

Indigenous governance, GIS, and the context-driven modelling of values, concerns and seasonal uses of Country within the Yawuru estate

by

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Candidate's Declaration

I, Sandra Potter, declare that this thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge, it contains no material previously published or written by another person, except where due reference is made in the text. This thesis does not exceed 100,000 words in length, exclusive of footnotes, tables, figures and appendices.



Sandy Potter

Date: 26 July 2020

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Abstract

Geographic Information Systems (GIS) which capture, store, query, analyse and display geospatial data (Chang, 2016:1) have begun to play a key role in facilitating indigenous governance and land claims across the globe. This thesis examines the use of GIS as part of broader Indigenous efforts to achieve self-determination in relation to Australia's native title system. It uses settler colonial theory and Pratt's conception of the contact zone (Pratt, 1991) to frame context-grounded GIS techniques for grappling with entity-based spatial narratives in settler states.

The research presented is part of a GIS partnership between the Yawuru people of Broome, Western Australia and the Fenner School of Environment and Society, The Australian National University (ANU). It draws on Indigenous methodologies, critical Geographic Information Science (GIScience) and qualitative GIS to extend on previous approaches to fuzzy index modelling and produce collective models of values, concerns, and seasonal uses of landscape for two sites in the Yawuru estate (Potter, 2013; Potter, Doran and Mathews 2016).

This thesis answers four questions:

- I. How can outputs from context-grounded spatial analysis which draws on qualitative analysis and fuzzy logic help support Yawuru governance in a post native title environment?
- II. What do settler colonial theory and Pratt's conception of the contact zone suggest about the likely impacts of this approach and its outputs for Yawuru engagement in a post native title environment? How are these insights contextualised by information drawn from sketch mapping interviews with Yawuru participants? What does this imply for Yawuru governance?
- III. How did this research extend on earlier work modelling values in a Yawuru context? What were the strengths of these extensions? What were their limitations? What implications does this have for adapting, refining, and further contextualising these techniques in future research?
- IV. To what extent can techniques and approaches to spatial analysis developed in this research be transferred beyond the context in which they were created?

This thesis argues that outputs from context-grounded spatial analysis which draw on qualitative analysis and fuzzy logic can support Yawuru governance by supporting negotiations over boating facilities at Entrance Point and Reddell Beach and informing access management at Crab Creek. It uses settler colonial theory, Pratt's conception of the contact zone, and qualitative analysis of sketch mapping interviews to highlight the strength of Yawuru organisations work to

retain close control of Yawuru GIS-based representations and employ GIS as one of many approaches to supporting governance following native recognition.

This thesis also examines how a context-grounded approach to GIS has extended on previous work and produced technical innovations, including new qualitative weighting and directional buffering techniques. It highlights the limitations of these techniques and recognises the challenges of combining Indigenous knowledges with Western science through GIS. This thesis contends that, with critical respect for context, it is possible to transfer elements of this research to support governance and decision making within and beyond the Yawuru estate. It concludes by making recommendations for policy and future research in this space.

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List of acronyms and abbreviations

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
ANU	The Australian National University
BT	Broome Town
CC	Crab Creek
CEO	Chief Executive Officer
COAG	Council of Australian Governments
Cth	Commonwealth
DPAW	West Australian Government Department of Parks and Wildlife
Esri	Earth Sciences Research Institute
FCA	Federal Court of Australia
Fenner School	The Fenner School of Environment and Society
GIS	Geographic Information Systems
GIScience	Geographic Information Science
GIScientist	Geographic Information Scientist
GPS	Global Positioning System
ILO	International Labour Organisation
ILUA	Indigenous Land Use Agreement
NAILSMA	North Australian Indigenous Land and Sea Management Alliance Ltd.
NBY	Nyamba Buru Yawuru
NT	Northern Territory
PBC	Prescribed Body Corporate
PGIS	Participatory Geographic Information Systems
RNTBC	Registered Native Title Body Corporate
SCA	Special Control Area
UN General Assembly	United Nations General Assembly
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WA	Western Australia

Yawuru PBC

Yawuru Prescribed Body Corporate

Yawuru RNTBC

Yawuru Registered Native Title Body Corporate

Chapter 1: Introduction

Following centuries of oppression and resistance, the decades since the 1960s have seen increasing government recognition of indigenous peoples’¹ sovereignty, rights and titles to land around the globe (Engle, 2010). As part of this movement, former British settler states including Australia, Canada, Aotearoa/ New Zealand and the United States are making pronounced efforts to respond to indigenous peoples’ claims through varying forms of recognition (Forbes, 1998; Herne, 2001; Porter and Barry, 2015). In turn, indigenous peoples in those states are employing the language of rights and rights-based recognition to reassert self-governing powers (Champagne, 2013; Engle, 2010; Gilbert, 2007; Tauli-Corpuz, 2007). That is, indigenous groups are reclaiming the right to shape their own futures in their own ways (Cornell, 2013). In Australia, it is now more than 25 years since native title was first recognised by the High Court as Eddie Koiki Mabo and others successfully put forward their claim to Mer (Murray Island) in the Torres Strait (National Native Title Tribunal, 2017a).

Today, native title remains one of the principal ways that some Indigenous peoples in Australia, who can demonstrate continuity of connection to Country², are able to assert rights over their customary lands (Jackson, 1996; McKenna, 1995). According to the National Native Title Tribunal, “[n]ative title is the recognition by Australian law that some Indigenous people have rights and interests to their land that come from their traditional laws and customs” (National Native Title Tribunal, 2013). These rights vary from community to community but essentially consist of rights to access land, hunt, fish and gather food or traditional resources for cultural and commercial purposes, to visit and protect important places and sites, and to teach law and custom on Country (Brennan *et al.*, 2015a; National Native Title Tribunal, 2013). Where native title recognition is exclusive, these rights are held as against the whole world (Strelein, 2009).

At the time of writing, exclusive or non-exclusive native title has now been recognised over more than 34.7% of Australia’s land mass³. This percentage continues to increase as part of Indigenous peoples’ dynamic and ongoing fight for recognition. Indeed, as of December 2018, native title has been determined to exist in part or all of 370 determination areas (National Native Title Tribunal, 2018b).

¹ Throughout this thesis, the use of an upper case ‘Indigenous’ in relation to people, peoples, communities, or values refers to the First Peoples of Australia and the Torres Strait Islands, while a lower case ‘indigenous’ refers more generally to the First Peoples, aboriginal peoples, native peoples, or autochthonous peoples of the world. Exceptions are made for Indigenous methodologies and Indigenous knowledges as described later in this thesis.

² In this thesis, following (Rose, 1996:7) the term Country is used to refer to “a place a place that gives and receives life. Not just imagined or represented, it is lived in and lived with. People talk about country in the same way that they would talk about a person: they speak to country... visit country, worry about country, feel sorry for country, and long for country...”. Here, Country is capitalised following Pelizzon and Kennedy (2012).

³ Derived from data from the National Native Title Tribunal (2016a) and the Australian Bureau of Statistics (2016a), based on native title data from August 3rd 2018.

Once their native title is recognised, Indigenous peoples face a host of new administrative challenges and opportunities (Dodson and Smith, 2003). Many of these challenges require them to engage in highly inequitable negotiations which share several key characteristics with Pratt's seminal conception of the "contact zone" – a space where previously separated peoples come into contact and establish relations "involving conditions of coercion, radical inequality, and intractable conflict" (Pratt, 2008:8). With hard work, native title negotiations can sometimes result in significant benefits for Indigenous peoples (Taylor *et al.*, 2014). However, native title recognition also brings considerable risks. These include financial burdens, taxation, and the social fracturing possible when communities are confronted with contentious proposals without veto powers (Yu, 2013b). Such risks and potential benefits require relevant Indigenous governance bodies to engage carefully and strategically following native title recognition.

To date, the academic community has spent considerable energy lauding the advantages and decrying the limitations of native title (Brennan *et al.*, 2015a; Dodson, 1996b; Herne, 2001; Hewitt, 2011; Smith and Morphy, 2007; Vincent, 2017; Wolfe, 2000), describing native title's new governance institutions (Langton, 2015; McGrath *et al.*, 2013; Strelein and Tran, 2007; Weir, 2007), and outlining the governance challenges which face these institutions and Indigenous peoples more generally following a successful native title determination (Barcham, 2013; Bauman *et al.*, 2013a; Bauman *et al.*, 2013b; Storey *et al.*, 2013). Yet, relatively little research has focused on producing practical tools to help with post native title governance (see Austin *et al.*, 2017; Maclean and The Bana Yarralji Bubu Inc., 2015; Moorcroft *et al.*, 2012; and Pert *et al.*, 2015 for exceptions).

Given that control over Country and territory are key issues for both settler states like Australia and indigenous peoples around the globe (Wolfe, 1999), it is unsurprising that indigenous peoples are increasingly turning to Geographic Information Systems (GIS) as a tool to support monitoring, management, decision making and governance (Taylor *et al.*, 2012). However, many indigenous peoples have not had the opportunity to critically engage with GIS technology (Palmer and Rundstrom, 2012), or take full advantage of its capacity for visualisation and spatial analysis to support decision making (Harmsworth *et al.*, 2005). This thesis examines both contextually and analytically grounded uses of GIS to support post native title governance, drawing on case studies conducted with Yawuru people, the traditional owners and recognised native title holders of an area in and around Broome, Western Australia.

This introductory chapter details the international context and practical imperatives for this research. It situates the strengths and limitations of the existing native title system in global and historical contexts and argues that many of the challenges which face native title holders stem from the way this title has been recognised. This chapter also briefly introduces the Yawuru case

study used to test these tools. Then, it outlines the research questions for this thesis, states the scope of this research, and details the structure of the remainder of this thesis.

To be clear, this introduction does not provide a detailed critique of Australia's native title system. Such critiques may be found elsewhere (Bauman *et al.*, 2013b; Bauman *et al.*, 2013c; Brennan *et al.*, 2015a; Langton and Frith, 2010; McGrath *et al.*, 2013; Moreton-Robinson, 2015c; Smith and Morphy, 2007; Vincent, 2017). It also does not evaluate the myriad ways that Indigenous peoples have sought to assert self-determination within and beyond the native title system. That is beyond the scope of this research.

Instead, this chapter outlines the importance of Australia's contemporary native title system as part of broader Indigenous efforts to achieve self-determination. It argues that there is a need for tools to support land-related Indigenous governance, negotiation and decision making following native title recognition. It then briefly introduces the Yawuru case study used to test these tools and outlines the research questions for this thesis. Finally, this chapter states the scope of this research and details the structure of the remainder of this thesis.

1.1 The international context and practical imperative for this research

1.1.1 The Global Context

To some extent, Australia's native title recognition is unique in that Australia is a Western settler state which is yet to use any form of treaty to acknowledge Indigenous sovereignty and recognise some Indigenous rights. Yet, the recognition of native title rights in Australia is part of a global trend. Two key international agreements, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the International Labour Organisation (ILO) Convention 169 (1989) presently contain clauses which protect and enshrine Indigenous rights.

The ILO Convention 169 (1989) "specifically provide[s] a detailed list of rights for Indigenous peoples" (Gilbert, 2007:209). Article 13 of the convention, for example, states that "governments shall respect the special importance for the cultures and spiritual values of the peoples concerned of their relationship with the lands or territories" (ILO, 1989:5). Article 14 states that "governments shall take steps as necessary to identify the lands which the peoples concerned traditionally occupy, and to guarantee effective protection of their rights of ownership and possession" (ILO, 1989:5). Moreover, Article 15 states that "the rights of the peoples concerned to the natural resources pertaining to their lands shall be specially safeguarded" (ILO, 1989:5).

At present, ILO Convention 169 is the only legally binding instrument to enshrine international indigenous rights. However, this convention does not recognise a right to self-

determination. Nor does it specifically include a principle which protects indigenous peoples' capacity to give their free, prior and informed consent to developments which may occur on their traditional lands. For these reasons, it is the UNDRIP and not the ILO Convention that is perceived by many Indigenous peoples to set "the minimum international standards" for Indigenous rights (Tauli-Corpuz, 2007).

The UNDRIP is a non-binding, soft-law document which recognises the collective rights and land rights of indigenous peoples around the globe. It was endorsed by 144 countries of the United Nations General Assembly in 2009 following more than two decades of negotiation (Gilbert, 2007; McKeehan and Buppert, 2014). While the UNDRIP is not judicially enforceable (Champagne, 2013), it has been referred to in litigation in Australia and is often leveraged by indigenous peoples as they negotiate with states and third parties following restitution of their customary lands (Davis, 2012b).

Unlike the ILO Convention, the UNDRIP recognises an indigenous right to self-determination. It also incorporates the related principle of free, prior and informed consent. While there is no singular or specific interpretation of either principle, the principle of self-determination is generally defined as the right of all peoples "freely determine their political status and freely pursue their economic, social and cultural development" (United Nations General Assembly, 2007:3). As outlined in the UNDRIP preamble, this principle derives from a broader right afforded to all peoples through the Charter of the United Nations, the International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights as well as the Vienna Declaration and Programme of Action (United Nations General Assembly, 2007:2-3). While the principle of self-determination lacks specificity, this right remains "fundamental to the aspirations of Aboriginal communities" (Davis, 2012a: 78).

The principle of free, prior, and informed consent is strongly related to self-determination (Hanna and Vanclay, 2013). Fundamentally, it "recognizes indigenous peoples' inherent and prior rights to their lands and resources and respects their legitimate authority to require that third parties enter into an equal and respectful relationship with them based on the principle of informed consent. Procedurally, free, prior and informed consent requires processes that allow and support meaningful choices by indigenous peoples about their development path" (Motoc and the Tebtebba Foundation, 2004:15). The principle of free, prior and informed consent has been incorporated into several articles of the UNDRIP (Articles 10, 11, 19, 29, 30, 32). These articles focus on preventing relocation; protecting culture and cultural manifestations; engaging with legislation which may impact indigenous peoples; controlling the disposal of hazardous wastes and military activities on indigenous lands; and, influencing projects which may affect indigenous lands, territories, or other resources.

Overall, the UNDRIP functions as a key reference document for many indigenous peoples. Nonetheless, the declaration relies on the codification of its articles in national laws, policies and political norms (Champagne, 2013; Hanna and Vanclay, 2013). At the time of writing only Bolivia has adopted the UNDRIP as national law. Moreover, the extent to which the law is effectively implemented in Bolivia is debated (Fontana and Grugel, 2016; Tockman and Cameron, 2018). However, it is not Bolivia, but Canada, Aotearoa/ New Zealand and the United States that are Australia's closest parallels as Western settler states.

1.1.2 Indigenous rights in (other) Western settler states

Australia, Canada, the United States, and Aotearoa/ New Zealand were the only four nations to vote against the UNDRIP in 2007 (Gover, 2015). As such, the UNDRIP's reliance on national law for implementation is particularly problematic for indigenous peoples in these states. While each state offered a subtly different reason for their objection in 2007, many were afraid that a right to self-determination could facilitate indigenous secession. To date, none of these Western settler states have fully ratified the UNDRIP. Whilst these states have endorsed the declaration, these endorsements have been qualified by "the same objections they expressed during its development and [...] gave as reasons for their negative votes" (Gover, 2015:346). Australia, Canada, the United States and Aotearoa/New Zealand have also enshrined some indigenous rights within their national laws whilst remaining somewhat ambivalent towards the UNDRIP (Champagne, 2013). This is important, as where indigenous peoples are recognised to hold relatively strong rights in settler states through law, policy or custom, this recognition has had a largely positive impact on indigenous lives, economies and well-being. It is in this context that this section briefly reviews the recognition of Indigenous rights within Canada, the United States and Aotearoa/ New Zealand and outlines the impact of that recognition on indigenous well-being in those states.

In Canada, some indigenous rights and title were formally recognised as early as the 18th Century. The British *Royal Proclamation of 1763*, for example, "sought to regulate relations with relevant Amer-Indian peoples in all British possessions in North America" (Lavery, 2017: 67). This proclamation supported the recognition of Aboriginal title in Canada and facilitated a number of historic treaties (Tully, 2009). Later, key common law cases such as *Calder v Attorney General of British Columbia* (1973) SCR 313, *R v Sparrow* (1990) 1 SCR 1075, and *Delgamuukw v the Queen in right of British Columbia* (1997) 3 SCR 1010 extended the recognition available through the declaration (Mulrennan and Scott, 2000; Nettheim *et al.*, 2002). Indeed, in 1973 the Canadian government finally recognised that Aboriginal rights and title continued to exist over land not addressed by historic treaties or other legislation. They introduced both a comprehensive claims process to provide "a policy framework for the assessment and negotiation of claims based on

Aboriginal title” and a specific claims process to address “claims arising from treaties and the takings of reserve lands” (Specific Claims Tribunal Canada, 2011; Usher, 2003). This process in turn facilitated transfers of land ownership, financial compensation, self-governance agreements and the sharing of resource revenue (Aboriginal Affairs and Northern Development Canada, 2015).

The Canadian state’s recognition of Aboriginal rights has supported Aboriginal self-government in Canada. Today, some First Nations in Canada are also able to control access to minerals in areas where they hold a recognised interest (Grant *et al.*, 2014). In Canada, recognition of indigenous rights has opened opportunities for entrepreneurship and economic development (Anderson *et al.*, 2006).

Flaws remain in the Canadian system (Corntassel, 2012; Daigle, 2016; Pasternak, 2015; Szablowski, 2010), and the impacts of recognition are not evenly distributed. The murder and disappearance of Aboriginal women since the 1980s (Anderson, 2016; Gilchrist, 2010; Saramo, 2016; Walsh, 2017) and disparities in health and education also remain key issues for many indigenous peoples in Canada (Smylie and Firestone, 2016). Indeed, Coulthard (2014) makes a strong case that indigenous peoples in Canada should pursue self-recognition over state-based recognition. Nonetheless, the strong and early recognition of Aboriginal rights in Canada has created space for some contemporary indigenous self-governance and cultural revival.

In the United States, the early recognition of indigenous rights through treaties, combined with the Marshall Trilogy of cases in the United States Supreme Court, the *Indian Self-Determination and Education Assistance Act 1975* (USA) and the *Tribal Self-Governance Act 1994* (USA) have enabled many tribes to operate as (semi-)sovereign nations supported by complex land management, planning and governance systems (Bruyneel, 2007; Cornell, 2013; Hausam, 2013). At present, there are currently 567 tribal governments recognised by the United States government that have specific legislative, judicial and regulatory rights and powers (Bureau of Indian Affairs, 2018).

Within reservations in the United States, the local governing authority is the tribal government. The semi-sovereign status of reservations means that many tribes are able to control, extract and tax mineral and other resources within their lands, if they so choose (Bond, 2002; Cornell and Kalt, 1992; Silvern, 2008). Likewise, other tribes have used their location and semi-sovereign status to generate revenue from casinos and the sale of tobacco-based products (Anderson, 2013). As in Canada, benefits from the recognition of indigenous rights are not evenly distributed. Different tribes have different powers in law enforcement, education, taxation and water rights (Joseph *et al.*, 1999) and despite the wealth generated by some tribes in the south-western United States, many continue to experience significant disadvantage (Whitney Mauer,

2017). Nonetheless, many tribes in the United States have taken advantage of their status to not only create diverse social and cultural programs, but also assert control over their lives and lands.

In Aotearoa/ New Zealand, the Treaty of Waitangi (1840), the *Treaty of Waitangi Act 1975* (NZ) (*'Treaty of Waitangi Act'*) and the creation of the Waitangi Tribunal have enabled redress of historic claims since 1984. This redress has included the *Māori Fisheries Act 2004* (NZ), which “formally established Te Ohu Kaimoana, the corporate trustee of the Māori Fisheries Trust along with its associated entities, to allocate the assets transferred through the Māori Fisheries Settlement from the Crown to *iwi*” (Durette, 2007:14). It has also included cash payments as compensation for the loss of land opportunities, rights and recognition of a range of subsistence and commercial interests in timber, some minerals and other natural resources. Combined with other legislation such as the *Resource Management Act 1991* (NZ), *Te Awa Tupua (Whanganui River Claims Settlement) Act 2017* (NZ), the Treaty of Waitangi and the *Treaty of Waitangi Act* have resulted in widespread Māori involvement in environmental decision making (Bess, 2011; Matunga, 2013; Nettheim *et al.*, 2002; Sherman, 2006; Stokes, 1992). Accompanied by a wave of cultural revitalisation as well as social, economic, and educational programs, this legislation has increased opportunities for Māori to be involved in management of their whenua (customary lands) (Harmsworth *et al.*, 2005; Murphy, 2008; Spolsky, 1989; Wayne *et al.*, 2012). Despite some limitations, these Acts have benefited Māori peoples (Clapcott *et al.*, 2018; O'Bryan, 2007; Stokes, 1992; Williams, 2013).

In Australia, native title recognition stemming from the decision in *Mabo v Queensland (No. 2)* (1992) 175 CLR 1 (*'Mabo'*) and the following the *Native Title Act 1993* (Cth) (*'Native Title Act'*) has often resulted in a seat at the negotiation table for Indigenous peoples (Bauman *et al.*, 2013a; Strelein and Tran, 2007). It has also facilitated agreement making, and co-management opportunities (Bauman *et al.*, 2013a; Jojola, 2008; Strelein, 2001). Nonetheless, as will be demonstrated in the following section, a legacy of *terra nullius* (the idea that prior to British settlement Australia's land belonged to no one) and the relatively limited form of recognition afforded by native title ensure that challenges continue to accompany such new opportunities for Australia's Indigenous peoples.

1.1.3 The history of native title in Australia

As outlined earlier, this thesis is primarily concerned with supporting the Indigenous governance which occurs in Australia's contemporary post native title environments. However, the context in which Indigenous rights have been recognised in Australia is starkly different from Canada, Aotearoa/ New Zealand and the United States. This section details several of these

differences and outlines how they have impacted native title rights. It illustrates several of the complexities facing Indigenous peoples following native title recognition.

Despite the British Crown's initial orders to take land in Australia only with the consent of the natives (Borch, 2001; Simpson, 1993-1994), the British ultimately relied on an enlarged notion of *terra nullius*, or the idea that land in Australia did not belong to anyone, in order to justify their territorial sovereignty over that land (Lavery, 2017). The British were firmly aware that Indigenous peoples lived in Australia, then known as New Holland. They could not, then, claim that no one lived in or occupied or Australia (Brennan *et al.*, 2015a). Instead, to justify their claims they effectively argued that Indigenous peoples in Australia were so 'backward' or "low on a scale of social organisation as to be ignored by the 'institutions and legal ideas of civilised society'" (Lavery, 2017:56). According to this justification, there was no need for a treaty with Indigenous peoples in New Holland because the Occupation of Backward Peoples doctrine "purportedly permit[ed] a territory inhabited by 'uncivilized inhabitants in a primitive state of society' — so-called 'backward peoples' — to be lawfully dispossessed of their territories and occupied by 'more advanced peoples'" (Lavery, 2017:76).

While the enlarged notion of *terra nullius* used by the British in claiming sovereignty in New Holland was ultimately overturned in the *Mabo* decision, it was also highly damaging. This notion generated a significant delay in the recognition of many Indigenous rights. It contributed to violent dispossession, killing, regulation, the forced separation of families, and systemic discrimination (Mykyta, 2004-2005:96). As outlined earlier, while other Western settler states ostensibly recognised some form of Indigenous sovereignty and title as early as the 18th and 19th Centuries, it took until 1992 for the first allodial native title to be recognised in Australia.

Native title recognition in Australia did not occur in a vacuum: Indigenous peoples in Australia have been resisting the structural and physical violence of colonialism for hundreds of years (Moreton-Robinson, 2015a). Many Indigenous peoples have engaged in the frontier wars; continued to live on and visit their ancestral lands; and worked hard to protect or revive their languages, laws and customary practices. They have done this despite violence, clearing, forced separations, imposed religions, destruction of Country, spatial segregation and incarceration, working within and beyond settler structures to defend their land and cultures, protest the cruelties of colonialism, and pursue their rights (Maddison *et al.*, 2011; Moreton-Robinson, 2004; Pedersen and Woorunmurra, 2011; Reynolds, 1990; Russell, 2005; Walter, 2010). Of particular relevance to this thesis is a key sequence of protests and cases which have built important momentum for the recognition of native title rights in Australia.

As outlined in Table 1.1 below, these events included, amongst others, the creation of the Yirrkala bark petitions to protest against the sale of part of the Arnhem Aboriginal Land Reserve

Table 1.1: Key events in the lead up to the Mabo Decision

Event	Description	Impact
<i>The Pilbara Pastoral Worker's Strike 1946</i>	Aboriginal workers on two dozen stations in the Pilbara region went on strike on 1 May 1946 to demand better working and living conditions. Many Aboriginal people were gaoled during the strike, which continued until mid-1947.	The State government initially agreed to substantial reforms, including increased wages, but this was later withdrawn. Some Aboriginal workers decided never to return to the pastoral industry. The strike “limited the extent to which it would be possible to take Aboriginal labour for granted” (Hess, 1994:82).
<i>Yirrkala Bark Petition 1963</i>	The Yolngu people of Yirrkala “presented two petitions [written in Yolngu Matha and English] to Federal Parliament in protest against the sale of part of the Arnhem Aboriginal Land Reserve to a bauxite mining company without any consultation with the traditional owners” (National Native Title Tribunal, 2017a:2).	A bipartisan Parliamentary Committee of Inquiry was established which acknowledged Yolngu rights and recommended the payment of compensation. These recommendations were not implemented and there was no constitutional change at the time.
<i>The Freedom Ride 1965</i>	A bus tour of regional New South Wales from Sydney to Kempsey aimed at opposing racial discrimination and mistreatment.	Brought racism to national attention (AIATSIS, 2015).
<i>Wave Hill Walk-Off 1966-1975</i>	200 Gurindji people walked off Wave Hill station to reconnect with Country and protest both poor work and pay conditions and the appropriation of Gurindji lands. The protest lasted nine years.	The walk-off contributed to pressure on the Commonwealth government to recognise Aboriginal rights.
<i>The 1967 Referendum</i>	After more than 10 years of extensive campaigning by Indigenous and non-Indigenous Australian, 90.88% of Australians voted in favour of the Referendum (Burney, 2017). The referendum removed a clause from s 51 (xxvi) which did not allow the Commonwealth to legislate for the ‘aboriginal race’. It also repealed s 127 which prevented ‘aboriginal natives’ from being counted in the census (Wood, 2012).	The 1967 census meant that Indigenous people, but not peoples were included in the census. It also allowed the Commonwealth to make laws in relation to Aboriginal people. This facilitated national legislation including the <i>Aboriginal Land Rights Act</i> and later the <i>Native Title Act</i> (Watson, 2018).
<i>Milirrpum v. Nabalco (1971) 17 FLR 141 (‘The Gove Land Rights case’)</i>	When recommendations of the Parliamentary Committee inquiry were not implemented, Yolngu people took their case to the Northern Territory Supreme Court in the first litigation on native title. They challenged the validity of mining leases.	The Supreme Court of the Northern Territory ruled that the doctrine of Aboriginal or native title to land had never been, and presumably never could be, a part of Australian common law.

Event	Description	Impact
<i>Aboriginal Tent Embassy</i> 1972	The Aboriginal Tent embassy was originally set up to protest Prime Minister William McMahon's rejection of land rights in favour of 50-year leases.	The Aboriginal tent embassy serves as a visible reminder of Aboriginal presence in the heart of the nation's capital. It has served as a focal point for numerous discussions and rallies since its creation.
<i>Racial Discrimination Act 1975 (Cth)</i> (' <i>Racial Discrimination Act</i> ')	The <i>Racial Discrimination Act</i> made it unlawful to discriminate against people based on race, colour, descent, or national or ethnic origin.	The High Court has used the <i>Racial Discrimination Act</i> to strike down state legislation and clear the case for the <i>Mabo</i> case where Queensland sought to pre-emptively extinguish native title.
<i>The Aboriginal Land Rights Commission (Woodward Royal Commission)</i> and <i>Aboriginal Land Rights Act 1976</i>	The <i>Aboriginal Land Rights Commission</i> , also known as the Woodward Royal Commission, was established in 1973 in response to the Gove Land Rights decision. Its task was to inquire into appropriate ways to recognise Aboriginal land rights in the Northern Territory.	The review led to the handing over of land to the Gurindji people. The <i>Aboriginal Land Rights Act</i> which was the "first attempt by an Australian government to legally recognise the Aboriginal system of land ownership and put into law the concept of inalienable freehold title" (National Native Title Tribunal, 2017a:6) was also a result of this review.
<i>Coe v. The Commonwealth of Australia</i> (1979) HCA 68; 24 ALR 118	Wiradjuri man Paul Coe disputed Australia's status as a settlement, suggesting that "the Australian state was illegitimately founded and had unlawfully dispossessed the Indigenous people of their lands without fair compensation" (Muldoon and Schaap, 2013:194).	Plaintiffs in the <i>Mabo</i> case and other cases were not able to challenge the validity of the Crown's claim "to sovereignty in proceedings before a domestic court. The High Court could, however, examine the consequences of acquisition of sovereignty, including [...] whether that law allowed for the recognition of native title" (O'Connor, 1992:254).

to Nabalco, a bauxite mining company; the creation of the Aboriginal Tent Embassy to protest William McMahon's rejection of land rights; and the introduction of the *Aboriginal Land Rights (NT) Act 1976* (Cth) ('*Aboriginal Land Rights Act*') in response to the Gove Land Rights decision and later the Woodward Commission. This later event represented the "first attempt by an Australian government to legally recognise the Aboriginal system of land ownership and put into law the concept of inalienable freehold title" (Central Land Council, 2019, p. 1 of 4), but applied only in the Northern Territory.

In 1982, drawing on the legacy of resistance outlined so far, Eddie 'Koiki' Mabo, David Passi and James Rice started proceedings against the State of Queensland in the High Court of Australia to secure recognition of Meriam peoples' allodial native title to Mer (the Murray Islands) in the Torres Strait (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012; National Native Title Tribunal, 2012). Mabo, Passi, and Rice faced considerable resistance to their claim. Indeed, the Queensland government retrospectively passed the *Queensland Coast Islands Declaratory Act 1985* (Qld) in an attempt to extinguish native title around their home (National Native Title Tribunal, 2012). It was only on the 3rd of June 1992 following ten years of litigation, that the High Court of Australia recognised Meriam Peoples' pre-existing and continuing native title to Mer as founded in their traditional laws and customs through Mabo No. 2 (Strelein, 2009). Six months after Mabo's death from cancer, the six judges of the High Court found that applying the enlarged *terra nullius* notion to the already-inhabited New Holland was ahistorical, discriminatory and unjust (Brennan *et al.*, 2015a).

The High Court's finding in *Mabo* partially overturned the extended notion of *terra nullius* which had operated to that point (Langton, 1996) and provided Australia's first common law recognition of native title. It also opened the door to recognising the native title of other Indigenous peoples across Australia. Yet, this finding did not erase the devastating spiritual, social, economic and cultural impacts of colonialism. Instead, it facilitated a limited recognition of Indigenous rights and protected settler property by placing considerable constraints on where and how native title could be recognised. According to the High Court's decision, native title rights could only be recognised where they could be proven under traditional law, where native title claimants could demonstrate they were descended from traditional owners prior to white settlement and where native title had not been extinguished by an Act of the new sovereign state (Herne, 2001; Mykyta, 2004-2005; Strelein, 2009). As Indigenous critical theorist Aileen Moreton-Robinson has argued, in the *Mabo* case the High Court "invent[ed] a rule of extinguishment that did not exist under common law, to allow for inconsistent grants to extinguish native title prior to the Racial Discrimination Act 1975" (Moreton-Robinson, 2015c:68).

The *Mabo* decision generated considerable uncertainty for governments, landholders, and Indigenous peoples across Australia. It did not precisely define what it meant by the continuity necessary to retain native title (Pearson, 2003). It also did not specify whether certain leases, including pastoral leases, extinguished native title (Pearson, 1997; Tehan, 2003). Perhaps most concerning to settler governments, the *Mabo* decision potentially invalidated exclusive possession land grants made by the Crown since the introduction of Australia's *Racial Discrimination Act* in 1975. The *Native Title Act 1993* (Cth) was created to address some of this uncertainty.

As introduced in 1993, the *Native Title Act* recognised and constrained the native title recognised by the court. Specifically, it created a mechanism to establish and determine native title. It also validated past acts which may have been invalid following the introduction of Australia's *Racial Discrimination Act* in 1975 and, in exchange, established a fund for Indigenous peoples who will not benefit from native title due to prior extinguishment (Kildea, 1998). Despite the significant compromises made by Indigenous peoples during negotiations around the *Native Title Act*, the Act's passage was contested by some states. Western Australia, for example, passed the *Titles (Validation) and Native Title (Effect of Past Acts) Act 1995* (WA) to explicitly limit the power of native title recognition. While this legislation was later found to be inconsistent with Australia's *Racial Discrimination Act* and struck down by the High Court of Australia, few native title claims were successful in that state before 2000.

Since 1993, the way native title is recognised in Australian law has continued to evolve through court decisions and legislative amendments as outlined in Table 1.2. At times, this evolution has had the potential to enhance Indigenous peoples' control of their traditional lands.

The High Court's ruling on *Wik Peoples v Queensland* (1996) 187 CLR 1 ('*Wik*'), for example, held that native title was not necessarily extinguished by pastoral leases, expanding the area where non-exclusive native title could be claimed. Later, the High Court's ruling in *Akiba on behalf of the Torres Strait Regional Seas Claim Group v Commonwealth of Australia* (2013) 250 CLR 209 ('*Akiba*') decision found that native title rights can include rights to trade and derive income from native title lands and resourcing – the first recognition that native title rights might also include commercial rights (Brennan, 2015; Strelein, 2015). Additionally, *Griffiths v Northern Territory of Australia* (2016) 332 ALR 362 ('*Timber Creek*') provided the first publicly available judicial guidance on native title compensation (McKenna and Shave, 2016). At the time of writing, the *Timber Creek* case is still subject to appeal in the High Court of Australia. Nonetheless, the calculations in this case included a solatium payment “in recognition of the loss or diminution of connection or traditional attachment to land” (National Native Title Tribunal, 2017a:7). This compensation for loss does not erase the inter-generational trauma visited by

Table 1.2: The evolution of native title law in Australia following the Mabo decision.

Legislation or Court Ruling	Topic(s)	Impact on native title rights and interests
<i>Native Title Act 1993</i> (Cth)	Native title	Created a legislative framework for the recognition and protection of native title. Created a mechanism by which native title rights can be established and compensation determined. Left the status of native title under certain leases unclear.
	“Future acts”	Set out procedures for governments to follow in ‘future acts’ and provided a mechanism to validate past future acts or proposals to deal with land in a way that affects native title rights and interests (National Native Title Tribunal, 2017b:1).
	National Native Title Tribunal	Created the National Native Title Tribunal to research, mediate and perform other functions.
	Aboriginal/ Torres Strait Islander Representative Bodies	Made provision for the establishment and funding of these bodies.
<i>Western Australia v Commonwealth</i> (1995) 183 CLR 373	Validity of the <i>Native Title Act</i>	The High Court found that the <i>Native Title Act</i> was a valid exercise of the Commonwealth’s constitutional power and that legislation put forward by Western Australia to undermine the act was inconsistent with the Racial Discrimination Act. It made it clear that native title was now a permanent feature of Australia’s legal system.
<i>Wik Peoples v Queensland</i> (1996) 187 CLR 1 (‘ <i>Wik</i> ’)	Pastoral leases	Native Title was not extinguished by the grant of pastoral leases. However, “if there was any inconsistency between the rights of the native title holders and the rights of the pastoralist, the rights of the pastoralist prevailed” (Hiley, 2002:268)
<i>The Howard Government’s Ten Point Plan and Wik Amendments</i>	Sunset clause	The Ten Point Plan was designed to significantly reduce power granted to Indigenous peoples from the Wik Decision.
	Revised Claims process	Applications for determination of native title now to be made by the Federal Court and not the National Native Title Tribunal.
	Validated Intermediate Period Acts	Validated Acts between when the <i>Native Title Act</i> commenced and when Wik was decided.
	Confirmed Past Extinguishment	The Act Confirmed past extinguishment, including in a couple of controversial circumstances.
	Changed right to negotiate	Excluded particularly activities which would have triggered the right to negotiate under the old act.
	Indigenous Land Use Agreements	Replaced original agreements measures with very detailed Indigenous Land Use Agreements.

Legislation or Court Ruling	Topic(s)	Impact on native title rights and interests
<i>Members of the Yorta Yorta Aboriginal Community v Victoria</i> [2002] 214 CLR 422 ('Yorta Yorta')	Connection	Set that, "in order for native title to be recognised, a group had to show that: they formed a society, substantially the same as that which existed at sovereignty, and had continued to observe a system of laws and customs which were, again, substantially unaltered from those observed by their ancestors at sovereignty" (National Native Title Tribunal, 2017a:2). Many believed this would make claims difficult in highly settled areas.
<i>Western Australia v Ward</i> (2002) HCA 28; 213 CLR 1 ('Ward')	Connection	The case confirmed that physical presence on Country was clear evidence of maintained connection, however, it was not required. Instead the key question was "whether, for each generation of the relevant society since sovereignty, those laws and customs constituted a normative system giving rise to rights and interests in land and whether this normative system was observed through generations".
	Bundle of rights	Native title was viewed as a bundle of rights and interests. This introduced the concept of partial extinguishment.
<i>Yanner v Eaton</i> (1999) 201 CLR 351	Extinguishment	State law did not extinguish the exercise of native title rights and interests unless the legislation had the clear and plain intention of doing so.
	Rights to hunt	Rights to hunt could include the use of modern transport and weapons
<i>Yarmirr v Northern Territory</i> (2001) 208 CLR 47	Rights over sea	Native title rights exist over the sea and seabed. However, these rights were initially deemed to be non-exclusive and non-commercial. Exclusive rights were deemed inconsistent with public rights to navigate and fish.
<i>Akiba on behalf of the Torres Strait Regional Seas Claim Group v Commonwealth of Australia</i> (2013) 250 CLR 209	Commercial rights to fish	Commercial rights to fish existed in a determination relating to 13 Torres Strait Island communities
<i>Willis on behalf of the Pilki People v State of Western Australia</i> (2014) FCA 714	Commercial rights to exploit resources	Rights to commercially exploit resources recognised "provided the right was consistent with the group's traditional system of law and custom" (National Native Title Tribunal, 2017a:5)
<i>De Rose vs State of South Australia</i> (2013) FCA 988 ('De Rose')	Native title compensation	The <i>De Rose</i> consent determination which was the first determination of native title compensation. Details of the settlement were confidential and provided little guidance for other groups.
<i>Griffiths v Northern Territory of Australia</i> (2016) 332 ALR 362 ('Timber Creek')	Native Title compensation	Determination on compensation which provided the first judicial guidance on how compensation should be calculated. Included a solatium payment which was "in recognition of the loss of diminution of connection or traditional attachment to land" (National Native Title Tribunal, 2017a:7).

Legislation or Court Ruling	Topic(s)	Impact on native title rights and interests
<i>McGlade v Native Title Registrar</i> (2017) FCAFC 10 (' <i>McGlade</i> ')	Indigenous Land Use Agreement	The <i>McGlade</i> decision held that the <i>Native Title Act</i> required all named applicants to be party to an agreement for it to be registered as an Indigenous Land Use Agreement. The Commonwealth then rapidly amended legislation to reverse the impact of <i>McGlade</i> for registered Indigenous Land Use Agreements and some Indigenous Land Use Agreements awaiting registration, and to change the requirements for who must be parties to future Indigenous Land Use Agreements.

settler colonialism. Yet, it provides important resources to support native title holder aspirations into the future.

Despite the influence of the *Wik*, *Akiba* and *Timber Creek* decisions, many court cases have constrained native title's potential to enhance Indigenous peoples' control over their lives and lands (Walker, 2015). The *Fejo* case, for example, found that once extinguished, native title could not be revived, even where the act extinguishing native title was later determined to be invalid. Later, in 2002, the *Yorta Yorta* case imposed a burden of proof and continuity which essentially, required "evidence of a society and a system of law cognisable to [a] settler system" (Tehan, 2003:562) dominated by white men (Moreton-Robinson, 2015b) for Indigenous peoples to successfully claim native title. Similarly, the *Ward* case allowed for the partial or piecemeal extinguishment of native title rights and increased the capacity for those rights to be incrementally eroded over time. Combined, these cases situated native title as a bundle of fragmented, over-specified, vulnerable and permanently extinguishable rights (Brennan, 2015; Strelein, 2015; Walker, 2015).

In cases where Australia's legal system has decided in favour of Indigenous interests on native title, these decisions have often been undermined through settler politics. After the *Wik* decision found that native title could exist under some pastoral leases, for example, the Howard government introduced a ten-point plan which validated past acts, upgraded non-Indigenous title, restricted the Indigenous right to negotiate around future acts and extinguished some native title (Moreton-Robinson, 2015c). More recently, then Prime Minister Malcom Turnbull effectively reversed the *McGlade* decision which required all named applicants to sign an ILUA in order for it to be valid, by introducing the *Native Title Amendment (Indigenous Land Use Agreements) Bill 2017* (Cth) (Castledine and Song, 2017).

1.1.4 The strengths and limitations of native title

Native title recognition has resulted in several important developments for Indigenous peoples in Australia. The first Aboriginal and Torres Strait Islander Social Justice Commissioner, Michael (Mick) Dodson, asserted that "[t]here is no denying that the recognition of native title that resulted from that case was a monumental step forward, not only for the recognition and protection of indigenous interests in land but for indigenous rights generally" (Dodson, 1996b:12). Michael Gooda has also argued that "the recognition of our native title provides a unique opportunity for many [Indigenous peoples] to overcome disadvantage" (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012:13).

From a community perspective, Nyaparu Rose a Nyangumarta Elder from Western Australia argues that "[n]ative title is very important to us because it has allowed us to get our Country

back, to protect our spirits and sites, to go camping, hunting and fishing. Before native title we never had any recognition as traditional owners, we had no rights in our own Country. Now we feel empowered”. (Nyaparu Rose in Yamatji Marlpa Aboriginal Corporation, 2009). Nolan Hunter, Chief Executive Officer (CEO) of the Kimberley Land Council, states that “native title puts traditional owners in a stronger position to negotiate agreements, manage their Country, and set terms and conditions for access [to Country]” (The Sydney Morning Herald, 2011, p.1 of 2). Further, research by Smith and Morphy has shown that for groups “characterised by ongoing connection to ‘Country’ and continuities in cultural production, [...] but also by transformations in the articulation of Indigenous identities and property rights as a result of colonial disruption—native title has, on balance, proved to be a positive social phenomenon, allowing the recognition of Indigenous identity *and* practical benefits to a number of groups” (Smith and Morphy, 2007:25).

Yet, while native title can result in benefits for Indigenous peoples, the native title system does not enshrine customary rights or explicitly facilitate Indigenous self-determination (Brennan *et al.*, 2015b; Dodson, 1996b; Langton, 2015). Native title is not equivalent to commercial rights and does not include a right to veto development (O’Faircheallaigh, 2006). The recognition of native title is bounded by Western systems of land tenure (Wensing and Small, 2012). It is also underpinned by the concept of extinguishment (Dodson, 1996b) and frequently involves a lengthy court process which assumes a reversal of the court’s usual burden of proof (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012; Claudie, 2007; Mykyta, 2004-2005; Pearson, 2003). Unless native title rights are deemed to be exclusive, they are considered subordinate to all other common law and legislative rights held in the area (Glaskin, 2003; Pearson, 1997). Moreover, Indigenous peoples in Australia receive no restitution for lands acquired prior to Australia’s implementation of the *Racial Discrimination Act* and even land which has recognised native title rights remains vulnerable to extinguishment through either lapsed connection to land or executive termination (Pearson, 1997). Finally, native title, and in particular exclusive native title, frequently results in financial costs and liabilities for Indigenous peoples, such as vulnerability to local rates, without a concomitant income source (Altman, 2014).

