environment Trust, and Trees that Count as programs they have participated in.

The respondents had had various interactions with government agencies, Tasman District Council in particular, and this was something that many respondents wanted to discuss when talking about conservation work.

All of the respondents had heard of the volunteer groups in the area, particularly the pest eradication scheme. All had rat traps either through the scheme or of their own accord on their properties. Discussion around volunteer groups indicated that most respondents didn't directly have anything to do with any group unless it was trapping on their property. Some respondents indicated that they felt a bit obligated if they joined a volunteer group or asked for help.

5.4.2 Phone Interviews

5.4.2.1 Introduction – Phone Interviews

There were nine participants in the interview process. Five of these responded as part of the web survey, with a further four being recruited by other participants and did not do the web survey themselves.

Coding was based on common themes in the responses as shown in Figure 5.3f below.

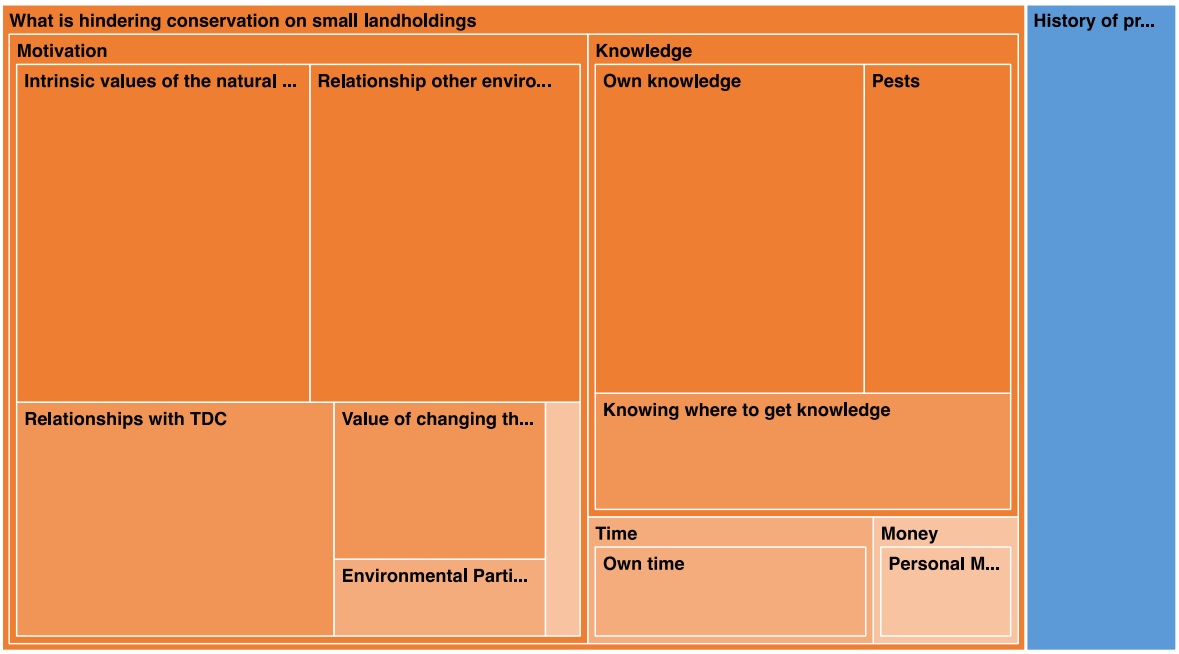


Figure 5.4.7 – Diagram of the common themes from the phone interviews.

From the web survey four master groups were made for things that were perceived to be barriers to conservation on private land. These were Time, Money, Knowledge and Motivation. These formed the basis of the analysis of the phone interviews.

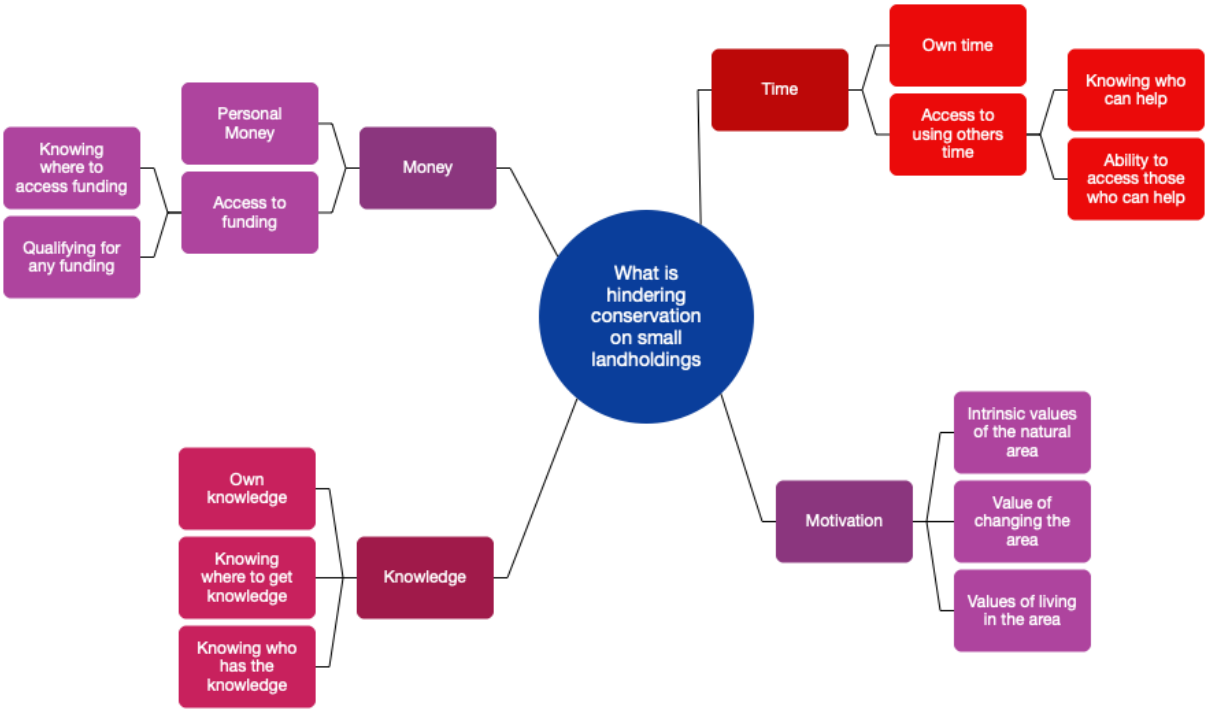


Figure 5.4.8: Mindmap of codes and themes

5.4.2.2 Phone Interview Responses – Time

Time came up three times in the interviews by three different respondents. Each of these respondents talked about what they might like to do on their property and then when reflecting on the amount of work they have decided that it is too much for them to accomplish.

In each case it was not time alone that was mentioned but other factors such as how are we going to do things or where do we start? Respondents' quotes from interviews in relation to time as a barrier included:

“It's a mixture of time and effort and every time we think we should do this then we think how are we going to keep the paddock eaten down because it's too steep to mow.

So we need to fence what we need to be plant and then we go oh god let’s think about this another day.”

“Yeah, we think well we could buy a whole lot of root trainers and plant a couple of hundred plants or get a whole lot of friends to come around and give us a hand and then you think ok we are going to fence it, how are we going to do that and then you have to get the weedeater out to go around them from time to time so they don't get swamped by the long grass and yeah. So it's mostly logistics that gets in the way.”

“As I get older I certainly find that I don't have the energy for those sorts of things like I used to do.”

These are a portion of the discussion around time from the three respondents who bought up time as a potential barrier to conservation.

5.4.2.3 Phone Interview Responses - Money

Money only came up twice in the interviews. Once the interviewee directly stated that they would like to plant natives but could not afford to do it themselves. The other time was part of a discussion about the respondents' interactions with Tasman District Council (TDC) during the subdivision process. The respondent believed TDC wanted them to plant up the riparian strip that TDC had taken as part of the subdivision process but when they asked TDC for money for this they were told there was none.

5.4.2.4 Phone Interview Responses – Knowledge

Limits to their own knowledge was a large reason for not doing conservation work on their properties. This was further divided into knowledge of where to get plants, which came up 6 times and own knowledge (or knowing what to do) which came up 11 times. One applicant repeatedly said that they would have appreciated more information since they bought their property on what to plant and where to source good quality plants at reasonable prices. This respondent had also had interactions with volunteer groups and TDC but still felt their knowledge in this area was lacking.

The knowledge discussed included knowledge of where to put pest traps, what plants to plant, how to fence the planted area, and frequently how to keep weeds down around the

plants. These comments came from property owners who had been there for twenty years and those who had recently bought.

5.4.2.5 Phone Interview Responses – Motivation

There was motivation for the intrinsic values of the estuary and respondents in general indicated they lived there due to the natural beauty of the area. All respondents indicated that they were motivated to do something on their property and no respondents indicated that they didn't want to improve the conservation values of the area. Below are three direct quotes from the interviews in relation to respondents valuing the amenity of the area:

"Originally I'm from Auckland and I think around the estuary is a very beautiful area. So the geography of the area is really attractive."

"Yeah, absolutely and what we could do was help keep the estuary or improve the estuary it would be a great thing."

"It's a wonderful estuary and um there could be other things to help."

5.4.2.6 Interactions with government agencies

The respondents had had various interactions with government agencies, Tasman District Council in particular, and this was something that many respondents wanted to discuss when talking about conservation work. Below is a quote from one respondent about working with the local council on conservation as part of subdivision process.

“We tried working with the Council but it just went nowhere.” “We had cleared it of all the pine trees, gorse and it was looking really, really nice. We approached and said look, we would like to plant it all up in natives but we can't afford to do it ourselves. Could you please either supply the plants and we'll plant them or we'll supply the plants if we can get your help and they said no and they gave us an A4 sheet with the plants that wanted us to plant on it. They said it's our land but you have to look after it. So since then it has reverted back to blackberry, bracken.”

5.4.2.7 Interactions with Volunteer Groups

All of the respondents had heard of the volunteer groups in the area, particularly the pest eradication scheme. All had rat traps either through the scheme or of their own accord on their properties. Discussion around volunteer groups indicated that most respondents didn’t directly have anything to do with any group unless it was trapping on their property. Some

respondents indicated that they felt a bit obligated if they joined a volunteer group or asked for help.

5.5 Summary of Results

The results show that there is a pattern of land cover change over time with the pattern between the 1940s and 1980s aerials showing clearing of tree/bush cover and increasing orchard and grass cover. In contrast between 1980 and 2020 there is an increase in tree/bush cover and a substantial increase in building cover. This coincides with the increase in the number of titles shown in the survey plans throughout the years.

The survey results indicate that the landowners feel that time and physical ability are the main barriers to conservation measures on their properties. Whereas money did not appear to be a barrier. Landowners were motivated towards conservation with most landowners valuing the natural beauty of the area and having the want to maintain and enhance this. There was a mix of knowledge and this would indicate that knowledge sharing would be a benefit in this area.

Chapter 6 - Discussion

6.1 Introduction

The aerial land cover comparison shows a marked transformation in land cover between the 1940s and 1980s in the study area. Originally characterised by a few buildings with extensive orchard and grass cover, the land use shifted to a higher density of buildings alongside a decrease in orchard and grass coverage. This change coincided with a large increase in the number of titles, including the creation of numerous small lifestyle blocks, as confirmed by the survey plan analysis. These patterns support the assumption that the area transitioned from predominantly productive orchards and farms to mainly small lifestyle oriented properties.

The survey data indicates that landowners in the area are motivated towards conservation values, with many drawn to the area for its natural environment. However, levels of conservation knowledge vary, particularly in practical skills such as trapping, planting and weed maintenance. In addition, the perceived barrier of time was identified as a key barrier preventing greater involvement of private landowners in local conservation initiatives in the area.

This chapter examines historical land use change, the ecological value of the Waimea Inlet, the characteristics and motivations of lifestyle block owners, and the barriers and opportunities for conservation on private land.

6.2 Aerial Land Cover Comparison

The aerial land cover comparison indicates an increase in productive land use in the area between 1940 and 1980, as evidenced by a 35% increase in orchard coverage and a 60% increase in grass areas. This pattern aligns with the region's agricultural history, beginning with the establishment of the first orchards in the 1930s and subsequent growth in horticulture and agriculture. The New Zealand Land Cover Database (Land Cover Database Version 5.0, Mainland, New Zealand 2019), is a nationwide database that has mapped land use cover across New Zealand from 1996 categorizes 33 mainland land cover types. This database shows that up to 2008, a significant portion of the Hoddy Peninsula was classified as orchard, transitioning to High Producing Exotic Grassland thereafter. A similar transition is seen in exotic forest in the study area which was also converted to High Producing Exotic Grassland by 2008. Oral histories gained during the interview process support these findings.

One survey participant, a descendant of a family involved in orcharding since the 1930s, corroborated this historical narrative, describing the area's predominant use for orchards and farming from the 1930s to the 1990s. By the 1980s, the land use was primarily grass and orchards, supported by local knowledge that indicates extensive horticultural and agricultural activities during this period. Recent changes have resulted in land fragmentation and an increase in buildings.

Between the 1940s and 1980s, tree and bush cover declined by 48% across the peninsulas (Figure 5.2.1). From the 1980s to 2020, this trend reversed, with a 26% increase in tree/bush cover. This rebound coincided with a shift from larger productive blocks to smaller lifestyle blocks, as discussed in the survey results. Additionally, during this time there has been an increase in volunteer groups, such as the Battle for the Banded Rail group, which has planted native trees in the area for nearly two decades.

The 26% rise in tree/bush cover between the 1980s and the 2020s, as shown in Figure 5.2.2, is likely to reflect more land being used for gardens or planted for conservation purposes. Volunteer groups who have been active in planting along the estuaries in the study area have likely contributed to this. This trend is also consistent with the shift from productive to lifestyle blocks. The maps in Figure 5.2.1 show the distribution and pattern of trees/bush in 2020 is markedly different from that in the 1940s and 1980s. However, while there is more overall tree/bush coverage the results show that fragmentation of the individual tree/bush patches has increased. In 2020, there were 250 patches of trees/bush, compared to 25 patches in 1940 and 107 patches in 1980.

At the same time, orchard use has decreased by 69% from the 1980s to 2020, underscoring the shift away from productive use. Building density has increased from 25 in the 1940s to 94 in the 1980s and 280 in the 2020s, further demonstrating the move away from productive land.

6.3 Survey Title Comparison

The survey plans show relatively stable title numbers between 1928 and 1981, followed by a sharp increase of about 100 titles between 1981 and 2022. This timing is consistent with the change in land use discussed above and the development of the area from productive horticulture and agriculture into lifestyle blocks, partly driven by the apple industry downturn, and improved commuter access with the new State Highway.

6.4 Conservation

The Waimea Inlet supports many native and migratory birds, including matuku hūrepo (Australasian bittern), kōtuku ngutupapa (royal spoonbill), kuaka (bar-tailed godwit), kōtuku (white heron), koitareke (marsh crake), mātātā (fernbird) and moho pererū (banded rail) (Davidson and Moffat, 1990). Birds nesting on the edge of estuaries face several challenges with the rise in sea levels, primarily due to habitat alteration and loss. These issues can significantly impact their nesting and overall survival. (Liu and Liu, 2014).

Schuckard & Melville (2019) warn that sea level rise will place coastal birds under threat of “coastal squeeze,” with limited natural migration opportunities due to human land modifications. Recommendations from Robertson & Stevens (2012) and the Ministry for the Environment (2021) stress the need to facilitate inland habitat migration, and note that species like the banded rail can colonise new areas if predators are controlled.

The Waimea Inlet Management Strategy (Waima Inlet Management Strategy, 2020), developed by the Waimea Inlet Forum, outlines objectives and outcomes for the Waimea Inlet, including actions such as:

- managing and restoring key habitats on public and private land,
- developing ecological corridors and transition zones, and
- increasing the area of saltmarsh and naturally vegetated dune and estuary margins.

A key target of the plan is to increase the naturally-vegetated estuary margin by 10 km (to an average width of 10m) by 2030. While this study demonstrates an increase in vegetation in the study area, it also highlights the need to connect fragmented patches into continuous corridors. The Waimea Inlet Restoration guide (Waimea Inlet Restoration, 2020) emphasizes the long-term ecological and cultural benefits of restoration, including the enhancement of habitat for taonga species, and the creation and enhancement of vegetation corridors from the sea to inland areas for native species to migrate inland if sea levels rise. Achieving these outcomes will require the cooperation of multiple landowners, with the nonproductive use of many lifestyle blocks making them ideal for such initiatives.

The Waimea Inlet Action Plan, instituted in 2010, undergoes annual implementation reports to ensure adherence to its objectives. This plan includes a response to climate change, which is likely to necessitate the planting of vegetation on private lands. The study identifies fragmented patches of vegetation across the peninsulas, suggesting the potential for connecting these patches by collaborating with private landowners to establish larger tracts of forest or bush vegetation. Visualizing patterns of land-use change over time reveals the shifts that have occurred, providing valuable insights to inform future conservation strategies.

Community conservation initiatives, such as the Battle for the Banded Rail project, managed by Tasman Environmental Trust, have planted over 40,000 native plants and installed 6,000 predator traps along the Waimea Inlet's western arm, including the study area (Tasman

Environment Trust, n.d.). There is strong evidence that coordinated native planting, supported by multiple agencies, can produce significant ecological benefits. However, future resilience for coastal bird populations will depend on inland habitat creation, in this case linking fragmented patches on private land and public land to form continuous corridors.

Lifestyle block management experience and practices vary widely. Survey data shows that 83% of the properties in the study were smaller than 20,000m², with the majority unused for production and maintained primarily for recreational and amenity purposes. The smaller size of the properties limits their productive potential, which is consistent with international findings on rural lifestyle blocks (Spyra et al., 2021; Kam et al., 2019; Sorice et al., 2014).

The results of this study indicate that policies advocating for comprehensive conservation plans on private lifestyle blocks within this region would be advantageous for future habitat creation, especially considering rising sea levels. Such plans should be targeted and encompass pest control measures, as increased vegetation often correlates with a rise in pest populations. Fragmentation of habitats frequently leads to significant degradation in the structure and composition of remnant natural vegetation, resulting in considerable biodiversity decline (Cross et al., 2016).

Land use changes over the past century, including changes in the wider estuary catchment, have degraded habitats. Recent years have seen conservation measures implemented, primarily on public land near the inlet's edge. Anticipated Sea level rise makes it essential to provide inland nesting vegetation to ensure species resilience. Strategically planting

native vegetation on privately owned small lifestyle blocks, particularly where they link with revegetation projects on public land, could help create larger, less fragmented vegetation corridors, providing nesting options to aid with species resilience into the future.

Sea level rise has been identified as likely to have adverse impacts on birds occupying coastal marshes around estuaries in the Tasman/Nelson region (Schuckard & Melville, 2019). The study shows that coastal vegetation in this area has been altered by development and human activity. Schuckard & Melville (2029) note that there is currently little opportunity for the natural migration of coastal marshes landward due to human modifications and as such, coastal birds will be subject to 'coastal squeeze' – a matter of concern in many parts of the globe.

Peri-urban land cover change reflects global urbanisation patterns (Huang et al., 2009). Understanding the changing patterns and driving forces of urban sprawl is crucial, given urbanization's role as a major cause of global environmental change (Seto & Fragkias, 2005). In the study area, while vegetation overall has increased, fragmentation has also increased meaning that it is not necessarily suited to native wildlife habitat and planting choices are often left to individual landowners without targeted ecological guidance.

There is evidence that planned native planting including different agencies does make a difference. The Battle for the Banded Rail project which has been overseen by Tasman Environmental Trust and has used community and school groups to plant over 40,000 native

plants on key sites and 6000 predator traps along the western arm of the Waimea Inlet, including the study area (Tasman Environment Trust, n.d.).

Robertson & Stevens (2012) proposed a target of increasing the area of natural vegetated 200m terrestrial margin by 10% by 2021 and noted that 'where the natural vegetated terrestrial margin is being reduced in area through coastal squeeze, encourage migration inland and explore other possibilities to mitigate or minimise losses'. This target has not been met and the Waimea Inlet Forum has adjusted its objectives accordingly. In addition Ministry for the Environment in the Coastal Policy Statement (MfE, 2021) includes the need for local government to allow for areas for biodiversity change to occur (e.g., migration of species). Schuckard & Melville (2019) note that birds such as the Banded Rail have the ability to disperse widely and there is a high likelihood of areas of suitable habitat being naturally colonised if predators are controlled adequately.

The land use maps show that tree/scrub has increased in the study area but the onsite photos show that this is not necessarily native vegetation or vegetation that suits the area it is in for the native wildlife habitat use. Guides for the area tend to be generalistic to native restoration planting and the planting plan is left up to individuals. Given that many of the birds inhabiting the area are shore birds their specific requirements may not be recognised by landowners who are new to the area (which given the increase in subdivision would be the majority of landowners).

6.5 Landowner Motivations

The survey showed that the majority of landowners did not use much of their property for productive purposes and large parts of the properties are in grass. This is in keeping with other international findings. Sorice et al (2014) found a trend of motivation shifting towards a preference for natural and cultural amenities away from agricultural-productive use of lifestyle blocks in the southern Great Plains of the USA. In this study landowners in the area showed that they valued the nature of the area and had the motivation to protect the biodiversity of the area. However, land management practices did not fit with the current conservation land management practices in the area. In this study there was evidence that motivation was high but there were barriers to participating in current conservation initiatives.

Mendham and Curtis (2010) found that a behavioural 'gap', whereby there is a disconnect between the pro-environmental attitudes of lifestyle landowners and their adoption of improved practices, can prevent best-practice natural resource management. This study investigated the possible barriers that create the gap preventing smaller landowners from further conservation efforts on their property. Meadows et al (2018) noted that small-acreage landowners will require greater access to labour support and other subsidised resources to implement recommended practices on their study of forest recovery Noosa hinterland. The demographic of this study showed that a large portion of landowners are older (57% of the residents are aged over 50) and that needs to be taken into account as this in itself could indicate potential barriers, such as less ability for physical work.