Given these limitations, a number of Indigenous peoples have actively avoided the native title system (Sutton, 2003; Vincent, 2017). Others seeking to engage in that system have been excluded from it. For example, when combined with the exclusive forms of tenure more commonly found in the more densely populated areas of south-eastern Australia, “the continued land association aspect of the [*Mabo*] ruling means that native title rights often do not extend to those living in urban or regional areas, even where these areas were traditional lands” (Atkinson *et al.*, 2010:316). This has generated a spatial irony whereby those Indigenous peoples most

greatly impacted by colonialism are also the least likely to succeed when seeking redress through the native title system.

Many Indigenous people who have sought native title have expressed their disappointment with the system. Noongar man Glen Kelly, for example, who heads the South West Aboriginal Land and Sea Council in Western Australia, has argued that native title is a “whitefella legal construct” designed to “control traditional law and custom” (Glen Kelly in Mara, 2014, p. 3 of 7) and Eve Vincent’s book *Against Native Title* documents the disappointment expressed by ‘Aunty Sue’, Sue Coleman Haseldine, and many of her mob in relation to a native title claim near Ceduna, South Australia. While Vincent’s book ends with a softening of opinion towards native title, and Aunty Sue accepting an invitation to join the Prescribed Body Corporate (PBC), the process was clearly disruptive for Kokatha, Wirangu and Mirning in the Ceduna area, as it has proven for other Indigenous peoples (see Burke, 2011a; Sutton, 2003, and others for further discussion).

In many ways, native title recognition has resulted in the growth of Australia’s Indigenous estate (Altman, 2012; Altman and Markham, 2015) and relieved the Australian government of the “international embarrassment of *terra nullius*” (Wolfe, 2000:142). Yet it has also developed “a hierarchical relationship between Indigenous interests and the interests of others [...and] reintroduce[d] an element of dependency of Indigenous rights on the good will of the state” (Strelein, 2005:265). In effect, while this system has brought benefits to some Indigenous peoples, it has also “ke[pt] the practical outcomes of *terra nullius* substantially intact” (Wolfe, 2000:142) and generated significant governance challenges for Indigenous peoples.

1.1.5 Native title and Prescribed Body Corporates

As the corporate structure for Australia’s post determination landscape, registered native title holders’ corporations, more commonly known as prescribed body corporates (PBCs) are an essential component of Australia’s native title system (McGrath *et al.*, 2013). As imposed, hybrid governance bodies they are also an important, if controversial, new form of Indigenous governance (Weir, 2007). According to the *Native Title Act*, PBCs perform two functions. First, they “protect and manage determined native title in accordance with the objectives of the native title holding group” (Strelein and Tran, 2007:2). That is, PBCs are responsible for asserting and protecting native title rights to maximise community benefits from native title. Second, they “ensure certainty for governments and other parties interested in accessing or regulating native title lands and water by providing a legal entity to manage and conduct the affairs of the native title holders” (Strelein and Tran, 2007:2). That is, they act as a single port of call for diverse and often disagreeing native title communities, thereby facilitating Western development.

Beyond their legislated roles, PBCs are frequently involved in service delivery for many Indigenous peoples as well as social, cultural and environmental activities as outlined in Table 1.3. These activities often interact with a range of local, state and federal legislation concerning “land and water management; tenure issues; biodiversity and environmental protection; cultural heritage; and land use planning including town planning” (McGrath *et al.*, 2013:35). This legislation may, in turn, confer additional obligations on PBCs. As a result, many PBCs manage and protect cultural heritage sites; control feral pests and weeds; maintain watercourses; establish and maintain firebreaks; and clear and remove rubbish (McGrath *et al.*, 2013; Weir, 2007). At times, they do so without being paid for their services.

Table 1.3 Summary of typical examples of PBC Activities

<i>Environmental</i>	Mining and resource sector agreements Land and water conservation partnerships Pastoral, agricultural and farming activities
<i>Social</i>	Return to Country programs Education and employment
<i>Cultural</i>	Recording and archiving cultural information Cultural tourism Heritage and conservation programs
<i>Economic</i>	Cultural tourism Economic and business development
<i>Other</i>	Research partnerships

To be clear, PBCs are not autochthonous or customary governance bodies (Redmond, 2007; Smith, 1995; Smith and Morphy, 2007). They operate in a hybrid landscape and have legal obligations to both native title holders and settler systems (Smith and Morphy, 2007). In practice, PBCs can sometimes undermine customary law and generate tension with existing governance bodies (Bauman *et al.*, 2013b, 2013c; Vincent, 2017).

PBCs are also heterogeneous. McGrath and colleagues argue that there is “considerable diversity in the location, size, assets and incomes of [PBCs], as well as in the length of time that they have been in operation, the nature of their native title determination and the extent of their landholdings” (McGrath *et al.*, 2013:30). While some receive income from settlements which are intended to stem potential legal action and often tied to particular applications, many continue to receive no funding despite the responsibilities outlined above. Additionally, there is considerable variation in PBC structure. Some native title holders have customised PBCs to align more closely with traditional modes of governance and their own aspirations (Strelein and Tran, 2007). Others have embraced hybrid forms of governance, where traditional law makers sit on the PBC board alongside elected representatives.

Despite variation within and between PBCs, many are confronted by common challenges. First, they must **comply** with legislation, regulation and customary law, effectively remaining accountable to groups which may have competing interests. Second, they need to **make complex decisions** efficiently and effectively, with limited resources. Third, they must **negotiate** with both internal and external stakeholders – often this includes contending with third parties in highly asymmetric environments with limited legislative support. Each of these challenges are examined in turn below.

In terms of compliance and accountability, PBCs operate in an intercultural legal environment (Bauman *et al.*, 2013b; Martin, 2003; Weir, 2007). From an internal perspective, transparency and compliance with Traditional Law are crucially important to maintaining PBC accountability and legitimacy (Bauman *et al.*, 2013b). This frequently requires extended periods of consultation and negotiation including ongoing community meetings, Annual General Meetings, Ordinary General Meetings, and reporting mechanisms including newsletters, radio programs and websites (Bauman *et al.*, 2013b; Weir, 2007). From an external perspective, PBCs are accountable to Federal Government and other agencies (Barcham, 2013; Weir, 2007). All PBCs must submit general annual reports to the Office of the Registrar of Indigenous Corporations for public record along with other reports as outlined in Table 1.4. Many also need to file progress reports for individual grants, often for amounts less than several thousand dollars.

Table 1.4: Reporting requirements for registered Aboriginal corporations. Table adapted from Australian Government Office of the Registrar of Indigenous Corporations (2015).

Size and income of corporation	Report required
<i>Small corporations</i> (consolidated gross operating income < \$100,000)	1. General Report only
<i>Small corporations</i> (\$100,000 > consolidated gross operating income > \$5 million) <i>Medium corporations</i> (consolidated gross operating income < \$5 million)	1. General report 2. Financial report 3. Audit report OR Financial report based on reports to government funders
<i>Large corporations</i> (and / or consolidated gross operating income > of \$5 million)	1. General report 2. Financial report 3. Audit report 4. Directors' report

The communication and reporting required of PBCs to comply with the existing statutory and regulatory model is expensive and complex (Strelein and Tran, 2007). The demands of this model are such that many PBCs are struggling, often without government support, to achieve their own aspirations (Bauman *et al.*, 2013c; McGrath *et al.*, 2013) and comply with traditional law

and accountability structures (Howitt *et al.*, 2013; Storey *et al.*, 2013). Frequently, given the heavy external reporting burden placed on PBCs, internal communication and consultation does not match community expectations (Weir, 2007). In a worst-case scenario, this can delegitimise PBCs and trigger an incapacity spiral in which they lose both external funding and internal support (Bauman *et al.*, 2013c). Ensuring that PBCs are efficiently accountable to external and internal parties is consequently a key component of good governance and ensuring the broader protection of native title.

In terms of decision-making, the second main challenge confronting PBCs arises where PBCs are faced with strategic, tactical and operational decisions on a regular basis as the legal representative for native title groups (Weir, 2007). As representatives of the local native title holders, PBCs must decide how to represent the opinions of their diverse group while continuing to meet their statutory obligations, including the aforementioned obligations to provide a single point of contact for developers while, at present, being unable to veto development. At times this may result in decisions to emphasise economic benefits at the expense of environmental and holistic goals (O'Faircheallaigh and Corbett, 2005). At other times it may result in selective engagement in service delivery which consumes time and resources to improve quality of life for their constituents. Often, PBC strategic decision making is hampered by chronic underfunding (Bauman *et al.*, 2013b). Consequently, it is imperative that PBCs efficiently, effectively, and transparently allocate their fiscal and human resources as part of their governance (McGrath *et al.*, 2013).

Finally, a right to negotiate around developments under the *Native Title Act*, combined with the reporting and transparency requirements outlined above places a considerable engagement burden on PBCs. PBCs must engage with many internal and external stakeholders as part of their legislated roles. These stakeholders may include state and local governments, natural resource extractors, planners, the tourism industry, the pastoral industry, corporate interests, research bodies, members of the broader local community and, finally, other Indigenous groups which have historical, but not traditional, ties to the area (Yawuru Native Title Holders Aboriginal Corporation, 2013). The relationships of individuals within PBCs and PBCs as a whole can be by historical inequities, personal histories, and even ideological conflicts (Doohan, 2013).

As they currently exist, the negotiations in which PBCs engage are often far from equitable (Howlett and Lawrence, 2019; O'Faircheallaigh, 2006; Strelein and Tran, 2013). Indigenous peoples and native title holders are frequently treated simply as one among many group of stakeholders, and often they are among the most poorly resourced of these groups. Moreover, many of these negotiations occur between groups of people that had been historically separated in time and space. These negotiations, then, create contact zones where PBCs must engage and

grapple without guarantee of a successful outcome. The following sections briefly outline some of these engagements. Specifically, they focus on the key issues of negotiating with natural resource extractors, engaging with town planners, negotiating with governments, engaging with community stakeholders and consulting with their own constituents in the wake of native title recognition.

1.1.6 Negotiations with natural resource extractors

Perhaps some of the most challenging negotiations which can confront PBCs are those which occur with multi-national resource extraction companies which focus on mining, petroleum, gas and timber among other resources (Dodson, 2012; Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012). Successful negotiation with these companies offers advantages for both natural resource extractors and Indigenous peoples (Doohan, 2013; O'Faircheallaigh, 2006). For the company, it offers a 'social licence to operate' which demonstrates their commitment to corporate social responsibility (Banerjee, 2008; Doohan, 2013). For native title groups, it offers a chance to minimise impacts on Country, seek new economic opportunities and implement new social programs (O'Faircheallaigh and Corbett, 2005). It is rare, however, for Indigenous peoples to negotiate a successful outcome which enables their ongoing involvement in the management of Country (Altman, 2009; O'Faircheallaigh, 2006). In part, this can be related to a failure to translate the notion of free, prior, and informed consent, which while vague would allow Indigenous peoples' to realistically say no to mining and other developments on their traditional lands and is a fundamental tenet of the UNDRIP, into Australian law (Altman and Peterson, 1984; Heiner *et al.*, 2019; Trebeck, 2007).

The concept of free, prior and informed consent is far-reaching and incorporated in several articles of the UNDRIP (Articles 10, 11, 19, 29, 30, 32). Of relevance to the recognition of native title in Australia is Article 32 which states that:

"States shall consult and cooperate in good faith with the indigenous peoples concerned...in order to obtain their free, prior and informed consent prior to the approval of any project affecting their land or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources." (United Nations General Assembly, 2007:9)(emphasis added).

The conception of free, prior and informed consent could be construed to include most infrastructure, development, mining and utilities projects undertaken on Indigenous lands. Such a conception is, however, far from the severely limited "right to negotiate" afforded under Section 29 of Australia's *Native Title Act*. Presently, this right to negotiate applies only to certain "future acts" which will restrict or impinge on native title rights, including some mineral and gas

exploration. Indeed, while Indigenous peoples hold a right to veto developments under the *Aboriginal Land Rights Act*, they cannot do so through their native title system. As it currently stands, the native title system does not even guarantee native title holders a percentage of any wealth plundered from their traditional lands (Edgeworth, 1994; O'Faircheallaigh, 2006).

Within the current system, where a future act is identified and it has not been expedited by the relevant minister, native title communities have six months to negotiate with natural resources extractors or others expecting to benefit from the proposed act. If an agreement cannot be reached under the right to negotiate, any party can apply to the National Native Title Tribunal to arbitrate the matter. This arbitration is often inadequate from an Indigenous perspective: it cannot offer compensation, and rarely hampers mineral development (O'Faircheallaigh and Corbett, 2005). The tribunal conducting the arbitration relies purely on Western style evidence of “how the *enjoyment* by the native title party of the bulk of its registered rights and interests *in the area of the proposed tenement* will be affected in an immediate and real manner by the proposed future act” (referring to *Bissett v Mineral Deposits (Operations) Pty Ltd* (2001) 166 FLR 46, 65) [emphasis added], in Sumner and Wright [2009]). Thus far, many Indigenous peoples have not provided such evidence in a form accepted by the tribunal. In many respects, this failure to provide evidence deemed acceptable to Western courts is not because such activities are low impact. Instead, it is indicative of an “information democracy deficit” (Dodson, 2012) or information asymmetry whereby Indigenous peoples “...don't have a lot of the data or the information that government agencies have got, or the plans that they have for future usages of the Country” (Dodson, 2012). Such information asymmetries significantly impair PBC capacity to make rapid and informed choices in this time-tight and high-pressure decision environment. They create a clear gap between the concept of free, prior and informed consent as envisaged by the UNDRIP and the limited ‘right to negotiate’ afforded under native title (Yawuru Native Title Holders Aboriginal Corporation, 2013; Yu, 2013b).

In the current system, given poor translation between the principle of free, prior and informed consent, and the extremely constrained right to negotiate facilitated by native title, it is rare for Indigenous peoples to negotiate a successful outcome which enables their ongoing involvement in the management of Country (Altman, 2009; O'Faircheallaigh, 2006). Indeed, even comparatively successful negotiations with natural resource extractors which secure promises of employment, cash payments, training and land management opportunities do not guarantee a positive outcome from mineral extraction (Yu, 2013b) and long-term resource extraction frequently has little positive impact on local community development (Altman, 2009). Profit driven corporations, including natural resource extractors, are ill-suited to taking over the government's responsibility for social welfare (Banerjee, 2008:74).

1.1.7 Engaging in town planning

A second key area of engagement for some PBCs is the area of town planning. Three quarters of Australia's Indigenous people live in urban or regional areas (Walter, 2016), yet even within these towns the Indigenous community is often "economically, spatially and socially separated" from the non-Indigenous population (Atkinson *et al.*, 2010: 318). Both globally and in Australia, cities continue to be among the most hostile environments to Indigenous interests (Lea *et al.*, 2012; Njoh, 2010; Sandercock, 2004) and throughout Australia's colonial history, Indigenous peoples have been pushed to the margins of a town, only to be moved again as the town expanded (Jackson, 1997a; Porter, 2012). Today, town planning and zoning frequently continue to infringe on Indigenous interests (Howitt *et al.*, 2013; Jackson, 1997b) and many of the tenure forms which dominate towns are viewed as extinguishing native title (Porter, 2013).

Involvement in town planning and governance initiatives can be crucially important for PBCs and Indigenous peoples who seek to reduce certain forms of structural violence and receive adequate and appropriate service provision. Indigenous peoples continue to claim native title in urban areas (Wensing and Porter, 2016). Moreover, towns and cities are homes for many Indigenous peoples and consequently key points of contact with other Indigenous groups as well as loci for service provision (Walter, 2016). Towns can also function as key points of contact with other Indigenous groups (Doran and Young, 2013; Prout, 2011; Taylor *et al.*, 2014). Indeed, where a PBC has successfully claimed native title in an urban area, that group is often then recruited to function as a key point of contact with other Indigenous peoples by virtue of their status as traditional owners. Finally, many PBCs operate from within towns as outlined in the "Find a PBC" website (Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), 2018).

Town planning has the potential to positively impact the lives of Indigenous people in Australia (Cosgrove and Kliger, 1997; Kliger and Cosgrove, 1999). Moreover, the planning profession increasingly recognises the need to integrate multi-cultural interests into plans (Qadeer, 1997; Sandercock, 2000; Storey *et al.*, 2010; Thompson, 2003). Indeed, a number of planning practitioners and academics have made compelling arguments for the need to fundamentally reshape, and even reappropriate planning theory and practice to better incorporate Indigenous interests (Barry and Porter, 2012; Cosgrove and Kliger, 1997; Indigenous Planning Working Group, 2010; Jackson, 1997a, 1997b; Matunga, 2013; Peters, 2005; Porter, 2017; Porter *et al.*, 2017; Sandercock, 2004; Walker *et al.*, 2013; Wensing and Porter, 2016). Nonetheless, multi-cultural planning in Australia rarely accounts for the unique rights and interests of Indigenous Australians (Indigenous Planning Working Group, 2010; Margerum *et al.*, 2003; Wensing, 2013). Instead, it often emphasises development and commercialism over Indigenous

interests (Sandercock, 2000:9) and leaves many PBCs to engage in hierarchical planning structures which hostile to traditional Indigenous modes of communication (Cosgrove and Kliger, 1997; Kliger and Cosgrove, 1999; Porter, 2006). Given the lack of cross-cultural tools and training available to planners within the current system (Indigenous Planning Working Group, 2010), Indigenous peoples are often called on to assume the sole burden of bridging the cultural divide (Yunupingu, 2009). Consequently, PBCs remain under significant pressure to leverage all potential administrative, legal, political and social options available to them, if they wish their values and interests to be integrated into the planning process (O'Faircheallaigh and Corbett, 2005).

1.1.8 Negotiations with settler governments

As was alluded to earlier, Australia is well behind its settler colonial counterparts in recognising the prior and unceded sovereignty of Indigenous peoples (Cornell, 2013). At present, Australian governments do not recognise Indigenous peoples' right to sovereignty and self-determination. In contrast to the United States and Canada where some negotiations are framed on a government-to-government basis, the current system in Australia means that native title holders in Australia typically negotiate with governments as interest groups rather than as recognised "nations" in their own right (Ellemor, 2003; Glaskin, 2003).

Since the 1967 referendum, Australia's national government has held many decision-making powers related to Indigenous rights (Bennett, 1985). For native title holders, these powers influence their capacity to raise funds from their customary lands, to control the management of those lands, and even regulate finances within their communities. Despite policy rhetoric around self-determination in the 1970s, and the homelands movement, the national government's decision-making powers have not been deployed to facilitate Indigenous self-determination (Davis, 2012a; Dodson, 1996a).

Since native title was recognised in 1992, there have been significant shifts in government rhetoric around Indigenous affairs, if not always government practice. As outlined earlier, in 1993, the Keating government introduced the *Native Title Act* to both protect and contain native title. However, by the mid-1990s, the Howard government retreated from a focus on land rights by focusing instead on "practical reconciliation" as a metaphor for settler government-driven economic advancement and assimilation (Altman *et al.*, 2009; Altman and Hunter, 2003; Hunter and Schwab, 2003). That government also introduced the *Northern Territory Emergency Response Act 2007* (Cth), more commonly known as "the Intervention", which declared a state of emergency in Indigenous townships and town camps (Lovell, 2012; Stringer, 2007). Ostensibly due to concerns around child-welfare, but conflated with larger rhetoric around Indigenous

dysfunction, the Intervention was also viewed as an attempt by a settler government to resume control of Indigenous land (Howard-Wagner, 2012; Lovell, 2012; Stringer, 2007).

In the wake of the Intervention and an apology to the Stolen Generations⁴, the Rudd/ Gillard government shifted policy focus to the now highly critiqued and negatively framed Council of Australian Governments (COAG) Closing the Gap strategy, which focused on reducing disparities between Indigenous and non-Indigenous Australians in terms of health and education outcomes (Altman *et al.*, 2009; Australian Government Department of Prime Minister and Cabinet, 2017; Biddle and Taylor, 2012).

Later, following the Liberal/ National Coalition's election in 2013, the Abbott government reverted to the neo-colonial and neo-liberal white paternalistic stance of making decisions *for* Indigenous peoples rather than making decisions *with* Indigenous peoples (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2014). Then, in 2017, the Turnbull government consulted with Indigenous peoples, but failed to hear their call for a First Nations Voice enshrined in the Constitution and a Makarrata Commission to "supervise a process of agreement-making between governments and First Nations and truth-telling about our history" made during the Uluru Statement from the Heart (Conifer *et al.*, 2017; Referendum Council and Commonwealth of Australia, 2017). As Megan Davis eloquently notes, in doing so, they "revealed the limitations of Australian retail politics" (Davis, 2018:13) for supporting Aboriginal aspirations.

The critiques above have focused on Australia's national government, and its failure to heed the advice of Indigenous peoples and PBCs, let alone devolve its powers for decision-making. However, similar challenges are evident when PBCs engage with state and local governments. While some local governments attempt to incorporate native title holders and traditional owners in planning mechanisms, such engagements are routinely conducted on the government's terms (Cosgrove and Kliger, 1997; Jackson, 1997a; Kliger and Cosgrove, 1999; Tarran, 1997). Additionally, councils attempting proactive planning processes are often hampered in such efforts by minimal cross-cultural training (Howitt *et al.*, 2013; Margerum *et al.*, 2003; Tarran, 1997), mistrust from past injustices, market forces, state and national legislation and a feared public backlash from their non-Indigenous constituents (Jackson, 1996).

At the state level, some governments such as Victoria have begun the process of slowly working towards a multi-pronged treaty. Others, including Western Australia have proposed, though not implemented, substantive changes to their *Aboriginal Heritage Act 1972* (WA)

⁴ The term 'Stolen Generations' describes Aboriginal children who were forcibly removed from their families and communities because of government policy. Many of these children were raised in institutions, fostered out, or adopted by white families. This removal of children "broke important cultural, spiritual and family ties and has left a lasting and intergenerational impact on the lives and wellbeing of Aboriginal and Torres Strait Islander people" (AIATSIS, 2014b, p. 1 of 3).

(*‘Aboriginal Heritage Act’*) which would have undermined Indigenous peoples’ capacity to protect Country (Vaughan, 2016); worked hard in the courts to fight particular native title claims (Burke, 2011a); and more recently, re-opened fractured shale gas mining in the state’s north-west (Laschon and Shine, 2018). While policies shift from state to state and government to government, few recognise a need to seriously engage with Indigenous peoples on a nation-to-nation basis. Given this, PBCs are often reliant on local good will, and their own tenacity, to bring about appropriate reforms.

1.1.9 Negotiations with community stakeholders, including other local Indigenous residents

For many PBCs, successful governance also involves negotiating and creating alliances with various community stakeholders. Alliances with environmental groups have, for example, contributed to the creation of the jointly-managed Barmah-Millewa National Park (Pickerill, 2009) and helped hold mines like Century Zinc Mine in Queensland’s Gulf of Carpentaria region to account for violations of community agreements (Trebeck, 2007). They have also facilitated the combined efforts of the Wangan and Jagalingou Traditional Owners Family Council and environmental groups such as 350.org to “Stop Adani” and the development of the Carmichael Coal mine (Lyons *et al.*, 2017). Yet while these alliances are potentially valuable, they can also be tension-filled (Langton, 2013; Markham and White, 2013; Vincent and Neale, 2017). For example, there may be tensions between environmentalists’ desire to “conserve” or “protect” an area and Indigenous peoples desire to protect Country whilst also benefiting from economic development (Pickerill, 2009; Porter, 2012). Beyond environmental alliances, PBC governance decisions, such as whether to accept concessions from a mining company which favour native title holders rather than to continue to oppose a mine’s construction, will impact other members of the local community (Burnside, 2013).

PBCs do not just engage with environmental groups, but other local residents, interest groups and Indigenous peoples. This range of community stakeholders can make for complex and challenging negotiations. It can also make for valuable interactions. The Yawuru Jarndu Aboriginal Corporation – trading as Nagula Jarndu (Saltwater Woman) is a not for profit incorporated body with a membership of 70 Indigenous women and is governed by 8 Yawuru women Directors which first started operating in 1987. Today, the organisation is focused on social enterprise and “[Indigenous women at the centre] are supported to engage with the broader Aboriginal Arts community and participate in valuable opportunities including the Darwin Aboriginal Art Fair, Revealed (Perth), and many other exhibitions both in regional areas and capital cities throughout Australia” (Nagula Jarndu Women’s Arts and Resource Centre, 2019, p.2 of 3). Similarly, prominent Yawuru community members including Eunice Yu and Patrick

Dodson worked with many in Broome's polyethnic community to ultimately over-throw the Broome Shire Council's decision in 2009 to suspend the sister-town relationship between Broome and Taiji, which was established because of the area's shared history around pearling, due to controversy around Taiji's practice of culling dolphins (Kaino, 2011).

Finally, the relationships that PBCs hold and maintain may be most important, and most fraught when interacting Indigenous peoples who have historical, but not traditional, ties to the local area (Edgar, 2011). Such groups are frequently forced to compete with native title holders for resources and authority (Strelein, 2013), and are often impacted by the politics of inclusion and exclusion around native title. As an example, Aboriginal Land Trust lands, which frequently house Indigenous people who experience considerable socio-economic disadvantage, are subject to native title claims, even exclusive native title claims, which can result in evictions of present residents (Taylor *et al.*, 2014; Wensing and Taylor, 2012). Beyond this, as representatives of the traditional owners of a given area, PBCs and native title claimants may be called on by local councils to help engage with, and even regulate, local itinerant Indigenous people in ways that can further strain intra-Indigenous relationships (Mailer *et al.*, 2010; Scambary, 2007).

Though by no means the sole responsibility of PBCs, a failure to create and maintain constructive relationships can further fracture communities already divided by the native title claims process (Vincent, 2017). Given that "the debilitating effects of intra-Indigenous conflict [...] always prove inimical to agreement" (Smith, 1998:21) and that native title can place significant social strain on Indigenous peoples, maintaining respectful and balanced connections to community stakeholders and other local Indigenous residents is crucial to ongoing PBC governance in a settler colonial context.

1.1.10 Consultation and negotiation with their own constituents

A final area for PBC engagement is with their own constituents. Ultimately, PBCs are not complete incarnations of the peoples they represent. Legally, PBCs are *required* to consult with their members on issues which involve the extinguishment or surrender of native title (AIATSIS, 2006; Strelein and Tran, 2007). However, the consultation burden *expected* of most PBCs is considerably more elaborate. Adding to this complexity is substantial diversity among native title holders: members of a single group are often different ages, and may hold different affiliations and family connections. Many may also have different aspirations for the native title rights and interests of the community (Barcham, 2013; Hunt and Smith, 2007; Weir, 2007). Additionally, not all people who belong to a native title holding group are members of its PBC. Indeed, there is often considerable contention around who is, and is not, considered a native title holder for certain Country. Ultimately, while PBCs are expected to provide a single point of

negotiation for developers, they are rarely able to fully represent the heterogeneous and diverse viewpoints of their constituents (Vincent, 2017). Maintaining accountability in this environment then requires PBCs to consult with, report to, and even negotiate with members of their own communities (Howitt *et al.*, 2013), complicating an already challenging environment following native title recognition.

1.1.11 The need for practical support of PBC governance

Native title recognition is not a panacea for the many challenges facing Indigenous peoples in contemporary Australia and supporting PBC governance is not the only way to engage with these issues. Nonetheless, for some Indigenous peoples, native title recognition and co-management arrangements have “provided a significant entry point into having some say in [land and sea] management” (Bauman *et al.*, 2013a:57). Moreover, where native title is appropriately leveraged and adequately resourced through strong and effective governance, it can contribute towards some semblance of self-determination by supporting greater Indigenous control over their own lives and lands. Perhaps most crucially of all, once a group has sought native title rights, those rights need to be defended. If not, imposed settler legal structures allow them to be undermined through future acts and the threat of extinguishment.

To date, considerable research effort has been spent examining the forms of PBCs and related governance bodies, evaluating the impacts and cultural appropriateness of PBCs as organisations, and regulating and supporting PBCs as Registered Indigenous Governance Bodies (The Aurora Project, 2012; Bauman *et al.*, 2013b; McGrath *et al.*, 2013; Storey *et al.*, 2013; Strelein and Tran, 2013; Weir, 2007). This effort has generated a range of policy recommendations as well as suggested structures and training for PBCs (see for example Strelein and Tran, 2007; Hunt and Smith, 2007). Indeed, McGrath *et al.* (2013) argue that research into building PBC governance capacity may be one of the most significant steps in assuring the assertion and protection of native title rights and interests. It may also be key to enabling Indigenous peoples to engage more effectively with the settler colonial contact zones which frame their daily governance and negotiations. Nonetheless, much research on PBCs to date has failed to critically examine tools, technologies, sciences, (or scientific mindsets) that may be used to support PBC decision making.

In general, as the vehicles for asserting and defending native title rights, PBCs find themselves as focal structures located at the nexus of a complex web of relationships, including with outside economic interests, governments, their own constituents and other Indigenous peoples. This nexus gives some PBCs considerable potential to employ various ‘arts of the contact zone’ or strategies in those environments (Pratt, 1991). It also makes them vulnerable to attack

from diverse actors and provides a strong practical imperative to support PBC governance. Given the number of negotiations and tactical, strategic and operational decisions that PBCs face on a regular basis, they have a clear need for decision support. The spatial nature of issues such as local development, natural resource management, natural resource extraction and service delivery, combined with a focus on land and the control of territory within settler colonial narratives suggests that decision support systems with a spatial element may be particularly appropriate for use by PBCs. This research seeks to address some of these issues by exploring GIS as a spatial tool to support post native title governance. It does this by exploring applications of GIS technologies with the Yawuru people of Broome, Western Australia.

1.2 A brief introduction to the Yawuru case study

Yawuru people hold native title in Broome, Western Australia, and surrounding areas (National Native Title Tribunal, 2016a). Their native title journey incorporates twelve years of protracted litigation; five years spent negotiating a land mark “Global Agreement” which provided A\$200 million in land and cash transfers; and three years of governance in the wake of this agreement (Government of Western Australia, 2010). As salt-water people, Yawuru people hold native title in and along the shores of Roebuck Bay (Yawuru RNTBC, 2013).

Like other native title communities, the Yawuru PBC faces an array of administrative and practical challenges across both rural and urban environments. In Broome, the Yawuru PBC confronts issues of population growth, urban development and overfishing (Yawuru RNTBC, 2013). These place considerable pressure on surrounding ecosystems (Yawuru RNTBC, 2013). Near the inland border of the Yawuru estate, Buru Energy has announced plans to open five fracking wells in the Canning Basin (Collins, 2013a). These fracking sites are within the catchment for nationally-significant, biodiverse, and Ramsar Treaty protected Roebuck Bay (Bennelongia, 2009). Challenges experienced by the Yawuru PBC extend beyond the border of their own native title estate. Although the onshore development of James Price Point 50 kilometres to the north of Broome was ruled to be illegal, Woodside is now proposing an alternative offshore gas rig that would place significant pressure on the town's infrastructure (Gribbin, 2013). Additionally, the Yawuru estate faces pressure from existing infrastructure such as the waste water plant which has overflowed into Roebuck Bay at least twice in response to record rainfall in early 2018 (Environs Kimberley, 2018). The Yawuru PBC and their subsidiary company, Nyamba Buru Yawuru (NBY), engage with these issues as traditional owners of the local area and are key stakeholders in the town's development. In addition, they are landholders who seek to enter the commercial market as a means of funding community development and maximising community benefit from native title recognition (Yu, 2013c).

To deal with these issues the Yawuru PBC have adopted a strategic knowledge vision to inform, support, and guide their community governance (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012). The use of Geographic Information Systems (GIS) technology to produce synthesised, analytical and collective cultural mapping outputs, is a key component of this vision, one that Yawuru chose to highlight when they recently hosted the National Native Title Conference alongside the Kimberley Land Council. Indeed, the Aboriginal and Torres Strait Islander Social Justice Commissioner's 2012 report records how:

“in partnership with the Fenner School of Environment and Society [(the Fenner School)] and [the Centre for Aboriginal Economic Policy Research (CAEPR)] at [The Australian National University (ANU)], the Yawuru Peoples are using [GIS] mapping technology to digitally map Yawuru Country. This process informs the geographic aspects of Yawuru Country and maps places of cultural and social significance for Yawuru Peoples. This work will also enable Yawuru Peoples to map and monitor historical, current and future use of Yawuru terrestrial and marine environments and provide Yawuru with evidence – both from a Yawuru cultural perspective and from Western science – to assess the actual and potential impacts of the various activities which occur on Yawuru Country” (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012:50).

This research falls under the Fenner School–NBY GIS partnership⁵, which is also referred to as “the GIS partnership” in this thesis. It extends on earlier work conducted in this partnership with Yawuru in 2013 and focuses on the production of practical and contextually appropriate techniques for mapping the Yawuru living cultural landscape, with a focus on cultural values and valued practices. While I bear sole responsibility for the quality of this written thesis, the work would not have been possible without considerable input from Yawuru research partners throughout the process.

1.3 Research questions

In line with the Yawuru Knowledge vision and the need to create and explore tools which can help PBCs and other Indigenous governance bodies to engage in a post native title environment, this research seeks to explore four questions:

- I. How can outputs from context-grounded spatial analysis which draws on qualitative analysis and fuzzy logic help support Yawuru governance in a post native title environment?

⁵ This is an ongoing, working relationship based around the use of GIS for post native title governance. It is an evolving partnership which does not have a formal name. As a postgraduate student writing from within the Fenner School, I use the term “the Fenner School–NBY GIS partnership” to describe this partnership.

- II. What do settler colonial theory and Pratt's conception of the contact zone suggest about the likely impacts of this approach and its outputs for Yawuru engagement in a post native title environment? How are these insights contextualised by information drawn from sketch mapping interviews with Yawuru participants? What does this imply for Yawuru governance?
- III. How did this research extend on earlier work modelling values in a Yawuru context? What were the strengths of these extensions? What were their limitations? What implications does this have for adapting, refining, and further contextualising these techniques in future research?
- IV. To what extent can techniques and approaches to spatial analysis developed in this research be transferred beyond the context in which they were created?

1.4 Research scope

As chosen with a reference group comprised of Yawuru people and some non-Yawuru staff from NBY, this study aims to model valued areas (values model), concerns held for valued areas (concerns model) and seasonal use of valued areas (seasonal use model) for Broome Town and Crab Creek (Figure 1.1). The values and concerns models are composed of a sequence of sub-models which extend on an earlier pilot study (Potter, Doran and Mathews, 2016) (Appendix 1) and may be used as a further proof of concept to inform Yawuru governance and guide future data collection across the Yawuru estate. The seasonal use model builds on earlier depictions of valued sites and incorporates a multi-temporal element into the modelling process.

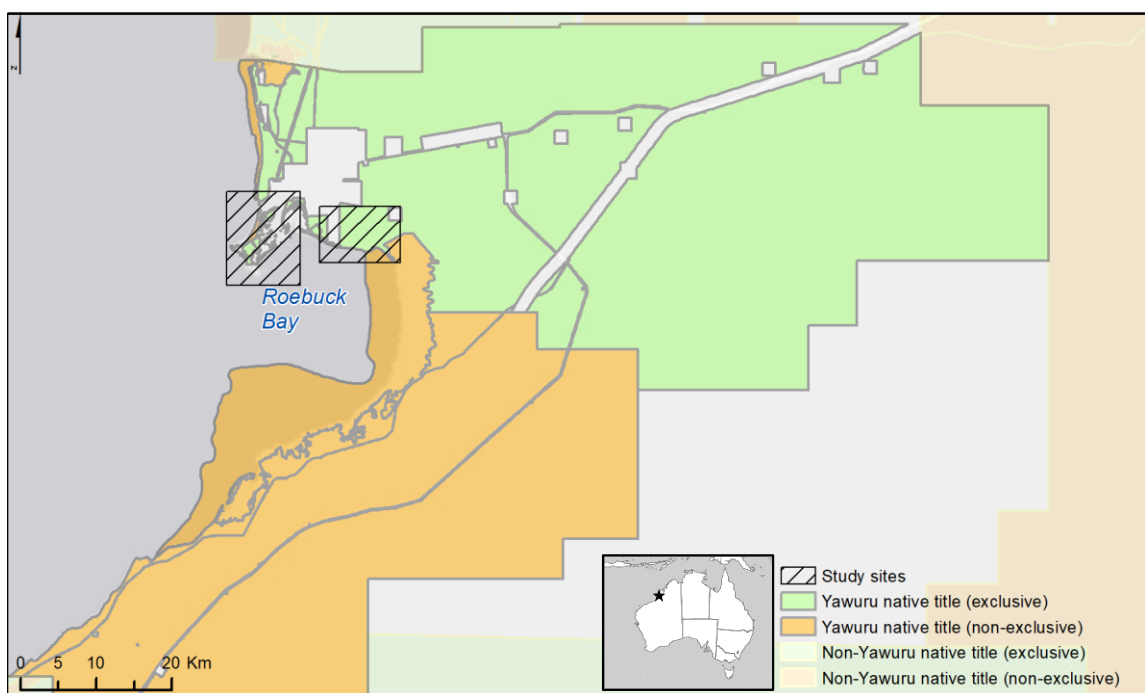


Figure 1.1: The Yawuru native title estate

Models for Broome Town are spatially constrained to the area south of Bilingurr while those for Crab Creek are constrained by the area immediately west of Crab Creek Road and the mouth of Crab Creek to the east and south. Although some data was collected on *Bugarrigarra* or dreaming sites, these sites are not incorporated into the values model. It is not within the scope of this study to produce a complete or comprehensive representation of all values, concerns, or seasonally used areas within the two study sites.

This thesis does not represent the views of all Yawuru people. Rather, it draws on primary data to produce three collective models from interviews with twelve Yawuru people. Moreover, it does not evaluate the long-term impacts of holding techniques developed in this research on post native title governance. Finally, this research presents an evaluation of techniques with a single governance organisation for a single native title holding group – as such, results from this research cannot be generalised to all native title holders.

1.5 Thesis structure

This chapter has introduced several practical imperatives for this research. It has established the research's rationale, scope and focus. Chapter 2 positions settler colonial theory and Pratt's conception of the contact zone as appropriate analytical frameworks for understanding elements of the post native title environment. It highlights how particular models of space have resulted in problematic and bounded modes of repossession through native title and explores contradictions associated with Indigenous GIS use in such environments.

Chapter 3 introduces the Yawuru case study as a means of investigating the role that geospatial technologies could play in the local contact zones of settler states. It also describes the two study sites used in this study.

Chapter 4 introduces my research standpoint and describes how I incorporated Indigenous methodologies⁶, critical Geographic Information Science (GIScience) and qualitative GIS into the research design. This chapter provides the rationale for GIS-based spatial analyses which draw on fuzzy logic in indigenous and Indigenous contexts. It also highlights the potential of qualitative analyses to inform and contextualise GIS-based representations in this research.

⁶ Following Louis (2007:133) and Kovach (2009) I use "Indigenous methodologies" to describe fluid, dynamic and circular approaches whose "main aim is to ensure that research on Indigenous issues is accomplished in a more sympathetic, respectful, and ethically correct fashion" (Louis 2007:133) from the perspective of First Peoples, aboriginal peoples, native peoples, or autochthonous peoples around the globe, not just Australia and the Torres Strait Islands.

Chapter 5 positions sketch mapping as an appropriate data collection technique to support spatial analysis in an indigenous context; outlines a semi-structured approach to sketch mapping interviews; and presents core outputs from the sketch mapping.

Chapter 6 introduces the context-grounded approach to spatial analyses and index modelling adopted in this research. It also outlines the iterative approach to qualitative coding used in this analysis.

Chapter 7 summarises the results of spatial analysis and index modelling in this study. It identifies sites of value and concern for participants; shows seasonal patterns in the use of valued sites; and displays some strategic information which may be used for decision support by Yawuru governance bodies.

Chapter 8 presents results gleaned from the iterative qualitative analysis of sketch mapping interview transcripts. It presents a series of strategies and practices participants employ to engage in a post native title environment and examines these strategies in light of settler colonial theory and Pratt's concept of the contact zone.

Chapter 9 discusses and interprets key findings in relation to the research questions and identifies how strategic intelligence from the spatial models may support Yawuru governance in a post native title environment. It uses settler colonial theory and Pratt's conception of the contact zone alongside observations from sketch mapping interviews and fieldwork to make several recommendations for Yawuru governance bodies. This chapter evaluates both strengths and limitations of the approach adopted in this research, draws conclusions about the extent to which this approach is transferable beyond the Yawuru context and argues that viewing Indigenous GIS use as an art of the contact zone may make a valuable contribution to broader critical GIS debates.

Chapter 10 summarises and concludes this thesis by making recommendations for policy and research and identifying areas for further investigation. It reflects on the role that GIS might play in reconciliation and nation building in post native title Australia.

Chapter 2: Literature Review

This chapter reviews literature relevant to this study. The first part of this chapter introduces the concept of settler colonialism. It argues that settler colonial theory provides an important mechanism for understanding the structural challenges faced by Australian native title holders (Chapter 1). It also explores how particular models of space facilitated the settler project and resulted in problematic and bounded modes of repossession and concludes by presenting a need to challenge these spatial structures.

The second part of this chapter uses Pratt's concept of the contact zone (Pratt, 1991) to examine how Indigenous peoples can engage with structural inequities following native title recognition in settler states. It positions contact zones as productive but inequitable sites of tension closely linked to the challenges of governing in a post native title environment. Finally, it examines the idea that Indigenous peoples can transculturate, that is adopt and adapt, certain "arts of the contact zone" (Pratt, 1991) which have been instrumental to settler power.

The third and fourth parts of this chapter outline Geographic Information Systems (GIS) technologies as one of the "arts" increasingly adopted by indigenous peoples around the globe. Part Three introduces some contentious issues associated with indigenous GIS use. Following Johnson, Louis and Pramono (2005), it argues that indigenous peoples would be well served by developing a critical GIS literacy which enables effective engagement with the technology and its history. To further encourage such literacies, Part Four describes and critiques five dominant indigenous approaches to GIS. It contrasts the power of current approaches with their use of spatial models which can support settler power, or their failure to harness the technology's analytical potential to support Indigenous governance.

Ultimately, Part Five of this chapter makes a call to explore a new approach to GIS which challenges the cadastral model and harnesses the technology's analytical potential to support post native title governance.

2.1 Understanding the complexities of a post native title environment through a settler colonial lens

Australia is a former British settler colony. Unlike colonies in Latin America, Africa and Asia, it was not explicitly designed to exploit Indigenous labour. Partly, this was a result of the low density of the pre-existing population, much of which was located in what were considered by the settler population as "unproductive" zones. Instead, settlers in Australia sought to erect a new colonial society on a land base expropriated from its First Peoples (paraphrased from Wolfe 2006:388). To a large degree, nations in the Global South have experienced decolonising Federal

moments and declarations of independence since World War Two (Collins, 2013b). However, settler colonial theorists posit that in Australia - and to a certain extent other British settler states such as the Canada, Aotearoa/ New Zealand and the United States – three characteristics of settler colonialism inhibit potential for similar decolonisation (Veracini, 2010; Wolfe, 1999).

First, settlers came to stay (Wolfe, 2006). They did not simply exploit labour and resources from a colony before returning to the metropole. Instead, settlers destroyed to replace (Wolfe, 1999:1). Settlement, the act of staying permanently, requires the deterritorialisation of Indigenous outsiders and the exclusion of others who might seek to claim the land (Veracini, 2010). Settlers reinforce this deterritorialisation through spatial mechanisms, such as cadastral (i.e. land parcel-based) mapping, and notions of Lockean improvement whereby a person's rights to property are the result of mixing their labour with the land (Porter, 2012). They also use narratives, such as ideas of smoothing a dying pillow (Wolfe, 1994) to position Indigenous peoples as “out of time” and “out of place” within the settler state. In his seminal book *Settler Colonialism: A theoretical overview*, Veracini (2010:20) argues that “when settlers claim land, it is recurrently in the context of a language that refers to ‘higher use’”.