Traditionally conservation and planting has been left to the landowner in New Zealand with rules through various acts (such as the resource management act and voluntary Queen Elizabeth II covenants) protecting areas of native vegetation. Landownership in the past involved more productive lands with more knowledgeable landowners who had more time and ability to work on the land. With the changing land use into smaller lifestyle blocks this study shows that there is a variation in knowledge and barriers including time and ability to perform physical tasks. However, it also shows a strong motivation towards conservation in the area. Balukas et al (2019) found in understanding landowner decision making place attachment values, land and wildlife stewardship beliefs, and conventional resource production ownership objectives matter.

The results of this study suggest that in this area conservation measures could be implemented without compromising productive land use if the conservation measures align with the landowner's motivations and capabilities. Implementing on the ground conservation actions on private land depends on landowners' willingness to collaborate with conservation organizations and their management capabilities (e.g. in terms of resources and knowledge) (Farmer et al., 2017; Hardy et al., 2017; Knight et al., 2010; Selinske et al., 2015). This would indicate that knowledge of landowners' values is necessary to ascertain whether conservation measures would be a possibility on their property. Understanding individual motivations for owning land is required in order to energize behaviours necessary to achieve land use goals (Greiner et al., 2009).

It is evident that a large portion of the land contained within these lifestyle blocks is not utilised for any productive purposes with a majority of landowners wanting to live an urban lifestyle on the small landholdings and keep the land as a way of having space and nature around them. This would indicate that conservation measures could be undertaken on these properties without affecting productive land. However, these measures would need to align with the property owners' motivations and abilities. This is a pattern consistent with peri-urban landowners globally (Spyra et al 2021, Kam et al. 2019, and Sorice et al 2014).

The range of knowledge is potentially due to the background of the landowners, with some landowners coming from urban living and having no farm experience to some landowners living in the area since it was productive rural land. This is consistent with other studies overseas where there is a trend in landowners in the peri-urban area changing from productive motivation to lifestyle and nature amenity motivation. This has been termed in some studies as amenity migration. Amenity migration is described as the movement of people, mostly affluent and residing in suburban or urban areas, to rural areas for specific lifestyle amenities (Abrams et al., 2012) and is a trend that is consistent with the results of this study. Kam et al (2019) found that their results suggested that communities in the peri urban area are becoming more fragmented with increasingly diverse values and motivations (Kam et al, 2019). The area of this study showed some diverse values and a diversity of knowledge but there was a clear value of nature and wildlife from all participants.

Gosnell et al (2012) found that landowners of the with lower levels of resource dependency have different attitudes toward the land and motivations for owning it that lead to land

management behaviours that are different than the production-oriented landowners. In this study the motivations of the lifestyle owners were towards the nature and recreational value of the area rather than the productive capacity of the land.

This range of knowledge indicates that there would be some merit in community sharing in terms of conservation so that those with more knowledge are able to impart and share it with those who have less knowledge. It may be that if conservation policies were pursued in this area they should take a community basis to utilise the existing knowledge of the landowners and make connections with those who have little knowledge.

In this study I explored the motivations of the landowners in the study area and the barriers to conservation on the private owned small lifestyle blocks. A majority of landowners were motivated by the nature and beauty of the area as well as the visual beauty and the unique wildlife. During the interviews participants all demonstrated knowledge of some of the local birdlife and all displayed a want to keep the area's natural values. This showed that the landowners have the want to maintain and enhance the natural beauty and wildlife of the area, whether for conservation purposes or for their own purposes of beautifying the land around them. Similarly, Sorice (et al, 2014) found that motivations for owning rural land are shifting from an agricultural-production orientation to a preference for natural and cultural amenities in the Southern Great Plains of the United States of America. They found that the change in land management practices had a significant effect on the ecosystem of the area. Closer to home, Kam (et al, 2019) showed that recreation and amenity relating to private cultural services are the main drivers of land acquisition and motivation for land use by

absentee landholders in New South Wales, Australia and a recent study in the Turitea Valley of New Zealand found that most participants also valued natural habitat (Pearson, 2021).

Perceived knowledge of the local wildlife was high among the respondents. This would further indicate that they are interested in and motivated about the natural surroundings and a large motivation of living there is the enjoyment of the natural wildlife to those that live there. Given their increasing numbers and key role in the ecological transformation of amenity landscapes, small-acreage landowners should be better recognised as a legitimate natural resource management opportunity and better supported to adopt improved forest management practices. (Meadow et al, 2018)

In addition to physical labour, time was another barrier that was clear in this study as well as not knowing where or how to start. In the survey lack of time as a barrier varied indicating some owners feel they have the time, whilst others don't. This is possibly linked to the variety seen in the knowledge and employment of the different landowners. Those who do not have the knowledge may feel they don't have the time as they are not sure of what is actually required. A community approach to conservation measures with shared knowledge and time could also help with this barrier. It has been noted overseas that capacity-related constraints including minimal practical experience and confidence, and limited time, finances and physical capabilities will often reduce interested landowners' involvement (Burnley and Murphy 2004; Pannell and Wilkinson 2009; Meadows et al. 2013, 2014). These barriers can also sometimes be due to a landowner's limited ecological understanding (Abrams et al. 2012).

Financial cost of labour was not ranked as ‘not a problem’ by any respondent. The cost of pest control was seen as not a problem to over 35% of respondents indicating that pest control is seen more as a necessity. In the interviews money was not strongly discussed as a barrier, with only one respondent noting that they could not afford the plants. Therefore, perhaps financial incentives alone will not be the solution for conservation measures but rather community focused measures that lessen the barriers of physical work, time and knowledge would be more engaging for small landowners.

Currently in this area there are a number of volunteer conservation groups active on the peninsulas where this study took place. The largest is run by the Tasman Environment Trust, a trust who implements a number of conservation measures around the Tasman region of New Zealand. The majority of the conservation measures so far have been on public land with some private land being included. However, in talking to a representative of the Trust it is open to working on private land and working with landowners (personal communication, 2020). When asked if they have participated in these conservation programmes landowners involved in the interviews felt that in order to plant on their land, they then had to be very involved in the volunteer group and this would require more time and more effort on their part. They therefore did not get involved with these groups. During the period of this study there has also been another project involving the Billion Trees planting programme run by the New Zealand government (MPI, 2024). This allocated funding for tree planting into the area of this study. One interview participant said they had applied for this as soon as they

heard about it but had been too late for applications. Other participants were not aware of this scheme.

It has been identified that the existing protected conservation areas and any new established protected areas worldwide will not be able to overcome the current trends of loss of wildlife (Mora & Sale, 2011). This is in part due to conservation areas often being isolated, having limited geographical coverage, having a lack of connectivity and their limited coverage of actual global biodiversity (Kam et al, 2015). These limitations apply to conservation areas in New Zealand where there is, among other things, the pressure of urban sprawl. Peri-urban sprawl creating rural lifestyle blocks is a trend in many countries including Europe (Spyra et al 2021), Australia (Kam et al. 2019) and America (Sorice et al. 2014). While in the past the use of policy instruments directed at conservation on these smaller lots may not have been effective due to the economics given the larger areas of land being developed into lifestyle blocks in New Zealand this could be reconsidered.

The peninsulas on the Waimea Inlet where this study took place are on the outskirts of the cities of Richmond and Nelson in the South Island of New Zealand. Land use has changed in this area recently from agriculture (mainly orchards) to smaller lifestyle blocks. The Waimea Inlet itself is an important ecosystem with many native and migratory birds nesting here including banded rails, and Australian Bitterns. The change in land use over the last hundred years as well as various land uses in the wider catchment has led to the degradation of the ecosystem. Recent years have seen a recognition of this and conservation measures start to be put in place, mainly on public land near the edge of the inlet itself. Given that sea

levels are predicted to rise there is a need for many of the native birds in this area to have vegetation for nesting further inland than what is currently available to ensure the stability of any future nesting. Privately owned small lifestyle blocks are in a position where they can be utilised to provide biodiversity and restorations measures for the good of the ecosystem.

Chapter 7 - Conclusion and Recommendations

7.1 Conclusion

This thesis presents the quantified results of land cover change along the study area on the Bronte and Hoddy Peninsulas. It also analyses these changes and looks for historic patterns in land cover change. The thesis then presents the results of any analysis of survey data and semi-structured interviews of private landowners in the study area. The objectives of the research were to:

- To quantify the land use change over time on the Bronte and Hoddy Peninsulas on the edge of the Waimea Inlet using spatial and temporal analysis and past survey maps.
- To identify attitudes and actions towards biodiversity conservation among lifestyle block landowners beside the Waimea Inlet.
- Focusing on the perceived motivators, barriers, and enablers of biodiversity action to determine if more can be done to support private landowners to participate in management activities to protect biodiversity in the Waimea Inlet.

This research is unique in that it looks at historical land cover patterns over time of a periurban area to identify the conservation needs for the area, which in this case is to unite fragmented patches of native bush areas. It then investigates the motivations and perceived barriers of the landowners in this area to identify what would be needed to implement a

coordinated conservation effort in this area including on private smallholdings. These two aspects of the research give a powerful tool for policy holders to get both a picture of the conservation needs and of the sociological needs in order for policies around conservation to succeed.

The land cover is shown to have changed significantly over time with small holdings and a large number of buildings added to the area in recent decades. The results of the interviews show small holdings that have large areas not being used for productivity and landowners who are motivated towards conservation. This indicates that the right policies in this area could succeed to connect the fragmented tracts of native bush creating habitat for the native species who use this area. The perceived barriers identified also set out what would be required to further succeed with conservation efforts in this area.

This research adds to a growing body of empirical evidence analysing land cover change, particularly in peri-urban areas. It also adds to research examining landowners' conservation behaviours and beliefs, confirming that respondents in this study area share similar motivations and perceptions of barriers and enablers with other small holdings landowners worldwide. However, this research goes further by examining the historical land cover change and identifying what would be required to succeed in conservation measures on the small holdings.

As well as adding to existing research this study gives a unique perspective of New Zealand lifestyle block owners in a particularly sensitive ecosystem, being the edge of an estuary. There are many similar areas in New Zealand that have had a land use change to small holdings particularly in coastal areas due to the amenity of these areas. The results of this

research show that these landowners are motivated towards conservation and with the right policies and strategies in place these small holdings are an ideal opportunity for conservation initiatives, particularly to cover land types that are often not included in New Zealand's national parks.

New Zealand has seen an increase in peri-urban sprawl leading to an increase in lifestyle blocks (smallholdings). There has been an increase of 5,383 hectares of land developed into small sized (>2 to ≤8 hectares) allotments between 2002 and 2019 in New Zealand. The total area of land in lifestyle blocks went from 280,557 hectares to 285,940 hectares, with a 59 percent increase of small-sized parcels with a dwelling, from 109,635 hectares to 173,800 hectares (Statistics NZ, 2021).

At the same time with stresses such as climate change and loss of endemic biodiversity there is a need for more conservation measures particularly in coastal areas and areas utilised by native species. Although thirty-two percent of New Zealand's land area is in public conservation estate, this land is biased towards high elevation vegetation types and poorly represents lowland areas (Cieraad et al., 2015; Monks et al., 2019; Pannell et al., 2021). A quarter of the remaining indigenous vegetation in New Zealand is found on private land, including threatened and rare biodiversity, with some species only being found on private land making the contribution of this land critical to the integrity of landscape-scale ecology (Brown et al., 2015; Environment Guide, 2018; Holdaway et al., 2012; Monks et al., 2019; Pannell et al., 2021). Due to the large portion of conservation land in New Zealand being on steeper, remote areas conservation needs to include private land in order to capture a variety of ecological systems.

This study used an area in Tasman, New Zealand which has undergone a large amount of subdivision in the last twenty years with many lifestyle blocks being developed. The study area is on the edge of a large estuary near to the towns of Richmond and Nelson in the South Island of New Zealand. Disproportionate increases in human population growth and development in coastal watersheds have adversely affected the structure and function of many estuarine and coastal marine ecosystems (Kennish, 2021). This is a concern as it becomes more evident that coastal ecosystems play an irreplaceable role in material production, climate regulation, water conservation, pollutant removal, biodiversity maintenance and other factors, and are some of the most valuable natural ecosystems on Earth (Liu, 2020).

Ecosystem services derived from estuaries range from benefits from food production and recreational opportunities to containment processing and cultural identity (Thrush et al, 2014). As a result of the various pressures on coastal systems, management actions need to be based on an understanding of the complexities, including nonlinear interactions, of multiple stressors on overall ecosystem functioning (Thrush et al, 2021). Land Use Cover Change (LUCC) is a crucial way in which human activities affect ecosystems, and LUCC changes the supply of ecosystem products and services by influencing ecosystem patterns and processes (Li et al., 2018). Dudley et al (2020) found that catchment land cover and estuary physical characteristics that control mixing are important environmental determinants of estuarine water quality in New Zealand (Dudley et al, 2020).

This study looked at the land cover changes alongside a portion of the Waimea Estuary using GIS mapping, available aerials and past survey plans. Private landowners were also surveyed to gauge the perceived motivation, barriers and enablers to conservation on their private land.

Land use changes in the peri-urban areas of New Zealand have seen more lifestyle owners and less productive land use. Andrew and Dymond (2013) found that lifestyle blocks occupy 10% of New Zealand's high-class land, while urbanisation since 1990 occupies 0.5%. They also noted that an average of 5800 new lifestyle blocks have been created every year since 1998.

In this study an increase in the productive land covers of orchard and grasses was seen between 1940 and 1980. This coincided with a decrease in bush/tree land cover. Between 1980 and 2020 there was a decrease in orchard land cover and an increase in bush/tree cover however the bush/tree cover was more dispersed and haphazard with no clear linkages between patches. In addition, on site spot checks of bush/tree cover showed a variance in what was being planted, it was not necessarily native plants or plants conducive to the ecosystem of the area.

The way in which private land (Hanley et al. 2012) is managed has major implications for biodiversity conservation nationally, and land managers have a critical role to play (Hanley et al. 2012, Thompson et al. 2015, Maseyk et al., 2021). Policies for conservation on private land include National Policy Statements and rules at the regional level that vary in each

district. Nationally, there is no cohesiveness to these policies and there is a lack of incentives to support the protection of biodiversity on land held outside of the public conservation estate, or where policies they do exist, there is a lack of compliance and monitoring necessary to achieve objectives and this varies in each region (Brown et al., 2015; Norton & Cochrane, 2000).

It is evident that a large portion of the land contained within these lifestyle blocks is not utilised for any productive purposes with a majority of landowners wanting to live an urban lifestyle on the small landholdings and keep the land as a way of having space and nature around them. This would indicate that conservation measures could be undertaken on these properties without affecting productive land. However, these measures would need to align with the property owners' motivations and abilities. A majority of landowners were motivated by the nature and beauty of the area as well as the visual beauty and the unique wildlife. There was a range of management capabilities and knowledge among the participants of our study. The range of knowledge is potentially due to the background of the landowners, with some landowners coming from urban living and having no farm experience to some landowners living in the area since it was productive rural land. This range of knowledge indicates that there would be some merit in community sharing in terms of conservation so that those with more knowledge are able to impart and share it with those who have less knowledge. It may be that if conservation policies were pursued in this area they should take a community basis to utilise the existing knowledge of the landowners and make connections with those who have little knowledge.

In addition to physical labour, time was another barrier that was clear in this study as well as not knowing where or how to start. Financial cost of labour was not ranked as not a problem by any respondent. In the interviews money was not strongly discussed as a barrier, with only one respondent noting that they could not afford the plants.

An ideal situation would be to use these nonproductive portions of periurban rural areas to create conservation corridors or larger conservation areas made up of smaller plantings on the lifestyle properties.

7.2 Recommendations

This study indicates that there is an opportunity for a community based conservation system using private land. The motivation for the preservation of the nature and wildlife of the area was evident with the majority of the participants living in this area due to the nature of the area. Involving lifestyle block landholders in conservation management would require programmes to be available to them to reduce the barriers that are currently stopping them. Community based programmes that connect the landowners and utilises the various knowledge already amongst them would be beneficial in this area due to the variety of knowledge of the landowners. In addition, policies that provide labour support to landowners for planting, weeding and pest control would be beneficial. There is a strong sense of kaitiakitanga (guardianship) towards the Waimea Inlet from the landowners and this could form the basis of extending conservation from mainly public areas onto conservation land.

7.2.1 Habitat Planting

Whilst the study showed an increase in tree/bush cover it also showed the vegetation cover was more dispersed. In addition, on site inspections show some of the tree/bush areas contained exotic species that were potentially not conducive to the desired ecosystem.

Currently in this area there are a number of volunteer conservation groups active on the peninsulas where this study took place. The largest is run by the Tasman Environment Trust, a trust who implements a number of conservation measures around the Tasman region of New Zealand. The majority of the conservation measures so far have been on public land with some private land being included. This study shows that the motivation for conservation is high in small landholders but that they feel there are barriers in knowledge, time and labour. Different strategies are needed other than those employed with productive landowners. Overseas policies with devices such as peer-mentoring programs and support for landowners to establish their own small native plant nurseries or to have local community nurseries (i.e. supplying seeds, volunteering labour), have been identified as ways to help to increase small-acreage landowners' forest management interests, knowledge, skills and activity. (Meadows et al, 2018).

Currently private landowners have guides that can be accessed for suitable vegetation to promote conservation in this area. There are also volunteer groups in action in the area, however they are limited by funding. The results of the survey showed landowners were time poor and therefore hesitant to participate with volunteer groups as the perception was

that they would be expected to join the groups and do a lot of planting in the area. If the landowners were aware that planting groups would plant on their land without any commitment from the landowner to other plantings it may open up new areas on private land to connect to existing plantings.

The land cover whilst showing an increase in tree/bush cover showed more dispersal and policies aimed at corridors and making connections between the different landowners could be helpful. In addition community shared knowledge and physical labour help would benefit private landowners.

The existing volunteer planting programmes operating in the area have shown positive results in planting success and a resultant increase in wildlife. Along the estuary it has been estimated that less than 0.25% of terrestrial forest remains within 700m of the Waimea Inlet (Scharkard and Melville, 2019).

Landowners also had a mixture of awareness of what to plant in the area and where to source plants. Whilst this information is available from Council and the Department of Conservation the fact that landowners were not aware of it shows more education is required in this area.

Acting in a local manner with clear intentions and easy to find information would be beneficial to the biodiversity of the area. For example knowing where to get locally sourced seeds and

plants, and the exchange of knowledge and time would benefit conservation efforts in the area. This would enable a more cohesive conservation programme that could create corridors linking the patches of vegetation. In addition it would minimise some of the barriers identified such as the lack of physical ability to carry out the work or the seeming complexity of the task.

Programmes that encourage collaboration could help with the lack of time and ability to perform the physical work that has been identified in this study. By connecting the different parts of the community there can be sharing of different physical abilities and knowledge.

Overseas policies using strategies such as peer-mentoring programs and support for landowners to establish their own small native plant nurseries or to have local community nurseries (i.e. supplying seeds, volunteering labour), have been identified as ways to help to increase small-acreage landowners' forest management interests, knowledge, skills and activity. (Meadows et al, 2018).

7.2.2 Pest Control

The survey showed a large number of private landowners were already doing some form of pest control. There is an active pest control scheme in the area that some landowners were involved in with traps provided for their property. However, it was noted that a barrier to this

was the ability to physically access the pest traps when in amongst vegetation such as gorse or on steep parts of the property. Other landowners were not aware of a pest control scheme but undertook their own pest control. As a number of landowners were older or didn't have the knowledge for pest control the existing scheme could be extended to include monitoring and emptying of traps where landowners were unable to do this. Again shared knowledge of possible pests and control measures between the community would help to keep pest numbers down.

7.2.3 Weed Control

It is recommended that knowledge and education of weed control be readily available in the area as some noxious weeds such as agapanthus were seen to be planted in gardens in the study area. Again, some landowners noted that they struggled with the knowledge and/or time to control weeds and a community approach to this would be beneficial towards conservation. Weed control undertaken with native planting would ensure native plants are not competing with weeds for sunlight, water and nutrients. This could be something the local groups extend into or provide knowledge of local landowners.

7.2.4 Monetary Incentives

There was no evidence that the cost of conservation was a barrier to private landowners. Programmes such as the government's Trees that Count programme provide trees on

successful application to landowners. However, this study showed that a greater barrier was the time and physical ability to plant rather than the cost of trees. Programmes that provide free labour for planting, weed control and pest control would be more enabling in the study area than free plants.

7.3 Evaluation of Research Methods

The research methods used in this study were suitable for the timeframe and resources available.

Given more time and resources the GIS component of this study would have encompassed the region to gain a better understanding of land cover change at a regional level. In addition more technical knowledge could have been used to map land cover from the aerials with more than one person visually looking at the land cover areas to provide a more accurate map.

In addition, if more time was intended or a larger team with more resources was available the methods would be slightly changed. Using a larger case study area such as the catchment of the Waimea Inlet or the Tasman Region would have provided a wider variety of landowners to participate and a greater number of participants in the survey. It could have also included horticultural and agricultural landowners who would bring a differing knowledge and skill set that wasn't present in this research. This would give a larger

overview that would have better represented the catchments or region and provided opportunities to see larger community patterns.

A larger study area would also have meant a larger population size for the survey and this would have statistically provided more general results that could be more readily applied to the wider population.

7.4 Recommendations for Future Research

While this study mapped land cover changes from aerials for the study area and looked at enablers, barriers and motivators of private landowners it did have limited resources and a limited timeframe. Further study of a larger area around the Waimea Inlet mapping land cover change over time from aerial photos would provide a larger picture of land cover change affecting the Waimea Inlet. An even larger regional land cover change would provide more detail to the patterns of change going on in an area of New Zealand that is experiencing reasonably high population growth.

Future research into private landowners of lifestyle blocks on a larger scale in New Zealand would provide more detail into national policies and the ability to utilise these lifestyle blocks for conservation. A number of policies within New Zealand currently focus on agricultural and horticultural land and the ability to include lifestyle blocks would provide a larger catchment wide strategy for conservation while taking some pressure off productive land to be used for conservation.