Second, as Veracini (2010) has summarised, invasion is an ongoing structure, not an event. Settler colonialism does not end when political allegiance to the metropole is severed through Federation (Veracini, 2010). Indeed, “lacking the possibility of a clearly defined decolonising moment (i.e., the moment in which settler colonialism discontinued), settler colonial contexts retained the policy objectives, if not the methods, of their pasts” (Veracini, 2010:11). As stated above, the dominant feature of settler colonies is not exploitation, but replacement (Wolfe, 1999). This creates “a sustained institutional tendency to eliminate the Indigenous population” (Veracini, 2010:9). It also informs “a range of historical practices that might otherwise appear distinct” (Veracini, 2010:9). The result is “an inherently dynamic circumstance where Indigenous [...] Others progressively disappear in a variety of ways [including] *extermination, expulsion, incarceration, containment, and assimilation*” (Veracini, 2010:16). Such disappearance is facilitated by a logic of elimination which pervades settler policy (Wolfe, 1999). This logic is designed to indigenise and enable settlers, neutralise migrants, and eliminate those indigenous Others who have a claim to sovereignty which undermines the morality of the settler state (Veracini, 2010).

Third, settler colonialism is mimetic (Veracini, 2010:15). The founding narratives of settler colonies often position those nations as separate and morally superior to the metropole (or original imperial power, i.e. Britain). Moreover, the logic of elimination which pervades contemporary settler policies is rarely overt. Instead, settlers will often attribute founding violence against indigenous peoples to “ruthless convicts” (Veracini, 2010:14) or a “need to defend themselves”,

rather than acknowledge these occurrences as highly racialized structures which support settler political and economic systems. In the same vein, settlers frequently position discriminatory practices as dealing with an immediate human rights crisis or social problem, rather than opportunities for greater regulation of indigenous peoples. In Australia, this is particularly apparent in the language governments used to justify discriminatory practices such as the Intervention (Lovell, 2012) and the closing of remote Aboriginal communities (Howitt and McLean, 2015). It also shows in the centralisation of services to those communities (Markham and Doran, 2015) and the introduction of income management measures such as restrictive Basics cards (Altman, 2016; Bielefeld, 2014) which have undermined Indigenous peoples' capacity for, and right to, self-determination.

2.1.1 Cadastral mapping, the settler project and native title

Given that settler colonialism relies on claims to land and the deterritorialisation of the indigenous Other, spatial mechanisms including cartography are often key instruments of the settler project. Maps, for example, sit at a knowledge-power nexus and are, in many ways, an imperial technology (Harley, 1989). Often, they are “used to facilitate and celebrate the further advances of explorers, and display worldwide imperial possessions” (Ryan, 1996:5).

In Australia, maps expanded and indigenised settler mobilities while erasing Indigenous peoples' spatialities from the Australian landscape (Clarsen, 2014). In terms of erasure, Ryan argues in *The Cartographic Eye* that “[t]he cartographic process of representing the unknown as a blank does not simply or innocently reflect gaps in European knowledge but actively erases (and legitimises the erasure of) existing social and geo-cultural formations in preparation for the subsequent emplacement of a new order” (Ryan, 1996:104). He demonstrates that settler mapping in Australia mapping rendered “the continent as an empty, inverted space desperately requiring rectification and occupation” (Ryan, 1996:104).

As a mechanism for establishing a new property system and spatial order, perhaps no form of mapping has been more instrumental to establishing settler power than the cadastral survey. Cadastral surveys create “complete and up-to-date official register[s] or inventor[ies] of land parcels in any state or jurisdiction containing information about the parcels regarding ownership, valuation, location, area, land use and any buildings or structures thereon” (Williamson, 1985:115). In Britain and France, nations with well-established and previously illegible property systems, cadastral surveys reflected and consolidated the power of the modernist state by facilitating taxation and land transfer (Scott, 1998). In settler states, cadastral surveys catalogued resources including land and functioned as a declaration of possession (Kain, 2002). They used particular signs and symbols to both describe a system of land tenure and create it through force of law. Today, cadastral systems in Australia and other common law countries form the basis of

spatial data infrastructure central to land administration (Ting and Williamson, 1999). They incorporate all parcels of land in the state and have a unique common identifier for each parcel (Williamson, 1985). They are continually updated, public (within “reasonable” limits), and supported both by a coordinated survey system with clear parcel boundaries and by information with legal status (Williamson, 1985).

In Australia, the cadastral model of space continues to demonstrate and reinforce settler power in a number of ways (Porter, 2012; Porter and Barry, 2015). Initially, the ‘instantaneous’ appearance of the cadastral grid in cadastral mapping contributed to the myth of *terra nullius* by ignoring all previous forms of tenure and at least 65,000 years of occupation. It made the land seem empty and welcoming to settlers and was often a large motivator in individual settlers’ decisions to migrate (Dalrymple *et al.*, 2003; Kain, 2002; Ryan, 1996). Then, cadastral mapping and Torrens titling facilitated rapid expansion of settler interests over the Indigenous landscape by dividing the land into a homogenous grid with individual units registered to settlers on a first-come, first-served basis (Porter, 2012; Scott, 1998). As an example, Figure 2.1 shows a town plan of Broome from 1890, while Figure 2.2 shows a rapid expansion of the planned town just sixteen years later in 1906.

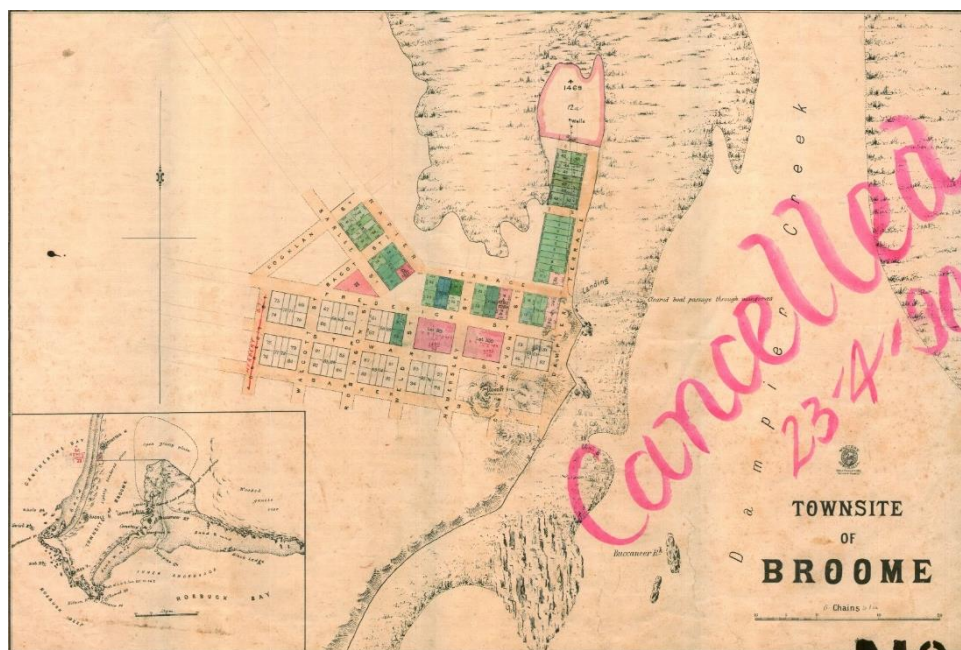


Figure 2.1: Town plan for Broome from 1890. State Records Office of Western Australia, Series S2168, Cons. 5698, Item 0228 Broome Sheet 1 [Tally No. 503849].

These grids supported the commercialisation of land and helped impose new economic and social orders uninfluenced by customary relationships to place (Dalrymple *et al.*, 2003). They also facilitated the taxation of land following its sale (Kain and Baigent, 1992; Scott, 1998).

Indeed, cadastral mapping gave clarity and surety by measuring and protecting individual settlers' stakes in the system (Kain, 2002): it neither recognised pre-existing rights, nor allowed those rights inherent in certain forms of property, including freehold title, to overlap (Williamson, 1985).

Finally, cadastral mapping locked up Indigenous places and facilitated racial separation (Byrne, 2003, 2008). Lines drawn around towns on cadastral maps were transformed both into reserves designed to contain Indigenous peoples and into physical barriers which, combined with policies such as the *Aborigines Act 1905* (WA) ('*Aborigines Act*'), barred Indigenous people from their own towns (Byrne, 2003; Prout and Howitt, 2009). For individual property owners, cadastral mapping generated property rights and provided them with a legal justification for the erection of

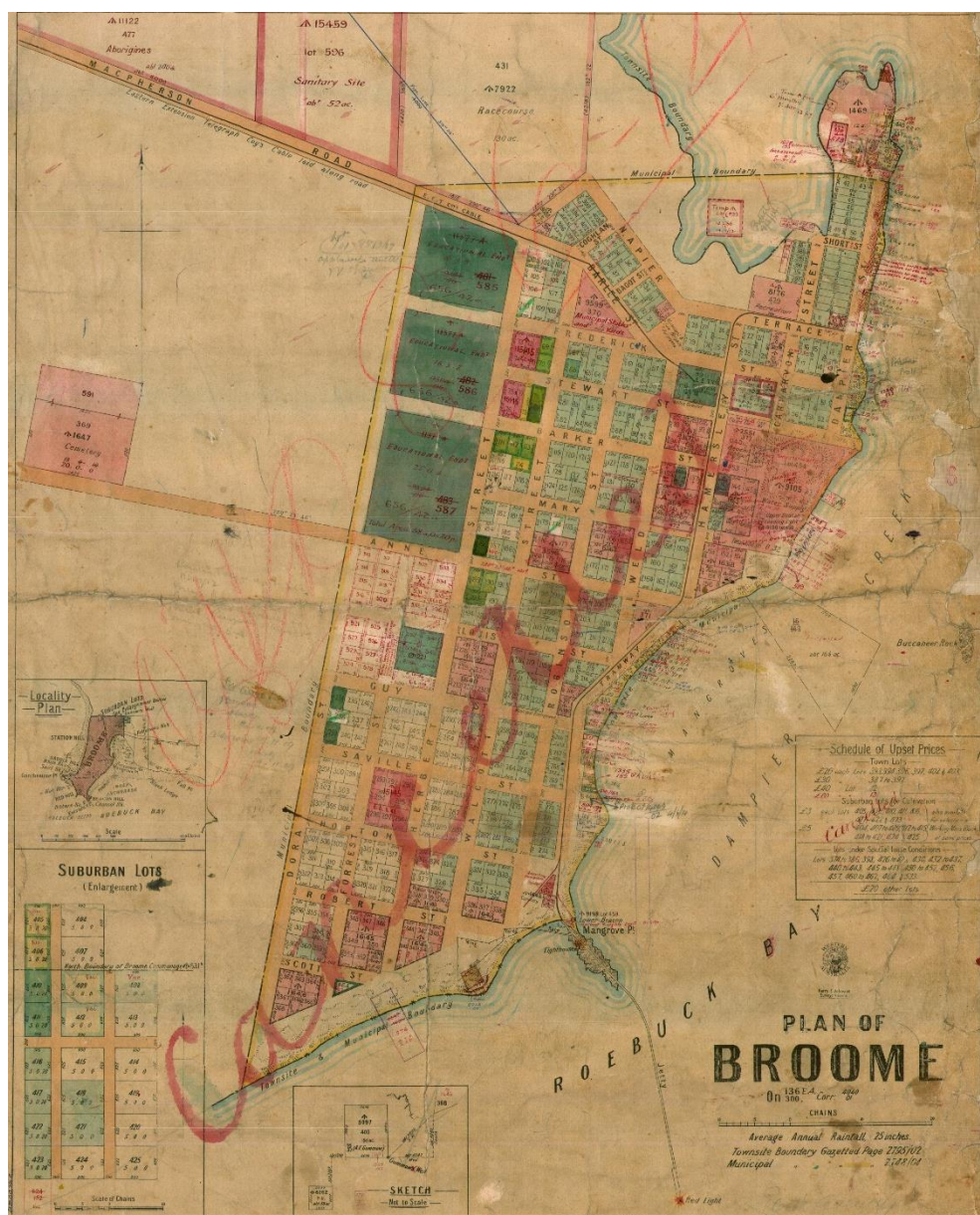


Figure 2.2: Town plan for Broome from 1906. State Records Office of Western Australia, Series S2168, Cons. 5698, Item 0230 Broome Sheet 3 [Tally No. 503851].

(Byrne, 2003; Neate, 1999). Indeed, the racial hierarchy facilitated by cadastral mapping was so pervasive and detrimental to Indigenous bodies that many Indigenous people who seek to challenge and subvert the cadastral grid continue to display intimate knowledge of this system (Byrne, 2008).

In many ways, the success of cadastral mapping as an instrument of legibility and control comes from a structure which renders space and place as abstract, rather than relational (Porter, 2006; Roth, 2009). “The cadastral model of space divides the world into discrete units, or entities, which are contiguous, non-overlapping, and registered to the ownership of just one individual or group through an associated database” (Williamson, 1985 as paraphrased in Potter *et al.*, 2016:9). It assumes that “the same objective standard can be applied throughout the nation, regardless of local context, to produce a complete and unambiguous map of all landed property” (Scott, 1998:44).

Cadastral maps consider “only the dimensions of the land and its value as a productive asset or as a commodity for sale. Any value that the land might have for subsistence purposes or for the local ecology was bracketed as aesthetic, ritual, or sentimental values” (Scott, 1998:47) and omitted from the map. Ultimately, cadastral maps delineate bounded territories for the purposes of inclusion and exclusion (Roth, 2009:209) which contributes to the violence of Indigenous deterritorialisation.

Today, the cadastral model underpins state-sponsored modes of recognition in Australia (French, 1998; Potter *et al.*, 2016; Turnbull, 2005). In particular, the *Native Title Act* and its subsequent amendments contain specific statutory mapping requirements bound by the cadastral model. First, claimants cannot make a claim over areas where native title is deemed to be alienated and extinguished by a prior exclusive possessory order, such as those operationalised through cadastral mapping (Bowen, 2000; Sparkes, 2000). This protects the settler property system. It also creates a spatial irony whereby people in first contact with European settlers are “punished” in an ongoing manner as they have often experienced the most disruption and may be unable to claim native title (Pearson, 2003; Strelein, 2005). These peoples’ relationships to Country are ignored, either due to the forced imposition of land tenure which is deemed by settler governments to extinguish native title, or by a perceived lapse in connection to Country. This creates a large area where Indigenous peoples are unable to claim even limited native title rights and protects property systems established by the settler state.

Second, Indigenous peoples must use entity-based mapping practices to delineate the boundaries of their claim during the application process (Bowen, 2000). To provide “reasonable

certainty” to governments, developers and respondents, such delineation must be accurate and binary (Bowen, 2000:2). Moreover, although groups can acknowledge some overlapping rights by enlarging the group making the claim, they cannot at present represent these rights in any way as part of the claim mapping process (P. McGrath pers. comm., 7 April 2017). Third, Australia’s native title system does not recognise the simultaneous relationships of two Indigenous groups to the same place where those groups make separate native title claims to the same area. Consequently, Indigenous groups cannot claim an area included in a previously successful native title claim (Sparkes, 2000), regardless of how those groups may have determined their traditional boundaries. Finally, despite the potential for contact between two systems in the claim process, if Indigenous peoples do not conform to statutory requirements of the *Native Title Act* they risk the failure of their native title claim (Bowen, 2000). That is, the native title system requires claimants to frame customary claims to territory within the entity-based system so often used to claim property. Should claimants fail to meet these requirements, they risk losing access to the limited rights and potential for negotiation which are available through the native title system.

The prescribed use of cadastral space to frame Indigenous rights within the *Native Title Act* is profoundly problematic. Such a model perpetuates a logic of elimination insofar as it continues to privilege the settler property system above the pre-existing rights of Indigenous peoples (Wensing and Porter, 2016). Moreover, cadastral space directly conflicts with Indigenous spatial ontologies, that is, the way that Indigenous peoples perceive spatial objects and the relationships between them. Beyond the relationality described above, Munn argues that in Indigenous fields of space “features, which are concentrated loci of a place’s authoritative power, do not define its spatial boundaries. Rather, they are the identifying centres from which a space with uncertain or ambiguously defined limit stretches out” (Munn, 1996:453). Here, Munn’s description of this field of action radiating from spatially concentrated loci emphasises continuity over the ‘crisp’ delineation of cadastral space.

Brazenor *et al.* (1999) argue that while land tenure defines cultural identity and is present in all aspects of life for Indigenous peoples, the boundaries of their territories are diffuse, overlapping with little physical demarcation. Indeed, so great is this emphasis on continuity that the AIATSIS Aboriginal Australia Map uses graded shading to represent the transitions between Indigenous language groups (AIATSIS, 2014a; Horton, 1996). The “recognition space” (Pearson, 1997) of native title provides a chance for Indigenous values to be recognised within current hegemonic settler spatial systems. It also limits the rights afforded to native title holders and places them within a “cunning” and rigid system of recognition that reinforces property structures imposed by the settler state (Povinelli, 2002).

2.1.2 Exploring the potential to resist settler colonialism by resisting imposition of the cadastral model

In addition to highlighting how imposed spatial structures support settler property systems, settler colonial theory is useful for conceptualising Indigenous resistance in settler states. Indigenous peoples were central to northern Australia's early pastoral system and there have been instances, such as the Gurindji walk-off, where Indigenous peoples have used control of their labour for political ends. Nonetheless, settler colonial theorists argue that settler emphases on exploiting land over labour mean that Indigenous people "can rarely use economic tools – such as a threat to withdraw labour – as leverage for political purposes" (Lovell, 2007:2; see also Wolfe, 1999; Veracini, 2010). Instead, these theorists contend that the most effective forms of resisting oppression available to Indigenous peoples include persistence which avoids elimination (Veracini, 2010) and counter-narratives which undermine hegemonic settler discourses and ideologies (Alloul, 2016; Attwood, 2004, 2005, 2017; Furniss, 2001).

Settler colonial theory highlights the power of territory-based narratives in settler colonial contexts. As an example, the *Mabo* decision undermined settler narratives of the Australian continent as *terra nullius* – or land belonging to no-one prior to British settlement. While the concept of *terra nullius* was fictitious (Borch, 2001; Mercer, 1993), it was also central to the perceived legitimacy of Australia as a settler state. As a result, the *Mabo* decision threatened settlers' claims to the just occupation of Indigenous lands (Russell, 2005). It also provoked significant fear and backlash from settler governments, mining interests (Mercer, 1997), and some members of the settler populace. Documented retaliations to the decision include a damaging advertising campaign from mining interests which argued that native title was a major impediment to mineral exploration and development (Lavelle, 2001), destruction of the Kalkadoon/Mitakoodi monument (Banivanua Mar, 2012; Furniss, 2001) and concerted political efforts to constrain recognition of these rights in the *Native Title Act*.

These reactions show the power of narratives in settler colonial contexts. Especially, where those narratives undermine settler claims to territory. This suggests that challenges to settler hegemony are not limited to legal challenges or the recording of Indigenous histories. They may also come from alternatives to the simplified and abstract space that has proven so central to settler power.

In this section, I have argued that settler colonial theory is both analytically and politically powerful. This theory identifies the importance of territory and land to both settlers and Indigenous peoples (Veracini, 2010). It provides a single theoretical lens which is able to incorporate a range of the challenges confronting Indigenous Australians including the removal of children through the stolen generations, the Northern Territory "Intervention", the rolling back of native title rights in Howard's *Wik* amendments, the forced closure of Western Australian

communities and most recently, the Federal Australian Government's unwillingness to put key recommendations made in the Uluru Statement from the Heart to a referendum (Conifer *et al.*, 2017). It also suggests the power of narratives to undermine the settler state by destroying the mimesis which is so central to its perceived legitimacy (Veracini, 2010). Finally, it focuses on the actions of settlers rather than the Indigenous Other and suggests a variety of mechanisms which might be used to resist these broader structures (Veracini, 2014).

Nonetheless, settler colonial theory offers few practical mechanisms for researchers and Indigenous peoples to engage with the immediate and pressing challenges of the post native title environment. As identified in Chapter 1, native title governance bodies seek to address the desires and concerns of their constituents. They often seek to protect their rights and secure benefits for their constituents in both the short and the long term. This requires the persistence central to resisting settler colonialism. It also necessitates engagement with a wide range of stakeholders in environments which are highly asymmetric in terms of the power and information available to actors. Furthermore, it sometimes requires compromises that may address immediate problems and place communities "on the front foot" in the long term (Dodson, 2012). While settler colonial theory can be used to interpret the longer-term goals of such environments, it is often ill-equipped to describe the active engagement, challenging and negotiation which occurs in such spaces. Consequently, the next section of this chapter looks to Pratt's concept of the contact zone to examine how Indigenous peoples can locally engage in the contested post native title environments of settler states.

2.2 The contact zones of the post native title environment

Whereas the utility of settler colonial theory is limited to settler states, Pratt's concept of the contact zone can be applied to any "space in which peoples geographically and historically separated come into contact with each other and establish ongoing relations, usually involving conditions of coercion, radical inequality, and intractable conflict" (Pratt, 2008:8). Pratt notes that her concept of the contact zone "is often synonymous with the 'colonial frontier.'" However, she argues that the term 'colonial frontier' "is grounded within a European expansionist [or settler] perspective (the frontier is a frontier only with respect to Europe [or the settler society])" (Pratt, 2008:8). Thus, viewing such a place as a contact zone "shifts the centre of gravity and the point of view. It invokes the space and time where subjects previously separated by geography and history are co-present, the point at which their trajectories now intersect" (Pratt, 2008:8). A contact zone, while asymmetric, is a point of mutual engagement between two or more individuals or groups. It is a space which is similar to the messy coexistence described by Howitt (2006).

To avoid feeding into or repeating modes of “Othering”, settler colonial theorists usually focus their efforts on a study of the settler society, its history and narratives. With exceptions such as Banivanua Mar (2012) who examined the cleaning of the Kalkadoon/ Mitakoodi monument by Indigenous elders, these theorists often do not focus on Indigenous peoples’ resistance to the settler state. Yet, “[p]eople on the receiving end of European imperialism did their own knowing and interpreting sometimes [...] using the Europeans' own tools” (Pratt, 2008:7).

Pratt notes that “[w]hile subjugated peoples cannot readily control what the dominant culture visits upon them, they do determine to varying extents what they absorb into their own, how they use it, and what they make it mean” (Pratt, 2008:7). That is, subjugated peoples engage in transculturation, a transformative process which involves “the acquisition or imposition of foreign material, and the fusion of the indigenous and the foreign to create a new, original cultural product” (Taylor, 1991:91). Of particular interest to Pratt is how the master’s tools are transculturated or transformed into ‘arts’ for engaging in the contact zone. In her first speech on this topic, Pratt used a book produced by literate Andean Guaman Poma and sent to King Philip III of Spain forty years after the fall of the Inca Empire to illustrate key elements of these arts.

Guaman Poma worked as a mediator between the Incas and the Spanish colonial administration. The book he sent to King Phillip III was over 1200 pages long and “[w]ritten in a mixture of Quechua and ungrammatical, expressive Spanish” (Pratt, 1991:34). This book included an autoethnographic text called the *Nueva corónica* ‘New Chronicle’ which rewrote one of the main official discourses used by Spain to “represent their American conquests to themselves” (Pratt, 1991:34). It positioned Andean peoples at the centre of the Christian world and ended “with a revisionist account of the Spanish conquest, which, Poma argues, should have been a peaceful encounter of equals with the potential for benefiting both, but for the mindless greed of the Spanish” (Pratt, 1991:35). In this book, according to Pratt “Guaman Poma mirrors back to the Spanish (in their language, which is alien to him) an image of themselves that they often suppress and will therefore surely recognize” (Pratt, 1991:35). He also “combines a description of colonial society in the Andean region with a passionate denunciation of Spanish exploitation and abuse” (Pratt, 1991:35). Thus, “Guaman Poma constructs his text by appropriating and adapting pieces of the representational repertoire of the invaders” (Pratt, 1991:36). These include drawings which transculturate Spanish styles while incorporating “specifically Andean systems of spatial symbolism that express Andean values and aspirations” including elements of moral directionality (Pratt, 1991:36).

Guaman Poma’s book used narrative to encourage critical self-reflection on the colonial situation and promote more amicable relations between conquistadores and Incas. It was also written in two languages and spatial styles such that its texts and images have different meanings

for mono-lingual and bi-lingual, as well as mono-cultural and bi-cultural, readers. Nonetheless, the book never reached the king. Indeed, it was overshadowed by work written by another mestizo Inca Garcilaso de la Vega (Pratt, 1991:37) and sat, largely untouched, in a Danish library for more than three hundred years.

In many ways, Guaman Poma's book suffered from "[m]iscomprehension, incomprehension, dead letters, unread master-pieces, [and] absolute heterogeneity of meaning" (Pratt, 1991:37). It was not recognised as a tour-de-force until the progressive humanist turn of the 1970s. Nonetheless, for Pratt, Poma's book illustrated how marginalised groups are able to appropriate "arts of the contact zone" to parody and subvert the dominant power while expressing their own heterogeneity. Thus, Pratt's analysis of Guaman Poma's work illustrates the power and peril that transculturation and subversion of hegemonic discourse may offer Indigenous peoples in structurally unequal contact zones of settler states.

Pratt's work originally focused on travel writing and pedagogy. It has since generated considerable research in these areas (see for example Blair, 1998; Layne and Lipponen, 2014; Marwitz and Dallas, 2003). It has also been used to interpret the interactions which occur in disciplines including literature (McAuliffe, 2011; O'Malley, 2006; Taylor, 2010), music (Guarracino, 2009), youth work (Patel, 2012), development theory (Bracarense, 2013; Conway, 2011), planning (Barry and Porter, 2012; Porter and Barry, 2014, 2016), medicine (Anderson, 2012), conservation (Sundberg, 2006), religion (Chidester, 2008) and research (Manathunga, 2009). In a settler colonial context, Porter and Barry have examined how settler states use texts to powerfully mediate "the conditions and the boundaries of the contact zone between Indigenous people and state-based planning systems" in Victoria, Australia and British Columbia, Canada (Porter and Barry, 2016:41). Indeed, there are strong parallels between Porter and Barry's work and the way that the previously discussed statutory mapping requirements of the *Native Title Act* continue to constrain opportunities for mutual recognition within the native title system.

Returning to the issues of mapping and native title, it is clear that the discourses contained in maps and other spatial technologies have often supported Imperialism and facilitated the dispossession of Indigenous peoples around the globe (Crampton, 2001; Harley, 1988, 1989, 1990, 1992; Rundstrom, 1991; Sletto, 2014). Nevertheless, many indigenous peoples are transculturating these same technologies to engage with imperial powers and facilitate their own governance following repossession. Indeed, in a now quasi-ubiquitous statement Nietschmann noted that:

"More indigenous territory has been claimed by maps than by guns. This assertion has its corollary: more Indigenous territory can be reclaimed and defended by maps than by guns. Whereas maps like guns must be accurate, they have the additional advantages that they are

inexpensive, don't require a permit, can be openly carried and used, internationally neutralize the invader's one-sided legalistic claims, and can be duplicated and transmitted electronically which defies all borders, all pretexts, and all occupations” (Nietschmann, 1995:37).

In Australia, as senior Yawuru man Peter Yu observed in a keynote address at the 2013 World Indigenous Network Conference in Darwin:

“Some native title groups such as mine, the Yawuru in the Broome region [are] developing geospatial mapping technology that combines Indigenous knowledge and practical observations with Western scientific data. The development of comprehensive maps will help planning and decision-making regarding development and demonstrate to all parties where development can and cannot proceed” (Yu, 2013a).

Indigenous peoples are already actively transculturating GIS as part of repossession and their engagement with the complexities of a post native title environment and, in doing so, integrating Indigenous and Western scientific knowledges. Nonetheless, the transculturation of technologies like GIS, which has capacity to “captur[e], stor[e], query, analys[e], and display geospatial data” (Chang, 2016:1), presents both challenges and opportunities to Indigenous peoples. To further explore this phenomenon, the next section explores challenges linked to the technology’s history and origins, including those related to the integration of Indigenous knowledges and Western science⁷. It also assesses the five approaches to GIS use most adopted by contemporary indigenous peoples around the globe.

2.3 Indigenous peoples’ transculturation of GIS technologies

Like cadastral mapping, GIS initially evolved to support the governance of modernist states. The first GIS extended the earlier work of McHarg (1992). In a break with the property-based focus of the cadastral model and much planning to that time, McHarg encouraged governments to *Design with Nature* by developing physical overlay techniques which considered economics, but also incorporated natural processes and social values. GIS thus evolved from recognition of a need for decision support in land use planning and a belief that the components of such decisions could be broken down into individual layers of digitally stored geospatial information.

From a technical standpoint, GIS have been “primarily associated with statistical and quantitative spatial analysis” (Pavlovskaya, 2009, p.13). They evolved to search for patterns and anomalies, to summarise, to compare reality to theoretical predication, or to reveal correlations

⁷ Following Dei (2000) I use the term Indigenous knowledges to reflect the knowledges held by First Peoples, aboriginal peoples, native peoples, or autochthonous peoples of the world and contrast these knowledges with Western science.

(Goodchild, 2003:501). Their capacity for visualisation provided an opportunity to “communicate the consequences and trade-offs associated with policy choices” (Salter *et al.*, 2009:2091). This in turn gave stakeholders “an enhanced understanding of planning alternatives and more meaningful opportunities for input” (Salter *et al.*, 2009:2091). It also provided opportunities to “to unveil previously hidden natural and social landscapes with an authority of science” (Pavlovskaya, 2009, p.15). Combined, these capacities have potential to summarise patterns and anomalies or support decisions and communicate this in a way which takes advantage of the brain’s capacity for pattern recognition (Golledge and Stimson, 1997a).

Initially, GIS technologies were only available to governments or research institutions with sufficient resources to develop and maintain in-house systems through regular and extensive re-programming. They were mostly available to Western scientific institutions and well-resourced modernist states. By the 1980s, however, advances in computing and the commercialisation of GIS by corporations including the Earth Sciences Research Institute (Esri), reduced the cost of GIS technology. This made the technology available to businesses (Longley *et al.*, 2011; O’Sullivan and Unwin, 2010a) and resulted in a proliferation of “toolbox” GIS with new applications for pre-packaged technology.

Today, GIS use has become ubiquitous as it is employed by governments at a range of levels (Australian Government Geoscience Australia, 2007; Hirst, 2012; Roche, 2014), as well as by many community groups (Craig and Elwood, 1998; Eisner *et al.*, 2012; Elwood, 2006a). Indeed, settler government departments and agencies are increasingly “spatially enabled” (Taylor *et al.*, 2014) in that they organise around concepts of place and location to reduce redundancy and rapidly produce multiple decision alternatives (Duncan, 2006).

In Australia, the Department of Human Services uses spatial infrastructure to support service delivery and emergency responses, provide location information, accurately assess government benefits, and identify incorrect payments and fraud (Sandison, 2012). Australian states and territories are now engaging in key departmental collaborations including the West Australian Land Information System, and the “Virtual ACT” a “whole of government” approach to spatial information (Hirst, 2012). Indeed, many local Australian governments now use GIS as a key element of their land use planning practices (Jacoby *et al.*, 2002; Nedovic-Budic *et al.*, 2004; Pettit *et al.*, 2015). As Australian government departments become spatially enabled, they can more efficiently and effectively inform decisions about land use planning. This in turn gives settler governments more precise and effective control over Indigenous lands.

In the late 1980s-1990s, as the use of GIS increased among indigenous peoples and began to dominate university departments, a number of critical Geographic Information Scientists (GIScientists) brought “social theory, science and technology studies, and philosophy”

(Schoorman and Leszczynski, 2006:726) to bear on GIS technology and principles. These theorists were concerned by the association of GIS with a positivist epistemology, as well as the ways that GIS remains closely linked to power, capitalism and state control. As an example, in the 1990s, Global Positioning System (GPS) access was divided into a “robust” system accurate to 30 metres secured for military use and a deliberately “degraded” system accurate to 100 metres available to civilians and corporations (Pickles, 1995, 2006). Today, the military continues to play a large role in the development and appropriation not only of GIS technologies (Pickles, 1995), but of human geographers more generally (Wainwright, 2016). Unmanned aerial vehicles (drones) which draw on both GIS and GPS are widely used by militaries (Shaw and Akhter, 2014). They also play a key-role in state-based intelligence services, counter-terrorism, law enforcement and targeting tax evasion (Crampton, 2015). Increasingly, GIS is also controlled by transnational corporations such as Google who use and sell its outputs for geomarketing analysis (Grekousis and Hatzichristos, 2013), improving delivery (Miller and Shaw, 2015) and targeting location based advertising (Bauer and Strauss, 2016).

Many Critical GIScientists remain acutely aware of GIS’ military associations, surveillance capacity, assumed objectivity, masculinity, capacity to serve large corporations and public agencies rather than the disenfranchised, and lack of attention to epistemologies and ontologies (Elwood, 2010, 2011; Schoorman, 2006). Their work has resulted in far more nuanced approaches to GIS. For example, the work of critical GIScientists in the mid-1990s included development of a Participatory GIS (PGIS) stream which was both “rooted in an understanding of the contradictory capacity of GIS technologies to empower and disempower, and in a commitment to fostering bottom-up GIS applications that incorporate diverse forms of local knowledge and participation” (Elwood, 2006c:198). Similarly, GIScientists who focus on qualitative GIS have challenged the association of GIS with purely positivist epistemologies, by critically examining the technology by employing GIS in mixed-methods and political research. Researchers in this tradition frequently emphasise colliding epistemologies and embrace the challenges of working in this interface, maintaining critical awareness of social and political structures throughout their research (see Cope and Elwood, 2009). Nonetheless, many researchers remain deeply sceptical of whether GIS could be effectively and appropriately transculturated by indigenous peoples (e.g. Chambers, 2006; Rundstrom, 1995, 1998), especially given the challenges of integrating Indigenous knowledges and Western science.

Some of the most vocal critiques of GIS use by indigenous peoples have come from Robert Rundstrom. Early in his career, Rundstrom (1991:10) was approached by Inuit in Nunavik to assist in a mapping project designed to inscribe “a small portion of Arctic text from Ottawa” with their own toponymy. Although at the time Rundstrom (1991:10) noted that there were

fundamental differences between the “inscriptive” mode of mapping inherent in GIS and the “descriptive” or performative elements of mapping often performed by indigenous peoples, he respected the “conscious and concerted decision [of his research partners] to engage the enfranchised culture on its own terms, turning its technology and politics to their own purpose”. By the mid-1990s, however, Rundstrom had begun to display a deep, almost paternalistic, scepticism towards indigenous peoples’ use of GIS technologies. In 1995, for example, Rundstrom (1995:45) argued that cross cultural use of GIS is “the newest link in a long chain of attempts by [W]estern societies to subsume or destroy indigenous cultures”. Indeed, Rundstrom (1995:45) categorised the cross-cultural application of GIS “technoscience” as a form of epistemic violence which is “toxic to human diversity”.

We can see from the preceding discussion that Rundstrom has a point. While Indigenous knowledges are diverse, there are great challenges in integrating these knowledges and Western science in any environment, let alone through a technology like GIS. Indigenous knowledges are frequently local and pragmatic knowledges, learnt through “informal trial and error processes” as well as “direct transmission and personal experience” (Ross *et al.*, 2011, p.34). Whereas Western science emphasises objectivity and often develops or relies on theory-led principles which are deemed to be universal or true regardless of context (Ross *et al.*, 2011; Stewart, 2019), Indigenous knowledges often incorporate spirituality and an understanding that not all phenomena may be comprehensible to human beings (Jackson *et al.*, 2019; Nakata, 2002). Indeed, Indigenous knowledges are differentiated, socialised and individualised in that individuals keep different knowledges within indigenous communities and these knowledges may be brought together through ceremony and gatherings (Povinelli, 1993). Whereas problems are resolved in Western science based on theories that are “true”, problems are solved with Indigenous knowledges by applying knowledge in accordance with social and normative rules (Ross *et al.*, 2011). Essentially, the epistemologies or ways of knowing which underpin Western science and Indigenous knowledge systems are so different that claims to knowledge made within one system cannot be validated by the other (Durie, 2004; Nakata, 2002).

There are also challenges in linking the ontologies, or constituents of reality, which underpin Indigenous knowledges, with those of Western science. The Cartesian model of space which underpins GIS draws on universal, fixed x-,y-coordinates and largely assumes that individuals are separate from their environment (Pavlovskaya, 2009; Yapa, 1998). By contrast, Indigenous ontologies are place-based, relational, and thoroughly adapted to local environments (Burarrwaja *et al.*, 2019; Kenny, 2013; Stanner, 1979; Strehlow, 1970). They are formed around diverse, complex connections to landscape and other metaphysical beings (Berndt, 1970; Rose, 2000).

Indigenous ontologies are also non-static and often cyclical (Prober *et al.*, 2011) in ways that link past, present and future (Arbon, 2007). This makes reflecting the “everywhere” and “everywhen” described by Stanner (1979) challenging in GIS, especially as basic level terms for landscape features often do not match between English and Indigenous languages (Mark and Turk, 2003). Similarly, while naming calls the landscape into being in Indigenous spatial ontologies (Morton, 1987), this process remains difficult to emulate in the digital environment of a GIS. There are also dangers in using a crisp and entity-based model to represent Indigenous visions of space, place, and Country, especially as there is “at least anecdotal evidence that Indigenous Australians [...] tend to view landscape more as a continuous field” (Mark and Turk, 2003:41).

There are profound challenges to integrating Indigenous knowledges and Western science under any circumstances (see Special issue – Mātauranga and Science of the New Zealand Science Review, edited by Mercier and Jackson, 2019), let alone when mediated by technologies like GIS which may decontextualize highly social Indigenous knowledges by storing that knowledge separately from the individuals who hold it (Nakata, 2002). In this context, Reid and Sieber (2019) have argued that the imposition of any universal geospatial ontology may continue elements of problematic assimilation. GIS technologies also continue to play key roles in state-based surveillance, which introduces additional dangers for Indigenous peoples in this space (for a more detailed examination see Bryan and Wood, 2015).

These are polemical issues. On the one hand, Indigenous peoples who engage with GIS technologies risk poor translation, inadequate capture, reification, and assimilation in negotiations. On the other hand, Indigenous knowledges are not just traditional knowledges: they include the experience of more than 200 years of “modernity” and Western capital systems (Walter and Andersen, 2013). Moreover, poor cross-cultural training means that Indigenous values and ontologies are often not taken seriously by settler governments (Emmanouil, 2017). In this sense, GIS is a powerful tool for many Indigenous groups precisely *because* it is so well accepted by Western institutions. It translates Indigenous ontologies into a form these institutions recognise, and so find difficult to ignore (Walter and Anderson, 2013).

Colliding ontologies and epistemologies within GIS is profoundly difficult. However, it is also highly generative (Brown and Knopp, 2008; Gibson *et al.*, 2010). Such collisions allow you to call into focus some of the problems with dominant knowledge and capital systems while retaining a critical view to the complexities of that space (Cope and Elwood, 2009). Finally, the power of GIS technology is such that critiques, including those made by Rundstrom (1995) have had little impact on the adoption of GIS by indigenous peoples (Olson *et al.*, 2016).

Today, GIS technology is used by many indigenous communities around the globe. In the global South (Latin America, Asia, Africa) GIS has been used for territorial claims (Fox, 2002; Rambaldi *et al.*, 2002; Wainwright and Bryan, 2009), land use planning (Ayers *et al.*, 2012; Hardcastle *et al.*, 2004; Livengood and Kunte, 2012), natural resource management (Bernard *et al.*, 2011; De Freitas and Tagliani, 2009; Rambaldi *et al.*, 2007; Smith, 2003) and conflict resolution (Kyem, 2004; Rambaldi *et al.*, 2002). In Canada and Alaska, GIS technology and geomatics have provided legal evidence for land use claims through map biographies and projects which incorporate multiple forms of media and storytelling (McCarthy *et al.*, 2012). In the 48 lower United States a push by multiple large agencies resulted in widespread uptake of GIS technology to support decision making and governance (Palmer and Rundstrom, 2012).

In Aotearoa/ New Zealand, uptake of GIS technology by Māori groups came later than in either the United States or Canada and has seen iwi (tribes), and hapū (sub-tribes) drawing on both the traditional analytical strategies of the United States and the participatory and culturally-sensitive visual strategies of Canada (Engle, 2001). They are now supported by Te Kahui Manu Hokai, the Māori GIS association, which was “set up to promote the use of Geospatial Information Systems and associated information technologies for the benefit and advancement of iwi Māori in Aotearoa” (Te Kahui Manu Hokai, Date Unknown). Finally, in Australia, Indigenous groups have begun to adopt select components of GIS technology including through the North Australian Indigenous Land and Sea Management Alliance Ltd.’s (NAILSMA) I-Tracker program (NAILSMA, 2012b).

This widespread adoption of GIS by indigenous peoples has resulted in calls for more subtle and critical uses of this technology. Indigenous geographers and cartographers including Jay Johnson, Renee Pualani Louis, Albertus Hadi Pramono and Margaret Wickens Pearce have outlined a need to encourage critical cartographic literacies among indigenous peoples. They have argued that “*indigenous communities need to become aware not only of the historical role of cartography in their dispossession but also of the ways in which cartography continues to betray these same communities today, even when the maps/GIS being produced are objectively intended to benefit their interests*” (Johnson *et al.*, 2005:89).

Indigenous peoples may be well served indeed by the literacies encouraged by Johnson, Louis and others. In the interests of encouraging such literacies, the next section of this review introduces and critiques some of the most common approaches to GIS displayed by indigenous peoples.

2.4 Five approaches to the transculturation of GIS by Indigenous peoples

Indigenous approaches to GIS can be divided into five dominant strategies: GIS as counter-mapping; GIS as data collection and storage for cultural and natural resource management; Tribal GIS; cybercartography; and critical geovisualisations. As examined below, each of these approaches has strengths and limitations in an indigenous context. Here, two issues are of particular concern. The first is the way that these approaches continue to draw on models of space bearing strong similarities to the cadastral model which has been instrumental to indigenous dispossession. The second is the way that many of these approaches use the ‘house-keeping’ functions of GIS without harvesting its analytical capacity to support decision-making, governance and engagement with the practical challenges which confront Indigenous peoples in a post native title environment.

2.4.1 Strategy 1: GIS as counter-mapping

Perhaps the most widespread form of GIS used by indigenous peoples is that linked to counter-mapping. Counter-mapping (Peluso, 1995), or tenure mapping, has been conceptualized as a “means of appropriating or transculturating the objectivist veneer of maps in order to produce rhetorically powerful, counter-hegemonic representations for political ends” (Mohamed and Ventura, 2000:92). Such ends include land claims made against the state and other site users. Thus, counter-mapping “appropriate[s] the state’s techniques and manner of representation to bolster the legitimacy of ‘customary’ claims” to land and resources (Peluso, 1995:384). This appropriation uses GIS for data collection, storage and presentation. It supports territorial disputes or other political claims and focuses on “high spatial accuracy in Cartesian terms” (Sletto, 2015:932). This includes the adoption of the fonts and styles of state agencies. It also includes creating highly conservative maps centred on the use of point and line data. As an example, one seminal guide to use and occupancy and counter-mapping, Terry Tobias’s *Living Proof* (Tobias, 2009), encourages people to record only the kill sites of individual animals and, even then, to simplify maps and overlays such that they produce an image of the most widespread land uses and activities of a group in living memory. Often, counter-maps are explicitly designed to stand up to the scrutiny of Western courts.

For many indigenous peoples, counter-mapping has been a successful political strategy. In Canada, counter-maps were central to the negotiation of the Inuvialuit Final Agreement (1984) and the Nunavut Land Claim Agreement (1993) (Freeman, 2011). In Nicaragua and Belize, communities have used counter-mapping in claims with the Inter-American Commission of Human Rights. In Australia, numerous groups have engaged in counter-mapping uses of GIS as

part of claiming native title or other land rights (Sparkes, 2000). For these groups and others, counter-maps produced using GIS have functioned as “island[s] of calm and reason that helps to validate their side of the story” (Jarvis and Stearman, 1995:1). Indeed, these approaches are now so widespread that, as is the case with native title in Australia, similar uses of GIS may be mandatory elements of legal claims to traditional lands (National Native Title Tribunal, 2008).