7.5 Overall Summary

This research was undertaken to address the gap of knowledge of land use change into lifestyle blocks in a rural area alongside an estuary. It provides information on the barriers, enablers and motivations of these private lifestyle block owners which can provide information to ensure policies and conservation work in this area is targeted and aligned to the values of landowners. By involving more private lifestyle block owners in conservation efforts native bush areas can be connected providing more habitat opportunities and also enhancing ecosystem services in the larger area. Government controlled conservation areas in New Zealand do not cover all ecosystems and large areas of New Zealand are being converted to lifestyle blocks making the understanding of these landowners a great benefit to policy makers.

There is the potential for significant conservation measures to be undertaken of private lifestyle blocks throughout New Zealand. Understanding the patterns of land use change and the actual use of these smaller lifestyle blocks in essential. Effectively managing conservation on private lifestyle blocks is challenging and involves understanding of the landowners themselves. The work done in this research shows clear patterns of land cover and land use changes. It also provides insights into how to engage these landowners and promote conservation on private lifestyle properties.

References

Abbasnezhad, B., & Abrams, J. B. (2025). Are prevailing policy tools effective in conserving ecosystem services under individual private tenure? Challenges and policy gaps in a rapidly urbanizing region. Trees, Forests and People, 19.

Andrew, R., & Dymond, J. (2013). Expansion of lifestyle blocks and urban areas onto high-class land: an update for planning and policy. Journal of the Royal Society of New Zealand, 43(3), 128-140.

Andrew, R., & Dymond, J. (2013). Expansion of lifestyle blocks and urban areas onto high-class land: an update for planning and policy. Journal of the Royal Society of New Zealand, 43(3), 128-140.

Assaf, C., Adams, C., Ferreira, F. F., & França, H. (2021). Land use and cover modeling as a tool for analyzing nature conservation policies – A case study of Juréia-Itatins. Land Use Policy, 100, 104895.

Balkanlou, K. R., Müller, B., Cord, A. F., Panahi, F., Malekian, A., Jafari, M., & Egli, L. (2020). Spatiotemporal dynamics of ecosystem services provision in a degraded ecosystem: A

systematic assessment in the Lake Urmia basin, Iran. Science of The Total Environment, 716.

Balukas, J. A., Bell, K. P., & Bauer, D. M. (2019). Classifying private landowners to improve understanding of management decisions and conservation opportunities in urbanizing forested landscapes. Journal of Environmental Management, 232, 751-758.

Bastian, C. T., Coatney, K. T., Mealor, R. D., Taylor, D. T., & Meiman, P. J. (2014). Priority of nature versus finances in land management attitudes of rural exurban landowners. Landscape and Urban Planning, 127, 65-74.

Bethlehem, J. (2010). Selection Bias in Web Surveys. International Statistical Review, 78(2), 161-188.

Briassoulis, H. (2020). Analysis of land use change: theoretical and modelling approaches. 2nd edition. Edited by Scott Loveridge and Randall Jackson. WVU Research Repository, 2020.

Butler, J. (2020). Evaluation of the Coastal Tasman Area and the Rural 3 Zone. Tasman Resource Management Plan Efficiency and Effectiveness Evaluation. Tasman District Council. www.tdc.govt.nz.

Calbi, M., Clerici, N., Borsch, T., & Brokamp, G. (2020). Reconstructing Long Term High Andean Forest Dynamics Using Historical Aerial Imagery: A Case Study in Colombia. Forests, 11(8), pg788.

Campos, C., Berthelsen, A., Gower, F., Floerl, L., Morrisey, D., & Gillespie, P. (2022). Long-term monitoring indicates no adverse effects to intertidal habitats from biosolids applications onto an adjacent coastal forestry plantation. 10.21203/rs.3.rs-1768252/v1. (preprint).

Carr-Cornish, S., & Hall, N. (2016). A case study of farming in Australias high rainfall zone: Exploring past and future potential farming intensification and biodiversity management. Australasian Journal of Environmental Management, 23(1), 21-35.

Cervelli, E., & Pindozzi, S. (2022). The Historical Transformation of Peri-Urban Land Use Patterns, via Landscape GIS-Based Analysis and Landscape Metrics, in the Vesuvius Area. Applied Sciences, 12(5), 2442.

Cieraad, Ellen & Walker, Susan & Price, Robbie & Barringer, James. (2015). An updated assessment of indigenous cover remaining and legal protection in New Zealand's land environments. New Zealand Journal of Ecology. 39.Claassens, L., Barnes, R. S. K., Wasserman, J., Lamberth, S. J., Miranda, N. A. F., van Niekerk, L., & Adams, J. B. (2020).

Knysna Estuary health: ecological status, threats and options for the future. African Journal of Aquatic Science, 45(1-2), 65-82.

Cortés Capano, G., Toivonen, T., Soutullo, A., & Di Minin, E. (2019). The emergence of private land conservation in scientific literature: A review. Biological Conservation, 237, 191-199.

Cortés-Capano, G., Hanley, N., Sheremet, O., Hausmann, A., Toivonen, T., Garibotto-Carton, G., Soutullo, A., Di Minin, E. (2021). Assessing landowners' preferences to inform voluntary private land conservation: The role of non-monetary incentives. Land Use Policy, 109.

Cousins, S. A. O. (2001). Analysis of land-cover transitions based on 17th and 18th century cadastral maps and aerial photographs. Landscape Ecology, 16(1), 41-54.

Cross, S. L., Cross, A. T., Merritt, D. J., Dixon, K. W., & Andersen, A. N. (2016). Biodiversity responses to vegetation structure in a fragmented landscape: ant communities in a peri-urban coastal dune system. Journal of Insect Conservation, 20(3), 485-495.

Curran-Cournane, F., Carrick, S., Barnes, M. G., Ausseil, A.-G., Drewry, J. J., Bain, I. A., Golubiewski, N.E., Jones, H.S., Barringer, J. and Morell, L. (2023). Cumulative effects of fragmentation and development on highly productive land in New Zealand. New Zealand Journal of Agricultural Research, 1-24.

Daily, G. C. S. A., Ehrlich, P., Goulder, L., Lubchenco, J., Matson, P. A., Mooney, H., . . . Woodwell, G. (1997). Ecosystem services: Benefits supplied to human societies by natural ecosystems. Issues Ecol., 2.

Davidson, R. J. and Moffat, C Robert. (1990). A Report on the Ecology of the Waimea inlet. Published by the Department of Conservation, New Zealand.

Dawson, T. P., Jackson, S. T., House, J. I., Prentice, I. C., & Mace, G. M. (2011). Beyond Predictions: Biodiversity Conservation in a Changing Climate. Science, 332(6025), 53-58.

Department of Conservation. About Estuaries. Retrieved from https://www.doc.govt.nz/nature/habitats/estuaries/about-estuaries/

Department of Conservation (2020). Te Mana o te Taiao - Aotearoa New Zealand Biodiversity Strategy 2020. Retrieved from https://www.doc.govt.nz/nature/biodiversity/te-mana-o-te-taiao-aotearoa-new-zealand-biodiversity-strategy-2020/aotearoa-new-zealand-biodiversity-strategy

Department of Conservation (2015). Waimea Inlet Restoration. Published by Department of Conservation, Motueka Office. Retrieved from https://www.doc.govt.nz/globalassets/documents/our-work/waimea-inlet-restoration-resource.pdf

Diamond, J. M., & Veitch, C. R. (1981). Extinctions and introductions in the New Zealand avifauna: cause and effect? Science, 211(4481), 499-501.

Drescher, M. (2014). What is it like to take care of the land? Toward an understanding of private land conservation. Rural Society, 23(2), 117-132.

Drury, R., Homewood, K., & Randall, S. (2011). Less is more: the potential of qualitative approaches in conservation research. Animal conservation, 14(1), 18-24.

Dudley, B. D., R. Burge, O., Plew, D., & Zeldis, J. (2020). Effects of agricultural and urban land cover on New Zealand's estuarine water quality. New Zealand Journal of Marine and Freshwater Research, 54(3), 372-392.

Dudley, B. D., R. Burge, O., Plew, D., & Zeldis, J. (2020). Effects of agricultural and urban land cover on New Zealand's estuarine water quality. New Zealand Journal of Marine and Freshwater Research, 54(3), 372-392.

Dudley, B. D., R. Burge, O., Plew, D., & Zeldis, J. (2020). Effects of agricultural and urban land cover on New Zealand's estuarine water quality. New Zealand Journal of Marine and Freshwater Research, 54(3), 372-392.

Dudley, B. D., R. Burge, O., Plew, D., & Zeldis, J. (2020). Effects of agricultural and urban land cover on New Zealand's estuarine water quality. New Zealand Journal of Marine and Freshwater Research, 54(3), 372-392.

Dymond, J. R., Shepherd, J. D., Newsome, P. F., & Belliss, S. (2017). Estimating change in areas of indigenous vegetation cover in New Zealand from the New Zealand Land Cover Database (LCDB). New Zealand Journal of Ecology, 41(1), 56-64.

Dymond, J. R., Shepherd, J. D., Newsome, P. F., Gapare, N., Burgess, D. W., & Watt, P. (2012). Remote sensing of land-use change for Kyoto Protocol reporting: the New Zealand case. Environmental Science & Policy, 16, 1-8.

Elliott, M., & Whitfield, A. K. (2011). Challenging paradigms in estuarine ecology and management. Estuarine, Coastal and Shelf Science, 94(4), 306-314.

Environment, M. f. t. (2010). New Zealand Coastal Policy Statement. New Zealand Government Retrieved from https://environment.govt.nz/acts-and-regulations/national-policy-statements/new-zealand-coastal-policy-statement

Ettehadi Osgouei, P., Sertel, E., & Kabadayı, M. E. (2022). Integrated usage of historical geospatial data and modern satellite images reveal long-term land use/cover changes in Bursa/Turkey, 1858–2020. Scientific Reports, 12(1), 9077.

Fraser, P. L., Ewers, R. M., & Cunningham, S. (2014). The ecological consequences of habitat loss and fragmentation in New Zealand and Australia. Austral Ark: The State of Wildlife in Australia and New Zealand, 45.

Feilding, N., Lee, R., & Blank G. (2017). The SAGE Handbook of Online Research Methods. Second Edition. Published by SAGE Publications, London.

Gooden, J., & Sas-Rolfes, M. (2020). A review of critical perspectives on private land conservation in academic literature. Ambio, 49(5), 1019-1034.

Greiner, R., Patterson, L., & Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices by farmers. Agricultural Systems, 99(2), 86-104.

Hoque, M. Z., Cui, S., Islam, I., Xu, L., & Tang, J. (2020). Future Impact of Land Use/Land Cover Changes on Ecosystem Services in the Lower Meghna River Estuary, Bangladesh. Sustainability, 12(5).

Hualin Xu, K. L., Tianzhu Ning, Gu Huang, Qianmei Zhang, Yuelin Li, Mengqi Wang, Yiming Fan, Weili an, Lingbo Ji, Qinfeng Guo & Hai Ren. (2022). Environmental remediation promotes the restoration of biodiversity in the Shenzhen Bay Estuary, South China. Ecosystem Health and Sustainability, 8.

Hurst, Z., & Kreuter, U. (2021). Place-Based Identities of Landowners: Implications for Wildlife Conservation. Society & Natural Resources, 34(5), 659-680.

Iftekhar, M. S., Tisdell, J. G., & Gilfedder, L. (2014). Private lands for biodiversity conservation: Review of conservation covenanting programs in Tasmania, Australia. Biological Conservation, 169, 176-184.

Ikutegbe, V., Gill, N., & Klepeis, P. (2015). Same but different: sources of natural resource management advice for lifestyle oriented rural landholders. Journal of Environmental Planning and Management, 58(9), 1530-1543.

Law, R., Whitehead, B., Cavanagh, J., Ardo, J., Harmsworth, G., Harris, L. (2024) Deliverable 8: Land Use Information System – Land Use Classification Framework: Final

Report. Manaaki Whenua – Landcare Research prepared for Ministry for the Environment. Contract Report: LC4488.

McAloon, J. (2009). landownership: landownership from the 1950s. Te Ara – the Encyclopaedia of New Zealand. Retrieved from www.teara.govt.nz/en/land-ownership/7

Jung, N. W., Lee, G.-h., Dellapenna, T. M., Jung, Y., Jo, T.-C., Chang, J., & Figueroa, S. M. (2024). Economic Development Drives Massive Global Estuarine Loss in the Anthropocene. Earth's Future, 12(4), e2023EF003691.

Kam, H., Metternicht, G., Baumber, A., & Cross, R. (2019). Engaging absentee landholders in ecosystem service delivery in south-eastern Australia. Ecosystem services, 39, 100988.

Kamal, S., Grodzińska-Jurczak, M., & Brown, G. (2015). Conservation on private land: a review of global strategies with a proposed classification system. Journal of Environmental Planning and Management, 58(4), 576-597.

Kauneckis, D., & York, A. M. (2009). An Empirical Evaluation of Private Landowner Participation in Voluntary Forest Conservation Programs. Environmental Management, 44(3), 468-484.

Kearney, S. G., Carwardine, J., Reside, A. E., Adams, V. M., Nelson, R., Coggan, A., . . . Watson, J. E. M. (2022). Saving species beyond the protected area fence: Threats must be managed across multiple land tenure types to secure Australia's endangered species. Conservation Science and Practice, 4(3), e617.

Langhans, S. D., Neilson, A., & Schallenberg, M. (2022). Cluster analysis reveals latent structure in stakeholder interests relevant to the management of Blueskin Bay estuary, Otago, Aotearoa New Zealand. New Zealand Journal of Marine and Freshwater Research, 56(3), 531-552.

Land Information New Zealand. (2010). Rating Valuation Rules (LINZS30300). Retrieved from Wellington, New Zealand: https://www.linz.govt.nz/regulatory/30300

Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote sensing and image interpretation: John Wiley & Sons.

Liu, W.-C., & Liu, H.-M. (2014). Assessing the Impacts of Sea Level Rise on Salinity Intrusion and Transport Time Scales in a Tidal Estuary, Taiwan. *Water*, *6*(2), 324–344.

Luby, I. H., Miller, S. J., & Polasky, S. (2022). When and where to protect forests. Nature, 609(7925), 89-93.

Macinnis-Ng, C., McIntosh, A. R., Monks, J. M., Waipara, N., White, R. S. A., Boudjelas, S., . . . Peltzer, D. A. (2021). Climate-change impacts exacerbate conservation threats in island systems: New Zealand as a case study. Frontiers in Ecology and the Environment, 19(4), 216-224.

Mannan, S. (2018). MPI Study of New Zealand Lifestyle Blocks and Animal Welfare. (MPI Information - Paper No: 2018/03).

Martin, V. Y. (2019). Four Common Problems In Environmental Social Research Undertaken by Natural Scientists. BioScience, 70(1), 13-16. doi:10.1093/biosci/biz128

Maseyk, F. J. F., Small, B., Henwood, R. J. T., Pannell, J., Buckley, H. L., & Norton, D. A. (2021). Managing and protecting native biodiversity on-farm – what do sheep and beef farmers think? New Zealand Journal of Ecology, 45(1), 1-9. Retrieved from https://www-jstor-org.ezproxy.massey.ac.nz/stable/27041251

McDowell, R., Dils, R. M., Collins, A., Flahive, K., Sharpley, A., & Quinn, J. (2015). A review of the policies and implementation of practices to decrease water quality impairment by phosphorus in New Zealand, the UK, and the US. Nutrient Cycling in Agroecosystems, 104.

Meadows, J., Emtage, N., & Herbohn, J. (2014). Engaging Australian small-scale lifestyle landowners in natural resource management programmes - Perceptions, past experiences and policy implications. Land Use Policy, 36, 618-627.

Meadows, J., Herbohn, J., & Emtage, N. (2013). Supporting Cooperative Forest Management among Small-Acreage Lifestyle Landowners in Southeast Queensland, Australia. Society and Natural Resources, 26(7), 745-761.

Megan McKenna, M. R., Richard Le Heron. (1998). Sustaining the Fruits of Labour: A comprehensive localities analysis of the integrated fruit production programme in New Zealand's apple industry. Journal of Rural Studies, 14(4), 393-409.

Ministry for the Environment. (2021,). How Land is Used in New Zealand. Retrieved from https://environment.govt.nz/facts-and-science/land/how-land-is-used-in-new-zealand/#:~:text=about%20our%20land-,Land%20use%20in%20New%20Zealand,used%20for%20agriculture%20and%20forestry.&text=8%20per%20cent%20is%20exotic,%2Dnative%20forest%20including%20forestry. Accessed 26 October 2021

Ministry for the Environment. (2024). LUCAS Land Use Map

Ministry for Primary Industries. (29 October 2024). One Billion Trees Programme. Retrieved from https://www.mpi.govt.nz/forestry/funding-tree-planting-research/one-billion-trees-programme/

Mitchell, H. a. M., J. (2004). Te Tau Ihu o Te Waka: A History of Maori of Nelson and Marlborough (Vol. I). Wellington, NZ: Huia Publishers in association with the Wakatu Incorporation.

Molloy, L. (2015). Protected areas - New Zealand's protected areas. Retrieved from http://www.TeAra.govt.nz/en/protected-areas/page-1

Monks, A., Hayman, E., & Walker, S. (2019). Attrition of recommended areas for protection: clearance of ecologically significant vegetation on private land. *New Zealand Journal of Ecology*, *43*(2), 1–11.

Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. Conservation Biology, 28(5), 1167-1177.

Moon, K., Blackman, D. A., Adams, V. M., Colvin, R. M., Davila, F., Evans, M. C., . . . Sandbrook, C. (2019). Expanding the role of social science in conservation through an engagement with philosophy, methodology, and methods. Methods in Ecology and Evolution, 10(3), 294-302.

Mora, C., & Sale, P. F. (2011). Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. Marine Ecology Progress Series, 434, 251-266.

Muhammad, R., Zhang, W., Abbas, Z., Guo, F., & Gwiazdzinski, L. (2022). Spatiotemporal Change Analysis and Prediction of Future Land Use and Land Cover Changes Using QGIS MOLUSCE Plugin and Remote Sensing Big Data: A Case Study of Linyi, China. Land, 11(3), 419.

Mumaw, L., & Bekessy, S. (2017). Wildlife gardening for collaborative public–private biodiversity conservation. Australasian Journal of Environmental Management, 24(3), 242-260.

Mumaw, L., & Bekessy, S. (2017). Wildlife gardening for collaborative public–private biodiversity conservation. Australasian Journal of Environmental Management, 24(3), 242-260.

National Library of New Zealand Cartographic Collection. Retrieved from http://natlib.govt.nz/a-z/cartographic-collection.

Nelson City Council, T. D. C. (5/10/2020). Waimea Inlet Management Strategy 2020. Retrieved from http://www.nelson.govt.nz/council/plans-strategies-policies/strategies-plans-policies-reports-and-studies-a-z/waimea-inlet-management-strategy/

Waimea Inlet Management Strategy, (2010).

Ngāti Rārua Ātiawa Iwi Trust. (2018). Te Moana the Legacy of our Taonga. Retrieved from https://www.nrait.co.nz/our-owners/te-whanake/te-moana-the-legacy-of-our-taonga

Nicholas, W. (2022). Research Methods - the basics (Third Edition ed.). London and New York: Routledge Taylor & Francis Group.

North, M. (2105). Report 02A:Moutere Ecological District – Northern Sector.

Norton, D. A., Butt, J., & Bergin, D. O. (2018). Upscaling restoration of native biodiversity: A New Zealand perspective. Ecological Management & Restoration, 19(S1), 26-35.

Norton, D. A., Suryaningrum, F., Buckley, H. L., Case, B. S., Cochrane, C. H., Forbes, A. S., & Harcombe, M. (2020). Achieving win-win outcomes for pastoral farming and biodiversity conservation in New Zealand. New Zealand Journal of Ecology, 44(2), 1-9.

O'Dea, R. E., Lagisz, M., Jennions, M. D., Koricheva, J., Noble, D. W., Parker, T. H., . . . Moher, D. (2021). Preferred reporting items for systematic reviews and meta-analyses in ecology and evolutionary biology: a PRISMA extension. Biological Reviews, 96(5), 1695-1722.

O'Donnell, C., & Robertson, H. (2016). Changes in the status and distribution of Australasian bittern (Botaurus poiciloptilus) in New Zealand, 1800s−2011. Notornis, 63, 152-166.

Pannell, D. J., Roberts, A. M., Park, G., & Alexander, J. (2013). Improving environmental decisions: A transaction-costs story. Ecological Economics, 88, 244-252.

Pannell, D. J., & Wilkinson, R. (2009). Policy mechanism choice for environmental management by non-commercial “lifestyle” rural landholders. Ecological Economics, 68(10), 2679-2687.

Pannell, J. L., Buckley, H. L., Case, B. S., & Norton, D. A. (2021). The significance of sheep and beef farms to conservation of native vegetation in New Zealand. New Zealand Journal of Ecology, 45(1), 1-11.

Patton, M. Q. (2002). Qualitative Evaluation and Research Methods (Third Edition ed.): Sage Publications, Newbury Park, CA.

Paul, S., & Nagendra, H. (2015). Vegetation change and fragmentation in the mega city of Delhi: Mapping 25 years of change. Applied Geography, 58, 153-166.

Paul, S., & Nagendra, H. (2015). Vegetation change and fragmentation in the mega city of Delhi: Mapping 25 years of change. Applied Geography, 58, 153-166.

Pearson, D. (2021). Lifestyle Properties, Ecosystem Services, and Biodiversity Protection in Peri-Urban Aotearoa–New Zealand: A Case Study from Peri-Urban Palmerston North. Land, 10(12), 1345.

Polyakov, M., Edwards, P., Kaine, G., Burton, M., & Stahlmann-Brown, P. (2024). Evaluating incentives to encourage native afforestation on private lands in Aotearoa–New Zealand. Landscape and Urban Planning, 244, 104979.