Despite the relative ubiquity of GIS-based counter-mapping, there are three main limitations to this approach. First, as is the case in native title mapping, the appropriation of entity-based cadastral mapping techniques in counter-mapping often focuses on the depiction of linear boundaries. Such boundaries often align poorly with indigenous worldviews, increasing potential for intra-and inter-community conflict (see Roth, 2009; Thom, 2009 for examples). They also often result in land being treated as property which has potential to be privatized despite the collective struggle inherent to the claim (Wainwright and Bryan, 2009). Second, even where counter-mapping does not directly engage with problematic boundary depiction, this approach may be overly conservative. For example, a point which depicts only the site where an animal was killed neither reflects the areas of land necessary to support that activity, nor movement associated with the hunt itself (Tobias, 2009).

Third, while counter-mapping engages in very simple forms of display and visualisations, it does not typically take advantage of GIS technology’s considerable capacity to query and analyse information to support indigenous decision-making. Indeed, in instances where the software and maps are stored and held by outside groups, it does not even provide indigenous peoples with the opportunity to use GIS on an ongoing basis. In many ways such capacity is more clearly harnessed by groups using GIS for cultural and natural resource management.

2.4.2 Strategy 2: GIS as data collection and storage for cultural and natural resource management

The recognition of land claims or the introduction of new legislation can enable indigenous peoples to take a more active role in the management of their traditional lands. Thus, many indigenous peoples who may have used GIS technology in the process of claiming their customary lands subsequently turn to the technology’s house-keeping functions to store, display and query data. Often, this involves using GIS to collect and store data to support cultural and natural resource management.

Frequently, the use of GIS for cultural and natural resource management is driven by indigenous peoples in response to practical imperatives. In northern Australia, for example, NAILSMA’s I-Tracker program resulted from calls made by ranger groups for user friendly technology to capture, store and report field data to support a range of land and sea management

tasks (Ansell and Koenig, 2011; Cybertracker Conservation, 2015; Ens, 2012; Jackson *et al.*, 2009; NAILSMA, 2012b, 2014). In Arnhem Land, remote sensing and GIS were integrated with traditional knowledge in the West Arnhem Land Fire Abatement project to inform rangers of the effect of their work and impending wildfire (Russell-Smith *et al.*, 2009; Russell-Smith *et al.*, 2015). In Victoria, the Wathaurung Aboriginal Corporation's use of tablet devices and ground-penetrating radar came about through a need to record sacred sites for protection in response to the introduction of new heritage laws (Woodley *et al.*, 2013).

Overseas in Aotearoa/ New Zealand, many Māori groups followed Harmsworth's model for incorporating indigenous values into GIS at least in part because of a series of national laws which necessitated the consideration of Māori cultural interests for land use planning and environmental management (Engle, 2001). Engle, for example, worked with ten Māori organisations who used GIS to integrate large, and previously separate blocks of information to support an iwi census, "enliven" cartography of culture with video, and support management of fisheries, forests, properties and other assets (Engle, 2001).

Tool-oriented GIS applications have a number of benefits for indigenous peoples. Cybertracker, for example, was originally designed with Kalahari San in Africa (Ansell and Koenig, 2011; Cybertracker Conservation, 2015), to capture GPS-based data for monitoring and management (Liebenberg *et al.*, 1999). In Canada, Cyber-Tracker has been used by Cree and Naskapi First Nations to monitor the effects of mining on reindeer husbandry and Caribou hunting (Herrmann *et al.*, 2014). In Africa, it has been used to measure informal settlements in Cape Town (Barry and Rüther, 2005). The Australian iteration of Cybertracker, called I-Tracker by some, has helped to support internal decision making in natural resource management (Jackson *et al.*, 2009), fisheries (Grech *et al.*, 2008), weed management (Ansell and Koenig, 2011), and fire control (Heckbert *et al.*, 2011). It has provided consistent collection of point-based data which is of higher calibre than hard copy data collection (Ansell and Koenig, 2011) and can be used as baseline data for ongoing monitoring and wildlife management activities (Ens, 2012). It has improved the efficiency and accountability of ranger management by providing information on, and records of, the deployment of human resources (Ens, 2012). It has facilitated regional databases as well as partnerships with research institutions and commercial bodies (Chester, 2013; Storrs *et al.*, 2000). In the case of the West Arnhem Land Fire Abatement initiative, I-Tracker has been integrated with information from the North Australia and Rangelands Fire Information site. This, combined with extended and ongoing training, has allowed the complete handover of fire abatement management to the community and resulted in additional sources of income and employment for those involved (Heckbert *et al.*, 2011).

In cultural heritage management, the Wathaurung approach created registers used to monitor and protect against culturally insensitive development or site desecration. These registers included data encryption for security as well as multiple levels of access enabling compliance with cultural laws around gender, age, status and taboos around death (Woodley *et al.*, 2013). Similarly, in Aotearoa/ New Zealand Engle and colleagues note that GIS enabled greater capacity for negotiation within the current system (Engle, 2001).

A further example of GIS uses to capture both cultural and natural resources is that put forward by Harmsworth (1998) in Aotearoa/ New Zealand. Harmsworth (Harmsworth, 1998; Harmsworth *et al.*, 2005; Jollands and Harmsworth, 2007) was able to demonstrate the potential congruence between *Mātauranga Māori* (Māori knowledge) and GIS. In particular, he was able to demonstrate the technology's capacity to analyse data, maintain data in culturally sensitive ways which included by privacy layers and obscuring the exact location of sacred sites, refer users to appropriate knowledge holders where knowledge was too sensitive or privileged to be held in a digitised form and to incorporate multimedia to provide additional context to the data (Harmsworth, 1998). Since that time, various iwi and hapu have used GIS to support agro-ecology led management of a Māori farm (Moore *et al.*, 2016); to inform freshwater management (Harmsworth *et al.*, 2016); and to inform fisheries management across Aotearoa/ New Zealand (McCallion *et al.*, 2018).

Nonetheless, as with counter-mapping, such uses of GIS for cultural and natural resource management have limitations. Many of these applications continue to rely on entity-based models of space to comply with Western heritage and legislative norms. As examined above, such entity-based models of space risk supporting highly bounded modes of recognition perpetrated by the settler state. Moreover, point-based data for natural resource management is often difficult for indigenous peoples to interpret (Grech *et al.*, 2008) and the display of such data rarely takes advantage of GIS' capacity for visualisation (Pearson and Gorman, 2010). Perhaps worse, given the minimal resources available to communities, the I-Tracker program often hinges on non-Indigenous input during program set-up, monitoring and analysis (Ens, 2012). Similarly, while Wathaurung Aboriginal Corporation determines data collection and management techniques (Woodley *et al.*, 2013), complex analyses, database and program management continue to be conducted by researchers at Victoria University, Melbourne with minimal skills transfer. Rarely then, does the transculturation of GIS for cultural and natural resource management create in-house capacity for spatial analyses which could readily fill ongoing needs for decision support.

2.4.3 Strategy 3: Tribal GIS

In the United States, the Bureau of Indian Affairs and their Geographic Data Service Centre in Lakewood, Colorado encouraged adoption of GIS through free or subsidised hardware, software, training and data to encourage the technology's uptake (Chapin *et al.*, 2005; Palmer and Rundstrom, 2012). By the mid-1990s nearly 10% of recognised tribes adopted GIS (Chapin *et al.*, 2005:626). They used the technology to support a range of governance activities including natural resource management, law enforcement, cultural heritage management, education, healthcare, property development, hazard management and even enterprise approaches to spatially enabled governance (Taylor *et al.*, 2012). Today, many of these tribes can be considered "spatially enabled" in the sense most commonly used by Western governance bodies.

Unlike both the cartographic-legal strategy and data collection for cultural and natural resource management, the Tribal GIS approach often draws on the technology's analytical capacity to support both internal decisions and external partnerships. The Siletz Tribe used GIS overlays to protect critical wildlife habitat (Smith and Kramer, 2012), while the Squaxin Island Tribe used a multi-criteria evaluation to prioritise areas for salmon restoration (Keesecker, 2012). Other tribes have drawn on GIS for planning timber sales (Bernards, 2012), managing road and transportation networks (Ellis, 2012; Hutton, 2012), preserving tribal history (Cancel and Backhouse, 2012) examining epidemiology (Kelley *et al.*, 2012; Olson, 2012; Painte and Kerski, 2012), and supporting decisions around land use planning (Arviso, 2012; Krohn, 2012; Smith and Colvin, 2012).

Despite its clear potential to support internal governance, there are limitations to Tribal GIS. First, it is not clear that tribes adapt analytical techniques to align with their ontologies (Hi'iaka Working Group, 2011; Johnson *et al.*, 2005). Thus, many tribes continue to remain stuck in a cadastral mapping and modelling paradigm. Second, in some instances the top-down approach to Tribal GIS adopted by both national agencies and private corporations has perpetuated colonial approaches and left tribes reliant on external agencies for expensive software which is now central to their governance strategy (Palmer and Rundstrom, 2012). These concerns have led some indigenous groups to embrace cyber-cartography.

2.4.4 Strategy 4: Cyber-cartography

Cyber-cartography "produces interactive, multimedia, multisensory online products" (Taylor, 2009a, p.1 of 12) which are "applied to a wide range of topics [...] including topics not usually mapped" (Taylor, 2009a, p. 3 of 12). Since 2009, cyber-cartography has largely been driven by the efforts of the Geomatics and Cartographic Research Centre and groups in northern Canada to preserve Indigenous knowledges and perspectives "in ways that seek to transcend the

barriers of incommensurability between Indigenous knowledge and the [W]estern European assumptions that support geospatial technologies” (Pyne *et al.*, 2009, p. 2 of 10). The use of cyber-cartography is spreading and it is now employed to present the views of indigenous peoples in the United States (Aporta *et al.*, 2014; Eisner *et al.*, 2012; 2017), Latin America (Young and Gilmore, 2017), Aotearoa/ New Zealand (Brown and Nicholas, 2012) and Australia (FORM, 2017; Milroy and Revell, 2013; University of Tasmania, 2016). They have produced atlases of traditional lands which can include place names, videos, trading routes, information on treaties, stories, history and information volunteered through a Web 2.0 interface (Eisner *et al.*, 2012; McCarthy *et al.*, 2012).

Cyber-cartography has been deliberately designed by both indigenous peoples and their research partners to align with elements of Indigenous worldviews. First, cyber-cartography is often multi-dimensional and multi-sensory (Caquard and Cartwright, 2014; Kyem and Saku, 2009; Taylor, 2009a) meaning not only that it takes advantage of GIS capacity for visualisation, but also that it mimics real-world multi-sensory learning experiences and supports a variety of learning styles (Taylor, 2009a). Second, cyber-cartography has a capacity to capture narratives and incorporate elements of traditional storytelling (Pearce, 2014; Pearce and Louis, 2008; Pyne *et al.*, 2009) encouraging dialogue and integration between worldviews (Young and Gilmore, 2017). Finally, data from cyber cartography is stored through a network and often protected through multiple layers of access which aim to comply with Indigenous knowledge traditions (Brown and Nicholas, 2012; Pyne *et al.*, 2009). In essence, cyber-cartography uses many of the features of Web GIS to provide a distributed, multi-media service which aims to capture the more descriptive elements of GIS in order to record indigenous peoples’ connection to the land in a way which aligns with their ontologies and can be readily accessed by future generations.

Nonetheless, there are limitations to the use of cyber-cartography by indigenous peoples. Technological divides between possibly remote communities and research institutions mean that ease of access for the researcher does not equate to ease of community access (Eisner *et al.*, 2012). As a result, several cyber-cartographic atlases have had low community response rates (Eisner *et al.*, 2012). Indeed, cyber-cartography does not necessarily guarantee community control over information included in maps: in several instances, copyright over cyber-cartographic atlases produced with Indigenous knowledges rests with the research institution rather than the community (see for example University of California Los Angeles American Indian Studies Centre 2017, University of Tasmania, 2016). Additionally, multi-media inputs can still be reductionist. Thus, “being digitally interactive or multi-layered does not in itself offer a closer correspondence to customary forms of cultural mapping” (Brown and Nicholas, 2012:319).

Ultimately, the nature of online objects is such that core spatial elements of cyber-cartographic atlases continue to rely on the map user clicking on the entity-based objects which are so problematic in counter-mapping and native title claims. Moreover, there are risks inherent to the online format as cyber-cartographic projects sit in the space between intellectual property laws and traditional knowledge laws (Scassa *et al.*, 2015). This is particularly true should a group be forced to use freely available online tools including Google Maps and Map Maker because “the standard Google licence provides that while any [intellectual property] rights in information layered upon Google service such as Map Maker remains with the contributor, the company holds an irrevocable worldwide licence to use or disseminate the information, and to create derivative works based on the information” (Scassa *et al.*, 2015:46).

Perhaps more importantly, the publicity associated with cyber-cartography is not the same as empowerment (Young and Gilmore, 2014). If a community holds a map and associated information in-house, they can tailor those outputs to their intended audience. Once online, it can be difficult to prevent this information being used to counter community interests (Scassa *et al.*, 2015; Young and Gilmore, 2014, 2017). Even carefully compiled information can be taken out of context, or mocked (Scassa *et al.*, 2015). Finally, although cyber-cartographic atlases may have some limited capacity for online spatial analysis (Kyem and Saku, 2009), it is not clear that such features have been effectively appropriated and transculturated by Indigenous peoples.

2.4.5 Strategy 5: Critical visualisations

Unlike cyber-cartographic atlases, critical visualisations are not inherently created, stored or accessed through a web interface. Instead, following Kwan (2015:244), these visualisations focus on “making the invisible visible” in a way that “seeks to challenge and transform the prevalent dynamics of social power [... and] reduce the adverse effects of social power on marginalised social groups”. Critical visualisation, is not conducted exclusively with Indigenous peoples, but also with Muslim women (Bagheri, 2014; Kwan, 2008), street vendors (Kim, 2015), and other marginalised groups (Kwan, 2002; Schwanen and Kwan, 2012).

In a native Hawai’ian context, Pearce and Louis made efforts to capture the essence of Nu’alolo Kai “a place of seasonal changes so significant that traditionally the mapping of this place was always in motion” (Pearce and Louis, 2008:117). Here, Pearce and Louis used lighting to address the fixed, seasonless and timeless sense of the map by animating the sun’s movement and rendering it across a southwest portion of Nu’alolo Kai; they then re-rendered the map to show tidal fluxes at different times of day. Additionally, Pearce and Louis both shifted to using a low, oblique perspective to overcome the disembodied space of the conventional map and used

animation to create a shift in temporal perspective which “overc[a]me the seasonless space of conventional mapping of Nu’alolo Kai” (Pearce and Louis, 2008:120).

In British Columbia, Lewis and Sheppard (2005, 2006) have used critical visualisations in their work with the Cheam First Nations Band of the Sto:lo Nation in the Upper Fraser Valley to “construct three-dimensional visualisations of the future landscape under different [logging] scenarios” (Lewis and Sheppard, 2006:291) in order to support engagement and understanding during the consultation process. As noted by Kim (2015:15), “[t]he promise and possibilities of debunking and retooling cartography are significant: by opening up who can make a map and the kinds of maps that are made, overlooked phenomena can be reclaimed, different perspectives can be made apparent, and new knowledge constructed”. Finally, the Winnemen Wintu used critical cartography and visualisation to bring together information from existing paper maps, georeferenced historical description and GIS datasets using the same projection in order to visualise patterns and relationships and explain controversy around territorial disputes (McTavish and Davis, 2012).

In critical visualisations, information is stored locally and map styles can be targeted to their anticipated audience. Indeed, in-house storage and analysis enables indigenous peoples to secure the geographic coordinates of sensitive areas, without the risks of holding such information externally, or online. Additionally, critical visualisations enable indigenous communities and researchers to take different spatial and temporal perspectives which enable a greater sense of embodiment in the landscape than the ‘view from nowhere’ afforded by planimetric cadastral maps and land use plans. Critical visualisation enables the mapmaker to capture movement and change through the use of video. Moreover, critical 3D visualisations are often more easily understood by Indigenous peoples than changes proposed in land use and other planning documents.

Certainly, the approaches to critical visualisations adopted in indigenous contexts so far have limitations and, as with any application of GIS in an indigenous context, there is still a need for critical reflexivity during production. Even moving visualisations designed to display depth of place continue to privilege sight as the primary way Indigenous peoples perceive the world (Pearce and Louis, 2008). Critical visualisations can also be reified, that is artificially fixed and made concrete. For example, indigenous peoples may have the capacity to store, but not update, critical visualisations constructed out-of-house. Additionally, visualisations influence emotions (Kwan, 2007), and in some cases they suppress rather than stimulate debate (Sheppard and Cizek, 2009). Thus, if a visualisation is “too polished” Indigenous peoples may feel unable to question the underlying data (Krygier, 2002).

Ultimately, critical visualisations deliberately subvert scientific modes of mapping, including those most used by legal systems. Thus, they may not be useful in cases where there is a legal challenge to indigenous rights. Finally, it remains unclear whether any of the visualisations constructed by or with Indigenous peoples so far have really drawn on GIS's capacity for spatial analysis and thus whether they have taken full advantage of the technology's capacity to support Indigenous decision making.

2.5 A call to explore a new form of mapping

As outlined above, each of the five dominant strategies for indigenous transculturation of GIS have a number of limitations: many fail to harness the technology's analytical potential, others do not adapt such potential to the local context. Counter-mapping, for example, uses 'scientific' mapping techniques to secure state-sponsored rights. GIS for cultural and natural resource management supports reporting and negotiations with third parties regarding these recognised rights. Yet, neither strategy aligns well with Indigenous spatial ontologies nor harnesses the technology's analytical capacity. The Tribal GIS approach permits both data collection and analysis – yet given the top-down introduction of this approach, it is rarely tailored to fit local context. Informed by criticisms of both counter-mapping and cultural and natural resource management strategies, cyber-cartography draws on the flexibility of its online format to produce outputs which more closely align with Indigenous spatial ontologies. This technique also carries risks inherent to its online format. Finally, critical visualisations have yet to truly focus on depicting indigenous peoples' relationships to their traditional lands, or to clearly integrate their results with the technology's potential for spatial analysis and decision support.

This section has established a need to explore approaches to the use of GIS in indigenous contexts which not only begin to address some of the criticisms levelled at such uses of the technology, but also use an understanding of GIScience, or the science and concepts which underpins GIS (Goodchild, 1992), and play to the technology's strengths in terms of its capacity for analysis and visualisation. This review thus positions a case study which examines the use of GIS visualisation and spatial analysis by Australian native title holders as not only able to respond to the practical impetus to support Indigenous engagement in a highly complex and inequitable post native title environment but also able to: a) explore the transculturation of GIS as an "art of the contact zone" by Indigenous peoples in a post native title context; b) explore alternatives to the cadastral model of space which has so dominated both indigenous dispossession and repossession; and c) draw on the strengths of GIS technologies while partially addressing critiques which have been levelled at the use of GIS in indigenous contexts.

Chapter 3: Research context

This chapter introduces the immediate practical and spatial context for this research considering the need to explore alternatives to the five dominant approaches to GIS among indigenous peoples outlined in Chapter 2. It introduces Yawuru people and their connection to Country, outlines settler interests in Broome and examines elements of Broome's history of oppression and resistance. It then outlines the Yawuru native title journey and explores Yawuru people's innovative approach to post native title governance, including their corporate structure, strategic knowledge vision, and engagement in research.

The second part of this chapter outlines how this study has been driven by a practical and pragmatic partnership between Yawuru governance bodies and researchers at the Australian National University (ANU). Specifically, it introduces the partnership between the Fenner School and NBY and examines my history as a researcher within that partnership. Finally, this chapter presents the two study sites within the Yawuru estate used in this thesis and outlines their relevance to Yawuru governance bodies.

3.1 Yawuru people and their Country

Yawuru people are connected by kinship, language, and traditions. They hold native title in and around the township of Broome on the Dampier Peninsula in the Kimberley region of north-west Western Australia. According to *Walyjala-jala buru jayida jarringgun buru Nyamba Yawuru ngan-ga mirlimirli: Planning for the future: Yawuru Cultural Management Plan*, hereafter referred to as the Yawuru Cultural Management Plan, their Country:

“extends southwards from Wirrjinmirr (Willie Creek), following the coast around Roebuck Bay to Bangarangara on the south-eastern end of Thangoo. To the west, Yawuru Country extends from the ridges of Garawany near Nila Bubica and across to Manigarragarbu, near old Dampier Downs on the north-western end of Walan-garr (the Edgar Ranges). The eastern boundary extends south through Dibingujarra and then cuts across the pindan plains to the coast at Bangarangara.” (Yawuru RNTBC, 2013:32).

In Yawuru Law, “everything comes from *Bugarrigarra*, the time when creative beings traversed the Country, naming the landscape, defining the languages that people would speak and setting down our rules and customs” (Yawuru RNTBC, 2013:30). Consequently, Yawuru Country is crossed by an “intricate network of [...] dreaming tracks” (Yawuru RNTBC, 2013:30) some of which are connected to traditions in central and eastern Australia. Indeed, the area is so spiritually rich that anthropologist Patrick Sullivan argued “... the Broome region, in religious terms, [is] intensely crowded. It may not be an exaggeration, and may give some indication of its uniqueness,

to say it is something of a Jerusalem, Mecca, or Varanasi [for] a significant part of Aboriginal Australia.” (Sullivan, cited in WA Government Department of Parks and Wildlife (DPAW), 2015a:4). One consequence of this richness, alongside a relative abundance of fresh water, has been the historical sharing of Yawuru Country through large gatherings which were held with groups of surrounding countrymen (Yawuru RNTBC, 2013:32).

Yawuru people identify as “saltwater people” and are intimately connected to their Country (Sullivan, 2014; Yap and Yu, 2016c; Yawuru RNTBC, 2013). They recognise six seasons and view their Country is a “living cultural landscape” centred on Roebuck Bay (Yawuru RNTBC, 2013:158). For many Yawuru people, seasonal knowledge and Law remain key elements of their dynamic and evolving relationship with Country (Yawuru RNTBC, 2013).

Today, Yawuru Country includes the township of Broome, Western Australia which is 2,240 km by road from Perth, the state capital in the south, and 1,870 km from Darwin in the Northern Territory. The town is also 3,000 kilometres south of Singapore (Johnson, 2014). In 2014, Broome had a permanent population of over 17,300 people (Australian Bureau of Statistics, 2016b). This can increase by more than 40% in peak tourist season, which typically runs during the drier, cooler months from May to October (AEC Group, 2012; Broome Visitor Centre, 2012).



Figure 3.1: Broome, Western Australia

Broome is home to approximately 3,700 Indigenous people, one quarter of whom identify as Yawuru (Taylor *et al.*, 2014). Yawuru people hold native title over nearly 5,300 square kilometres in and around Broome (Figure 3.1). However, five other groups have recognised native title rights within the broader Broome Shire including the Bardi Jawi, Ngurrara, Karajarri, Nyikina Mangala and Nyangumarta (National Native Title Tribunal, 2018c; Shire of Broome, 2013a:48) and several native title claims within the Shire remain undetermined. A number of other Aboriginal people also hold historical, but not traditional, associations with the area often linked to the town's past as an administrative and pearling capital for settler governments (Balint, 2012; Glowczewski, 1998).

A combination of smaller community pressures and attractions in Broome means that the town also attracts a large temporary Indigenous population, some of whom have lived in the town for many years (Prout, 2011). Indeed, "Broome's regional hospital and prison, two large shopping precincts, a range of restaurants and fast food outlets, several bars and liquor outlets, and the West Kimberley football competition [as well as] several cultural festivals and sporting carnivals throughout the year" attract significant numbers of Indigenous people to the town (Prout, 2011:282). Many of these people stay with family, live at one of the town's reserves, or failing that camp in one of several areas around the town including Kennedy Hill, One Mile, the Male Oval, and the mangroves around Dampier Creek (Farrer and Mitchell, 2014). A number are also increasingly likely to access short stay accommodation which is owned by NBY and run by MercyCare (Government of Western Australia, 2019).

3.2 Settler interests in Broome

For a town of just over 17,000 people, Broome has captured settler Australian imaginations since the late 1800s (Sassoon, 1999). Individual settler interests in Broome have tended to focus on economic and, later, lifestyle opportunities associated with the area (Shire of Broome, 2013a). Settler governments on the other hand, have tended to emphasise the town's regional role as a coastal hub, service centre and staging point for national defence (Hawke and Smith, 2012; Shire of Broome, 2013b). Broome's permanent fresh water sources facilitate a relatively large and stable population (Paul *et al.*, 2014), while its protected bay and declared deep-water port have supported its role as a trading centre (Bach and Australian Government The Department of Commerce and Agriculture, 1955; Edwards, 2009). As a coastal hub, Broome has assisted the natural resource extraction, pastoral and, eventually, the service and tourism industries by importing the materials and trade necessary to support inland invasion (Pedersen and Woorunmurra, 2011). As a governance centre, Broome has played a role in the administration of key settler policies including the *Aborigines Act* (Balint, 2012). It was a staging point for frontier

wars (Pedersen and Woorunmurra, 2011) and today acts as a service and transport hub for the broader Kimberley region (Australian Government, 2015). On the international defence front, Broome was central to World War Two evacuations (Gracey and Spargo, 1996) and continues to be pivotal in border security operations (Australian Government, 2015).

Historically, settler pressure on Yawuru Country has fluctuated with the local economy; increasing in eras of relative prosperity and diminishing as the town has contracted following economic collapse (Jackson, 1997a). Today, this economy relies on tourism, construction, and transport services (AEC Group, 2012) and the town is now considered a lynch-pin in the development of Northern Australia by local, state and national settler governments (Australian Government, 2015; Kimberley Development Commission, 2015; Shire of Broome, 2014b). Settler colonialism continues to exert significant pressure on Yawuru Country and this pressure is unlikely to diminish in the near future (NAILSMA, 2012a; Yu, 2013a).

3.3 The historical context for contemporary Yawuru engagements with settler Australia

From the 1860s, Broome's history has been characterised by a series of attempts at asserting settler control which have been met with various forms of resistance from Yawuru and other Aboriginal people. This history has direct implications for contemporary Yawuru governance. The first organised attempt by Europeans to occupy Yawuru Country ended in late 1865 when a settlement formed by the Roebuck Bay Pastoral and Agricultural Association collapsed following repeated attacks by Yawuru and Karajarri warriors, threatening the viability of pastorally-based invasion in the region (Pedersen and Woorunmurra, 2011). However, this respite from occupation was short-lived. By the late 1800s the hunt for pearls and pearl shell had begun to drive settler invasion of Australia's north-west (Bach and Australian Government The Department of Commerce and Agriculture, 1955). Indeed, it was the discovery of abundant pearl beds in Roebuck Bay combined with the availability of freshwater soaks and the relative protection of Dampier Creek that, for the first hundred years, drove the expansion of Broome over Yawuru Country.

Today, pearling is central to Broome's mythology and luxury pearl retailers dominate much of the Chinatown area (Figure 3.2). In the 19th Century, however, the contact zones of colonialism were dominated by brutality and slavery. In the pearling industry, European invaders relied upon enslaved Aboriginal people who had been rounded up on pastoral stations and sold for 25 pounds sterling to dive for pearls (Gracey and Spargo, 1996; Moore, 1994). This created a group of Aboriginal people who hold historical but not customary ties to Yawuru Country (Balint, 2012). In this era, Aboriginal resistance was characterised by evasion; escaping enslavement through

death or running away; and continuing violent reprisals for the invasion of Country (Pedersen and Woorunmurra, 2011). Nonetheless, as recounted by Pedersen and Woorunmurra (2011:26-27):

“Aboriginal communities were torn apart as countless young men and women were taken from their homelands and forced onto ships scattered along the coast. The capture of large numbers of Aboriginal divers, many of whom suffered lonely and horrific deaths, was made possible through close collaboration between pearlers and the sheep glaziers. Both groups make significant profits from a system of slavery that supported European occupation of the North.”



Figure 3.2: Photograph of luxury pearl stores in Chinatown, the heart of Broome. These are two of approximately eleven pearl vendors within the Chinatown area. Image taken by the Author, 2013.

The pearling industry’s transition from free- to suit-diving, near the turn of the century, was accompanied by a shift in labour exploitation and indentured Asian divers were brought in to operate the complex and heavy diving suits necessary to exploit deeper beds (Edwards, 2009). Indeed, by 1909 around 92% of the approximately 2,267 people associated with the pearling industry were Asian while only 1% were Aboriginal (Sassoon, 1999). This change in labour-exploitation created new and novel opportunities for resistance through trading and sexual alliances between Aboriginal people and Asian divers (Kabir, 2006; Yu, 1999). It also generated a siege mentality in the local settler population, a failed experiment to introduce white navy divers

to the region (Bailey, 2002) and more generally, a harsh regime of racial oppression (Choo, 2011; Ono and Lea, 2000).

Settler governments leveraged diverse legislation in their attempts to control Aboriginal and Asian lives throughout the Kimberley. The *Aborigines Act*, for example, gave the Chief Protector of Aborigines legal guardianship over all Indigenous children. This Act facilitated the declaration of prohibited areas around Dampier Creek estuaries and town boundaries where Indigenous people were forbidden to enter. It also meant that all co-habitation between Aboriginal and non-Aboriginal people had to be approved by the Chief Protector. Finally, the *Aborigines Act* gave settlers the capacity to create reserves which could be used to spatially isolate Indigenous people.

Using the powers given by the *Aborigines Act*, settlers in Broome prohibited Indigenous people from coming inside ‘the common gate’ - a cattle fence which was used to declare the town boundary as show in a land use plan from 1890 (Figure 3.3). They also segregated a number of services which were available to Broome’s increasingly ‘Creole’ community (Yu, 1999) and attempted to control the interactions within and between Indigenous and exogenous Others. Tactics including constant surveillance, raids, brutality and forced separation were common (Choo, 2011; Kaino, 2011; Yu, 1999). As an example, in 1928 the Inspector of Aborigines, Ernest Mitchell, drew a map which both colour-coded the Aboriginal and Asian populations in Broome, and named individual households in order to support this regime (Museum of Western Australia, 2016).

In this environment of fear, Yawuru and Aboriginal people forged trading alliances, evaded surveillance by living on the fringes of town, and attempted to carve out a space for their families to live (Yu, 1999). They also raided fish traps put out by Asian pearl divers; continued to speak in Yawuru language; ran away from raids; and appealed to Queen Elizabeth II outlining the “unresolved relationship between Britain and the Indigenous people of Australia” (Yu, P., 2018, p.2 of 6, see also Lingiari Foundation, 2007; Yawuru RNTBC, 2013; Yu, S., 1999). None of these acts of resistance, however, fully mitigated the brutality of settler efforts to assert control over Yawuru Country and Yawuru lives. Nor did they erase the spatial scars of this era which continue to be visible in the town’s layout (Taylor *et al.*, 2014; Fieldwork Notes June 2013, May 2015 & June 2017). Indeed, research by Taylor and colleagues (2014) was able to identify two major concentrations of Indigenous households in the oldest suburbs of Broome which lie in the south of the area, in part reflecting numerous policies implemented by settler governments. Given local land use plans for new developments in the town’s north (Shire of Broome, 2014a), this is likely to result in a Broome South that is predominantly Indigenous and largely associated with the distribution of public rental (Homeswest) accommodation and a Broome North that is mostly non-Indigenous.



Figure 3.3: Plan of Broome operational from 1890 – 1906. This plan includes the municipal boundary in yellow which was used as the declared town boundary under the *Aborigines Act*. State Records Office of Western Australia, Series S2168, Cons. 5698, Item 0229 Broome Sheet 2 [Tally No. 503850].

While the *Aborigines Act* was used to regulate Indigenous lives until the 1970s, by the 1980s such measures were increasingly distasteful to the settler populace (Lingiari Foundation, 2007; Prout, 2011). At this point, planning and zoning increasingly supported settler control over the Broome area. They provided a conveniently sanitised mechanism to emphasise a ‘public good’ which was often directly at odds with Indigenous interests (Jackson, 1996). As the township of Broome expanded over Yawuru Country and tourism became a dominant force in the local economy, settler governments used planning and zoning changes to convert some of the reserves

originally intended to contain Indigenous lives into a suite of sanitised commercial and residential developments. Indeed, to the distress of many Yawuru people, a suite of developments were proposed, and often approved, for highly significant areas including Minyirr/ Gantheaume Point, Kennedy Hill, and Fisherman's Bend throughout this time (Cosgrove and Kliger, 1997; Jackson, 1997a; Kliger and Cosgrove, 1999; Rabbitt, 2004; Tarran, 1997).

Today, the *Our North, Our Future: White Paper on Developing Northern Australia* (Australian Government, 2015), hereafter referred to as the Northern Australia White Paper, which outlines a twenty-year vision for expansion of land sector development of Australia's North, continues to place pressure on the Broome landscape (Australian Government, 2015; Morrison *et al.*, 2018). The Northern Australia White Paper is designed to facilitate substantial and rapid growth in food and agribusiness, resources and energy, tourism and hospitality, international education, and healthcare, medical research and aged care, while also tackling what settler governments across Australia's north perceived as the biggest barriers to such development, including the complexity of land arrangements and native title. Broome is identified as a regional hub within the white paper – an area which can facilitate development and support services throughout the region. Indeed, under this policy, Broome's population is expected to grow from 17,300 people in 2014 (Australian Bureau of Statistics, 2016b) to 25,000-30,000 people by 2036, while the broader Kimberley region is expected to reach a permanent population of up to 92,000 people by the same year (Kimberley Development Commission, 2015).

As Yawuru leader Peter Yu argued in his 2013 keynote at the World Indigenous Network conference: *"Northern Australia is at a transformative point in history and facing existential questions about its future. Does it follow the established Western economic development paradigm that has seen wealth created at a huge cost to [Indigenous people as well as] cultural and environmental destruction? Or, does it embark on a new paradigm that sees wealth generation, and cultural and environmental sustainability as indivisible and integrated? [...] With huge reserves of offshore and onshore gas and a serious push to use northern waters for food production there is compelling evidence that the next wave of northern development will be real and transformative"* (Yu, 2013a).

At the time of writing, the town of Broome continues to develop and expand over Yawuru Country (Rabbitt, 2004) and Yawuru people continue to experience significant levels of social disadvantage (Dodson, 2012). Yet, Yawuru and other Aboriginal people in Broome have not been passive victims of colonisation (Cosgrove and Kliger, 1997; Tarran, 1997; Yawuru RNTBC, 2013). Instead, they continue to advocate for their rights and Country at the local, regional and national level, as well as to forge a variety of alliances with Indigenous, environmental, community, academic and political groups (Yawuru RNTBC, 2013).

3.4 Native title and the Yawuru Global Agreement

The Rubibi native title claims (Rubibi Community v State of Western Australia [2001] FCA 1553; Rubibi Community v State of Western Australia (No 6) [2006] FCA 82) were some of many mechanisms employed by Yawuru people to protect their Country and secure their recognition as prime stakeholders in Broome's development. These claims were complex. Under the *Native Title Act*, only one group could have their claim recognised over the town site (Neate, 1999). However, several sub-groups including Yawuru, Djugan and Goolarabooloo had strong connections to certain areas within the claim (Burke, 2011a). The Rubibi Working Group was initially designed as a strategic alliance to assert claims in a (potentially) hostile settler legal system and the joint Rubibi claim was launched in late 1994 (Burke, 2011a; Glowczewski, 1998). While the legal process was ultimately divisive and this alliance was subjected to significant strain, Yawuru people used the claim to vigorously fight for their rights (Dodson, 2013). They collected oral histories to support the claim, provided extended evidence in a hostile court, and actively participated in court hearings which were conducted on Country in 2000 (Burke, 2011a; Glowczewski, 1998). Outside of the claim, the Rubibi Working Group actively asserted their rights and scrutinised the planning process, recruiting academics from RMIT to help them engage in local planning structures (Kliger and Cosgrove, 1999).

Local, commonwealth and state governments feared claims made over the township and a significant proportion of the surrounding area could constrain or stymie development in the region. Given this concern, they deployed a range of strategies to ensure that the Rubibi native title claim did not succeed (Dodson, 2012). Having illegally acquired some areas in Broome which had native title, the state attacked claimants on the basis of their ethnicity, resisted mediation, and made concerted efforts to discredit the claimants' anthropologist (Burke, 2011a; Dodson, 2013). When the Walman Yawuru group asserted a separate application for determination of the claim area, state agencies attempted to exploit this division by using testimonies in both claims to undermine those of the competing group (Burke, 2011a). Indeed, the Commonwealth government and the Shire of Broome continued to pursue an appeal against the Rubibi claim in the Federal Court until just six months before they signed the Yawuru Global Agreement with claimants (Yawuru RNTBC, 2013).

Yawuru people had their native title officially recognised when Justice Merkel decided in the Rubibi Working Group's favour in 2006 (Rubibi Community v State of Western Australia (No 6) [2006] FCA 82), following 12 years of intense litigation. This decision both provided formal recognition of Yawuru people as native title holders of the area in and around Broome and acknowledged that some land near Cable Beach had had its native title illegally extinguished (Yawuru RNTBC, 2013). It provided Yawuru people with some recognised rights. Where

exclusive possession was recognised, these included rights of possession, occupation, use and enjoyment as against the whole world [Rubibi Community v State of Western Australia (No 6)]. On the land and waters where native title had been partially extinguished, they included rights to live on, access, move about and use Country. They also included rights to access, use and take any of the resources of the land and waters (including ochre) [Rubibi Community v State of Western Australia (No 6)], although it is unclear whether this includes a right to use resources for commercial purposes. Finally, they included the right to engage in spiritual and cultural activities and the right to care for and maintain and protect the land and waters, including places of spiritual or cultural significance. A key part of these rights is a capacity to negotiate around, but not veto, any developments which might impinge upon them (Dodson, 2012). As has been experienced by some Indigenous peoples around Australia, for Yawuru people, the outcome of the native title claim was significant, but not a panacea (Bauman *et al.*, 2013b; Smith and Morphy, 2007; Strelein, 2013).

As was shown in Figure 1.1 (Chapter 1, p. 33) and is the case in most of Australia, the Rubibi native title determination resulted in a somewhat limited and spatially bounded patchwork of recognition by the settler state. Native title was found not to exist in a significant portion of the claim area (Dodson, 2013). Where native title did exist, the claim did not provide the monetary resources necessary to execute the rights and often expensive responsibilities held by newly recognised native title holders (Yawuru Native Title Holders Aboriginal Corporation, 2013). For example, the Shire of Broome initially charged NBY significant amounts in ongoing taxes and rates for the land returned to Yawuru people, even where this land remained undeveloped and was not generating active income (Rodney Nichole, pers. comm., 8 June 2017). Moreover, in a case of the lateral violence and collective trauma described by Osborne (2015), a number of intra- and inter-community schisms were exacerbated by a divisive claim process (Balint, 2012; Burke, 2011a).

Following recognition of their native title by Justice Merkel in 2006, Yawuru people entered into negotiations with local and state governments intended to provide compensation for the illegal extinguishment of native title on some Yawuru lands (Government of Western Australia, 2010). While ostensibly engaged in these good-faith negotiations, the local government continued to appeal the native title determination, until their appeal was dismissed by the High Court of Australia in 2008 (*The State of Western Australia v Sebastian* [2008] FCA 65). Thus, it was only with the Yawuru Global Agreement that truly constructive steps were taken towards relative Yawuru freedom from the state and capacity to engage as primary stakeholders on their Country.

The Yawuru Global Agreement was signed in 2010, five years after the initial recognition of Yawuru native title (Yawuru RNTBC, 2013). This Global Agreement comprised both a

Prescribed Body Corporate Indigenous Land Use Agreement, and the Yawuru Area Agreement and provided compensation for past illegal acquisition of Yawuru lands by the State of Western Australia (Yu, 2010). It was, at the time, the largest settlement to be reached over a native title claim in Australia, valued at \$200 million in cash and land transfers. Under this agreement, the Yawuru Registered Native Title Body Corporate (Yawuru RNTBC), also known as the Yawuru PBC, which is the body responsible for holding and managing native title for Yawuru Native Title Holders, received freehold title to approximately 80% of Broome's developable land (Skelton, 2010; Yawuru RNTBC, 2013; Yu, 2010). The Global Agreement thus provided the Yawuru PBC with a base to enter the free market and generate their own income (Government of Western Australia, 2010; Yawuru RNTBC, 2013; Yu, 2010). It also committed the Yawuru PBC to negotiate in good faith with the Shire of Broome and to compromise in regards to certain Future Acts on Yawuru Country (Government of Western Australia, 2010).

As a future Senator and senior Yawuru man Patrick Dodson noted in 2010, the Global Agreement: *"represents a serious cutting of the government umbilical cord. [Yawuru people] are in the marketplace now and we have to develop commercial skills to run joint ventures and that means getting good advice"* (Dodson in Skelton, 2010). It also meant that Yawuru were exposed to tax liabilities (Government of Western Australia, 2010). Using resources from this agreement, the Yawuru PBC has embraced a form of governance which draws on both customary Yawuru knowledges, and some Western approaches to management as outlined in the Yawuru Cultural Management Plan (Yawuru RNTBC, 2013). As an example, of the twelve directors on the Yawuru PBC, six are selected because they have responsibility for customary law, and six are voted in by members (NBY, 2018b). Today, the Yawuru PBC and its subsidiary company NBY continue to negotiate as key landholders and prime stakeholders in Broome's development. They engage with diverse bodies and interest groups including state and local governments, local arts bodies, natural resource extractors, local research institutes, non-profit organisations and many others as outlined in their annual reports (NBY, 2015b, 2017; Yawuru RNTBC, 2014, 2016).

Since 2010, the Yawuru people have reached two additional Indigenous Land Use Agreements. The first, the Yawuru Ungani Project Indigenous Land Use Agreement was registered with Buru Energy and Diamond Resources (Fitzroy) in 2015. It allows for the transport of oil along a road or pipeline. There "[i]n return for agreeing to the production licence and project titles, Yawuru received financial and other benefits. Yawuru did not consent to any fracking or extinguishment of native title" (NBY, 2015b:21). The second, the Yawuru Nagulagun / Roebuck Bay Marine Park Indigenous Land Use Agreement, includes a Joint Management Agreement for that area and "provides detail on management and administrative arrangements for the marine park, including establishment of a joint management body, joint management objectives, roles

and responsibilities for each party, decision-making processes and administrative functions” (DPAW, 2016b:9).

3.5 Innovative governance arrangements and a strategic knowledge vision

The Yawuru PBC recognise the simultaneous challenges and opportunities of native title recognition (Dodson, 2012, 2013) and have adopted innovative governance arrangements as part of their post native title journey. In addition to adopting the PBC format required by the *Native Title Amendment Act 1998* (Cth), they have formed a subsidiary company, NBY (Dodson, 2012), which is responsible for the management of the Yawuru PBC’s assets, negotiations with external stakeholders, and implementation of various social, cultural and environmental programs. These include efforts at language revival in schools (NBY, 2018d). Recently, they have also extended to three further subsidiaries: Yawuru Holdings, which manages the other subsidiaries; Yawuru Properties Pty. Ltd., which includes a 50% stake in a local construction company; Yawuru Agricultural Pastoral Company Pty. Ltd., which engages in pastoral work on Roebuck Plains Station; and, NBY Technologies Pty. Ltd., which functions as a local information technology firm (NBY, 2018a). As an additional protective measure, Yawuru have also created a regulatory body Murra Mala Pty. Ltd. which appoints directors to NBY and is designed to “separat[e] the ‘business’ of the PBC from the commercial and other activities of NBY” (NBY, 2016).