Polyakov, M., Pannell, D. J., Pandit, R., Tapsuwan, S., & Park, G. (2013). Valuing environmental assets on rural lifestyle properties. Agricultural and Resource Economics Review, 42(1), 159-175.

Potter, B. (2001) Estuaries. A resource prepared for NIWA. Retrieved from https://niwa.co.nz/coasts/estuaries/estuaries#valueecol

Qi, Y., Lian, X., Wang, H., Zhang, J., & Yang, R. (2020). Dynamic mechanism between human activities and ecosystem services: A case study of Qinghai lake watershed, China. Ecological Indicators, 117, 106528.

Rabalais, N. N., Turner, R. E., Díaz, R. J., & Justić, D. (2009). Global change and eutrophication of coastal waters. ICES Journal of Marine Science, 66(7), 1528-1537.

Recanatesi, F. (2015). Variations in land-use/land-cover changes (LULCCs) in a peri-urban Mediterranean nature reserve: the estate of Castelporziano (Central Italy). Rendiconti Lincei, 26(3), 517-526.

Robertson, B. P., & Savage, C. (2021). Thresholds in catchment nitrogen load for shifts from seagrass to nuisance macroalgae in shallow intertidal estuaries. Limnology and Oceanography, 66(4), 1353-1366.

Rodrigues-Eklund, G., Hansen, M. C., Tyukavina, A., Stehman, S. V., Hubacek, K., & Baiocchi, G. (2021). Sample-Based Estimation of Tree Cover Change in Haiti Using Aerial Photography: Substantial Increase in Tree Cover between 2002 and 2010. Forests, 12(9), 1243.

Rust, N. A., Abrams, A., Challender, D. W., Chapron, G., Ghoddousi, A., Glikman, J. A., . . . Said, A. (2017). Quantity does not always mean quality: The importance of qualitative social science in conservation research. Society & Natural Resources, 30(10), 1304-1310.

Salt Ecology and Tasman District Council. (2022). Waimea Inlet Estuary Monitoring Programme. Published by Tasman District Council. https://tdc-production.catalystone.cove.catalyst.net.nz/my-region/environment/environmental-management/estuaries/waimea-inlet

Schuckard, R. & Melville, D. S. (2019). Coastal Birds of the Tasman/Nelson Region - A review of current information. Report prepared for Tasman District Council and Nelson City Council.

Selinske, M. J., Cooke, B., Torabi, N., Hardy, M. J., Knight, A. T., & Bekessy, S. A. (2017). Locating financial incentives among diverse motivations for long-term private land conservation. Ecology and Society, 22(2).

Selinske, M. J., Howard, N., Fitzsimons, J. A., Hardy, M. J., Smillie, K., Forbes, J., . . . Knight, A. T. (2019). Monitoring and evaluating the social and psychological dimensions that contribute to privately protected area program effectiveness. Biological Conservation, 229, 170-178.

Simmons, B. A., Archibald, C. L., Wilson, K. A., & Dean, A. J. (2020). Program Awareness, Social Capital, and Perceptions of Trees Influence Participation in Private Land Conservation Programs in Queensland, Australia. Environmental Management, 66(3), 289-304.

Sise, J. (2022). Lifestyle Block Analysis: M02 (2024/23). A report by AbacusBio Ltd prepared for the Ministry of Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/61048-Lifestyle-block-analysis

Sneegas, G., Beckner, S., Brannstrom, C., Jepson, W., Lee, K., & Seghezzo, L. (2021). Using Q-methodology in environmental sustainability research: A bibliometric analysis and systematic review. Ecological Economics, 180, 106864.

Snelder, T. H., Larned, S. T., & McDowell, R. W. (2018). Anthropogenic increases of catchment nitrogen and phosphorus loads in New Zealand. New Zealand Journal of Marine and Freshwater Research, 52(3), 336-361.

Spyra, M., Kleemann, J., Calò, N. C., Schürmann, A., & Fürst, C. (2021). Protection of peri-urban open spaces at the level of regional policy-making: Examples from six European regions. Land Use Policy, 107, 105480.

Statistics New Zealand. (8 December 2020). National Population Projections: 2020 (base) - 2073. Retrieved from https://www.stats.govt.nz/information-releases/national-population-projections-2020base2073

Statistics New Zealand. (2021). Land Fragmentation. Retrieved from https://www.stats.govt.nz/indicators/land-fragmentation

Sun, X., Crittenden, J. C., Li, F., Lu, Z., & Dou, X. (2018). Urban expansion simulation and the spatio-temporal changes of ecosystem services, a case study in Atlanta Metropolitan area, USA. Science of The Total Environment, 622-623, 974-987.

Sutherland, W. J., Dicks, L. V., Everard, M., & Geneletti, D. (2018). Qualitative methods for ecologists and conservation scientists. Methods in Ecology and Evolution, 9(1), 7-9.

Swaney, D. P., Humborg, C., Emeis, K., Kannen, A., Silvert, W., Tett, P., . . . Henocque, Y. (2012). Five critical questions of scale for the coastal zone. Estuarine, Coastal and Shelf Science, 96, 9-21.

Tang, J., Li, Y., Cui, S., Xu, L., Ding, S., & Nie, W. (2020). Linking land-use change, landscape patterns, and ecosystem services in a coastal watershed of southeastern China. Global Ecology and Conservation, 23, e01177.

Tasman Environmental Trust. Battle for the Banded Rail. Retrieved from https://www.tet.org.nz/projects/battle-for-the-banded-rail/

Upadhyay, R. K. (2020). Markers for global climate change and its impact on social, biological and ecological systems: A review. American Journal of Climate Change, 9(03), 159.

Taylor, M., Davison, A., & Harwood, A. (2025). Transdisciplinary pathways for wildlife conservation: A method for navigating socio-ecological systems on private lands. People and Nature.

Tedesco, A. M., Brancalion, P. H., Hepburn, M. L. H., Walji, K., Wilson, K. A., Possingham, H. P., . . . Perez-Hammerle, K.-V. (2023). The role of incentive mechanisms in promoting forest restoration. Philosophical Transactions of the Royal Society B, 378(1867).

Tehrany, M. S., Pradhan, B., & Jebuv, M. N. (2014). A comparative assessment between object and pixel-based classification approaches for land use/land cover mapping using SPOT 5 imagery. Geocarto International, 29(4), 351-369.

The Prow. (February 10 2025). Retrieved from www.theprow.org.nz/enterprise/orchards-of-the-nelson-region/

Thrush, S. F., Hewitt, J. E., Gladstone-Gallagher, R. V., Savage, C., Lundquist, C., O'Meara, T., . . . Douglas, E. J. (2021). Cumulative stressors reduce the self-regulating capacity of coastal ecosystems. Ecological Applications, 31(1), e02223.

Thrush, S. F., Townsend, M., Hewitt, J. E., Davies, K., Lohrer, A. M., Lundquist, C., . . . Dymond, J. (2013). The many uses and values of estuarine ecosystem. Ecosystem services in New Zealand–conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand, 226-237.

Topp, E. N., Loos, J., & Martín-López, B. (2021). Decision-making for nature's contributions to people in the Cape Floristic Region: the role of values, rules and knowledge. Sustainability Science.

Topp, E. N., Loos, J., & Martín-López, B. (2021). Decision-making for nature's contributions to people in the Cape Floristic Region: the role of values, rules and knowledge. Sustainability Science.

Torabi, N., Mata, L., Gordon, A., Garrard, G., Wescott, W., Dettmann, P., & Bekessy, S. A. (2016). The money or the trees: What drives landholders' participation in biodiverse carbon plantings? Global Ecology and Conservation, 7, 1-11.

Towns, D. R., & Daugherty, C. H. (1994). Patterns of range contractions and extinctions in the New Zealand herpetofauna following human colonisation. New Zealand journal of zoology, 21(4), 325-339.

Urlich, S. C., & Hodder-Swain, J. L. (2022). Untangling the Gordian knot: estuary survival under sea-level rise and catchment pollution requires a new policy and governance approach. New Zealand Journal of Marine and Freshwater Research, 56(3), 312-332.

Vaddiraju, S. C., Talari, R., Bhavana, K., & Apsana, S. (2023). Predicting the future land use and land cover changes for Saroor Nagar Watershed, Telangana, India, using open-source GIS. Environmental Monitoring & Assessment, 195(12), 1-18.

Valiela, I., & Bowen, J. L. (2002). Nitrogen sources to watersheds and estuaries: role of land cover mosaics and losses within watersheds. Environmental Pollution, 118(2), 239-248.

Van Grieken, M. E., Roebeling, P. C., Bohnet, I. C., Whitten, S. M., Webster, A. J., Poggio, M., & Pannell, D. (2019). Adoption of agricultural management for Great Barrier Reef water quality improvement in heterogeneous farming communities. Agricultural Systems, 170, 1-8.

Van Grieken, M. E., Thomas, C. R., Roebeling, P. C., & Thorburn, P. J. (2013). Integrating economic drivers of social change into agricultural water quality improvement strategies. Agriculture, Ecosystems and Environment, 180, 166-175.

Walliman, N. (2022). Research methods : the basics (Third edition. ed.): Routledge.

Williams, B. A., Archibald, C. L., Brazill-Boast, J., Drielsma, M. J., Thapa, R., Love, J., . . . Rhodes, J. R. (2024). Optimal investments in private land conservation depend more on landholder preferences than climate change. Environmental Research Letters, 19(12).

Williams, E. (2013, 2018). Australasian Bittern. New Zealand Birds Online. Retrieved from www.nzbirdsonline.org.nz

Yin, R. K. (2018). Case study research and applications: design and methods (Sixth edition ed.): Sage Publications Inc.

Young, J. C., Rose, D. C., Mumby, H. S., Benitez-Capistros, F., Derrick, C. J., Finch, T.,Morgans, C. (2018). A methodological guide to using and reporting on interviews in conservation science research. Methods in Ecology and Evolution, 9(1), 10-19.

Zabala, A., Sandbrook, C., & Mukherjee, N. (2018). When and how to use Q methodology to understand perspectives in conservation research. Conservation Biology, 32(5), 1185-1194.

Zhou, P., Huang, J., Robert Gilmore Jr, P., & Hong, H. (2014). Land classification and change intensity analysis in a coastal watershed of Southeast China. Sensors, 14(7), 11640-11658.

Appendix I: Private Land Conservation Survey

Start of Block: Intro and Consent

Q1 Welcome to the Waimea Inlet landowner's biodiversity survey. This survey is part of my Masters of Environmental Management, which I am studying through Massey University. The survey should take under 10 minutes to complete. I am looking at conservation on private land.

The aim of this study is to get the views of private landowners on how they feel about undertaking land management practices that might help towards the conservation of native species on the Waimea Inlet.

The results of this survey will be kept anonymous and any reports produced from the results will be presented in such a way as to keep individual landowners anonymous. *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 Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 x 85271, email humanethics@massey.ac.nz*

By clicking the arrow below and continuing with this survey you are confirming that you are willing to take part in this study.

This means that you have read and understand (or have had read to you in your first

language) the details of the study. You have had the details of the study explained to you, any questions you had have been answered to your satisfaction, and you understand that you may ask further questions at any time. You have been given sufficient time to consider whether to participate in this study and you understand participation is voluntary and that you may withdraw from the study at any time.

If you have any questions about the survey or experience any technical difficulties with the survey please contact me Katrina O'Connor on oconnor4321@gmail.com or my supervisor Prof Diane Pearson d.pearson@massey.ac.nz. Please only complete this survey with regard to land near the Waimea Inlet.

_____

_____

_____

_____

_____

End of Block: Intro and Consent

Start of Block: General About You

Q2 Do you live on this property? Do you own it or rent/lease it?

- ○ Own and live here (6)
- ○ Own and live elsewhere (7)
- ○ Rent and live here (8)
- ○ Lease and live here (9)
- ○ Lease and live elsewhere (10)
- ○ Other (11) _____

Q3 How many people live at this residence?

- ○ 1 (4)
- ○ 2 (5)
- ○ 3 (6)
- ○ 4 (7)
- ○ 5 (8)
- ○ 6+ (9)

Q4 What are the approximate ages of the people living at this residence? (click as many as appropriate).

- ☐ 0 - 12 (4)

- [ ] 12 - 15 (5)
- [ ] 15 - 18 (6)
- [ ] 19 - 30 (7)
- [ ] 30 - 50 (8)
- [ ] 50 - 65 (9)
- [ ] 65 + (10)

Q5 What ethnicity are the people living at this address (note you can click more than one)?

- [ ] Maori (please write iwi or tribe below) (4)

_____

- [ ] New Zealand with European descent (5)
- [ ] Asian (6)
- [ ] Pacific Island (7)
- [ ] African (8)
- [ ] European (first generation in NZ) (9)
- [ ] American (10)
- [ ] Other (write below) (11)

_____

Q6 What is the approximate combined income of residents at this property?

- ○ $0 - 40, 000 (1)
- ○ $40,000- 60, 000 (2)
- ○ $60, 000 - 80, 000 (3)
- ○ $80,000 - 100,000 (4)
- ○ $100, 000 + (5)
- ○ Prefer not to say (6)

Q7 Please tell us what you are currently employed as:

_____

Q8 Do you commute to work?

- ○ Yes (1)
- ○ No (2)

Q9 What is the size of this property?

- ○ 0 - 5000 m2 (4)
- ○ 5000 - 10000 m2 (5)
- ○ 10000 - 15000 m2 (6)
- ○ 15000 - 20000 m2 (7)
- ○ 20000 m2 + (8)

Q10 Please indicate the approximate land coverage of the following:

	0 - 20% (1)	20 - 40% (2)	40 - 60% (3)	60 - 80% (4)	80 - 100% (5)
House (4)	☐	☐	☐	☐	☐
Productive Land (5)	☐	☐	☐	☐	☐
Sheds (6)	☐	☐	☐	☐	☐
Native Shrubs (7)	☐	☐	☐	☐	☐

Native Trees (8)	☐	☐	☐	☐	☐
Non-native scrub (9)	☐	☐	☐	☐	☐
Non-native trees (10)	☐	☐	☐	☐	☐
Grass (11)	☐	☐	☐	☐	☐
Other (describe below) (12)	☐	☐	☐	☐	☐
Concrete/Paved area (13)	☐	☐	☐	☐	☐

Q11 How long have you lived here:

- ○ Under 1 Year (4)
- ○ 1 - 2 years (5)
- ○ 2 - 5 years (6)
- ○ 5 - 10 years (7)

- ○ 10 + years (8)

Q12 What do you use for household water supply?

- ○ Private Bore (4)
- ○ Reticulated supply (5)
- ○ Shared bore supply (6)
- ○ Rainwater tank only (7)
- ○ Other (8) _____

Q13 How old is your septic system?

- ○ 0-2 years (4)
- ○ 2-5 years (5)
- ○ 5-10 years (6)
- ○ Over 10 years (7)
- ○ Not sure (8)

Q14 When did you last have your septic system serviced?

- ○ 0-2 years (4)
- ○ 2-5 years (5)
- ○ 5-10 years (6)
- ○ Over 10 years (7)
- ○ Not sure (8)

Q15 Where does your household and hard area stormwater get directed to?

- ○ It doesn't get captured at all (4)
- ○ Captured into a tank and onto land (5)
- ○ Captured and onto the land (6)
- ○ Captured and into the sea (7)
- ○ Other (8) _____

Q16 Have you taken part on any environmental program on your property?

- ○ Yes (1)
- ○ No (2)

Q17 If you answered yes to Q16 please give details below as to the agencies or volunteer groups involved and what was done on your property as well as an approximate date of when the work was done:

_____

End of Block: General About You

Start of Block: Location

Q18 How important are each of the following as reasons for why you own this parcel of land? (1 = Very Unimportant, 5 = Very Important)

	Extremely important	Very important	Moderately important	Slightly important	Not at all important
	0	1	3	4	5
To have a scenic view ()					

To protect nature and biologic diversity ()	
For land investment ()	
To be in the countryside ()	
To be close to town ()	
For productive capacity ()	
For privacy ()	
As a family landholding ()	
For access to recreation ()	
Access to the water ()	
To be around wildlife ()	
For land use ()	
To run a business from ()	

Q19 Please provide any more detail as to why you own this land:

_____

Q20 Rank the following into the order of what you think is the best thing about living by the Waimea Inlet? (1 = best thing)

_____ The native wildlife (1)

_____ The nature around the inlet. (2)

_____ Being close to town. (3)

_____ The views onto the inlet. (4)

_____ The views of the hills. (5)

_____ The productive capacity of the land. (6)

_____ The history of the area. (7)

_____ Easy access to the sea. (8)

_____ The property suits my business. (14)

Q21 Is there anything else that you think should be on the list of the best things about living near the Waimea Inlet?

_____

Q22 What do you think is the worst thing about living near the Waimea Inlet?

_____

Q23 Move the slider as to how you rate the following as important values of the Waimea Inlet? (0 = not important, 5 = very important)

	Not important 0	1	Somewhat important 3	4	Very important 5
Visual Beauty ()					
Cultural Significance ()					
Historical significance ()					
Value to tangata whenua ()					
Recreational values ()					
Unique wildlife ()					

Unique vegetation ()	

Q24 What do you think could be improved around the Waimea Inlet?

_____

End of Block: Location

Start of Block: Land management

Q25 How often do you do the following on your property.

	Most of the time (many times a year)	Most of the time (once a year)	Sometimes (every 2 - 3 years)	Rarely (once every 3 + years)	Never

	0 1 2 3 4
Use sprays for weed control ()	
Physically pull weeds for weed control ()	
Pay an outside business for weed control ()	
Use chemicals for pest control ()	
Trap for pest control ()	
Pay an outside business for pest control ()	
Do any other pest control (specify below) ()	

Q26 Please add any additional information about what you do for weed and pest control on your property:

_____

End of Block: Land management

Start of Block: Barriers

Q27 How much are the following are preventing you from doing more conservation work on your land (0 = Not a problem, 5 = Major problem)

	Not a problem 0 1 3 4 Major problem 5
Financial cost of plants ()	
Financial cost of labour ()	
Need the land for productive purposes ()	
Lack of time ()	
Not knowing what to plant ()	
No desire to do more ()	
Cost of pest control ()	

Q28 What would help you to achieve more conservation work on your property?

_____

End of Block: Barriers

Start of Block: Knowledge

Q29 Rank your knowledge of the following (0 = I know nothing, 5 = I am an expert)

	I nothing	know some things	I know reasonable knowledge	I have a good knowledge	I have a expert	I am an
	0	1	3	4	5	
Native plants ()						
Pest control ()						
Invasive species in this area ()						
Soils ()						

Which native plants are appropriate for your property ()	
Where to plant on your property for biodiversity ()	
Wildlife that exists on your property ()	
Wildlife in the Waimea Inlet ()	

Q30 As part of my study I would like to interview a few landowners. If you would like to take part in an individual interview of about half an hour where you are able to give more detailed information please provide your email address and name below (please note your details will not be associated to your responses in this survey they are purely for me to contact you).

_____

End of Block: Knowledge

Appendix II – Phone Interview Questions

Background Information

1. How long have you lived on this property?
2. What made you move here?

3. Were you nearby before then?

4. Have you seen many changes since you moved here? What have you noticed?

5. How do you use your property? Did you buy it for the use or have you converted it?

6. Has this changed over time?

7. Does your property go down to the sea? Have you noticed any changes in terms of the wildlife?

8. What is your view on the importance of the Waimea Inlet?

9. Did you realise there are internationally recognised endangered species that use the Waimea Inlet?

10. Discussion about some of the birds that use the inlet and whether they have seen them.

Vegetation

11. What type of vegetation do you have (particularly near the sea)?

12. Have you planted on this property? If yes, what?

13. Have you had any help with what to plant on your property?

14. If so, who has helped?

Pest Control

15. Do you notice pests in this area?

16. Do you do any pest control?

17. Have you had any help with pest control? If so, what?

Relationships

18. What available support do you know of?

19. Do you know where to go to get this or where do you think would be easiest to access this information?

20. Have you had anything to do with the volunteer organisations in this area? Battle for the Banded Rail, Waimea Inlet Forum etc.

21. Have you had any dealings with outside agencies who operate in this area (Council, DOC,)?

22. Are there things that could be done in this area to help you with conservation measures?

23. If there was a group you could join to help would you?

24. If you could get cheaper plants would you?

25. What would be the one most effective thing that could be done to help you with more conservation on your land?

26. Would you prefer

a. money for trees,

b. physical help planting or weed control,

c. knowledge of where and what to plant or where to source vegetation?

Appendix III - Flyers

Initial Flyer:

Waimea Inlet Conservation Survey

A study to give landowners a voice. Do you feel that conservation measures on the Waimea Inlet could be less confusing? Please join this independent study to anonymously share your views. Have a say in what you want to help you improve biodiversity on your land.



This survey is part of my Masters of Environmental Management research at Massey University. It is independent from any agencies working in this area. All results will be anonymous and will not mention individual names or identifying factors.

My name is Katrina O'Connor and I am based in Nelson. I hope to find ways to make conservation easier on private land. To help with this I am researching the land around the Waimea Inlet. I would love for you to answer my survey and let me know what you think about conservation on your land. Click on the QR code or enter the web address to access the survey. It should only take up to 10 minutes to complete.

Follow Up Flyer:

Waimea Inlet Conservation Survey

My name is Katrina O'Connor and I am completing a study on landowner's views around the Waimea Inlet for my Masters at Massey University. I need more participates in this survey to make the research viable.

r click on the QR code:

Please complete the survey by 18 July 2021

Please contact me at oconnor4321@gmail.com if you have any questions about this or can't access the survey.
Note: this research complies with Massey University's Code of Ethics for Research.

Appendix IV – Site Photos



Photo 1: The south-eastern part of the Bronte Peninsula showing a mix of native and exotic vegetation.



Photo 2: The western part of the Hoddy Peninsula with olive groves and a mixture of trees.



Photo 3: The western part of Hoddy Peninsula with a range of native and exotic trees and shrubs.



Photo 4: A garden with a mix of native and exotics on the eastern part of the Bronte Peninsula



Photos 5 and 6: The north western part of Hoddy Peninsula with large areas of grass.