Yawuru have also worked hard to outline their aspirations for post native title governance. Formally, these aspirations, which feature at the top of the Yawuru website are *mabu liyan*, *mabu buru*, and *mabu ngarrungunil*: which have been roughly translated as strong spirit, healthy Country and healthy community (Mathews *et al.*, 2011; NBY, 2018d; Taylor *et al.*, 2014). More simply, as included on the back of the 2018 Annual Report, they have been translated as “making *mabu liyan* real for all, always” (emphasis added) (NBY, 2018a:36). While the processes through which these aspirations are achieved can, at times, be contested – such as when an economic development designed to provide future financial security to support community programs may negatively impact a portion of Yawuru Country - these aspirations remain central to Yawuru decision making. Indeed, Yawuru governance bodies often focus on supporting these aspirations over the long term through partnerships and resource allocation following native title recognition.

The implementation of these aspirations remains complex. Indeed, native title recognition in a rapidly developing town forces Yawuru governance bodies to “spend a considerable portion of [their] own resources to develop and maintain capacity to make decisions that reflect the rights and aspirations of Yawuru native title holders within tight legal timeframes” (Yawuru Native Title Holders Aboriginal Corporation, 2013:2). Given this complexity, the Yawuru PBC have made an

active decision to implement a strategic knowledge vision to inform, support, and guide their community governance (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012). This vision aims to collate community, historic and diverse data on Country, to protect community values and customs, and identify opportunities for economic engagement and community growth (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012). It focuses on four pillars: Knowing our People and Community; Knowing our Country; Knowing our Story; and Building Economic Prosperity, each of which is supported by both Yawuru traditional knowledges and an active research program. While Yawuru knowledge systems sit at the heart of their strategic knowledge vision, Yawuru governance bodies are working to complement these knowledges with information drawn from Western knowledges and sciences. Indeed, as outlined in the Aboriginal and Torres Strait Islander Social Justice Commissioner 2012 Native Title Report:

“[t]he ‘Four Pillar Knowledge Vision’ focuses on gathering information about the Yawuru Peoples native title group and the broader Indigenous community residing in the Broome region to ensure that ‘governance arrangements in the post-native title determination era... [are] informed by locally controlled and customised information’. Notably, ...as an incorporated land-holding group, the Yawuru people of Broome are among the first in Australia to move in this area of information gathering, certainly in terms of the degree of local control, participation and conceptual thinking around the logistics and rationale for such an exercise” (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012:110)

3.5.1 Research and Yawuru governance

As outlined above, research plays a key role in informing Yawuru governance following native title recognition. Indeed, Yawuru organisations have commissioned their own research to pursue social, political and economic opportunities which align with their pursuit of *mabu liyan*, *mabu buru*, and *mabu ngarrungunil*. In doing so, they recognise that “data have important implications for Indigenous Peoples’ ability to exercise their individual and collective rights to self-determination” (The Global Indigenous Data Alliance, 2019, p.1) and assert their right to data sovereignty.

The concept of data sovereignty is central to many of the research relationships pursued by Yawuru governance bodies within their estate. In general, data sovereignty is “managing information in a way that is consistent with the laws, practices and customs of the nation-state in which it is located” (Snipp, 2016, p.39). Indigenous data sovereignty “refers to the right of Indigenous peoples to govern the collection, ownership, and application of data about Indigenous communities, peoples, lands, and resources” (Rainie *et al.*, 2019, p.301). It is a strategic tool of

decolonisation (Oguamanam, 2019) which responds to historic problems in research practices, and aims to guide good practice going forward (Lovett *et al.*, 2019).

Guidelines to support Indigenous data sovereignty have been issued by various governance bodies around the globe. Maïam nayri Wingara and the Australian Indigenous Governance Institute (2018, pp.3-4) have highlighted the need for data in research to: “prioritise Indigenous data needs; protect Indigenous data integrity; support Indigenous leadership and governance in data decision making; be accountable to Indigenous people/nations on decisions around data collection and use; and recognise Indigenous interests, including collective interests, in relation to data”. Similar principles have been outlined by Canadian First Nations (First Nations Information Governance Centre, 2020), as well as The Global Indigenous Data Alliance (2019) and Te Mana Raraunga (2018). In line with these principles, Yawuru governance bodies are careful to negotiate and pursue data sovereignty in their research relationships. They are also actively pursuing the repatriation of sacred materials and ancestral remains through the Wanggarli Burugun (We are coming home) Repatriation project (NBY, 2019a).

Much of the research run, endorsed, or facilitated by Yawuru governance bodies relates directly to their four-pillar knowledge vision. For ***Knowing our People and Community***, Yawuru commissioned one of the first Indigenous-run collaborative demographic surveys designed to identify Indigenous households in Broome and collect information on different language groups within the town (Taylor *et al.*, 2014). The ***Knowing our Country*** component includes mapping and monitoring areas across the Yawuru estate (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012). Yawuru Country managers have also been involved in a range of projects including water monitoring, snubfin dolphin surveys, spectacled hare-wallaby surveys, bilby surveys, Minyirr Park weed mapping, Broome Port weed control and monitoring rangelands in order to support Yawuru determined outcomes for their Country (NBY, 2015b).

Finally, for ***Knowing our Story***, Yawuru people have been involved in archaeological assessments of Roebuck Plains and conducted considerable research on their language, culture, and history. They have also worked to compile and digitise the historical records produced through the native title claim process “to inform future generations about the Yawuru Peoples and their Country” (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012:111). Much of this research and knowledge will be housed within the new Liyan-gan Nyirrwa Cultural Centre (Curran, 2015; NBY, 2015a, 2018a; Yawuru RNTBC, 2016).

In many respects, the Yawuru knowledge vision and their emphasis on data sovereignty as part of that vision have led Yawuru to become leaders within the research space. Indeed, NBY have had staff involved in leading research partnerships throughout the Kimberley. These include the Kimberly Indigenous Saltwater Science Project (Western Australian Marine Science

Institution, 2017), their involvement with the Roebuck Bay Working Group (Roebuck Bay Working Group, 2017) and their role in co-hosting the “Science on the Broome Coast” series of public lectures (Roebuck Bay Working Group, 2017). Additionally, Yawuru make explicit their expectations of external researchers (Yawuru RNTBC, 2013). These expectations include that research on Yawuru Country will produce outputs which are useful and relevant to supporting outcomes determined by Yawuru people (Yu, 2011) and that researchers will actively collaborate in the interests of Yawuru people (Yawuru RNTBC, 2013).

Like many Indigenous peoples, Yawuru people have had negative research experiences which complicate contemporary attempts at respectful and negotiated partnership research (Fieldwork notes 2015). Several Yawuru people have recorded how their knowledge has been exploited without appropriate respect or compensation. Yawuru woman Mary Tarran, for example, fought against the development of a house at Minyirr and articulated her experience of research fatigue when faced with repeated requests for the same information from both researchers and local planning agencies (Tarran, 1997). At times, the research record has also been used against Yawuru interests. During the Rubibi native title claim, the records of anthropologists who had spent short periods of time in the area were used to undermine the joint claim process. Indeed, the field notes of the claimant’s anthropologist were even leveraged by the state to challenge the Rubibi claim (Burke, 2011a, 2011b). Additionally, a book called *Broome-time* which was a part-memoir, part-exposé on the Broome community helped to undermine faith in outsiders seeking community information (Skene, 2002). Given these local experiences, and the ways that intellectual property protection may be considered a key avenue for development in Indigenous contexts (Drahos and Frankel, 2012), it is unsurprising that many Yawuru individuals continue to remain wary of even well-intentioned research projects.

Yawuru governance bodies have established protocols designed to facilitate greater control over the research conducted on their community and want to be able to say no to research, where necessary. They also want to be actively involved in, and have some measure of control over, any research conducted on or with Yawuru people (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012; Yawuru RNTBC, 2013). In particular, these governance bodies are acutely aware of the importance of data sovereignty and the need to retain in-house data control (Kukutai and Taylor, 2016; Yawuru RNTBC, 2013). They emphasise reciprocity in research and, where possible, expect capacity transfer as part of the research process (Peter Yu, pers. comm., 8 June 2017). Given this, they have often sought to mitigate research risk by forming close and respected partnerships with individual researchers or research institutes including ANU (Dodson, 2012).

3.5.2 The Yawuru - ANU relationship⁸

In part, the Yawuru-ANU relationship draws direct connections between prominent Yawuru people and the ANU as an institution. Professor, and now Senator, Patrick Dodson, for example, is both a Yawuru law man – someone who can speak for Yawuru Country, and a former member of the ANU Council. Similarly, NBY CEO Peter Yu currently sits on the ANU Council (ANU, 2017a) and delivered the 2018 ANU Reconciliation Lecture, while Mick Dodson is a Professor of Law who recently retired as head of the ANU National Centre for Indigenous Studies (ANU, 2017b). These connections have equipped certain Yawuru people to make direct recommendations to the ANU Executive Council across diverse issues, as well as facilitating connections with researchers and professional staff. Peter Yu, for example, used his 2018 Reconciliation Lecture to argue that ANU should contribute to a “National History and Reconciliation Centre” which documents “oral histories of the First Peoples and settler communities of this Country and combin[es] those stories with archival sources to build a bank of knowledge that would be an uncontested truth” (Yu, 2018, p. 5 of 6). As the inaugural director of the National Centre for Indigenous Studies Mick Dodson positioned that centre as a hub for Indigenous studies within the university. Finally, Patrick Dodson used a message to the ANU Vice-Chancellor in 2012 to both commend the relationship between ANU researchers and Yawuru people, and to ask that the relationship be extended into the future. There, he argued that “this is an extraordinary relationship with a University who can bring academic skills, competencies, and are also in the process of trying to transfer some of those skills to our people here in an organised way” (Dodson, 2012).

Some non-Yawuru researchers at ANU have also worked closely with Yawuru people and governance bodies and, in doing so, directly provided context for this research. At the Centre for Aboriginal Economic Policy Research, for instance, Mandy Yap (Yap and Yu, 2014, 2016b, 2016c) worked on operationalising the capability approach to development by defining and selecting indicators of wellbeing which are grounded in the knowledge systems and lived experiences of Yawuru people. Similarly, at the National Centre for Indigenous Studies, Edward Wensing worked with the Bardi Jawi and Yawuru PBCs to explore potential mechanisms to reform planning and land tenure in order to make them more equitable for Indigenous peoples (Wensing, 2002, 2013, 2014, 2016; Wensing and Porter, 2016; Wensing and Small, 2012). From a Yawuru perspective, Yap’s work has been used by Yawuru to help feed into the Liyan centre

⁸ An overall relationship between the ANU and Yawuru has not been formalised and consequently there is no official name used to describe it. In this thesis, written from the perspective of a postgraduate at ANU, it is referred to as the Yawuru - ANU relationship or the relationship.

and overall measures of well-being, while Wensing's work has helped to inform Yawuru approaches to tenure and development in different parts of their estate.

Most significantly for this study, in 2011 a team led by John Taylor at the Centre for Aboriginal Economic Policy Research were commissioned to support the Yawuru Native Title Holders Aboriginal Corporation and the Kimberley Institute in conducting The Yawuru Knowing Our Community Survey. This survey was "the first [...] to be knowingly comprehensive in coverage and to be developed, managed, conducted, and controlled entirely by local Indigenous organisations and local Indigenous residents for the primary purpose of informing their own local planning needs" (Taylor *et al.*, 2014:3). It helped to locate Yawuru people (Dodson, 2012) and "set a precedent in the acquisition and application of demographic information for internal planning and community development in the post-native title determination era" (Taylor *et al.*, 2014:1). One innovative element of the survey relevant to this research was the way it linked results with geocoded national address files within a GIS "to generate new spatial perspectives on community planning issues" (Taylor *et al.*, 2014:18).

The GIS component of the survey demonstrated systematic deficits in the way households on Aboriginal Land Trust lands are captured by the national census (Taylor *et al.*, 2014). These deficits affect some of the most marginalised Yawuru households and have direct implications for the allocation of state and federal resources which rely heavily on census data. Holding information on poor census capture of these communities has enabled NBY to present this information to a range of government institutions and pressure them for appropriate policy reforms. As an example, additional GIS analysis was able to demonstrate that around 79% of Indigenous dwellings in Broome had low or poor access to public transport (Taylor *et al.*, 2014:24). This "spatial mismatch between the distribution of Indigenous dwellings and a key urban service" (Taylor *et al.*, 2014:25) had implications for a range of social issues, including school non-attendance. Indeed, Yawuru people were able to leverage this GIS analysis to successfully advocate for an alternate bus route serving a greater percentage of Indigenous households in Broome (Doran, 2016). Ultimately, the interest generated in GIS from the demographic survey and past projects by external researchers led to the development of a smaller partnership between NBY, Bruce Doran, and some of his students at the Fenner School (Dodson, 2012; Taylor *et al.*, 2014). It is this partnership which provides the immediate institutional context for this thesis.

3.5.3 The Fenner School–NBY GIS partnership

The Fenner School-NBY GIS partnership, hereafter referred to as "the GIS partnership", focuses on the use of GIS-based mapping to represent the Yawuru notion of a living cultural

landscape (Doran and NBY, 2018). This partnership developed around employing GIS technology to represent Yawuru views of Country for Yawuru determined applications. As Patrick Dodson outlined in his 2012 message to the ANU Vice-Chancellor:

“we started this on the basis that the Yawuru after the native title determination and negotiations needed to get some really serious data in order to help inform decisions about investment, about services, about the way of life or the needs of our communities. [...] There is a real need for us to be empowered through knowledge systems, and the technology that goes with knowledge systems, about a whole range of things from land use, to management systems, to conservation concerns, and there are cultural and social issues.”

As shown in Box 3.1, Dodson used this speech to identify how Yawuru might use increased GIS capacity to address challenges across their estate. He outlined several goals for the GIS partnership including the introduction of student projects and the creation of a multi-objective land use model to help support decision-making in the Yawuru estate. He also introduced broader aspirations to change the paradigm of consultation to one more closely aligned with Yawuru data sovereignty and the principles of free, prior, and informed consent outlined in the UNDRIP. To a large degree, the partnership has focused on achieving these goals. It has also responded to

Box 3.1: Extracts from Patrick Dodson’s 2012 message to the ANU Vice-Chancellor outlining the potential of GIS mapping in a Yawuru context (Dodson, 2012)

“There is a real need for us to be empowered through knowledge systems, and the technology that goes with knowledge systems, about a whole range of things from land use to management systems to conservation concerns and there are cultural and social issues.”

“We need to have a clear cultural map of our own customary estate and our usages as well as where the water is, where the grass is, where the terrain is, what kinds of things live in these habitats, so that we not only just protect the rights and interests of the Yawuru people in this instance but we also work out ways to be to enable the environment, nature, to be resilient and to survive.”

“We have six seasons in the Yawuru calendar, and there are certain things that happen in those six seasons. We identify what is supposed to be happening according to the Yawuru people, and we’ll correlate that to what the company is saying in terms of their reports, and any aberrations that might occur. Now to map all that is tremendously exciting and importantly, some of our young people are now being toolled up to use GPSs, we’re getting some cooperation with the companies to provide the data to us. We obviously need to put this into a management arrangement within our own structure.

Then the company can come back to us and say “Okay, this is now the blueprint of where we want to locate our infrastructure on this land, or where we want to go and drill holes, do seismic surveys, 3D surveys, whatever it is. We can put that on top of the map and then basically on the desktop rearrange things or negotiation shifting of the preferred locations that the company’s got against our flora and fauna surveys and our cultural heritage surveys.

Ultimately, then there’s a need to go out onto the land and physically locate where the infrastructure is going to go and to set up a monitoring process in relation to that. Now that’s not a big change, but it requires companies to come to the table with a lot more than just simply complying with what the law requires of them from a Western position but recognising that we have Native Title Rights and Interests and we want to assert those but in a way that we will be able to collaborate with the company’s interests as well as our own.”

emergent issues including the handback of Roebuck Plains Station, the creation of various management plans across the Yawuru estate, and proposed re-developments for the Chinatown precinct.

As is often the case in partnership research (Barnes, 2000; McKenna and Main, 2013), the GIS partnership has been facilitated by key individuals within larger institutions. At ANU, the partnership has been anchored by Bruce Doran, a senior lecturer on GIS since 2011. At NBY, the partnership has received high-level support from Patrick Dodson and Peter Yu as outlined publicly in Dodson's Message to the ANU Vice-Chancellor and Yu's keynote speech at the World Indigenous Network Conference in Darwin (Dodson, 2012; Yu, 2013a). On a day-to-day basis it has largely been anchored by Dean Mathews, Julie Melbourne, and other members of what was formerly known as the Land and Sea Unit and is now part of the broader Native Title and Environmental Services team. Over more than six years, we have shared expertise relevant to key issues as part of the relationship. Bruce and his students have brought technical knowledge, GIS research experience and theoretical frameworks drawn from behavioural geography and mathematics. At the same time, Yawuru collaborators including Dean Mathews have contributed their deep contextual understanding of both the Yawuru living cultural landscape and key issues facing both NBY and Yawuru people more generally. Techniques employed in the partnership have developed over time, blending through formal and informal conversations around management issues, methods, approaches and ethics. They draw heavily on both the Yawuru Four Pillar Knowledge Vision and *mabu liyan*, *mabu buru*, and *mabu ngarrungunil*, the aspirations which guide Yawuru governance. These concepts are clearly explained to any new students involved in the partnership, who are required to sign onto them as part of the Draft ANU-NBY Code of Conduct (Appendix 4a).

To date, the GIS partnership has generated strategic information used to help address key challenges across the Yawuru estate. This has included "high quality capacity building around GIS" alongside "research from students which is relevant to future projects and developments" (Doran and Nyamba Buru Yawuru, 2018, p.2 of 3). At Yulleroo, work from the partnership supported engagements with local natural resource extraction company Buru Energy who hold licences to conduct controversial fractured shale gas mining, 'fracking', in the area (Collins, 2013a). On Roebuck Plains, analysis of Landsat imagery has demonstrated inundation of the plains in Man-gala, the Yawuru wet season (Doran, 2016) and Maddie Gardner (2014) used a mixed methods approach to develop a fuzzy model of hunting accessibility. Also at Roebuck Plains Station, Mia Sandgren (2017) adapted techniques developed in Potter *et al.* (2016) to define Yawuru tourism priorities for the area. Sandgren created a spatial model of those priorities and integrated them with existing datasets to define areas of conflicting and competing values and

tourism-appropriate sites. At the same time, Rory Taylor (2017) investigated how the nationally generated Water Observations from Space data, which shows historical surface water observations derived from satellite imagery for all of Australia from 1987 onwards (Australian Government Geoscience Australia, 2018), could be applied to support Yawuru water management on the station. Much of this information was integrated into a multi-objective land-use model for Roebuck Plains Station, a cattle station which sits in the middle of Roebuck Plains and was returned to Yawuru people in 2014 who now co-manage the station with the Indigenous Land Council (Bruce Doran, pers. comm., 2 June 2015).

Beyond the spatial information generated by the work outlined above the partnership has supported NBY by providing technical expertise and training as they have begun to set up their geospatial capacity in the Native Title and Environmental Services Unit. This support has included a combination of training, consultancy and help in securing the provision of ArcGIS software for in-house use, providing “a tool to assist the Yawuru community to make quality and informed decisions that account for cultural and other values, when considering land use in different contexts” (Doran and Nyamba Buru Yawuru, 2018, p.2 of 3). Finally, from an anthropological perspective, Maddy Brodie (2015) used qualitative analysis to explore future management directions for Roebuck Plains Station, emphasising the importance of a culturally-driven development agenda in this area.

For research partners at the Fenner School, the partnership has brought valuable grass-roots collaboration and on Country learning opportunities. Indeed, since 2012, a case-based module within a ‘capstone’ course at the Fenner School has begun to expose students “to Indigenous research methodologies that highlight the importance of reciprocity, trust and respect” (ANU, 2016:29). The subject matter for the case study is chosen each year in consultation with Yawuru stakeholders and addresses priority issues facing the community. To date, these issues have been the impacts of fracking by large multinational mining companies operating in the eastern part of the Yawuru estate, and the integration of cattle grazing with cultural and heritage management” (ANU, 2016:29). The partnership has also inspired several students “to undertake internships with Indigenous communities or go onto Honours or PhD research in this area” (ANU, 2016:29).

In 2013, I helped construct a collective Yawuru cultural values model for the in-town foreshore of Roebuck Bay in Broome in the first student-run project conducted as part of the GIS partnership (Potter, 2013). This model focused on representing access to resources, access to views of Roebuck Bay, and areas valued for pearling heritage within that portion of the Yawuru living cultural landscape in line with recommendations then made by Yawuru collaborators. It demonstrated “the potential of using a fuzzy index modelling approach as a common language to communicate Indigenous values and facilitate negotiation” (Potter *et al.*, 2016:17) and showed

how fuzzy logic may produce spatial representations of values which are more congruent with Indigenous perceptions of space than traditional Boolean models (see relevant published article in Appendix 1A). This pilot project revealed how simple overlay techniques could be used to equip Indigenous communities to engage with settler documents in a way which may reduce the information challenges outlined by Patrick Dodson in his 2012 speech (Potter *et al.*, 2016).

Following on from my Honours research, in 2014 as I started my PhD, I was asked to undertake a consultancy which overlaid the primary product of my Honours research on a visualisation of Broome's pre-contact landscape and digitised old town plans of Broome in order to visualise the town's expansion over time (e.g. Figure 3.4).

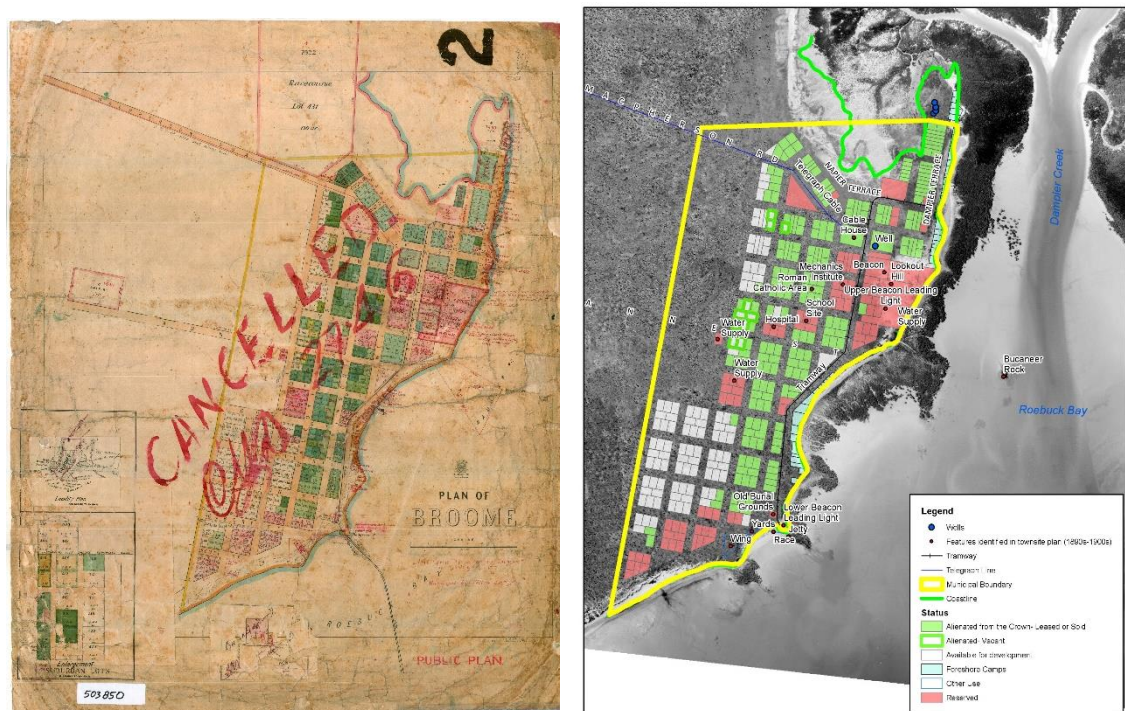


Figure 3.4: Figures comparing original land use plan to digitised version included as part of the report. The figure on the left is an original land use plan of Broome from 1890-1906 (State Records Office of Western Australia, Series S2168, Cons. 5698, Item 0229 Broome Sheet 2 [Tally No. 503850]). The figure on the right is a digitised version of that land use plan overlaid on an image of an imagined pre-contact landscape of Broome created by the author as part of a consultancy for NBY in 2014.

The Yawuru report to Paspaley followed discussions between Yawuru and Paspaley regarding the future of Chinatown and served as a cultural audit of the Chinatown area. It was designed to articulate some Yawuru visions for the space and facilitate better informed discussions around the future of that area (NBY, 2014). These discussions combined with the pilot study led to the selection of two study sites to be the spatial foci of this study as outlined below.

3.5.4 Study site selection

Two sections of the Yawuru estate were identified by a reference group of NBY staff to act as the spatial foci of this research (Figure 3.5). The first study site is a direct expansion of the in-town foreshore study site which was the spatial focus for my Honours research in 2013. The Broome town site (called Broome Town in this thesis) is an urban area which contains a number of cultural sites (Yawuru RNTBC, 2013), it is also the historical locus of settler interest in the Yawuru estate (Lingiari Foundation, 2007; Yu, 1999).

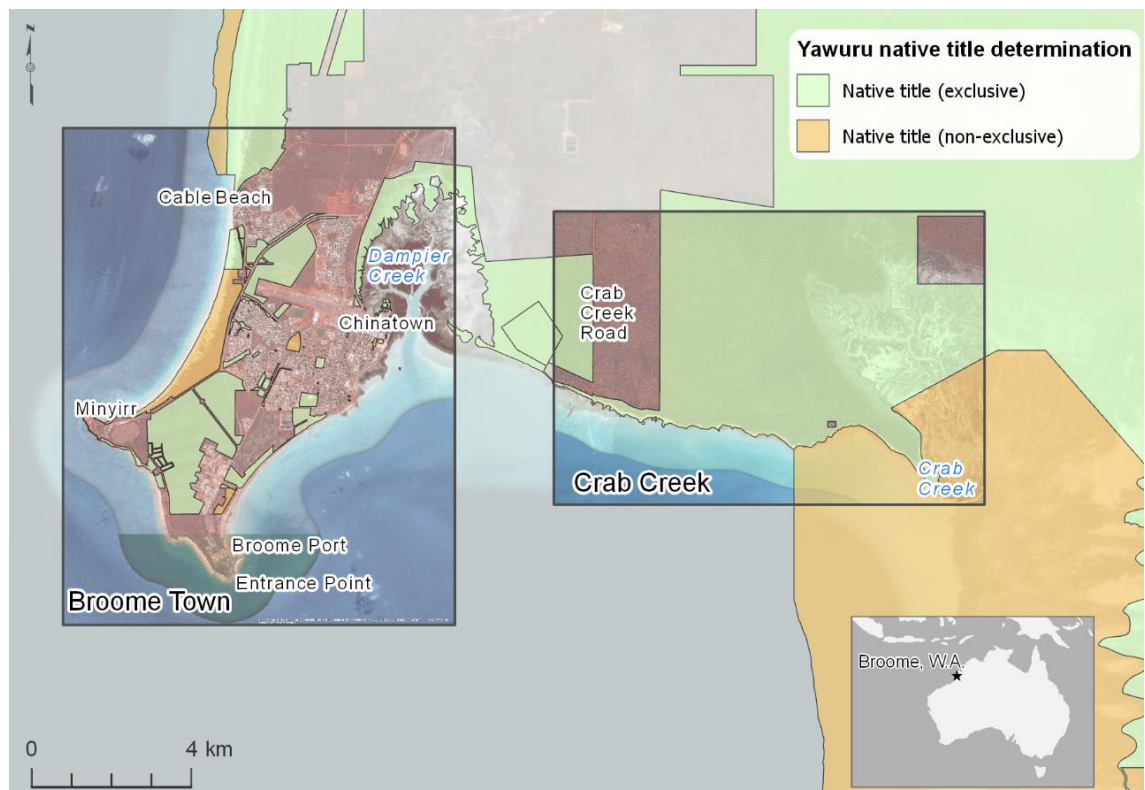


Figure 3.5: Study sites

Yawuru governance bodies were interested in mapping Broome Town for several reasons. First, for many Yawuru people, and particularly those without access to cars or other vehicles this is the most readily accessible portion of their estate (Dean Mathews, pers. comm., 15 July 2013). Such proximity to Yawuru life spaces mean that any developments or changes within the town site are likely to keenly affect Yawuru people. Second, Broome Town is under intense and sustained development pressure which continues to cause concern for many Yawuru people (Jackson, 1997a; McDowell, 2017; Tarran, 1997). Yawuru governance bodies need tools and information to engage with this growth and, where feasible, to harness and direct it within the town site. They need to respond to the values, concerns and needs of their constituents while navigating complex native title, management, and planning arrangements within the Broome

Town site. More generally, Broome Town provides an opportunity to explore the value of this mapping in a highly complex and contested area and extend on the pilot values modelling of Broome's in-town foreshore in 2013. In this it aligns with Yawuru aspirations to extend value-based GIS modelling across their larger estate (Taylor *et al.*, 2014).

In April 2015, a Yawuru reference group requested that GIS modelling in this study be extended to include Crab Creek, a peri-urban area located less than ten kilometres from Broome Town. Yawuru people often visit Crab Creek to engage in diverse customary and cultural activities including cultural ceremonies, camping, fishing, crabbing, hunting stingrays, collecting shells, and simply spending time with family. Indeed, many Yawuru people actively use Crab Creek to retreat from town life (Fieldwork notes, 2015).

In many respects the management issues that Yawuru face at Crab Creek are distinct from those in the town site. Under the Yawuru Global Agreement, much of the Crab Creek site was transferred to Yawuru as freehold title on the condition that it was leased back to the state for management under the *Conservation and Land Management Act 1984* (WA) ('CALM Act'). Today, the Yawuru Park Council helps to co-manage Crab Creek with the Department of Parks and Wildlife of the State of Western Australia (DPAW) for the use and enjoyment of Yawuru people and the broader Broome community (DPAW, 2015b). This means that Yawuru governance bodies have greater control over the management of Crab Creek than they do the town site. It also means that they are obliged to consider how management strategies in Crab Creek will impact on the town's broader community.

Historically, the area of Yawuru Country at Crab Creek was less impacted by settler interests than Broome Town (DPAW, 2015b). Today, however, the area is under increasing use pressure as the closest coastal recreation park to Broome on Roebuck Bay. For some Yawuru people, use of Crab Creek by third parties impinges on the privacy necessary to conduct cultural activities and ceremonies within the area. This can generate tensions around co-management. Co-management of Crab Creek is also complicated by previously unregulated access to the area which generated spur roads down to the beach. While these roads provide some Yawuru families with vehicular access to the beach, they also contribute to erosion in the area. Finally Crab Creek includes part of a 34,119 hectare site recognised under the Ramsar Convention on Wetlands of Importance especially as Waterfowl Habitat (Sharon Griffiths and Associates, 2010). While this wetland regularly supports more than 100,000 water birds the Ramsar convention also imposes management requirements which extend beyond the scope of the *CALM Act* (Sharon Griffiths and Associates, 2010).

While both the Broome Town and Crab Creek study sites are important to Yawuru governance bodies, the operational decisions and development negotiations which Yawuru people

engage in typically occur at smaller spatial scales (Darren Stevens, pers. comm., 19 May 2015). In part, this is due to limited resource availability and the ways that the settler state has arranged access, reserves and tenure across these areas. Ultimately, the two study sites can be broken down into key areas which have distinct associations for Yawuru people and are likely to be the subject of specific development plans or negotiations. Most of these areas are identified as key sites in Yawuru planning documents and many emerged as important areas in the values modelling (Chapter 7). These sites are presented in Sections 3.5.5 and 3.5.6.

3.5.5 Key areas in the Broome Town Site

The Broome Town site is highly diverse. Figure 3.6 and Figure 3.7 compare the relative levels of native title recognition and zoning across Broome Town. These figures demonstrate the comparatively high diversity of native title recognition and the complexity of zoning in small areas. Figure 3.8 shows the Broome Coastal Reserves Master Plan for the south of the site. The Broome Coastal Reserves Master Plan was prepared by CCS Strategic and Acacia Springs Environmental and UDLA for the Shire of Broome to “guide the Shire’s contribution to an effective multi-party management plan for the town’s coastal reserves” (CCS Strategic *et al.*, 2013, p. 3 of 16). It demonstrates the prevalence of co-managed areas in the south of the site.

Given the relative density of development, history of settlement, complexity of management arrangements, and increased exposure that the resident Yawuru population have to the townsite, this site is commonly divided into smaller areas as highlighted in Figure 3.6. Key features of the townsite include:

- **Dampier Creek:** A popular fishing location which contains a number of cultural sites and includes 6km² of mangroves (Sharon Griffiths and Associates, 2010).
- **Broome’s in-town foreshore:** An area from Chinatown in the north to Town Beach in the south which can be broken down further into smaller areas including:
 - o **Chinatown:** Broome’s commercial and social heart. The epicentre of Broome’s pearling industry, and site of initial colonisation.
 - o **Kennedy Hill:** a highly significant cultural and historical site.
 - o **Town Beach:** a local swimming beach and fishing spot. The viewing site for Broome’s famous “staircase to the moon”.
- **Simpson Beach:** a fishing and spearing beach popular with locals, but rarely accessed by tourists.
- **Port/Jetty/Entrance Point:** Broome’s port and a popular fishing spot. This site is managed by the Broome Port Authority, but contains a significant area and remains a popular spot for many Yawuru people. Some Yawuru people also launch boats in the

area. Recent discussions about expanding the port mean that Yawuru people could lose recreational access to the area.

- **Reddell Beach:** A relatively isolated section of coastline in the Broome town popular for fishing and shelling. The subject of perennial marina development proposals.
- **Minyirr/Gantheaume Point:** A significant area immediately adjacent to Broome's racecourse which has been subject to contentious development proposals.
- **Minyirr Park:** An "A-Class" reserve system which is jointly managed by the Rubibi Working Group, Yawuru native title holders, and the Shire of Broome. Here, Yawuru are working to control erosion, manage weeds, and prevent fires.
- **Cable Beach:** A popular tourist beach made famous for its white sand, camel trains and sunsets. One of the few areas in Australia where cars are allowed to drive directly onto the beach.

Tables 3.1 to 3.11 provide a visual outline of each of these sites and underscore their importance for Yawuru governance and management.

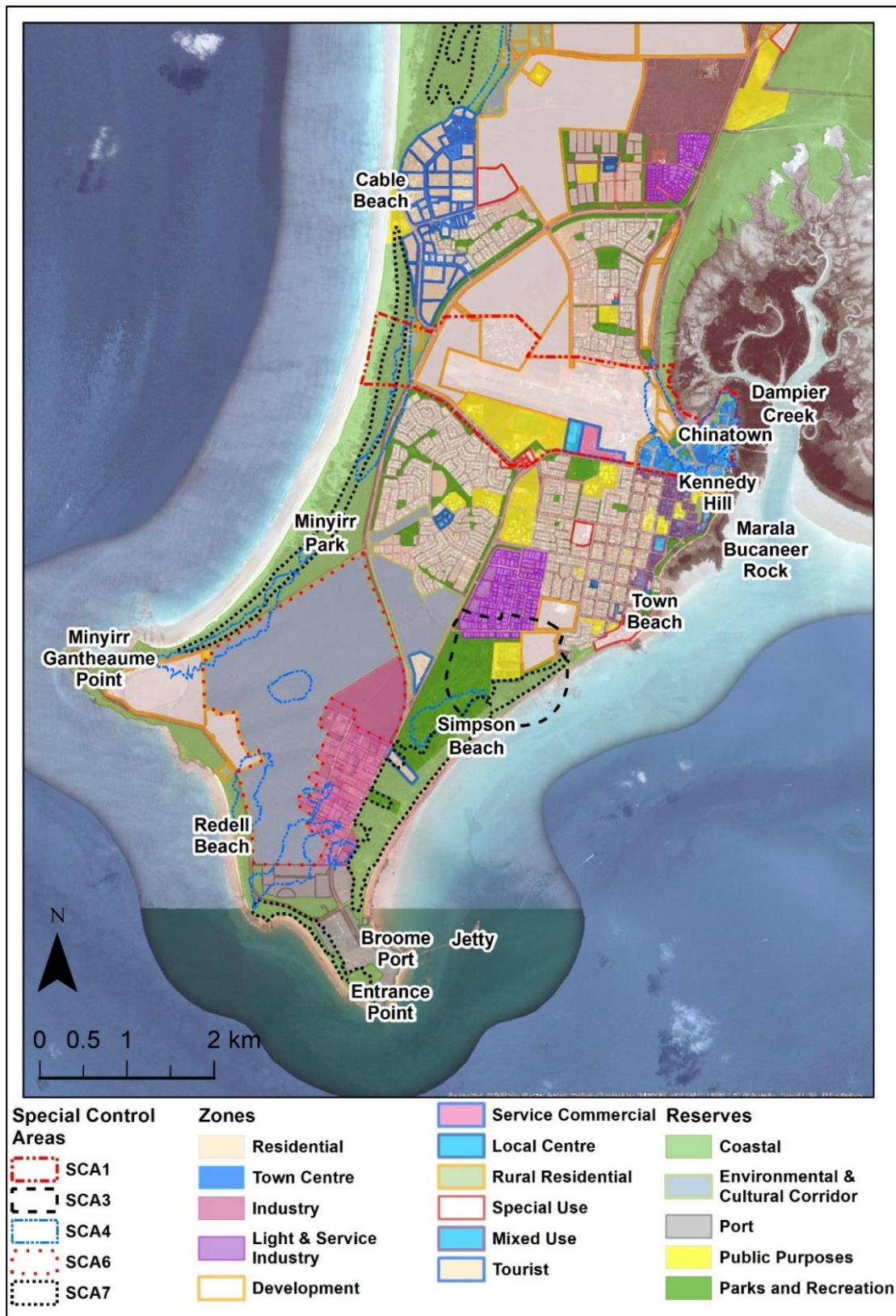


Figure 3.6 Special Control Areas, Zones and Reserves from the Shire of Broome Local Planning Scheme Number Six in Broome Town.



Figure 3.7 Native title in Broome Town.

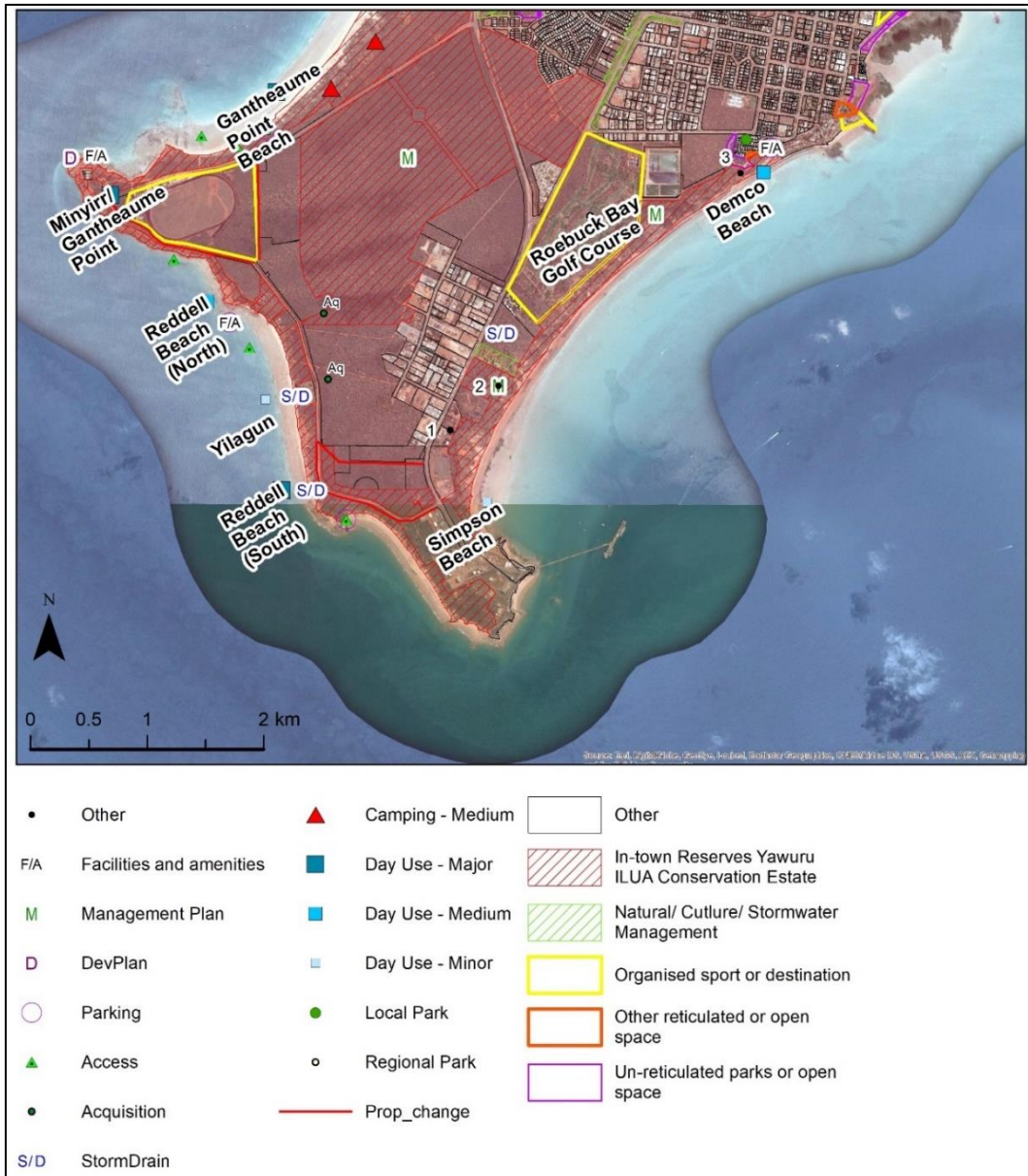


Figure 3.8 The Broome Coastal Reserves Master Plan south of Broome Town

Table 3.1: Dampier Creek

	Specific Yawuru interests and concerns: Valued by Yawuru people for fishing and cultural sites which sit within the area Management and tenure: Much of the water is controlled by the Broome Port Authority, and the land around the water is reserved. Native title recognition: Some exclusive native title recognition around the fringes of the mangroves. Native title “does not exist” in a legal sense over much of the area because of the declaration of the Broome Port. Key issues: Boat speed and over-use, marina proposals. Increased presence of crocodiles has changed use of the area.
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View from the back of Chinatown looking over Dampier Creek at low tide during Barrgana. Image taken by the author, 2015.

Table 3.2: Chinatown (in-town foreshore)

	Some Yawuru interests: Yawuru people were excluded from much of Chinatown over-night during the Common Gate era. Nonetheless, many Yawuru people continue to hold a strong connection to the area. Chinatown is seen as representing “Old Broome”, before the arrival of tourism. Today, the area holds a shopping centre, pearl shops, historic buildings and Streeter’s Jetty. Many of these shops block views of the mangroves and Roebuck Bay. Management and tenure: Chinatown is zoned for Development. The area’s current redevelopment is being driven by the Shire of Broome and Paspaley Pty. Ltd. Buildings in the area must fit an old Broome theme, but can block views of the foreshore. Native title recognition: Some very small areas of exclusive native title recognition exist along the foreshore and around old pearling sheds in the north of the site. Key issues: Redevelopment and retaining the area’s cultural heart.
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Top: Area near Streeter’s Jetty showing a sign intended to highlight the area’s historical significance. Middle: Pearl shops in Chinatown. Bottom: One of Broome’s now iconic laneways. Images taken by the author, 2015.

Table 3.3: Kennedy Hill (in-town foreshore)

	Some Yawuru interests: Kennedy Hill is an important cultural and historic site for Yawuru people. It has also been the subject of multiple development proposals and holds some of the best views of Roebuck Bay. Despite Yawuru protests, The Mangrove Hotel was constructed immediately to the right of Kennedy Hill in the 1970s.
	Management and tenure: Much of the hill is now held by Yawuru in freehold title. The development of a hotel in the 1970s immediately adjacent to the site was highly controversial.
<i>Given the sensitivity of Kennedy Hill, I have not included a direct image of that site. These images show the Mangrove hotel which was built next to the Hill in the 1970s and the view towards Kennedy Hill from that hotel. Images taken by the author, 2015.</i>	Native title recognition: Some exclusive native title exists immediately adjacent to, but not in, this area.
	Key issues: Yawuru people continue to express concerns about out-of-towners sleeping rough in the area. Some also continue to express concern about the potential for redevelopment in the area.

Table 3.4: Town Beach (in-town foreshore)

	Specific Yawuru interests: Town Beach is a local gathering, swimming and fishing spot. It is also the site of the town's Old Jetty, which was important to many Yawuru people but demolished in the 1960s.
	Management and tenure: The Town Beach area is dominated by reserves which are managed by the Shire of Broome. Work commenced on redevelopment to facilitate the staircase to the moon viewing event in 2018.
	Native title recognition: Native title is not recognised in this area.
<i>Top: Town Beach from the jetty at moderate to high tide showing work on the boat launching ramp. Middle: Play facilities and a kiosk at Town Beach. Bottom: Cars parked at Town Beach for the staircase to the moon markets during Barrgana. Images taken by the author, 2015.</i>	Key issues: At the time of interviews, key concerns were around the loss of the old jetty and some anti-social interactions which occur in the area. This may have shifted since the start of redevelopment.

Table 3.5: Simpson Beach

	Specific Yawuru interests and concerns: Many Yawuru men and boys go spearing stingray along this area. There are also culturally significant sites in and around the area. There is limited vehicle access to this area, and some Yawuru people go fishing at Demco Beach which is near the northern end of the beach. Yawuru also hold some free-hold property in this area.
	Management and tenure: Many of the dunes in this area fall under the In-town reserves of the Yawuru conservation estate. The beach itself is controlled by the Broome Port Authority.
Top: View from Demco towards Simpson Beach showing the dunes of Simpson beach and people fishing in the area. Bottom: View from Demco showing the Broome port jetty in the distance on the left. Images taken by the author, 2015.	Native title recognition: Areas of exclusive and non-exclusive native title recognition can be found in the dunes near the Golf Course and industrial area. Native title is not recognised on the beach itself because of the declaration of the Broome Port.
	Key issues: Some gas related infrastructure was being built near the area in the south of the site at the time of interviews.

Table 3.6: Broome Port/ Jetty/ Entrance Point

	Specific Yawuru interests: Some Yawuru people protested the construction of the Port. Today, however, many Yawuru people also fish from the jetty and launch boats within this area. Some Yawuru people also walk or fish at nearby Entrance Point.
	Management and tenure: The bulk of this site is reserved for the Port “to provide for industrial uses and activities which are associated with the Port of Broome, in addition to associated administration facilities and recreational uses” (Shire of Broome, 2014a:8). It is managed by the Broome Port Authority. A very small portion of Entrance Point falls into the Yawuru in-town conservation estate.
	Native title recognition: Native title was extinguished in this area through the declaration of the Broome Port.
Top: Broome Port jetty from the beach at low tide. Middle: People fishing along the Broome Port Jetty in 2015. At the time the fishing jetty was falling into disrepair. Bottom: Recent gas developments in 2015. Images taken by the author, 2015.	Key issues: Recent discussions about re-developing or expanding the port may threaten Yawuru people’s recreational access to the area. As of February 2019, this area is the most recently proposed location for construction of a safe boat harbour or marina.

Table 3.7: Reddell Beach

 <i>Top: View from the area near the Broome Race-course looking towards the Broome Port. Bottom: A sandy area of Reddell Beach looking towards Minyirr/ Gantheaume Point. Images taken by the author, 2015.</i>	Specific Yawuru interests: Reddell Beach holds one of the only areas of reef country within the Yawuru estate and is often accessed by Yawuru people fishing and searching for shells in the build-up to Man-gala or the Wet season.
	Management and tenure: Much of the beach falls within the in-town Yawuru conservation estate and is jointly managed by Yawuru with the Shire of Broome.
	Native title recognition: Exclusive native title is recognised in some portions of this area which have not been impacted by the declaration of the Broome Port or the creation of Broome racecourse.
	Key issues: This area has been the subject of perennial marina development proposals. In 2016 it was the only one of four areas within the Yawuru estate where Yawuru governance bodies argued that such a development could even be feasible from a cultural perspective.

Table 3.8: Minyirr/ Gantheaume Point

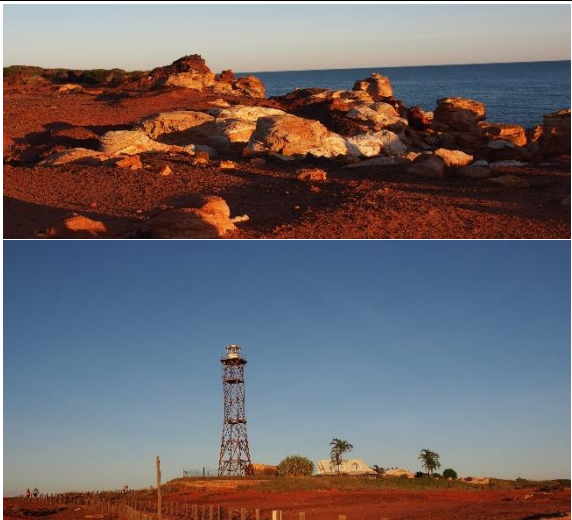
 <i>Top: The rocks of Minyirr near sunset – May 2017. Bottom: Looking back from Minyirr towards the light-house and a private dwelling. Images taken by the author, 2017.</i>	Specific Yawuru interests: Yawuru interests in the area vary. Many people gather shells and oysters and some hunt stingray. Some drive down onto the beach (where it is legal to do so), others avoid doing so. A number of people fish off the rocks in the area. Yawuru help to co-manage this area and have considered using a portion of the area to open a high-end restaurant or hotel as part of building economic prosperity.
	Management and tenure: Much of the area is co-managed by Yawuru, the Rubibi Working Group, and the Shire of Broome. Some of the area is managed by the Broome racecourse and the owners of the private dwelling.
	Native title recognition: There is limited non-exclusive native title recognition around the fringes of this area.
	Key issues: Erosion of the cliffs, past construction of a private dwelling (picture left), driving onto the beach, future development plans for the area.

Table 3.9: Minyirr Park

	Specific Yawuru interests: Minyirr Park contains culturally and ecologically significant species for Yawuru, including some important dune vegetation. It is also linked to a culturally significant area for Yawuru people. Management and tenure: Minyirr Park is jointly managed by the Rubibi Working Group, Yawuru native title holders, and the Shire of Broome. It was one of the first areas within Yawuru Country to come under co-management arrangements. Native title recognition: Non-exclusive native title is recognised over much of this area. Key issues: Yawuru are working to control erosion, manage weeds, and prevent fires. Infrastructure for a Yawuru cultural area was constructed in the mid-1990s in the park following the areas preservation as an “A-Class” reserve. Some of that infrastructure had fallen into relative disrepair.
<i>Top: Sign at one of the entrances to Minyirr Park indicating co-management of the area. Middle: The vegetation of Minyirr park looking towards Minyirr. Bottom: White sands and dune vegetation towards the middle of Minyirr Park. Images taken by the author, 2015.</i>	

Table 3.10: Cable Beach

	Specific Yawuru interests: There are some culturally significant areas near and adjacent to Cable Beach, including some rocks which are currently impacted by vehicles in the area. Many Yawuru people are eager to protect turtles which nest in the area. Management and tenure: An area where cars can access the beach. Some of the dunes to the north of Cable Beach fall within the Yawuru conservation estate. Native title recognition: There is exclusive native title recognition until the high-water mark north and south of many of the Cable Beach developments. Key issues: Cars on the beach and near an important site. Many of these cars drive too fast and increasingly there are conflicts between various site users in the area. Volume of tourists in the dry season.
<i>Top: Cable Beach near sunset in the dry season showing the now iconic camels and cars on the beach. Middle: Looking back towards a dining area largely used by tourists from the beach. Bottom: Kiosk selling food and drink at Cable Beach. Images taken by the author, 2015.</i>	

3.5.6 Key areas in the Crab Creek Study Site

As outlined earlier, the Crab Creek site has a relatively lower usage burden than the Broome Town site with its concerted development pressure. Some areas hold cultural sites but are not necessarily readily identified by the broader Broome community. Other areas, such as Sabu Rock, are heavily used for recreational activities (DPAW, 2015b). This is partly due to the facilities and access to the beach available at such sites and partly a result of the quality of the fishing in the local area (DPAW, 2015b). The draft Mangala-gun Management plan identifies several key management areas across the Crab Creek sites. These include:

- **Buga Wamba:** An important place which was proposed as a dedicated cultural area at the time of mapping.
- **Kaji Rock:** Access area to the shoreline, marked as a medium day-use site on the management plan.
- **Black Rock:** Access area to the shoreline, marked as a medium day-use site on the management plan.
- **Fall Point:** foreshore adjacent to the reserve leased to the Broome Bird Observatory who provide recreational and educational opportunities for visitors in addition to scientific research programs.
- **Sabu Rock (also known as Gurlbanwila or Dog Rock):** A very popular fishing site and boat launching area marked as a major day-use site in the proposed management plan at the time of the research.
- **One Tree/Mirrda:** The access point on the road closest to Mangala-gun or the Crab Creek water body.

It is important to note that the exact extent, location and names of some of these areas are contested. For example, what was known as Sabu Rock at the time of interviews is also colloquially called Dog Rock and has the name *Gurlbanwila* in Yawuru (DPAW, 2016a). However, the labels shown here and used in interviews were provided by NBY staff from the draft Yawuru Birragun Conservation Park and Yawuru Nagulagun/Roebuck Bay Marine Park joint management plans. As such, they are the main names used to refer to these areas throughout this study.

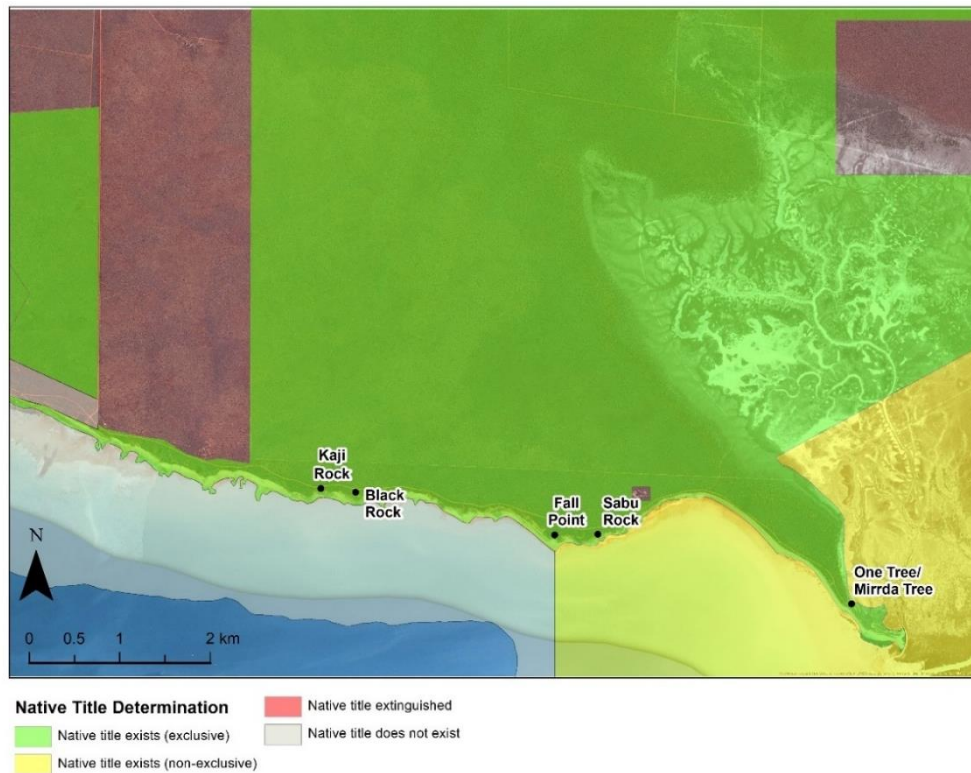


Figure 3.9 Native title recognition in Crab Creek

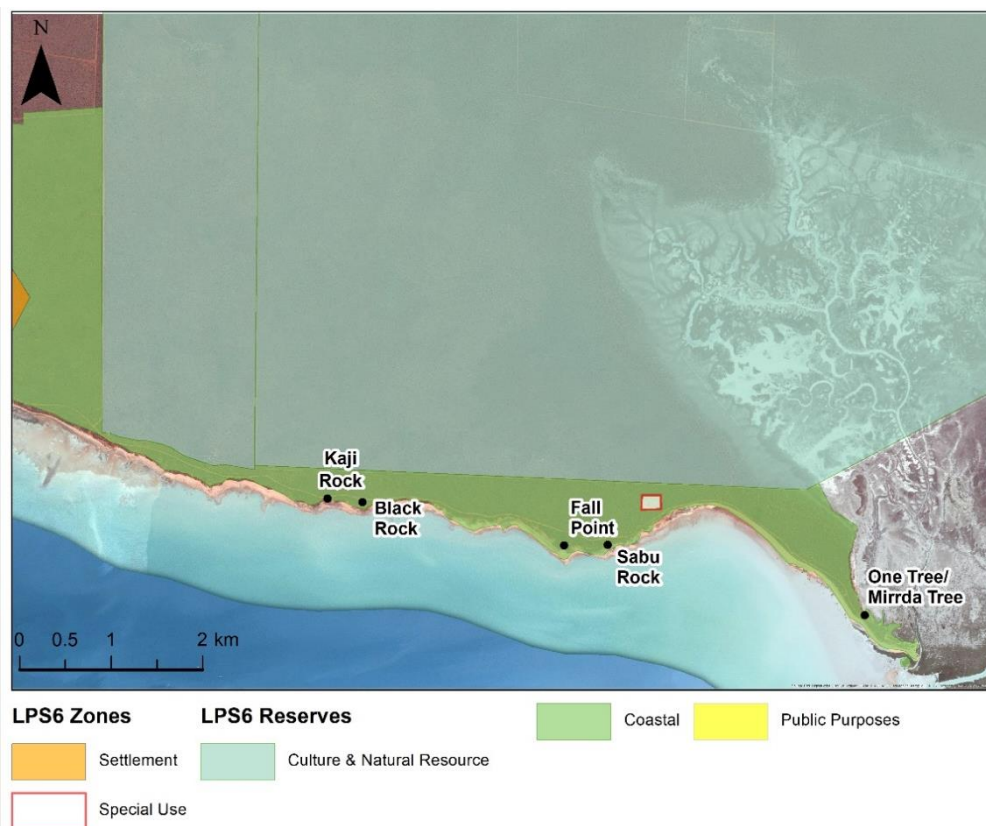


Figure 3.10 Local Planning Scheme Number Six in Crab Creek.

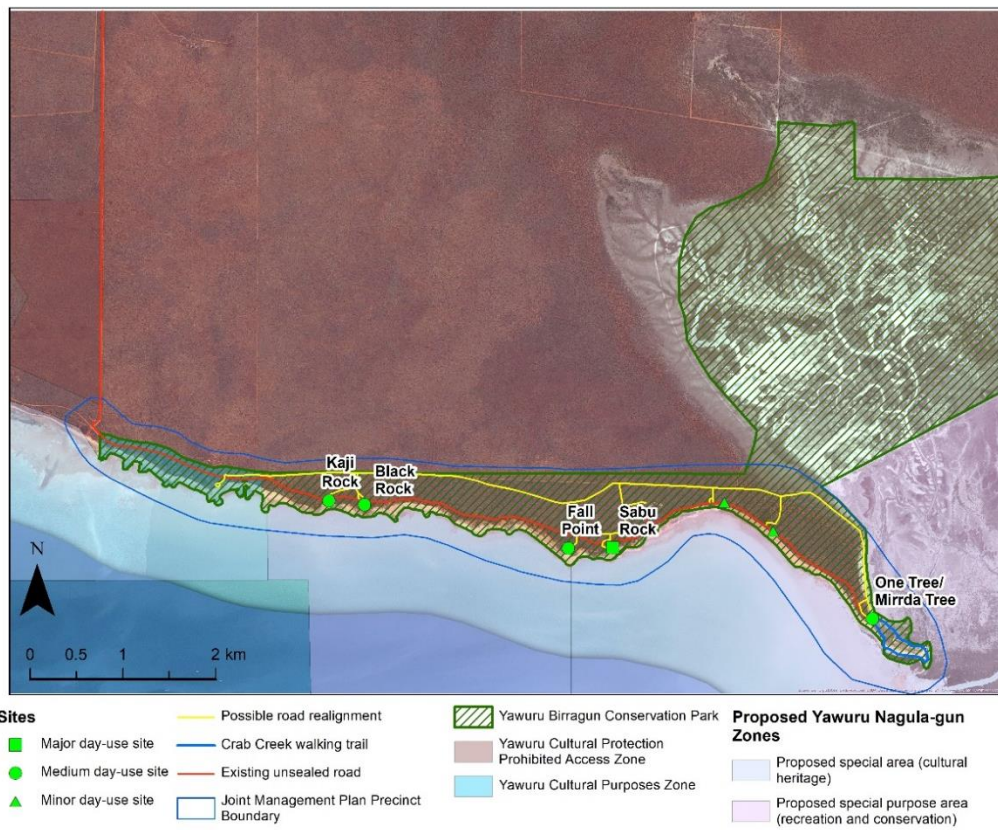


Figure 3.11 Draft Joint Management Plans in Crab Creek



Figure 3.12: Crab Creek

Figure 3.9 to Figure 3.11 compare these Crab Creek sites. They show the relative homogeneity of Crab Creek when compared to Broome Town. Much of Crab Creek also faces similar management issues, often linked to the impact of unregulated access to the area. Given this similarity, the sacred nature of several locations within Crab Creek outlined above and the contention around the exact locations and names assigned to individual sites, Figure 3.12 presents several images of Crab Creek but does not discuss the management issues associated with individual sites.

3.6 Conclusion

This chapter introduced Yawuru people as the traditional owners of the living cultural landscape in and around Broome, Western Australia. It explored settler interests in the town which serves a regional hub, service centre, and staging point for national defence, and outlined the historical context for contemporary Yawuru engagements with settler Australia over the town's pearling, Common Gate and tourism-driven eras.

This chapter introduced the Yawuru native title claim and Global Agreement which the Yawuru were able to reach with the State of Western Australia and others following an acquisition which illegally extinguished native title over some of their lands. It outlined Yawuru's Four Pillar Knowledge Vision and the role that research plays within Yawuru governance. It also outlined links between Yawuru governance bodies and ANU and situated a GIS partnership between the Fenner School and NBY as the immediate institutional context for this research.

Finally, this chapter set the spatial context for the PhD research. It introduced urban Broome Town and peri-urban Crab Creek as two sites within the Yawuru estate selected for study by NBY staff and outlined the diversity of native title, zoning, and management within these compact geographic areas.

Chapter 4: Research Design

This chapter outlines my approach to research design and introduces my research standpoint. It outlines how I engaged in, and related to, this research as a non-Indigenous academic working in a profoundly Indigenous space. This chapter also introduces the ways I incorporated Indigenous methodologies, critical GIScience and qualitative GIS into the research design. First, it highlights how I incorporated Indigenous methodologies through Louis' concepts of relational accountability, respectful representation, reciprocal appropriation, and rights and regulation (Louis, 2007). Then, it outlines how I used critical GIScience to both identify fuzzy index modelling as having potential to overcome limitations associated with the five dominant approaches to GIS adopted by Indigenous peoples, and explore the power structures which frame GIS use. Finally, it examines how and why I selected qualitative GIS to generate and frame GIS-based representations of Yawuru people's connections to Country.

4.1 Research Standpoint

An important and personal consideration for both the theories and approaches selected in this study stems from my own standpoint. Walter and Andersen (2013, p.45) state "research standpoint is arguably the most important determinant of a research project's methodology. It pre-exists and fundamentally influences our choice of theoretical frame and method". Standpoint includes the researcher's social, economic, and racial position, as well as the epistemologies (ways of knowing), ontologies (worldviews), and axiologies (values, or actions) which underpin the research process. Declaring and reflecting on your standpoint as a researcher is a vital element of bringing self-consciousness and reflexivity to any research (Walter and Andersen, 2013). It is particularly important for non-Indigenous researchers seeking to access Indigenous knowledges (Came, 2013; Glynn, 2008).

In terms of my social position, I am a middle-class but private school educated, white, Anglo-Australian female researcher from south-eastern Australia, in my late twenties. While I am technically the daughter of at least one recent migrant, my skin colour and racial status in Australia afford me significant privilege, as they do in the United States. For at least four generations on my Father's side, my family have lived as uninvited guests on unceded Aboriginal lands in and around *Naarm* (Melbourne, Victoria), and for the past ten years I have lived on unceded Ngannawal/ Ngambri lands in Canberra.

I was raised within an education system which emphasised secularism and the Western scientific method, albeit with Christian influences and roots. My interest in the humanities and

social sciences means my education was influenced by a curious blend of post-positivism and social constructivism.

From a personal standpoint, my interest in this research was fostered by my own connections to place through a family house, where I would often spend weekends visiting my Grandparents and Aunt and sailing with my father at a club he had joined when it first opened in 1968. While only purchased by my grandparents in the 1960s and located on unceded Bunurong land, this house looked over a rapidly changing and developing coastal area. As I grew up, family discussions centred on this view and local developments imbued me with a sense of curiosity around landscape change. They also instilled a deeply personal and relational connection to place. This sense of connection was brought into sharp relief by the loss of my Aunt and then Grandfather around the time I moved to Canberra. Although my connection to this place is profoundly limited in terms of the metaphysical and generations of connections to Country held by Indigenous peoples across Australia, it is deeply emotional. Drawing on this connection helped me to relate to the sense of loss and change experienced by Yawuru people, albeit in a limited way.

From a professional standpoint, my interest in working with Yawuru people on connection to place was fostered by my strong, sometimes naïve, sense of social and environmental justice, as well as my interest in fostering communication within and across cultures. This interest drove me to study GIS with a critical focus on social and environmental applications of this technology, as well as to explore the challenges of cross-cultural communication through language and translation studies. During my undergraduate training, I undertook two research projects on social and environmental applications of GIS for development in Papua New Guinea. I also completed my Honours research with Yawuru people as part of the ANU-Yawuru GIS partnership. While I recognise that I failed to turn my critical lens upon my own class structures in this study (Kerbo, 1981), I view this partnership as having the potential to produce important and tangible outcomes which align with the UNDRIP.

In terms of ontology, I recognise and believe in “an external world independent of the mind as well as that lodged in the mind” (Creswell and Creswell, 2017, p.11). Hence, I drew on both critical realism and bounded relativism in this study. Epistemologically, I view knowledge as coming from person-environment interactions. This means that there are numerous ways to generate and share knowledge, some of which are more likely to be relevant to a given context than others. Methodologically, I believe that purpose, setting and community needs should drive the choice of suitable methods in a project. I also recognise that all results are necessarily interpretative, influenced by both philosophical paradigms and the mental models of individual researchers. Finally, I believe axiology should be at the core of my research. I am committed to

research that engages with injustice, supports communities and individuals to pursue their aspirations, and facilitates critical reflection on approaches to engaging in this space.

In this research, I drew on pragmatism as a philosophical paradigm, including John Dewey's systematic approach to inquiry (Box 4.1). In adopting this problem-centred approach, I sought to "offe[r] a practical and outcome-oriented method of inquiry" which addressed needs and challenges identified by Yawuru governance bodies in the GIS-partnership (Onwuegbuzie and Combs, 2015, p. 413). I also recognised that "both the experiences we bring to research and the changes we hope to produce are context bound, embodied and emotional, and thoroughly social in nature" (Morgan, 2014:1051).

Box 4.1: John Dewey's systematic approach to inquiry. Adapted from Morgan (2014:1047).

John Dewey's systematic approach to inquiry and research

1. Recognise a situation as problematic
2. Consider the difference it makes to define the problem in different ways.
3. Develop a potential course of action to respond to the situation
4. Evaluate the likely consequences of potential actions
5. Take actions you feel are likely to address the problematic situation.

Working within the context of a partnership where Yawuru governance bodies had defined post native title governance as problematic and considered the use of GIS to address these problems, I considered the differences it made to frame these challenges in terms of settler colonial theory and Pratt's conception of the contact zone. I then developed an approach to representing Yawuru values, concerns, and seasonal uses of landscape, considering the potential impact of methodological choices at each stage of the research. Finally, I evaluated the likely consequences of this approach and produced methods and reports that I felt were likely to address some challenges in this space. As I outline in the following sections, I drew on Indigenous methodologies, critical GIScience and qualitative GIS throughout this process.

4.2 Indigenous methodologies and research paradigms

Conducting research with Indigenous peoples can be a fraught process for settler academics given our privileged positions and the continuing exploitation of Indigenous knowledges within and beyond the academy (Denzin *et al.*, 2008). Despite the enormous volume of data, including bones and cultural objects, collected on or from indigenous peoples very little of this data is collected by them, or in a way that is useful or meaningful for the communities in question

(Kukutai and Taylor, 2013, 2016; Taylor *et al.*, 2014). Indeed, Yawuru leader Peter Yu has argued that the categories used by the Australian Bureau of Statistics “are constructed in the imagination of the Australian nation state. They are not geographic, social or cultural spaces that have relevance to Aboriginal people” (Yu, 2011:2).

As Linda Smith outlined “[f]rom the vantage point of the colonized [research remains] inextricably linked to European imperialism and colonialism” (Smith, 2012:1). Indeed, Indigenous knowledges are increasingly patented, commercialised, and exploited by non-indigenous parties. Combined, the exploitation of Indigenous knowledges and resources without free, prior, and informed consent, or adequate payment, respect, reciprocity, or relevance to indigenous-identified challenges has led many indigenous peoples to display a deep scepticism or at least considerable wariness towards research (Smith, 2012). To a large degree, the Indigenous methodologies literature aims to identify and address such issues, while acknowledging the impact that research which is driven by or on behalf of indigenous peoples can have in helping to address challenges facing indigenous peoples around the globe (Smith, 2012; Walter and Andersen, 2013).

In general, the Indigenous methodologies literature focuses on carrying out research on indigenous issues in a manner which is “respectful and ethically sound from an indigenous perspective” (Louis, 2007:130). This literature is diverse and wide-ranging. Considerable portions of it are dedicated to the role of indigenous researchers in indigenous research (Denzin *et al.*, 2008; Foley, 2003; Smith, 2012), while other parts focus on identifying problem areas or the role that non-indigenous allies, including white settler allies, can play in this space (Bawaka Country *et al.*, 2018; Carlson, 2017; Porter *et al.*, 2017). Nonetheless, Renee Pualani Louis (2007:133) effectively identifies “four unwavering principles” which represent “overwhelming commonalities in the literature on Indigenous methodologies and Indigenous research agendas”. These principles are a vital element of this research in that they promote Indigenous knowledges; position indigenous community members as key partners or collaborators in the research; ensure that indigenous communities help to determine the research agenda; and facilitate bi-directional knowledge transfer. They also engage with indigenous peoples’ experiences of research exploitation and have been employed by researchers in a range of disciplines to help promote ethical research (Castleden *et al.*, 2012; de Leeuw *et al.*, 2012; Mercer *et al.*, 2009). As is outlined below, I drew on these principles in various ways during this research.

4.2.1 Relational accountability

The first principle of Indigenous methodologies identified by Louis is relational accountability. For Louis, relational accountability “describes the concept that [i]ndigenous

peoples share about their dependence on everything and everyone around them[and] implies that all parts of the research process are related, from inspiration to expiration” Louis (2007:133). It means that a researcher must think, and act, in a way which acknowledges these relationships and interconnections and not separate themselves from the research. This focus on relational accountability aligns with Indigenous ontologies in that it ensures that the research is focused on a variety of different relationships, including non-human relationships. It ensures that the researcher is focused on maintaining accountability with research partners, communities, and Country as a whole.

In this research, I aimed to incorporate relational accountability through co-supervision, a community reference group, and multiple levels of communication with NBY throughout the research process. In terms of co-supervision, Dr Bruce Doran is the primary anchor for the GIS partnership within the Fenner School. He was also the Supervisory Panel Chair, and Primary Supervisor for my Doctoral research. Additionally, this research was supervised by Dean Mathews, a Senior Project Officer within the NBY Native Title and Environmental Services Unit who also sits on the Yawuru PBC board. Dean also supervised my Honours year and was instrumental to the design of this project. Although Dean does not conduct GIS analysis as part of his work at NBY, he has undertaken some training in GIS. More importantly, he has a firm grasp of GIScience, the science and concepts which underpin GIS.

Co-supervision of this research has helped ensure that the pace of publication and the research process fit around other NBY activities and aspirations. Additionally, Dean, Bruce and Julie Melbourne, the non-Yawuru manager of NBY’s Native Title and Environmental Services Unit have used regular phone and Skype meetings, emails, video linkups, visits, and conferences to discuss, negotiate, plan, and present various aspects of the research partnership. Bruce, Dean and Julie have also closely engaged with NBY CEOs and I presented to and discussed my research with these CEOs at various points during the research.

NBY staff also had significant influence over the spatial and thematic foci of this study. Patrick Dodson, for example, outlined the importance of Yawuru seasons to Yawuru governance and decision making in his 2012 message to the ANU Vice-Chancellor and Sarah Yu was careful to reiterate this importance during my 2014 Chinatown consultancy. The modelling of concerns held by Yawuru people for their Country stemmed from my time in the Yawuru offices which showed how much of their resources were spent responding to these concerns.

Most explicitly and formally, the advice provided by a reference group formed of Yawuru people and NBY staff, including some non-Indigenous staff who have a long history of working with Yawuru people, was central to the research design. This reference group explicitly helped to shape the research questions, focus, and the recruitment of participants. The reference group also

suggested that the Broome Town study site discussed prior to commencing the PhD, be expanded to include Crab Creek during fieldwork.

4.2.2 Respectful representation

Second, Louis identifies the importance of respectful representation within Indigenous methodologies. Here, she argues that the researcher needs to not only reflect on how they present themselves, their research and the people or phenomena they are researching (paraphrased from Absolon and Willett, 2004 in Louis, 2007), but also accept when and where it is inappropriate to transmit knowledge outside the context in which it was shared. Paraphrasing Steinhauer, (2002:73), she argues that “[r]espect is not just about saying ‘please’ or ‘thank you’. It’s about listening intently to others’ ideas and not insisting that your ideas prevail” (Louis, 2007:133). Respectful representation aligns with principles of privileging indigenous peoples and their knowledges throughout the research process.

In terms of respectful representation, I was influenced by carefully articulated and negotiated Yawuru aspirations for governance as outlined in the Yawuru Cultural Management Plan, website, annual reports, and other strategic documents (NBY, 2015a, 2015b, 2018a, 2018b; Yawuru RNTBC, 2013, 2014). I also returned repeatedly to the clarity and simplicity of the Yawuru Four Pillar Knowledge Vision (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2012), as well as to the process of slowly building geospatial techniques to support Yawuru aspirations across their estate outlined in Dodson’s message to the ANU Vice Chancellor (Dodson, 2012).

Throughout this research, I sought explicit permission to share elements of the research process in conferences and other presentations. I also paid close attention to how these presentations and this thesis represented Yawuru people, and remained mindful of how research has been used against Yawuru interests in the past. All articles stemming from this research are to be co-authored with Dean Mathews and presented for comment and approval prior to publication.

Additionally, I drew on my Honours work, which highlighted the downside of anonymity in a Yawuru context, to encourage respectful representation in this research. In 2013, while NBY staff had been wary of individual Yawuru people being identified in the modelling, Jimmy Edgar expressly requested that his story, map, and contribution be acknowledged by name in the research. At the time, this required me to submit a variation to my ANU human research ethics application. In this study, I acknowledged the limitations of anonymity in indigenous contexts (Svalastog and Eriksson, 2010) and let participants choose how they would be identified in the research.

4.2.3 Reciprocal appropriation

The third principle Louis identifies is reciprocal appropriation. Reciprocal appropriation requires “adequate research benefits for both the [i]ndigenous people and the researcher” (Louis, 2007:133) to reverse the sense of power in a partnership and ensure co-investment in the research space. This concept recognises the knowledges and power exchanged in a research relationship, while positioning indigenous people as active and powerful agents in the research process.

In this study, I engaged with the concept of reciprocal appropriation by, wherever possible, grounding the research within the context of the GIS partnership and the desire of Yawuru governance bodies to develop and test techniques for mapping connections to Country which could be replicated across their estate. To be clear, this focus on reciprocal appropriation did not mean that I surrendered my capacity for critical analysis. Instead, it meant that some methods adopted in this study, including the use of GIS, were pre-existing criteria for this research.

In addition to the larger focus on reciprocal appropriation with Yawuru corporate and governance bodies, I regularly engaged in smaller acts of exchange. Having found that bringing home-made food to the office and preparing food for community events was seen as good manners, I continued to bake cookies, brownies, scones, and other savoury foods which I could bring to interviews, morning teas and office meetings throughout my time in Broome.

4.2.4 Rights and regulation

Finally, Louis highlights the importance of rights and regulation within the Indigenous research space. Here, Louis refers not to university-based regulation but instead to “research that is driven by Indigenous protocols, contains explicitly outlined goals and considers the impact of the proposed research” (Louis, 2007:133). The principle of rights and regulation is intended to facilitate non-extractive research which recognises Indigenous intellectual property rights. It incorporates both co-authorship and the publication of any research outputs in language which is clear and understandable.

In terms of formalised rights and regulation, I used institutional mechanisms and context-grounding to encourage ethical practice in this research. Ethics approval was required, and provided, from the ANU Human Research Ethics Committee (Protocol 2015/063). This process involved a half-day’s training in research ethics and then responses to a series of questions designed to promote ethical and risk averse research design from an ANU perspective. These responses were then evaluated by a committee and replies made to any concerns raised at this stage. Once approval was achieved, I was required to complete regular monitoring reports (every six months). Combined, this reflected the University’s approach to ‘High-Risk Protocols’ which

result when researchers engage with participants such as Indigenous peoples who are deemed to be in some way vulnerable or at risk of harm from the research process (ANU, 2018).

Additionally, the research was firmly grounded in the broader Fenner School-NBY GIS Partnership and conducted under the Draft ANU Yawuru Code of Conduct. As stipulated in Appendix 4, all data and project outputs will be owned by NBY, and additional publication resulting from this research will be co-authored with Dean Mathews or other NBY representatives.

The ANU ethics process and the draft code of conduct provided a solid foundation for engagement in an ethical research partnership, as did the community reference group. Nonetheless, mere compliance with such mechanisms, even a negotiated draft code of conduct, was not enough to guide the ongoing practical negotiations which are an essential component of ethical research with Indigenous peoples (Jackson, 2006). It was only by grounding my research in context and drawing on the broader critical GIScience and qualitative GIS literatures what I was able to develop a critical, context-grounded approach to developing GIS-based representations of Yawuru values, concerns and seasonal uses of landscape in this research.

4.3 Critical GIScience

The second key body of literature I drew on in my approach is critical GIScience. As outlined in Chapter 2, critical GIScience brings “social theory, science and technology studies, and philosophy” (Schuurman and Leszczynski, 2006:726) to bear on GIS technology and principles. Critical GIScience draws on Critical theory in that it rejects positivist inquiry, recognises that domination is subject to structural dynamics, and argues that scholarship should raise consciousness of political and social action (Blomley, 2006; Harvey, 2018). It also uses GIScience, which focuses on the spatial structures which underpin GIS (Goodchild, 2003). Research in critical GIScience is wide-ranging, but often focuses on the origins of GIS technologies, the contexts in which GIS techniques and technologies are deployed, and the spatial and ontological structures which underpin GIS (see Elwood, 2006b, 2010b; Harvey *et al.*, 2005; Leszczynski and Elwood, 2014; Schuurman, 2006, for examples).

As is outlined in the following paragraphs, in this research I drew on critical GIScience to frame and emphasise the power structures which surround using GIS in a post native title environment, as well as to identify raster-based models and fuzzy logic as spatial alternatives to the cadastral model which has been so problematic for Indigenous peoples in Australia.

4.3.1 Field-based GIS and fuzzy logic for representing Yawuru people's connection to Country

Critical GIScience research “focuses in part on the core challenges of representing and analysing spatial objects, their characteristics, and their relationships in a digital environment, and the consequences of these practices for social knowledge, representation, and power” (Elwood, 2008:123-124). This makes a critical GIScience approach which focuses on data structure and their underlying spatial ontologies well-suited to identifying ontologically aligned mechanisms for representing Indigenous peoples' connections to Country.

As outlined in Chapter 3, by drawing on critical GIScience through the GIS partnership, Yawuru governance bodies have found fuzzy index modelling to be an important tool for representing their living cultural landscape following native title recognition. In general, this is supported by broader academic literature within the area. Reilly (2004:234), for example, has observed that “Indigenous boundaries reflect a relationship to the ground [and] shift as that relationship changes” and to a large degree Indigenous practices and lives are place-based (Barry and Porter, 2012; Delafontaine *et al.*, 2012; Fairfax, 2002). Certainly, Cartesian logic - which underpins entity-based representations commonly used in Indigenous GIS - can be problematic when used to represent Indigenous forms of land tenure (Porter and Barry, 2015). Nonetheless, GIScience facilitates the recognition that this problem relates to certain uses of GIS. It is not endemic to the whole technology.

As is made clear in the critical GIScience literature, some GIS use fields instead of the entity-based models which underpin the cadastral system to represent space. Viewing the world as a field enables us “to imagine that the variation of an attribute of interest varies over space as some continuous mathematical function” (Burrough and McDonnell 2015, p.20). Such a view does not reduce the world to the strict yes / no of an entity-based model. Nor does it treat space as an “object” which is small, manipulable and therefore able to be owned and controlled (Couclelis, 1992). Instead, a field-based view of the world generally aligns with human perception at geographic scales and is suited to modelling change over time (Couclelis, 1992). Rather than asking the possessive/positional question “where is such-and-such an object?” facilitated by an entity-based model, a field-based model asks the more relational/contextual question “what is the world like at such-and-such a place?” (Galton 2004:41). As Yawuru have seen over time, field-based models are able to capture ambiguity and represent natural variation through the use of fuzzy sets or fuzzy logic (McBratney and Odeh, 1997).

Fuzzy logic is a mathematical approach for dealing with ambiguity and complexity which can be used to model natural variation across space (Burrough and McDonnell, 2015; Kandel, 1986). In fuzzy logic, ‘soft’ linguistic variables (e.g. deep, sandy, steep etc.) are frequently defined

by a continuous range of truth values from 0.0 to 1.0, where 0.0 indicates non-membership and 1.0 indicates complete membership (McBratney and Odeh, 1997). Not only is fuzzy logic often appropriate for representing complex concepts and systems which lack sharply defined boundaries, it is well suited to situations where only approximate information on components and connections is available (Robinson, 2003). Robinson (2003) has shown that the utility of the fuzzy paradigm increases with complexity and fuzzy logic provides a rich set of formalisms for representing and manipulating qualitative information drawn from natural language (Duff and Guesgen, 2002). Indeed, fuzzy logic has been employed as a cost-effective means of modelling various natural and social phenomena since the 1980s (Grekousis and Hatzichristos, 2013; Kim *et al.*, 2014; McBratney and Odeh, 1997; Mohamed and Elmahdy, 2017; Robinson, 2003).

Viewed through critical GIScience, synergies exist between fuzzy set theory and Indigenous spatial ontologies (Potter *et al.*, 2016). As outlined by French (1998:4), traditional law systems in Australia “may not include notions of precise boundaries” and “there may be a boundary zone of transition of responsibility from one tribe to the next” (Turk, 2007:238). Indeed, Indigenous epistemologies and fuzzy logic both work with uncertainty and rules of thumb to make significant, but not necessarily precise, statements about complex systems (Berkes and Berkes, 2009). For Berkes and Berkes, “Indigenous knowledge can be analysed as fuzzy logic and quantified with fuzzy sets, if it were desirable to do so” (Berkes and Berkes, 2009:11).

Some researchers and indigenous groups overseas have also worked to explore novel data collection techniques which draw on fuzzy concepts (Carver *et al.*, 2009; McBride *et al.*, 2017; Watson *et al.*, 2013). This includes the use of “spray-can” tools to capture values held by tribal and non-tribal residents of Salish Kootenai lands in Montana, the United States of America (Carver *et al.*, 2009); and the use of a three stage process to capture values and inform fire and fuel management adjacent to a tribal wilderness area (McBride *et al.*, 2017). These “spray-can” tools provided a quick data capture method while incorporating ambiguity and absence of clear boundaries. Yet even the later “Map-Me” tool (Huck *et al.*, 2014) which linked values directly to their spatial representations through a multi-point and attribute spray required comfort with digital interfaces and prevented participants from defining values to be mapped during spatial data collection.

The pilot study for this research took a different approach to data collection and fuzzy modelling of Indigenous values (Potter, Doran, and Mathews, 2016). This work recorded three values defined in collaboration with Yawuru participants on paper-based maps at a single scale. It then applied linear fuzzy buffers to these values based on collective contextual understandings of the study site. Given the comfort of Yawuru participants with paper-based sketch mapping exercises in the pilot study, this thesis further explores the use of grounded spatial analyses which

draw on sketch mapping and fuzzy logic to represent elements of Yawuru people's relationship to their living cultural landscape following native title recognition.

4.3.2 Drawing attention to the embedded structures and power dynamics framing Yawuru GIS use

At its core, a critical GIScience approach is concerned not only with the structures which underpin GIS, but also “with power embedded in the production and use of technology” (Harvey *et al.*, 2005:1). Indeed, critical GIScience research often focuses on “the implications of GIS use for participation and power in social and political processes where the technology is used” (Elwood, 2010b:47). This focus on structures facilitates measured reflection on the emancipatory potential of GIS. It also draws attention to the wider contexts in which GIS techniques and technologies are deployed.

In this study, I reflected the emphasis on power dynamics inherent to much of the critical GIScience literature in the theoretical lenses used to frame this research. Specifically, as outlined in Chapter 2, I used settler colonial theory to describe the structural challenges faced by native title holders and examine how these structures have been supported by certain models of space. I also drew on Pratt's art of the contact zone concept to explore the potential for simultaneous empowerment and disempowerment from Yawuru transculturation of GIS technologies. Neither of these theories is necessarily linked to GIS. Pratt's art of the contact zone concept can be applied to any power asymmetric environment where subjugated people transculturate tools from the dominant culture, while settler colonial theory was explicitly developed to explore and frame colonialism in settler states. Nonetheless, both theories strongly reflect the emphasis on power and social structures inherent to critical GIScience. They ensure that a critical GIScience focus on the power structures embedded in and around GIS use is central to this thesis.

4.4 Qualitative GIS

The final area where the critical GIScience literature has influenced this thesis is through the adoption of a qualitative GIS approach to developing and contextualising GIS-based representations in this research. Like critical GIScience, qualitative GIS “involves conceiving of GIS as a social and political practice, as discipline-and industry inscribed ways of making knowledge, and as an assemblage of hardware, software, data structures, and procedures for working with digital spatial data” (Elwood and Cope, 2009, p.16). Indeed, drawing on critical GIScience critiques from the 1990s, qualitative GIS explicitly recognises that GIS has always been “more than quantitative” (Pavlovskaya, 2009, p.13). Specifically, qualitative GIS “seek[s] to integrate qualitative forms of data into GIS, develop and support qualitative approaches to building knowledge and explanation with GIS, use GIS in research that emerges from multiple or

hybrid epistemologies, and theorize previously unrecognized forms of social knowledge that may be present in GIS applications” (Elwood and Cope, 2009, p.3).

Importantly for this research, a qualitative GIS approach treats all knowledge as partial and situated. As is outlined below, this approach recognises that “multiple epistemologies may be valid ways of fostering understanding and explanation *for particular purposes and in specific circumstances*”(Elwood and Cope, 2009, p.5, emphasis in original) and often aims to integrate multiple forms of knowledge in the research process. This hybridity makes a qualitative GIS approach well-suited to the integration of Indigenous knowledges with Western science through a GIS framework outlined by Peter Yu.

I drew on two closely related approaches to qualitative GIS in this research. The first approach “mesh[es] GIS and qualitative research [but] focus[es] upon GIS-based representations, including spatial data, maps, or other visual representations” (Elwood and Cope, 2009, p.17). This approach highlights the subjectivity inherent in both qualitative analyses and GIS, where coding is based on epistemologies, available data, and desired outcomes (Saldaña, 2013). It subtly undermines the “god-trick” (Haraway, 2013) or purportedly objective view of space which is often employed in mapping exploited by natural resource extractors and state powers. It also complements Yawuru and other Indigenous sciences in that it “include[s] subjective sources of information and consider[s] qualitative information relevant to their information gathering” (Louis 2004:10) and “pursu[es] holism by considering a large number of variables qualitatively” (Berkes and Berkes 2009:7).

This qualitative approach to GIS-based representation aligns with recognition that visualisation is often “the only common language to which all members of the community – young people and adults, poor and rich, powerless and powerful – can relate” (Al-Kodmany, 2002:320). Indeed, the integration of qualitative analyses into the GIS modelling process can challenge traditional understandings of GIS, model new representative practices (Wilson, 2009) and promote “more crucial engagement with the people who are being studied than using solely GIS or solely ethnography” (Bagheri 2014:175). This approach acknowledges that “even novice GIS users with limited resources can and do remake GIS in ways that challenge the epistemological and representational limits that have been assumed in much of the academic literature” (Elwood, 2009:58).

As I outline in Chapter 6, I integrated qualitative analysis into GIS- modelling in several ways. First, I used thematic coding to influence the factors included in the models. Then, I drew on qualitative information from sketch mapping interviews to parameterise the fuzzy index modelling of valued sites (Berkes and Berkes, 2009). Finally, I used content analysis and thematic coding to inform the weights assigned in the final models or GIS-based representations.

Throughout this process, I used non-cartographic information collected from sketch mapping interviews to ground the modelling in the Yawuru context.

The second approach to qualitative GIS I embraced in this study focuses on complementing GIS-based representations with qualitative analyses. This approach recognises that “a host of potentially significant details are lost in the [...GIS] transformation process” (Jung and Elwood, 2010:68), and explicitly avoids excluding non-cartographic data from the research (Bagheri, 2014). It also facilitates multiple analytical perspectives on a single data-point or issue (Brennan Horley) and enables the incorporation of emotional and embodied data in the research (Davies and Dwyer, 2007; DeLyser and Sui, 2013). This approach provides a verbal complement to the visual outputs of GIS (Pain, 2004).

I used this approach in two ways. First, and most simply, a small portion of the qualitative information which fed into GIS modelling is presented alongside GIS-based representations in this thesis. Second, as I outline in Chapter 6, I used complementary qualitative analyses to facilitate critical reflection around the GIS-based representations produced in this research. Here, I drew on settler colonial theory and Pratt’s conception of the contact zone to position GIS analysis as one of diverse Yawuru efforts to defend culture and Country following native title recognition as presented in Chapter 8.

4.5 Conclusion

This chapter described my research standpoint and outlined how I drew on Indigenous methodologies, critical GIScience and qualitative GIS in this research. It introduced the potential of fuzzy logic and spatial analyses to address the ontological and practical challenges facing indigenous peoples who use GIS technologies as outlined in Chapter 2. It also justified the use of qualitative analysis to inform and contextualise GIS-based representations in this study. The next chapter describes the semi-structured sketch mapping interviews used to collect data in this research.

Chapter 5: Data collection

This chapter outlines the use of sketch mapping to collect data which can inform and contextualise spatial analysis and GIS-based representations in this research. First, it introduces sketch mapping as powerful mechanism for data collection in both Indigenous and research contexts. Then, it outlines the process of data collection, including semi-structured sketch mapping interviews designed to elicit information on areas which are important to Yawuru people. Finally, it outlines the sketches and responses generated through data collection, as these form the basis of the spatial and qualitative analyses described in Chapter 6.

5.1 Sketch mapping

Sketch mapping is a simple, powerful data collection technique which can readily represent people's internal worlds and values, as well as support analysis, visualisation and integration with GIS. Fundamentally, sketch mapping is the process of transcribing the mind to the map (Curtis, 2016). Sketch mapping externalises people's perceptions of their landscapes and behaviours over space generating "cross-section[s] representing what is known about a scenario or setting at a particular time" (Golledge, 2010:2). It requires no more than butchers' paper or a patch of bare earth to generate an external representation of an individual's internal world (Chambers, 2006; Wridt, 2010).

Yawuru people have already employed sketch mapping for a variety of projects across their estate. Some of their sketch mapping has drawn from the traditions of use and occupancy mapping. The Yawuru Cultural Management Plan (Yawuru RNTBC, 2013), for example, includes maps generated with Terry Tobias and carefully refined for use in legal settings. The Cultural Management Plan also includes several maps which display indicative, but not actual, use of the Yawuru landscape across their six seasons. Today, sketch mapping is used by Yawuru governance bodies both in the field and in the office as they monitor land use and prepare co-management plans. Indeed, Yawuru governance bodies are increasingly integrating sketch maps into GIS analyses and drawing on techniques established through the GIS partnership (Mathews *et al.*, 2018).

Yawuru people's use of sketch mapping to facilitate and assert control over their lives and lands is not unique in an indigenous context where sketch maps are frequently used to transmit ecological knowledge, establish claims to territory and support land rights. Many indigenous peoples have engaged in use and occupancy mapping by creating map biographies to "map the areas [Indigenous hunters use] for various harvesting and harvest related activities [...] during their adult lives" (Weinstein 1993:10 in Chapin 2005:624). Those creating map biographies have

recorded the maximum extent of traditional uses of territory by both individuals and groups and used concentrations of points, lines, and polygons to mark high use areas (Chapin *et al.*, 2005). Many have also adopted the minimalist approach to spatial representation promoted by Tobias (2009) which involves extensive planning; elimination of redundant data from group maps; prominent qualifiers; and stringent community verification prior to data release.

Some indigenous peoples have also used sketch maps to delineate their traditional territories and strengthen land claims. In a proto-typical example of counter-mapping Peluso (1995:384) documented how indigenous peoples in Kalimantan, Indonesia used sketch maps to “appropriate the state’s techniques and manner of representation to bolster the legitimacy of ‘customary’ claims to resources [and redefine] claims to standing forest resources and harvestable products as claims to the land itself”. Likewise, McCall (2004) as part of the Dene Mapping Project in northern Canada used maps to designate land use and occupancy over time with Federal and Provincial governments, as well as with neighbouring indigenous groups and Thom (2009) observed how overlapping polygons were used in a Coast Salish territory in British Columbia to map overlapping claims.

While this research focuses on the integration of sketch mapping with critical GIScience within an indigenous context, the lineage of sketch mapping for data collection extends beyond the indigenous sphere. Indeed, the popularity of sketch mapping as a data collection technique can be traced to seminal works in the 1960s and 1970s which used sketch maps to understand spatial cognition (Downs and Stea, 1973), elicit information about people’s perceptions of the city (Lynch, 1960) and to provide an insight into the decision processes underlying spatial behaviour (Gould and White, 2012). Since that time, sketch mapping has been used to test wayfinding (e.g. Golledge, 1999; Golledge *et al.*, 2000), interrogate recall (e.g. Young, 1999) and document spatial cognition across different populations (e.g. Brown and Reed, 2009). It has also been used to explore the construction of maps, as when Pocock (1976) was able to demonstrate that mental maps elicited by a free-recall mapping technique exhibited certain recognisable characteristics.

More recently, sketch mapping has been used in applied and content-based analyses like those in this research. In such studies, sketch mapping has represented values (Brown and Raymond, 2007; Fagerholm *et al.*, 2012; Potter *et al.*, 2016; Strickland-Munro *et al.*, 2015; Strickland-Munro *et al.*, 2016), concerns (Sloan *et al.*, 2016), perceptions (Dickin *et al.*, 2014; Smith and Cartlidge, 2011; Young, 1999), emotions (Curtis *et al.*, 2014; Doran and Lees, 2005) and spatial behaviour (Doran and Lees, 2005; Doran and Young, 2013).

Sketch mapping is powerful in both research contexts and indigenous contexts where it provides an opportunity to elicit information about a large spatial area in a short period of time

(Kitchin and Blades, 2002). It encourages grounded and spatially specific responses from participants (Brennan-Horley, 2010) and permits the interviewer to interrogate any assumptions which might underlie the interview process (Gibson *et al.*, 2010). As outlined earlier, sketch maps can be drawn in many ways (Chambers, 2006; Wridt, 2010). This means that interviews can be conducted in the field, in community offices, in the home of participants, or even, where there is sufficient privacy, in a café (Curtis, 2016). This flexibility and the low cost of data collection materials when sketch mapping reduces the cost per interview relative to site visits (Curtis, 2016). It also gives the opportunity to select a mutually agreeable interview location which may reduce power imbalances in the interview process (Elwood and Martin, 2000).

Importantly, for a technique which is to be applied in a cross-cultural context, the low technology threshold of sketch mapping also mitigates many of the power imbalances inherent in interviews (Curtis, 2016) by positioning participants as local experts (Golobič and Marušić, 2007). Indeed, sketch mapping has been shown to reduce insider-outsider positionality (Boschmann and Cubbon, 2014), animate the interview process (Kemp and Brooke, 1995) and help convey marginalised voices to a diverse audience through a peer-to-peer dialogue (Rambaldi *et al.*, 2006). To paraphrase Fox and colleagues, sketch mapping is simple and non-threatening, easy to understand and useful for engaging diverse groups in conversations around natural resource management (Fox *et al.*, 2006:103).

Finally, and perhaps most crucially for a study intended to generate fuzzy index modelling of the Yawuru estate, sketch mapping readily integrates into GIS. Where cognitive maps represent a form of internal GIS (Golledge and Stimson, 1997b), sketch mapping produces the constituent components of a GIS in the form of points, lines and polygons (Kitchin, 1996). These components have been used to support visualisation of sources of creativity (Brennan-Horley, 2010; Brennan-Horley and Gibson, 2009; Brennan-Horley *et al.*, 2010; Gibson *et al.*, 2010), to “identify spaces that differed from the health department’s vector control priorities” when mapping community perceptions of mosquito risk (Dickin *et al.*, 2014:78), and to “cross-check perceptual differences between residents and police” (Lopez and Lukinbeal, 2010:53). They have also provided new opportunities for researchers to collectively visualise their initial reflections on research sites (Hawthorne *et al.*, 2015) and been used to “bridge landscape epistemes and illuminate the dynamics of land use in novel and syncretic ways” (Bauer, 2009:230).

In terms of analysis, sketch maps have been integrated with GIS to parse out specific relationships between data by interpolating between points and testing for correlation between multiple datasets within a single frame of reference (Bauer, 2009). Curtis and colleagues (2014) have also used sketch maps to support kernel density estimations, spatial filters and univariate local indicators of spatial autocorrelation which were designed to provide information on

perceptions of fear of crime among male youth in Los Angeles neighbourhoods. Similarly, Gibson and colleagues (2012) undertook network topology analysis of sketch mapping outputs by place of residence to reveal the extent of localism in cool and creative places in Wollongong, New South Wales. Sloan and colleagues (2016) employed GIS to measure the tortuosity of sketch mapping outputs as part of their analysis of the impact of base maps on sketch mapping. As further aids to analysis, GIS environments make it possible to store qualitative information directly alongside mapping outputs (Vajjhala and Walker, 2010). This history of analysis and visualisation bodes well for the integration of sketch maps into fuzzy index modelling of the Yawuru living cultural landscape.

To be clear, there are some risks to the use of sketch mapping for data collection in this study. In particular, despite its low technology threshold, sketch mapping often requires both time consuming digitisation and transcription (Boschmann and Cubbon, 2014; Curtis *et al.*, 2014). As outlined in the following section, I manually transcribed and digitised the sketch maps to prevent the costs of this transcription from burdening Yawuru governance bodies. Additionally, sketch mapping neither removes power inequities within mapping nor eliminates the risk of powerful elites within Indigenous groups determining the mapping process (Kyem, 2004; McCall and Minang, 2005). To address this, I paid close attention to power dynamics in and around the sketch mapping interviews and be aware of my contribution to these dynamics as a research partner of NBY. Sketch mapping also does not guarantee that Indigenous peoples will retain control over map products and how they are used (Corbett *et al.*, 2006). Yawuru people have, however, worked hard to retain their data sovereignty through their knowledge vision and the co-publication criteria included in the Draft ANU-NBY code of conduct may also help in this space.

Additionally, while elements of sketch mapping align with certain Indigenous mapping traditions, sketch mapping can render any conflicts in worldviews or perceptions readily visible (Bauer, 2009). It can also fix previously fluid and performative boundaries (Chapin *et al.*, 2005; Fox *et al.*, 2006; Peluso, 1995; Rundstrom, 1998) within an entity-driven or object-based view of space (Roth, 2009). Indeed, Thom observed in Coast Salish land that “the practice of single, polygonal representations of traditional territories [...] has confounded negotiations and exacerbated relations among kin and neighbouring First Nations communities.” (Thom, 2009:183). In part, as outlined in Chapter 6, I addressed this issue by using qualitative analysis of the non-spatial data generated through sketch mapping interviews to contextualise GIS-based analyses and representations in this research.

5.2 Methods

Despite the popularity of transcribing the mind to the map identified by Curtis (2016), there is no unified approach to sketch mapping (Curtis, 2012; Giesecking, 2013). This is somewhat unsurprising given the diversity of topics and motivations for sketch mapping outlined in the previous section. Historically, community sketch mapping protocols have been designed for use in high stakes applied environments (e.g. Brody 1986, Curtis 2016, Tobias 2009). These protocols often value storytelling and produce outputs which closely align with the cadastral model. They contrast strongly with behaviourist techniques designed to elicit information on spatial cognition which have comparatively low stakes for participants (e.g. Kitchin 1996, Kitchin and Blades 2002; Pocock 1976). Such techniques often emphasise spatial freedom of expression but may not include an interview. These discrepancies present challenges when designing techniques to collect comparatively high stakes data for index modelling. This section introduces the semi-structured approach to sketch mapping interviews adopted in this research. This approach was grounded in the Yawuru research context and partly guided by feedback from the reference group.

5.2.1 Sampling

5.2.1.1 Design

I used a purposive sampling approach in this study. Participants met the following criteria adapted from Tremblay (1957) and Lewis and Sheppard (2006):

1. Knowledge: Participants were Yawuru people who were familiar with and used the landscapes under study.

2. Willingness: Participants were willing to contribute their information to a collective Yawuru knowledge project and have their maps be held by NBY and stored or presented as a collective knowledge output.

3. Communication ability: Participants were relatively comfortable communicating with outsiders and able to discuss, where appropriate to do so with an outsider, the reasons sites were significant to them.

4. Representativeness: Participants were Yawuru people who, by virtue of their age, family affiliations and/or role within NBY as an organisation, were seen by the reference group to be generally representative of Yawuru people. Where possible, the reference group tried to select participants from different Yawuru families.

5. Role in the community: All but two participants had extensive contact with NBY and were aware of the organisation's role in the management of land and sea country across the estate.

I used these criteria to ensure that participants were broadly representative of Yawuru people, equipped, willing, and able to give their informed consent to the interview process. The criteria also ensured that participants were people who would feel comfortable communicating information about Country to an outside researcher working in close partnership with NBY.

5.2.1.2 Recruitment process

In line with a partnership research approach, recruitment in this study was driven by the reference group. The reference group produced an initial list of 23 potential participants who met the criteria outlined above and were perceived by that group as being broadly representative of Yawuru people. From that initial list, reference group members or NBY staff approached 16 potential participants and 11 consented to participate in the research. These 16 individuals were selected as part of a deliberate sampling technique designed to encourage participation from people over eighteen years old of different ages and genders. Later, we added more people to the list and approached them to help ensure a more representative sample of Yawuru people. Participants were initially contacted either by members of the reference group or other NBY staff who were familiar with the project. Two participants were members of the reference group and NBY staff who worked in what was then the Land and Sea Unit and the Cultural Heritage Unit.

An additional recruitment drive was made during a lunchtime meeting at *Mabu Yawuru Ngan-ga*, the language resource centre at NBY. Here, I provided lunch and made a presentation which both explained the research and described the likely interview process (Appendix 5A). This presentation also explained how sketch mapping interviews conducted in 2013 had been used to generate a collective values map.

Given the demands of a busy organisation, individuals drifted in and out of this presentation as they completed other tasks. Nonetheless, from the presentation alone, several women who were on the list provided by the reference group agreed to be involved in sketch mapping interviews the following week. I was also approached a week later by Anita Dean, a Yawuru woman who had not attended this meeting but volunteered at the language centre and requested to be involved in the project.

Sampling was an iterative process which continued until saturation. However, we had difficulty recruiting senior men: some were not available, and others declined to participate in the sketch mapping interview process.

5.2.1.3 Participant characteristics

In this study, 14 people completed 15 sketch mapping interviews. Four participants had combined interviews with two participants in each interview. Others elected to complete the sketch mapping exercises across two sessions as they left part way to attend to other

commitments. Two individuals subsequently withdrew from the research, leaving 7 women and 5 men in the final study. Almost all these individuals had extensive experience working with NBY as an organisation.

Following engagement with the reference group, the primary purpose of the interview was to trial a data collection technique which could elicit information to inform fuzzy index modelling in a post native title context. All interviewees were identified by reference group members as Yawuru people. Some also had additional heritage from around Australia and overseas. Although the age of participants was not recorded during the interview process, in line with ethics requirements, all were 18 years old or over.

The participants in this research were felt by the reference group to be, excepting the lack of senior men, broadly representative of Yawuru people. Some were retired, others were employed on a full-time or part time basis or conducting voluntary work. At least one participant had lived away from Broome for some period. All participants were familiar with both study sites.

5.2.2 Survey design

Sketch mapping interviews provide an opportunity to collect information across a range of spatial and sociocultural topics. Topics in the interview guide of this study were designed to inform Yawuru governance, contextualise the information collected in sketch maps, and help to support negotiations with external stakeholders (Appendix 5B). Question phrasing was selected in consultation with the reference group and finalised during the pilot interview (Appendix 5C). This phrasing followed the advice of reference group members to include additional prompts, keep the questions simple, and ensure interview language was non-threatening.

5.2.3 Base map design

As in Potter *et al.* (2016), I encouraged participants in this study to draw on mylar covered maps during the interview process. Following Curtis (Curtis, 2012, 2016; Curtis *et al.*, 2014), I considered base map size and type; landscape legibility; imagery choice; extent and zoom; labelled landmarks and accompanying instructions in designing the base maps.

I prepared A0 base maps for both study sites which were designed to be both legible and portable (Figure 5.1). The maps were not displayed side-by-side. Instead, I asked participants to draw on one map at any given point in time.

In the Broome Town area, labels included 10 landmarks, 4 regions, and 13 roads well-known in Broome (Figure 5.1, left). At Crab Creek, the study site which was added at the request of NBY staff, 8 labels were included which indicated landmarks or areas drawn from an early draft of the Man-galagun management plan (Figure 5.1, right). Regions and roads were not named at Crab

Creek. Only two roads are present in the area and one has no formal name. Instead, listed landmarks link to small regions or sites within Crab Creek.

Given its urban nature, Broome Town had considerably more built infrastructure than peri-urban Crab Creek. Nonetheless, the sites were close in proximity, with a 2.49km gap between the two study areas (Table 5.1). The base maps are presented in more detail in Appendix 5D.



Figure 5.1: Participants and sketch maps with base map imagery

Table 5.1: Comparison of map elements across base maps used for Broome Town and Crab Creek

Map element	Broome Town	Crab Creek
Area	122km ²	79km ²
Scale	1:48,436	1:13,000
Projection	World Geodetic System 1984 Web Mercator Auxiliary Sphere	World Geodetic System 1984 Web Mercator Auxiliary Sphere
Extent	Top: -2,027,198.75 Right: 13,609,923.24 Bottom: -2,039,667.28 Left: 13,600,100.56	Top: -2,029,301.966 Right: 13,623,207.48 Bottom: -2,036,652.1 Left: 13,612,409.38
Labelled landmarks	Broome Airport, Boulevard Shopping Centre, the Industrial Area, Broome Museum, the Golf Course, Goolarri Media, the Port, the Racecourse, the Life Saving Club	None
Number of labelled roads	13	0
Labelled areas	Minyirr, Chinatown, Entrance Point, and Cable Beach	Buga Wamba, Kaji Rock, Black Rock, Fall Point, Sabu Rock/ Blackberry Tree, Bird Observatory, Bundurr Bundurr, and Man-galagun/ Mirrda
Nature of site	Urban	Peri-urban

I used freely available DigitalGlobe imagery base maps, which come with ArcGIS software (10.3.1) to help construct the base maps in this research. This imagery was not dated but was downloaded in April 2015. It contained several artefacts, including a highly visible disruption in the inter-tidal zone where the Digital Globe imagery transitioned to lower resolution. Where participants commented on such disruptions, I explained they were artefacts of the map construction process. Some participants also found the gap between the two study-sites, included on the advice of NBY staff, disorienting.

5.2.4 Interview protocol

Typically, I interviewed participants in a room at the NBY offices. This location was well known and usually convenient to participants, most of whom attended the offices on a semi-regular basis. One interview was conducted in the participant's home at their request. As observed by Elwood (2000), the location of this interview gave me additional, largely unrecorded, insight into the participant's life.

The items I brought to each interview included: mylar covered maps and a variety of coloured markers (to draw the sketch maps) (Brennan-Horley and Gibson, 2009); interview prompt sheet and note book (to record observations during the interviews) (Luck, 2003; Pain, 2004); information sheet, consent form, and time sheet (to ensure that participants were able to provide their informed consent to the interview and were appropriately compensated for their time); an audio-recorder and camera (to, where participants consented, record and photograph the interview process); and, finally, homemade baked goods (usually cookies) and tea or water (to ensure that the participant was comfortable throughout the interview process) (Pain, 2004). Where I had not met participants on previous trips to NBY, I was introduced to them by NBY staff.

Before the start of each interview, I described a little bit about myself and the research. I also showed participants the interview questions, information sheet and consent form (Appendix 5E) as well as the two base maps which acted as spatial anchors for the research (Brennan-Horley and Gibson, 2009).

Informed consent is important in all social research, and particularly important in an Indigenous context. However, obtaining this consent can be fraught: it is vital that participants understand the focus of the research and how any information they provide will be stored and used both during and beyond the life of the project. Given this, I actively discussed the information sheet and the consent form with participants. I also gave participants the option of consenting orally or signing the consent form. All participants chose to sign the form. The consent process included an opportunity for participants to determine how they would be identified in the research. Some chose to be identified by their gender only, others by their full name, and still

others by a nickname or derivation of their full name. I audio-recorded all but one of the interviews at the participants' request. Once participants had consented to the research and had an opportunity to ask any questions about it, I started the interview.

I designed the interview guide used in this research to support an iterative spatial process whereby participants would mark a single significant area, and then answer a series of questions designed to contextualise the significance of that area. I also used a tick-box system as a visual prompt which allowed additional flexibility in question order (see Appendix 5F) and facilitated additional participant control over the interview process.

During the interview, participants actively marked the two base maps in the order of their choosing. Where the participant did not have enough time to complete both maps in a single session, a follow up session was used to capture data for the other site. One participant completed the map for Crab Creek only. I provided participants with a variety of permanent markers and asked the following question which used a formula similar to that adopted by Curtis and colleagues (2014):

“Are there any areas on this map that are significant to you? Can you draw one?”

Participants then drew on the map in response to that question. Participants were given the freedom to mark the maps in any way they wanted, to keep the interviews relaxed and flowing. I did not set a time limit for the interviews. Instead, these continued either until participants could not identify any more areas significant to them on either of the base maps, or until they ended the interview for other reasons.

5.2.5 Pilot interview

I planned two pilot interviews with participants who were also members of the reference group. Circumstances beyond our control meant that one of these interviews was unable to proceed during the pilot phase of this study. This participant was interviewed during the bulk of the data collection.

In line with the notion of respectful representation, we commenced the pilot interview with a collective examination of the interview questions. This process highlighted a need to emphasise to participants that they were being asked about areas significant to them as individuals. It also showed a need for participants to self-identify the seasons in which they used sites. This discussion showed the importance of prompts to elicit data on activities such as gathering bush-fruits and bush-medicine. Finally, it demonstrated the potential sensitivity of questions linking sites to people - some of whom might have passed away. While I tried to re-design this question with NBY staff, I ultimately left it in its original format. Instead, I was primed for any sensitivities which might arise from that question during interviews.

The pilot interview also showed a need to adapt several other elements of the interview process. First, the participant displayed a tendency to mark several locations at once. This highlighted the need to create the check-box interview guide used in all subsequent interviews. Secondly, the participant had difficulty seeing the numbers written on the Crab Creek study site to indicate key areas drawn from the Yawuru Cultural Management Plan, resulting in orientation problems. Consequently, I placed removable sticky labels which corresponded with each of these numbers on top of these sites in all subsequent interviews following the principle of relational accountability and listening to Yawuru people.

Given the participant's other commitments within NBY, at the end of mapping Crab Creek a decision was made to delay mapping the Broome Town site until the bulk of data collection.

5.2.6 Data collection

I conducted interviews in May to June 2015 which varied in length from 1-2.5 hours. Additional detail on the length and location of each interview can be found in Appendix 5G. The purpose of the interviews was not to produce a comprehensive representation of all values held for the study sites by Yawuru people, but instead to produce some recommended mapping procedures for the rest of the estate. Consequently, I continued interviewing until the appearance of repeat themes and locations indicated saturation for a pilot study.

5.2.7 Site visits

In addition to the sketch mapping interviews, I took part in two separate NBY field trips and participated in several informal fishing and crabbing excursions. The first NBY field trip, to look at Broome Sandstone and Entrance Point, included external researcher Vic Semeniuk, Land and Sea Unit staff member Dean Mathews, then GIS analyst Toby Munroe, and Yawuru Country manager Mr Gregory - who later participated in a sketch mapping interview. This trip provided insight into the geomorphology of Broome and the ways that other researchers were teaching Yawuru people to "read Country" according to Western science.

The second NBY field trip was to Man-galagun/ Crab Creek as part of a broader on Country discussion of land-use plans for the area facilitated by Yawuru and DPAW as part of co-management arrangements. Following plans made with the research reference group, I originally intended to record the concerns senior men held for the Crab Creek study site and engage with them on Country during this trip. Unfortunately, only one senior man attended the broader trip and opportunities for specific data collection on concerns with senior men were extremely limited. Instead, this trip provided an important opportunity to engage with several other participants on Country, including places they had discussed in the interviews.

5.2.8 Sketch map categorisation

I thematically classified the spatial outputs of sketch mapping into six main categories: points, lines, polygons, emblematic markers, location markers, and labels I had added during the interview. I recorded the dominant feature type in each map, as well as the presence or absence of multipart features. Additionally, I recorded the mean and median number of feature types included in each map, as well as the presence or absence of features where participants depicted the significance of the whole study area (Brennan-Horley, 2010).

Finally, I calculated the area covered by each feature, assuming each linear feature could be surrounded by a five-meter buffer. I then used pivot tables to examine the relative size of features across genders and study sites. These results are presented, alongside typical responses to interview questions, in the following section.

5.3 Outputs

A range of outputs were produced through sketch mapping interviews. This section reviews these spatial outputs, before assessing the types of responses given to each of the questions included in the interview guide.

5.3.1 Sketch maps

In total, 287 features representing places of significance were recorded across 22 sketch maps with a mean of 13.05 features marked in each map. As is outlined in Table 5.2 and Figure 5.2, sketch maps produced in this study were highly diverse including points, lines, polygons, Xs, arrows, textual and pictorial emblems representing the area's significance, and interviewer marked polygons. Single-part polygons appeared in the most sketch maps (14/22), followed by emblematic representations where pictures or text representing values were recorded for a site (11/22). Unenclosed polygons and lines appeared in the fewest maps (2/22). These were closely followed by multi-part points, maps which included both picture-based and text-based emblems, and maps where I had actively marked sites during the mapping process. Just over 40% of the maps included multipart features (9/22), while five included markings designed to convey the significance of the whole study site, three of which were polygons.

Table 5.3 represents the number of maps with dominant feature types. Polygons dominated the most maps (10/22) while locational indicators including Xs and stars dominated only a few maps (3/22). Interviewer markings and line-based features did not dominate any map.

The average area covered by each feature was 43.5 hectares (ha), with the area for Xs and stars calculated using their minimum bounding geometry. The average area of a feature (excluding background features) in Broome Town was 56.8ha while the average area of a feature with the

same exclusions in Crab Creek was 17.9ha with 161 features drawn for Broome Town and 84 for Crab Creek. The total area of features recorded across all participants excluding background features at Broome Town was 9151.0ha while the total area covered by all participants excluding background features as 1501.8ha at Crab Creek. In total 10,652.9ha were covered in all 22 maps across the two sites.

Figure 5.2: Sample sketches made by participants. These sketches have been cleaned and are being presented as black and white for presentation purposes. Numbers added to the points were added by the researcher during interviews.

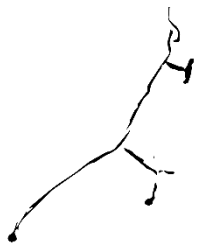
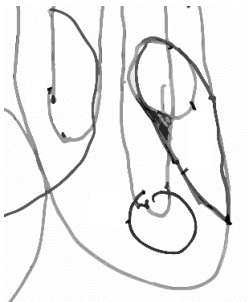
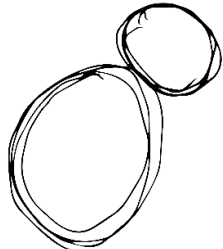
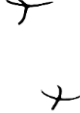
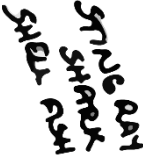
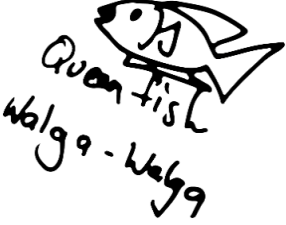
Points or Lines	 
Polygons	 
Location indicators (X, Arrow, Star)	 
Text	 
Picture or Picture and Text	 

Table 5.2: Feature types in sketch maps.

Symbol	Type	Number of sketch parts per site	Sketch definition	Number of maps with sketch	Percentage of maps with sketch
<i>Points</i>	Single part	1	Point designating x-, y-location at map scale	8	36.4
	Multipart	>1		3	13.6
	Any	≥1		8	36.4
<i>Line</i>	Single part	1	Line composed of nodes and vertices at map scale	10	45.5
	Multipart	>1		2	9.1
	Any	≥1		10	45.5
<i>Polygon</i>	Single part	1	Two-dimensional polygon representing an enclosed area at map scale	14	63.6
	Multipart	>1		6	27.3
	Unenclosed	1	Line abutting natural feature to create a polygon on base map	2	9.1
	Any	≥1	Two-dimensional polygon representing an enclosed area at map scale	14	63.6
<i>X, Star, short arrow</i>	Any	≥1	Emblems designed to indicate location	4	18.2
<i>Emblematic (Picture)</i>	Picture	≥1	Emblems or pictures related to the site	6	27.3
<i>Emblematic (Text)</i>	Text	≥1	Text related to the site	7	31.8
<i>Emblematic (Picture with text)</i>	Picture with text	≥1	Pictures and text related to the site	3	13.6
<i>Emblematic</i>	Any	≥1	Any emblems (pictures and/or text) related to the site	11	50.0
<i>Interviewer label only</i>	Any	≥1	Marking made by the interviewer based on participant's description	3	13.6
<i>Multi-part features</i>	Any	≥1	Any multipart features	9	40.9

Table 5.3: Dominant feature types in sketch maps

Dominant feature type	Number of maps	Percentage of maps
<i>Polygon</i>	10	45.4
<i>Emblematic</i>	5	22.7
<i>Point</i>	4	18.2
<i>X/Star</i>	3	13.6
<i>Line</i>	0	0
<i>Interviewer marking</i>	0	0
Total	22	100

Where background features were excluded, features drawn by men and women were similar in size with an average of 46.5ha per feature for women and 41.1ha per feature for men. Men, however, recorded a greater total area across their sketch maps at 5719.5ha as opposed to 4933.4ha for women. Men were also more likely to draw background features and, where included in the average feature size, these background figures increased the average area per site in hectares for men to 106.9, raising overall average site size to 76.9ha.

Given the discrepancies in areas covered by points and polygons, there were also significant discrepancies in the average size of the features drawn by the participant who drew the smallest features (1.5ha) and the area covered by features from the participant who drew the largest features (119.8ha). This discrepancy, and its implications for data preparation and analysis are discussed in greater detail at the end of this chapter and into the next chapter.

5.3.2 Interview responses

Responses to interview questions varied as outlined in Appendix 5H. Some questions produced relatively consistent information and stories related to the topic. These included questions on values, activities, concerns, barriers to site visitation, access and seasonal activities. Other questions, such as those on species collected during activities, were less defined. For example, participants often confused questions on emotions associated with sites. Finally, as predicted in the pilot interview, some participants found the question on people associated with sites somewhat sensitive.

5.4 Conclusion

This chapter introduced, trialled, and evaluated a semi-structured approach to sketch mapping designed to collect information to support spatial analyses in a Yawuru context. It demonstrated how sketch mapping can be combined with open-ended questions and semi-

structured interviews to produce rich and grounded spatial data with key informants. The conversion of this data into index models representing values, seasonal use of Country and concerns occupies the next chapter of this thesis.

Chapter 6: Analysis

Index modelling is a means of producing subjective but explicit representations of a range of values, concerns or other factors (model elements) in order to facilitate more environmentally, socially and culturally aware design (Castella *et al.*, 2007; Chang, 2016; McHarg, 1992). It has been used to support spatial decision making in a range of areas from siting landfills (Mahini and Gholamalifard, 2006) or wind turbines (Gimpel *et al.*, 2015) to supporting indigenous agroecology based management of a Māori trust-owned farm (Moore *et al.*, 2016). When combined with fuzzy logic, index modelling can be used to represent semantic relationships across space (Burrough and McDonnell, 2015). It can also emphasise continuity and connection across landscapes.

Research by Potter (2013), Potter *et al.* (2016) and Gardner (2014) has begun to establish the potential of fuzzy index modelling to help support Yawuru governance in a post native title context and spatially express elements of Yawuru relationships to their traditional Country. In this study, I extended that approach by adopting an explicitly context-driven approach to index modelling and spatial analysis. In this approach, I incorporated adaptations stemming from reference group feedback and combined index models to support Yawuru governance. I also explicitly embraced subjectivity and was guided by the ways Yawuru participants talked about their Country during interviews.

In general, context, the “setting for an event, statement, or idea, and [the] terms [in] which [it] can be fully understood” (Oxford, 2018c:1 of 1), is central to understanding geographic phenomena. Chen and Kwan have examined how activities to “access and procure food at the individual level [such as fishing practices or even shopping at a supermarket, are] shaped culturally and interpersonally by social contexts” (Chen and Kwan, 2015:1736). Similarly, Golledge and Stimson argued that the spatial decisions made by individuals were in part determined by their environmental and cultural context (Golledge and Stimson, 1997a:32). Indeed, the importance of context to spatial analysis and GIScience is now so widely recognised that one of three featured themes at the 2017 Association of American Geographers Annual Meeting was dedicated to the role of uncertainty and context in Geography and GIScience (American Association of Geographers, 2017).

Attention to context is also vital when working with Indigenous peoples. Thom (2009:183) has shown that maps can “confound[d] negotiations and exacerbat[e] relations among kin and neighbouring First Nations communities” when local spatial ontologies and other contextual elements are ignored in Indigenous mapping. Additionally, Taylor (2009b:115) has extensively discussed how efforts to translate research findings on policy ‘gaps’ “into coherent policy on the

ground is thwarted by a lack of ethnographically informed data that account for the intercultural world in which many Indigenous people exist and operate”. Finally, in relation to Indigenous governance, Smith (2016:127) has argued that “robust culturally informed data used in relevant contexts can serve as a foundation to support more effective and legitimate Indigenous governance”. In Indigenous settings, an awareness of context often facilitates empowerment. Ignorance of context, by contrast, often leads to wasted resources and other harmful outcomes.

In this research, I use context-driven spatial analysis to describe modelling which is iterative and responds directly to organisational needs. This approach recognises the constraints on time and resources faced by many Indigenous organisations, including NBY. It maximises available information use and facilitates the re-use of modelling procedures or outputs by harnessing software and techniques available to NBY. The approach also minimises the need to elicit additional information from individuals who face competing time demands in a post native title environment. It does this by thoroughly integrating qualitative and contextual information from sketch mapping interviews and fieldwork into analytic modelling. Finally, as outlined in Figure 6.1, this context-driven approach to modelling actively incorporates community input into the modelling process. It draws on Yawuru participants’ knowledge and use of their living cultural landscape and has a reference group outline core governance challenges to be addressed by the modelling. This approach includes community members directly in model assessment and means that data is returned to NBY upon project completion.

Ultimately, I created three separate index models through context-driven analytical modelling in this research, each designed to address a separate aspect of post native title governance. The first focuses on representing values in areas significant to Yawuru participants, the second represents seasonal use of areas identified as significant to Yawuru participants during sketch mapping interviews and the third focuses on concerns held for the same area. All three models rely on sketch mapping data compiled into a vector-based database before it is processed through fuzzy index modelling.

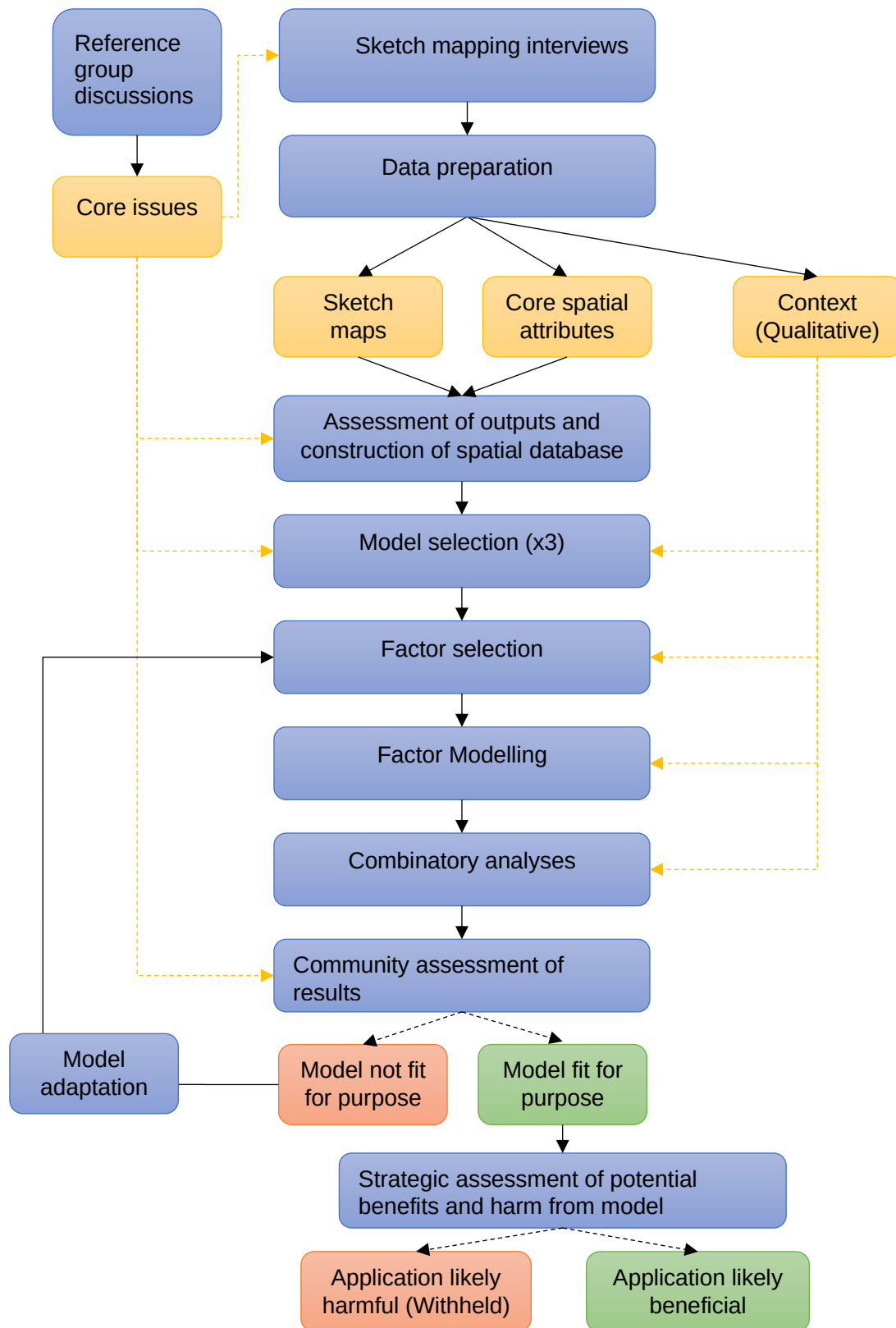


Figure 6.1: A context-driven approach to spatial analyses for use by Indigenous peoples

6.1 Creation of the spatial database

I used three priorities to drive creation of the spatial database from sketch mapping interview data. First, the database had to be grounded in participants' perceptions of their Country including factors, or model elements, defined by participants during sketch mapping. Second, the database had to readily support analytical modelling. It could hold additional or contextual information, particularly where elements mentioned by participants were ultimately not modelled, but such information could not be included at the expense of potential to produce the model. Third, the database had to facilitate equality between participants' responses. This meant that no style or approach to sketch mapping could be allowed to dominate model outputs. As outlined below, these priorities influenced both spatial elements of the database and associated attributes.

6.1.1 Digitisation

I designed digitisation in this study to create vectors which accurately captured participants' sketch maps and supported spatial analysis. Specifically, I removed A0 transparencies containing sketch mapping outputs the base maps and scanned them at 300 dots per inch resolution. I then cleaned and geo-rectified these scans using the marked corners of the geo-referenced base map imagery as anchor points. Root mean squared errors which describe the consistency of the transformation between control points did not exceed 10.0m for any of the rubber-sheeted maps. I then used heads-up digitisation and a graphics tablet to capture participants' sketches and, where relevant, marks I had made on the maps during interviews. For sketches deemed to represent points and polygons, I used the outer boundaries of individual graphics as inputs to the data standardisation process. I then visually allocated features as either points or polygons based on their size at map scale. I left line-based sketches in that format prior to standardisation. I also assigned each site a unique identifier based on one number assigned to the participant and another assigned to the site during sketch mapping.

6.1.2 Standardisation of sketch mapping inputs included in the spatial database

Standardising spatial inputs is central to values modelling (Brown and Pullar, 2011). Here, in line with effort to achieve respectful representation, I used standardisation to facilitate equity among participants' responses. As outlined in Chapter 5, the spatial products of sketch mapping were diverse. For standardisation, all features were determined to be points, multi-points, lines, or polygons as outlined in Figure 6.2 and Table 6.1.

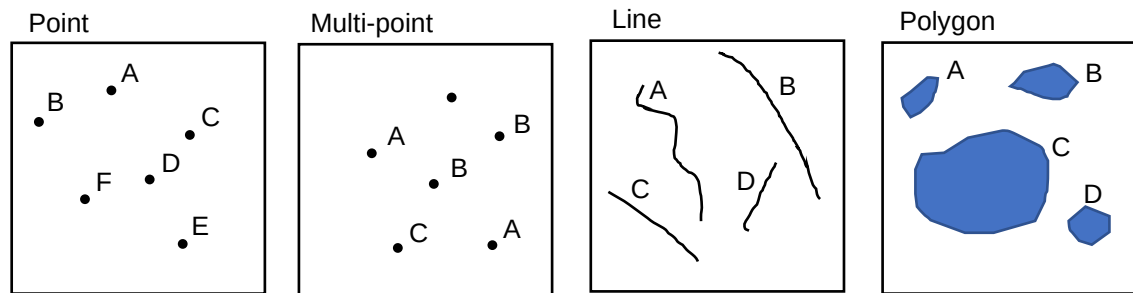


Figure 6.2: Point, multi-point, line and polygon features. Each letter indicates a unique feature.

Table 6.1: Point, multi-point, line and polygon features generated by the sketch mapping exercises.

Shape	Number of unique identifiers	Number of unique features
Point	63	63
Multi-point	7	33
Line	33	33
Polygon	146	146

Examination of the spatial database revealed large differences in the median area covered by points and polygons ($n = 2998.3\text{m}^2$ and $n = 157991.4\text{m}^2$ respectively). On average, polygons were more than fifty times larger than points. Additionally, line-based inputs did not give an area for their features. To standardise spatial inputs to modelling and ensure no participants were spatially disadvantaged by a decision to use points or lines over polygons, I enlarged point and multipoint sites to better align with mean polygon size. Here, I calculated both the median size of all polygon-based inputs, excluding background polygons, ($n = 157991.4\text{m}^2$) and the median radius of polygon sites ($n = 126.5\text{m}$) by treating polygons as circles. I then reduced point and multi-point sites to their centroids and buffered them by 130m (the mean polygon radius rounded to the nearest 10m). I converted line-based inputs to polygons using a 5m double-sided buffer. Given that these inputs tended to follow roads or tracks across the estate, this buffer distance was used to incorporate road width and a portion of the verge.

After buffering point, multi-point, and line features I merged them with polygon and background polygon inputs to form a standardised database which underpinned the analytical modelling.

6.1.3 Interview transcription

I made verbatim manual transcriptions of all audio-recorded sketch mapping interviews to capture the meanings conveyed by participants during interviews. This iterative process increased my familiarity with the transcripts (Poland, 1995) and aided my recall of the interview process (Dunn, 2010). In total, I transcribed more than 150,000 words. Additionally, I copied field notes and annotations made during the unrecorded interview without alteration. I stored all interview notes and transcripts on a password protected personal computer.

6.1.4 Preparation of the database's attribute table through spatial coding of interview transcripts

I used a multi-step process to convert interview transcripts into an attribute table associated with spatial features which could support spatial analysis. First, I organised all interview quotations by site and topic (e.g. concerns, values, activities etc.) in a Microsoft Excel table. Then, I summarised each quotation into its key themes. Table 6.2 lists each attribute of the spatial database which was derived from these elements. Given poor data capture on these topics, I did not derive attributes for emotions or people associated with a given site. I have provided more information on the process of deriving attributes used in analytical modelling in the Factor Selection section of the relevant model. Appendix 6A contains more information on descriptive coding of elements in the spatial database which were not used as factors in the analytical modelling process.

6.1.5 Collation of the spatial database

Following digitisation, standardisation, transcription, and preparation of the spatial database as described in sections 6.1.1-4, I used an attribute join to link the spatial database to associated sketches based on the unique identifiers assigned to each site.

6.2 Values model

The first of three index models produced in this research captured values participants expressed for areas which they considered to be significant across the two study sites. Techniques developed in this model helped shape seasonal use and concerns models created in the second and third parts of this research.

Table 6.2: Spatial database

Sub-Topic	Core spatial information	Number of attributes	Attribute Type	Attributes
Participant details	N/A	4	String	Participant number; participant name; vehicle; gender.
Location of significant places	Place name, study site	3	String	Site identifier; place name (if applicable); study site.
Significance of these places	Values held for site	8	Boolean	Cultural values; resource values; family; pearling heritage values; home; other.
			String	Concise description of values held for cultural sites; Information on gendered nature of cultural sites (if applicable); description of other values.
Activities conducted at site	Activity type	18	Boolean	Camping; cooking; fishing; fishing (line); fishing (boat); fishing (net); fishing (drag-net); shelling; oystering; collecting bait; crabbing; collecting turtle eggs; hunting turtle; hunting dugong; spearing stingray; spearing fish; hunting (land); gathering plants.
Species caught or gathered	Information on key species caught or gathered at site.	13	Boolean	Fish: reef or creek fish, <i>walga-walga</i> , bluebone, catfish, shark, other; Shells: <i>bunyman</i> and <i>lee</i> , cockles, oysters, other; Plants: <i>gungarra</i> , <i>gubinge</i> , other.
			String	Description of species targeted during hunting (land).
Season (of activity)	Months of the Gregorian calendar	13	String	Description of site use.
			Boolean	January, February, March, April, May, June, July, August, September, October, November, December.
Frequency of site visitation	Information on rates of visitation	5	String	Frequency of visitation (past); frequency of visitation (present).
			Short Integer	Frequency (past): low (1), medium (2), high (3). Frequency (present): low (1), medium (2), high (3). Frequency (maximum): low (1), medium (2), high (3).
Transport to site	Types of transport	4	Boolean	Car, car then walk, walk, boat.
People associated with site	Excluded	0	N/A	N/A
Barriers to site visitation	Types of barriers	12	Boolean	Road quality; closure; development; transport; other commitments; use of site by others; cultural reasons; inter-cultural interactions; mobility and health; other.
			String	Description of barriers identified as other.

Sub-Topic	Core spatial information	Number of attributes	Attribute Type	Attributes
Emotions associated with the site	Excluded	0	N/A	N/A
Site rating	Participant specific rating	4	String	Description.
			Short integer	Rating: low (1), medium (2), high (3).
Concerns about the site	Types of concerns	15	Boolean	Over-use; litter; species loss; inappropriate off-road vehicle uses; protection of important sites; species loss; over-exploitation; development (future); development (past).

6.2.1 Rationale

Several researchers have begun to explore the potential of capturing values for governance in a Yawuru context. Terry Tobias conducted use and occupancy mapping with several Yawuru people. In the pilot study for this research, I worked with colleagues to use fuzzy index modelling to produce a model of several cultural values held by Yawuru people for the in-town foreshore of Roebuck Bay (Potter *et al.*, 2016). Finally, Gardner (2014) used fuzzy index modelling to capture areas valued for their access to hunting on Roebuck Plains. These projects have fed into several Yawuru governance initiatives. Maps produced by Tobias were incorporated into the Yawuru Cultural Management Plan, the primary outputs of the pilot study were used to facilitate a common basis for understanding around potential developments in Chinatown, Broome and information produced by Gardner has fed into negotiations over fractured Shale Gas Mining ('fracking') at Yulleroo. These studies, however, were also subject to some limitations.

As examined in the literature review of this thesis, Tobias' approach to values mapping is often designed for use in courts. It does not capture the complexity or continuity of Indigenous peoples' relationships with Country. In Potter *et al.* (2016), our fuzzy index modelling went some way towards capturing this complexity, but modelled only a subset of values held by Yawuru people for the in-town foreshore, without accounting for seasonal or temporal variation. Additionally, the weighting techniques we applied assumed that all values should be weighted equally and are unlikely to be valid when considering more than four factors or values. Finally, Gardner (2014) began to explore a range of model parameters, but did so primarily in the context of a single value: access to hunting areas across Roebuck Plains. This study extends on values modelling with Yawuru people. It partially addresses Yawuru governance agencies' desire to establish values modelling procedures which can be replicated across their entire estate.

6.2.2 Methods

In this study, I took a context-driven approach to fuzzy index modelling grounded in descriptions provided by participants during sketch mapping interviews. I drew on numerous sources of information to guide factor selection, factor modelling and combinatory analyses. I then employed these sources to create practical analyses which were grounded in place yet minimised the need to elicit additional information from Yawuru people.

6.2.2.1 Factor selection

The first step in any index modelling process is factor selection. In this study, factor selection needed to be representative of sketch mapping data and make good use of the existing spatial

database. It also needed to produce analytically useful outputs which could be returned to NBY to support Yawuru governance.

Factor selection for the values model drew on information from the four sketch mapping interview questions listed in Table 6.3. Broadly, this information fell into four themes: 1) metaphysical and spiritual values linked to the *Bugarrigarra*; 2) valued activities or practices conducted in the area (practices); 3) non-activity- or practice-based values which facilitated connection to place (relationships); and 4) elements which determined the importance of a site to a participant but did not specifically account for the factors included in the other sub-models (measures of importance). Three of these themes became the core sub-components of the final values model. However, metaphysical and spiritual values linked to the *Bugarrigarra* were ultimately excluded from analysis.

Table 6.3: Sketch mapping interview questions which fed into the values modelling process.

Question Theme	Question
Significant places	“Why is this area significant?”
Activities conducted at site	“What activities do you undertake at this site?”
Frequency of visitation	“How often do you go there?”
Site rating	“Using a low, medium, high rating, how would you rate the importance of this site to you?”

6.2.2.1.1 Metaphysical and spiritual values

During sketch mapping interviews, several sites were identified which were valued for their metaphysical qualities. Often these areas were law grounds, “business sites” and “*Bugarrigarra*” or “Dreaming” sites. Participants clearly considered such sites to be important. Nonetheless, many participants expressed considerable hesitation before recording these sites in the interviews, if they recorded them at all. Details on the number of sites listed as being associated with these cultural elements and the number of participants who listed these elements can be found in Table 6.4. Following data collection, information on these sensitive areas was clearly incomplete.

Table 6.4: Metaphysical and spiritual values.

Factor	Definition	No. of sites	No. of participants
Cultural site	A site valued for its cultural significance, links to <i>Bugarrigarra</i> , use as a law ground or some other use.	46	8

Based on previous conversations with Yawuru research partners around the sensitivity of these sites and their capacity for in-house spatial analysis, I made the decision to exclude these values from the final values model. Instead, I used prominent disclaimers to note the absence of

metaphysical values in the model⁹. In the future, Yawuru metaphysical values may be captured using a qualitatively grounded and context-driven modelling process like that established over the course of this study. However, such modelling is likely to be best performed in-house by Yawuru technicians.

6.2.2.1.2 Practices

A second theme which quickly emerged through analysis of interview transcripts was the value placed by participants on practices, or activities, across the Yawuru estate. This theme generally emerged questions on significant places (Question 1) and from questions on the activities conducted at those sites (Question 2). Using thematic coding, I further separated this theme into resource collection based and non-resource collection-based practices.

In the resource collection sub-model, I used four criteria to divide valued resource collection practices into model factors. First, I distinguished between practices based on the quality of available information. Specifically, I asked: “Is information provided in the interviews detailed enough to warrant distinguishing between the practices?”. If not, I lumped practices into broad categories such as hunting on land or collecting plants.

Second, I distinguished between practices based on equipment. Here, I used the question: “If similar species are targeted through a practice, is the difference in tackle or equipment used during the activities sufficient to warrant a distinction between practices?”. If not, as in the case of collecting *bunyman*, lee, and cockles which are all bivalves (shells) and only require a bucket to be collected, I lumped activities together into larger practices (e.g. shelling). If so, as in the distinction between collecting oysters, which are still bivalves but require a hammer and chisel as well as a bucket for collection, I considered the practice to be a distinct factor in the modelling process.

Third, I distinguished between practices based on whether the species targeted by the activities were significant either culturally or in terms of their importance for management. Under this criterion, I considered turtle hunting and dugong hunting, which use similar equipment to be distinct practises. I made this distinction based on their cultural significance including their use on ceremonial occasions, but also on their management significance as expressed through attempts to track, catch, or seasonally protect turtles from vehicles on Cable Beach.

Finally, as requested by NBY staff, I used gear type to distinguish between fishing practices after reference group members and NBY staff identified that information on drag-netting and some other practices would be useful in a co-management.

⁹ Disclaimers read: NB: This map is indicative and does not include Bugarrigarra (Dreaming) sites.

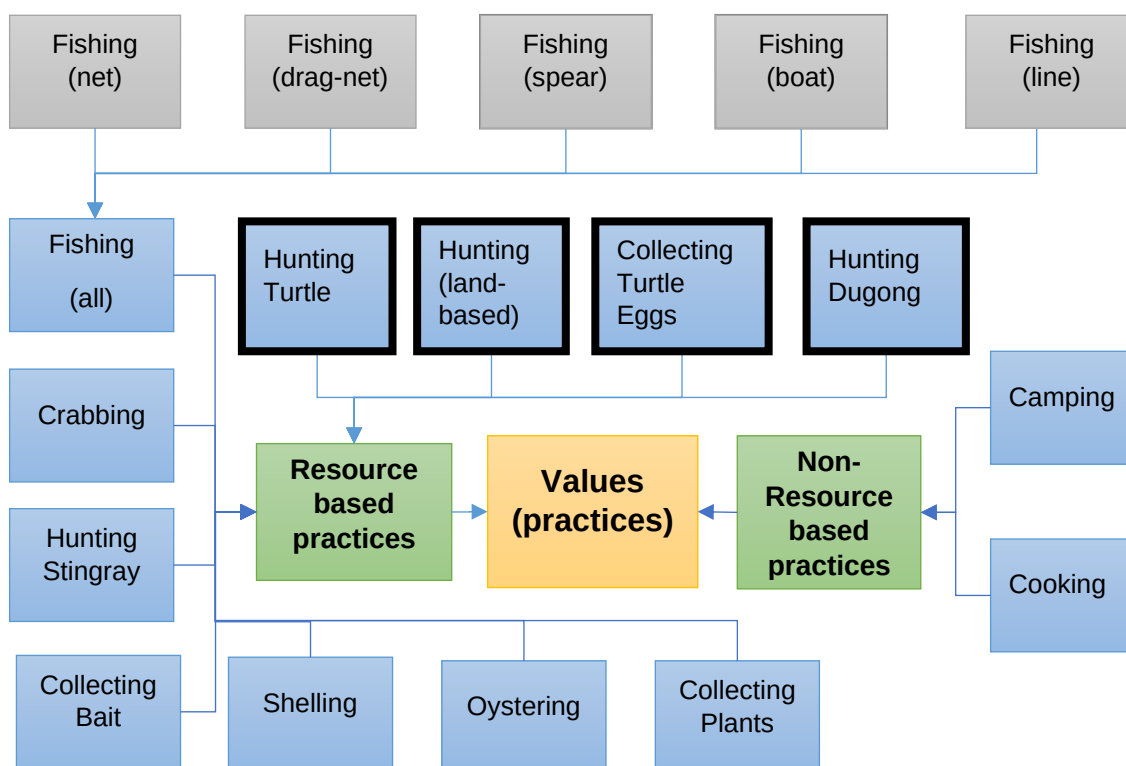


Figure 6.3: The practices sub-model

Table 6.5: Resource collection factors

Factor	Definition	No. of sites	No. of participants
Fishing (all)	A site used for any sort of fishing.	150	13
Fishing (line)	A site used for fishing with a handline or fishing rod.	131	13
Fishing (boat)	A site where fishing was conducted off boats.	22	8
Fishing (net)	A site where a net thrown by one person was used to catch fish.	28	9
Fishing (drag-net)	A site where a drag-net used by multiple people was used to catch fish.	12	4
Fishing (spear)	A site where fish were caught using a spear.	16	5
Shelling	A site where any shells, which were not oysters (and therefore not static) were gathered or collected.	62	13
Oystering	A site where oysters were collected.	28	13
Collecting Bait	An area where bait was collected through collecting shells, collecting octopus, or using a thrown net to catch bonefish.	46	11
Crabbing	A site where mud-crabs were collected from the shore.	69	13
Collecting Turtle Eggs	A site where turtle eggs were collected for consumption.	3	3
Hunting Turtle	A site where turtles were hunted.	7	4
Hunting Dugong	A site where dugongs were hunted.	5	3
Hunting Stingray	A site where stingrays were hunted using a spear.	58	10
Hunting (land)	A site where terrestrial animals were caught or accessed.	3	3
Plants	A site where plant materials including bush fruits, woods, medicines and or other materials were collected.	15	7

I only considered non-resource collection-based practices to be factors where they appeared to hold cultural significance. Thus, recreational practices such as swimming and playing, were not viewed as model factors. Instead, I combined these practices into an “other values” category within the non-practice sub-model.

The structure of the practices model is outlined in Figure 6.3. Definitions of each factor incorporated into the practices sub-model can be found in Table 6.5.

6.2.2.1.3 Relationships

As was the case for practices, I did not pre-determine categories in the relationships model. Instead, I used thematic coding to emphasise the meanings conveyed by participants during the interview process.

I faced several challenges in selecting relationship factors. As an example, participants repeatedly referred to valuing areas based on childhood memories, their association with family, or their status as home. Yet, these values intertwined as outlined in Box 6.1. They failed to meet the independence criteria often required in index modelling (Brown and Raymond, 2007). I also faced challenges related to poor spatial capture of some phenomena, over-inclusive values, and the failure of heritage values to align chronologically.

Box 6.1: Quotations demonstrating the connection between participants’ references to family, home and childhood memories.

*“We’ve still got an attachment to it. So, from that we still, we feel good because it brings us back **memories** of those visits, with **people**.” Dean Mathews*

*“If I sit on the rock [...] it just brings back **memories** [...] my **mother** used to actually sit on the rock, you know? [...] You look back and then you see the **grandchildren** running around, the kids, and, you know what I mean? [...] It’s a really good feeling. Because now we’re actually doing that with our **children**, what our **mother** did with us.” Rose Coffin*

*“Brings back a lot of **memories**. Good memories. You know, what I can remember Up the Hill [...] Kennedy Hill, that was our **home** [...] **Family** all lived there [...], lived in harmony there.” Martha Lee*

*“I think about my, um, **old people**. And, and you sit down and **think about what they used to do**, as a child **growing up** in that area. [...] So, every time I go out to those places, I always think of my **parents**.” Judy Edgar*

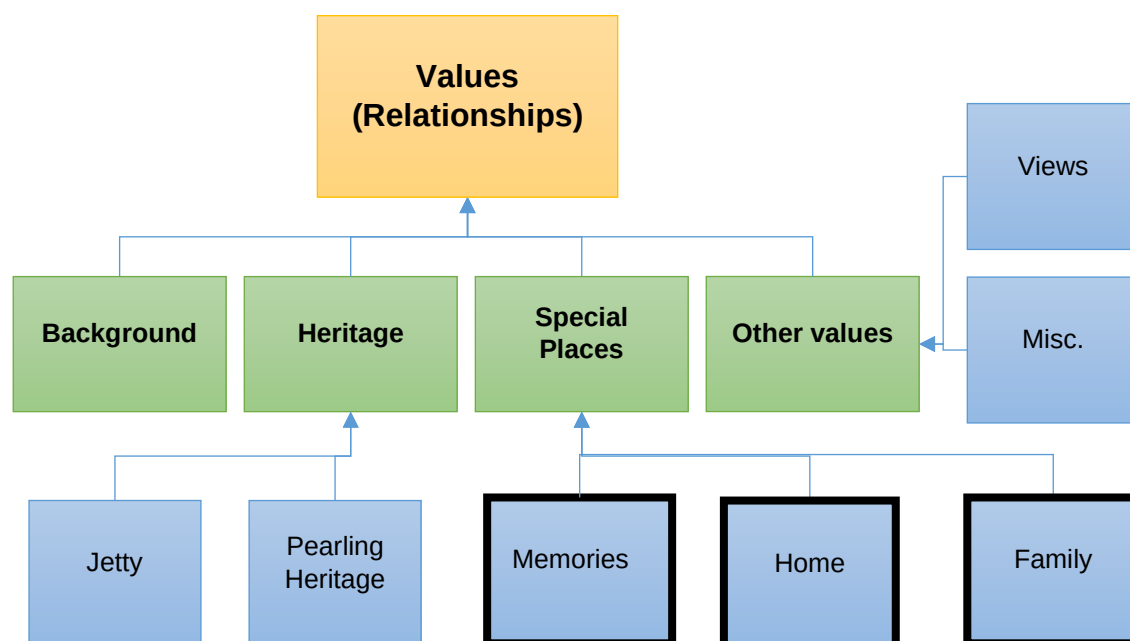


Figure 6.4: The relationships sub-model. Use of a maximum operator to combine factors is indicated by a bold border.

Ultimately, I customised the structure of the relationships model and its sub-models outlined in Figure 6.4 to overcome the challenges outlined above. I maintained factor independence by using a maximum operator to compile family, memories and home into a broader special places model. Similarly, I made chronological distinctions between values held for pearling heritage and the Broome Port jetty, then incorporated both elements into a broader heritage sub-model. These distinctions produced analytically useful factor models which also acknowledged the broader heritage significance of both sites.

Values for views were poorly captured in this study. Consequently, I de-emphasised this information and combined it with the “miscellaneous” factor model used to capture all values which could not be readily allocated to another category to form a broader “other values” sub-model. Finally, acknowledging the holistic values held by many Yawuru participants and following the logic used by Brennan-Horley *et al.* (2010), I deliberately incorporated the whole-of-map responses which Tobias and others have deemed to be “over-inclusive” (Brown and Pullar, 2011; Tobias, 2009). The background values factor acknowledged the importance of these areas whilst allowing areas with specific values to come to the fore during analytical modelling. Table 6.6 lists the final definitions of these factors alongside the number of sites and participants associated with them.

Table 6.6: Relationship factors

Factor	Definition	No. of sites	No. of participants
Family	A site valued for its association with family. Often associated with extended use alongside family members.	37	12
Pearling Heritage	A site valued for heritage from Broome's pearling era, from the time of settlement/ invasion until just after World War II.	21	6
Jetty	Values held for the Broome Port area. Constructed in the 1960s, the port post-dates Broome's pearling boom.	6	6
Memories	A site with strong personal historical associations and memories.	13	4
Home	A site which was considered a home to a Yawuru participant and other Yawuru people.	7	6
Other	Other undefined values including, but not limited to: aesthetic values.	22	9
Background	A polygon used by participants to indicate the importance of the whole study site.	3	2

6.2.2.1.4 Measures of site importance

In the values model, I used site rating and frequency of site visitation as proxies for importance of an individual site as perceived by the participant who identified it. Here, I standardised site ratings and frequency of visitation for each individual. As such, these measures are not standardised between participants. Where participants did not respond to a given question, site rating and frequency of site visitation were assumed to be medium. Figure 6.5 shows the structure of the measures of site importance sub-model and Table 6.7 contains definitions of each element.

Table 6.7: Measures of site importance

Factor	Definition	No. of sites	No. of participants
Site Rating	Low, medium or high rating as standardised for each participant.	Most	All
Frequency of visitation	Low, medium or high frequency as standardised for each participant.	Most	All

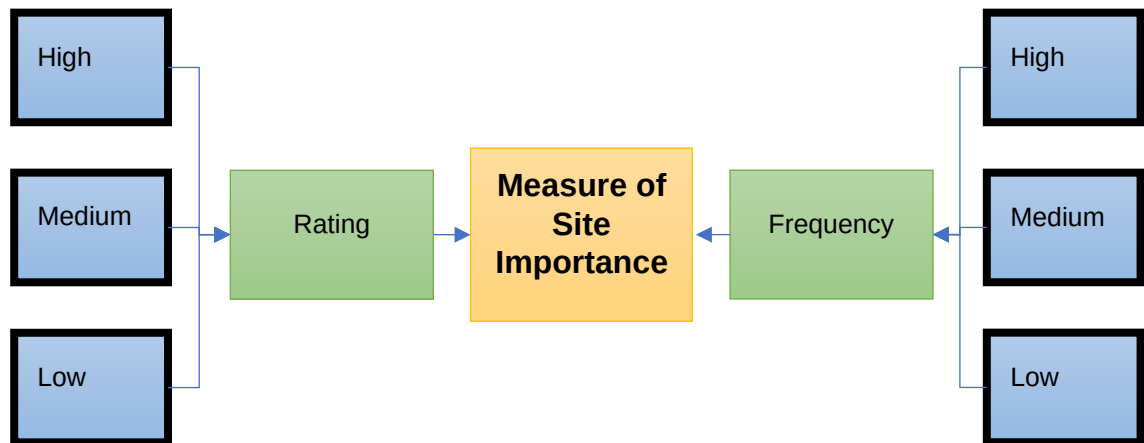


Figure 6.5: The measures of site importance sub-model. Use of a maximum operator to combine factors is indicated by a bold border.

6.2.2.2 Factor modelling and directional buffering

In this study, I used qualitative analysis of contextual information from interview transcripts to ground factor modelling in participants’ responses to interview questions. I also drew on Python, a programming language, to reduce the likelihood of human error during analysis. This increased the efficiency and replicability of modelling and ultimately lent considerable flexibility to the analytical process (Zandbergen, 2014).

In factor modelling, I used fuzzy logic to build a spatial representation of individual Yawuru values or factors which reflects the holism, continuity and connectedness of the Yawuru living cultural landscape (Yawuru RNTBC, 2013:117). Here, locations closer to sources which participants identified as being related to a given factor were considered ‘more’ highly valued (i.e. criterion value is closer to 1.0); while locations further away were considered less highly valued (i.e. criterion value is closer to 0.0).

Typically, when creating fuzzy buffers an analyst uses a mathematical function to represent the distribution of a phenomenon across space. They also select distances associated with the inner and outer bounds of these buffers as outlined in Figure 6.6. Here, I selected function type based on previous research modelling hunting accessibility with Yawuru people (Gardner, 2014) and used a cubed-then-inverted function to represent the decay of values over space. This function kept high values for an extended distance before rapidly dropping off at the outer edges of the buffer. To further reduce the need for data elicitation and ground the modelling in context, I then derived distance parameters from the descriptive coding of interview transcripts. Specifically, I collated interview quotations describing movements associated with valued practices in NVivo software and analysed them to extract distances and capture the activity spaces associated with

those practices. This analysis revealed a need to incorporate directionality into the fuzzy modelling of foreshore related practices.

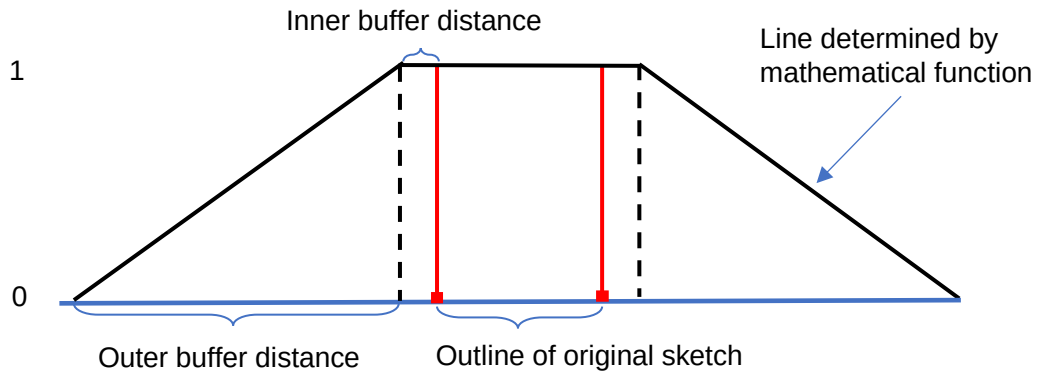


Figure 6.6: Components of an analyst-driven membership function.

To elaborate, Yawuru people actively adapt to the shifting nature of their foreshore environment. Broome has a 10m tidal range at certain times of year (Kimberley Ports Authority, 2017). From a Yawuru perspective, “the boundary of Nagula [sea country] is fluid, constantly moving with the tides, from low to high from neaps to springs” (Yawuru RNTBC, 2013:158). Approximately 45% of the Roebuck Bay area is exposed at low tide (Bennelongia, 2009:32). Consequently, Yawuru people will spend hours, or even days, waiting for the right tide to perform an activity (Sullivan, 2014). Additionally, different activities involve different uses of space which should be captured in the analytical models. As an example, qualitative evidence from the interview transcripts demonstrated that, when shelling, Yawuru people travel out large distances away from the shore on very low tides in their search for shells. Similarly, interview transcripts highlighted how, when hunting stingray, Yawuru people search for clear water and minimal changes in tide as they walk extended distances up and down the shoreline (Table 6.8).

Typically, as in Potter *et al.* (2016) and Gardner (2014), fuzzy index models do not incorporate directionality. Instead, they rely on buffers which are direction independent or isotropic in nature. These buffers extend equally in all directions. As outlined in Figure 6.7, direction independent buffers risk failing to adequately represent valued areas associated with movement perpendicular or parallel to the foreshore. They often did not capture Broome’s tidal range or activity-specific characteristics. Given this, I began to search for a direction dependent buffering process, that is an anisotropic buffering process, to use in this research.

The concept of directionality has been well explored by geographers in several fields. For instance, Mu (2008) demonstrated how directionality and directional buffers could be incorporated into emergency management scenarios by using relative distance based on

Table 6.8: Qualitative evidence for the directionality of some resource collection practices

Value (factor)	Use of space associated with activity value	Sample Qualitative evidence	Directionality
Hunting stingray	Extended movement up and down the shoreline. Performed on small tides.	<i>“But yeah, if I were to draw for stingray... Yeah, this whole beach.” Johnathon Pearson</i> <i>“That’s for, like, stingrays and birndany and um, um, janga. And that’s when we go all along here now. This side.” Judy Edgar</i> <i>“And the hot time, before I used to get dropped off here and walk to here. Wait ‘til, tell my family to wait for me here, like I’d walk with the boys, same time. Teaching. Look and learn off what I’m doing, remember which places that we are picking up all these stingrays, or whatever. Get them to wait me here. That way we’d walk with water. And whatever we catch, got in between, chuck it on the vehicle. Tell them to drive to this spot. Here. And then we’d walk there. Same thing, and then same thing again, over there.” Mr Gregory</i> <i>“Just walk it. Like we walk and through the day it’s probably knee-deep if it’s clear, visibility. And, um, that’s during the day, but also, we go at night. So, um... But it’s only that deep because the sharks bring them into the shallows and you’ve just got to watch out for crocodiles.” Mark Parriman</i>	Yes
Shelling – General	Conducted at low tide scouring a large area.	<i>“In general, you’re always looking around for other species and depending on where the reef or how far the tide is out. But other species that you can get are the, um, what we refer to as bunyman and lee shells. So, it’s like a mussel and a small baby pearl shell. Well, I think once you’re foraging it’s just... You come across bunyman and lee. You are always keeping an eye out for those species too. So, it’s quite broad. You are looking quite broadly.” Dean Mathews</i> <i>“We go down there if we’re shelling or look for bait, things like that. Big tide, low tide. Go out, you know.” June Cattermole</i>	Yes

percentages to construct shape-based buffers from generator points and pre-determined constrained convex polygons. Some researchers have also incorporated directionality into interpolation and kriging. In their evaluation of commonly used methods for interpolating river bathymetry, Merwade, Maidment and Goff (2006) found that anisotropic methods for interpolating point data performed significantly better than isotropic interpolation methods in a flow-oriented coordinate system. That is, methods which exhibit directional dependence were

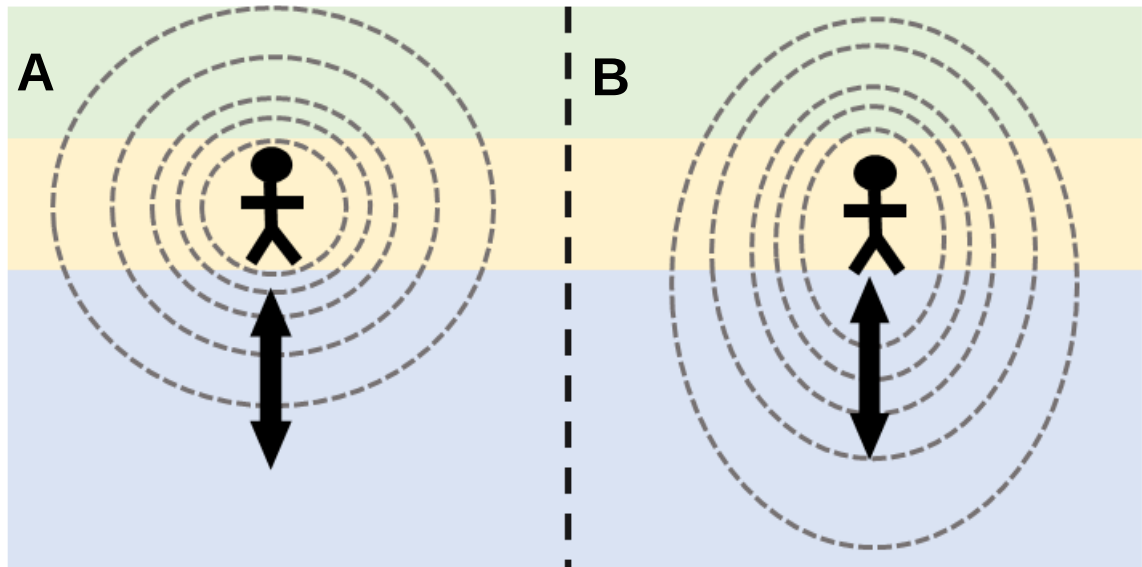


Figure 6.7: Figure A depicts the problems with using isotropic or direction independent buffering to capture directional activities such as moving in and out along the foreshore. Isotropic buffers extend into dune vegetation (green) and along the beach (yellow), but do not capture the dominant movement indicated by the double-headed arrow. Figure B shows how the directionality of movement is captured in an anisotropic (directional) buffering approach.

better suited to modelling river bathymetry than those which did not take direction into account. They accounted for this finding by producing an elliptical inverse distance weighting technique to provide a simple and computationally faster alternative to complex kriging methods which relied on geostatistics. Later, when Friedland *et al.* (2017:207) used isotropic and anisotropic kriging to estimate wind surfaces, they found that “anisotropic kriging is well-suited for interpolating wind speeds in meso- and macro- scale areas”.

Boisvert, Manchuk and Deutsch (2009) have also presented an algorithm that incorporates locally varying anisotropy in geostatistical modelling. This technique incorporates spatially varying range and direction parameters and gives a more accurate measure of the covariance or spatial dependence between points. Specifically, this technique optimises the path between two points in the presence of a locally varying anisotropy field to derive the maximum obtainable covariance which is then fed into kriging simulation. This helps to reproduce non-linear and geologically realistic features and means that kriging does not need to rely on straight-line distances for maximum covariance.

Nonetheless, to my knowledge, little guidance was available for a direction dependent approach to fuzzy buffering of a relatively small number of polygons such as those collected in sketch mapping exercises. Consequently, I set out to establish a values-based fuzzy directional buffering process which could be conducted using only information collected and processed from the sketch mapping interviews.

A grounded directional buffering approach suited to the descriptions provided by participants in this research needed to produce fuzzy buffers which were anisotropic relative to the shoreline. It also needed to facilitate exaggerated distances in at least one (dominant) direction and incorporate some level of movement in a non-dominant direction. Additionally, to retain the flexibility of the underlying spatial database, this technique had to facilitate the buffering of individual sites.

In this study, I approximated the shoreline using the Australian Bureau of Statistics' Australian Standard Geographical Classification Digital Boundaries for Australian States and Territories in 2011 (Australian Bureau of Statistics, 2016a). Using ArcMap 10.3 I clipped this approximation of the coast, converted it to a line, and simplified it to capture the dominant coastal orientation for the local area. Following simplification, no vertex was more than 1000m from its original location. This prevented large polygons depicting sites from being affected by very small features including very small coves which might not impact on Yawuru participants' use of that space. I then split the line, so each segment covered the area from one vertex to the next. I added the x-y coordinates of these vertices to the coastal feature's attributes and calculated the angle between the first and second vertex. I used this angle as a proxy for the dominate shoreline direction in the local area in directional modelling. Next, I used near analysis to calculate which shoreline segment was closest to the centroid of each shape drawn by participants. Then, I used an attribute join to add information on the angle of that segment to the vector-based database which captured participants' sketches.

Next, I used contextual qualitative information from interview transcripts to approximate the movement associated with a foreshore-based practice relative to the shoreline. First, I identified each practice as either directional or non-directional (Appendix 6B). Then, I used the qualitative information contained in Table 6.9 to estimate total movement and movement relative to the shoreline. Table 6.10 summarises information for practices where movement was parallel to the shoreline while Table 6.11 contains the distances used for practices conducted perpendicular to the shoreline. With this information I could create a copy of the original polygon and, if directional buffering was required, displace it such that it accounted for dominant movement either along (parallel to) the shoreline or out and back from (perpendicular to) the shoreline.

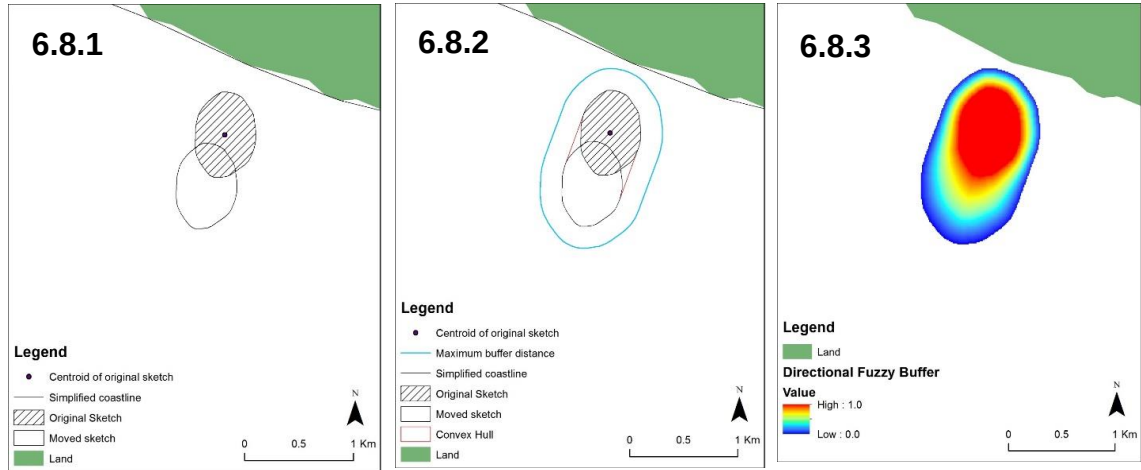


Figure 6.8: Uni-directional buffering process. The left image shows the process of copying and displacing the original sketch. The centre image shows the convex hull built around both sketches and the maximum buffer distance derived from that convex hull. The right image shows the constructed directional buffer.

For those practices where I determined movement to be perpendicular to the shoreline, I employed the displacement techniques outlined in Figure 6.8.1. I created a single copy of the and calculated a displaced centroid using Equation 1 where x is the new x -coordinate, y is the new y -coordinate, d is the displacement in metres identified through qualitative coding, and P is the angle perpendicular to the nearest coastal segment.

$$\text{Equation 1: } ([x = d \cdot \cos(P)], [y = d \cdot \sin(P)])$$

Following displacement, I generated a convex hull which enveloped both the moved and the original polygons to form the core of the outer boundary of the fuzzy buffer. Then, I created an additional Boolean buffer, which could be used to account for minimal non-directional movement associated with the practice, around the convex hull and converted it to a line using ArcGIS's polygon to line tool producing the line "maximum buffer distance" in Figure 6.8.2. The relative width of this buffer varied by practice in line with the qualitatively determined distances contained in the last columns of Table 6.10 and Table 6.11. I then calculated Euclidean distance from the feature representing maximum buffer distance, and from the original polygon.

From this point, I used a cubed then inverted function to create anisotropic fuzzy buffers which stretched the membership function between the original or "core" shape and its outer

Table 6.9: Summarised information on the directionality of practices

Value type	Value	Use of space associated with value	Description of site use associated with practice			
			Directionality	Dominant direction relative to the shoreline	Relative directional movement	Relative non-directional movement
Resource collection	Bait	Associated with large low tides and extended movement searching for bait.	Yes	Perpendicular	Large	Large
	Crabbing	Generally performed at low tide. Also associated with movement along the shoreline.	Yes	Perpendicular	Large	Large
	Fishing (boat)	Large movements associated with mode of transportation. Fishing is conducted close to the shore with minimal impact from tides.	No	None	None	Moderate
	Fishing (drag-net)	Associated with large low tides. Includes a large range of movement.	Yes	Perpendicular	Moderate	Large
	Fishing (line)	Associated with movement out and back from the shoreline on small to moderate tides.	Yes	Perpendicular	Small - Moderate	Small
	Fishing (spear)	Associated with extended movement up and down the shoreline in knee deep water.	Yes	Parallel	Moderate	Large
	Fishing (net)	Conducted while walking along the shoreline. Often performed at low tide.	Yes	Parallel	Moderate	Small
	Gathering Plants	Typically conducted close to a track often on the way to another practice.	No	None	None	Small
	Collecting Turtle Eggs	Associated with movement up and down the sand-dunes scouring for turtle eggs.	Yes	Parallel	Moderate	Small
	Hunting Dugong	Associated with a large range of movement. Progresses from shallow to deeper water.	Yes	Perpendicular	Moderate	Large

Table 6.10: Distances associated with valued practices conducted parallel to the shoreline derived from contextual information contained in interview transcripts.

Directional practice	Use of space associated with practice	Directional element		Buffer element	
		Movement parallel to the shore	Displacement (m)	General (Non-directional) movement	Buffer (m)
Fishing (spear)	Associated with extended movement up and down the shoreline in knee deep water.	Moderate	200	Large	500
Fishing (net)	Conducted while walking along the shoreline. Often performed at low tide.	Moderate	200	Small	200
Collecting Turtle Eggs	Associated with movement up and down the sand-dunes scouring for turtle eggs. Constrained to certain prolific areas.	Moderate	200	Small	200
Hunting Stingray	Extended movement up and down the shoreline. Performed on small tides.	Moderate	200	Large	500

boundary using Equation 2. There, V_i is the value assigned to pixels, D_1 is the distance outward from the original sketch and D_2 is distance inward from the maximum buffer distance.

$$\text{Equation 2: } V_i = 1 - \left(\frac{D_1}{D_1 + D_2} \right)^3$$

I then clipped the products of Equation 2 to the extent of the fuzzy buffer. I also created a raster which converted the maximum buffer polygon to a value of 1 and set all other cell values within the raster to 0. I multiplied this by the fuzzy buffer to produce the output in Figure 6.8.3.

When buffering practices with movement parallel to the shoreline I followed similar methods to those described above. Here, I made two copies of the original shapefile, then displaced the first using Equation 3 and the second using Equation 4, where x is the new x-coordinate, y is the new y-coordinate, d is the displacement in metres, and A is the angle parallel to the coastal segment closest to the shape's centroid as outlined in Figure 6.9. Again, this directional buffering relied on a Boolean buffer to account for non-directional movement. I then employed a cubed-then-inverted equation to create the fuzzy outputs and clipped these outputs to the maximum buffer polygon.

$$\text{Equation 3: } ([x = d * \cos(A)], [y = d * \sin(A)])$$

$$\text{Equation 4: } ([x = -d * \cos(A)], [y = -d * \sin(A)])$$

Table 6.11: Distances associated with valued practices conducted perpendicular to the shoreline derived from contextual information contained in interview transcripts.

Valued directional practice	Use of space associated with practice	Directional element		Buffer element	
		Movement perpendicular to the shore	Displacement (m)	General (Non-directional) movement	Buffer (m)
Bait	Associated with large low tides and extended movement searching for bait.	Large	500	Large	500
Crabbing	Generally performed at low tide. Also associated with movement along the shoreline.	Large	500	Large	500
Fishing (drag-net)	Associated with low tides. Includes a large range of movement.	Moderate	250	Large	500
Fishing (line)	Associated with movement out and back from the shoreline on small to moderate tides.	Small - Moderate	200	Small	200
Hunting Dugong	Associated with a large range of movement. Progresses from shallow to deeper water.	Moderate	250	Large	500
Hunting Turtle	Associated with a large range of movement. Progresses from shallow to deeper water.	Moderate	250	Large	500
Shelling	Conducted at low tide scouring a large area.	Large	500	Large	500
Oystering	Conducted at very low tides scouring large areas for the rocks.	Large	500	Large	500

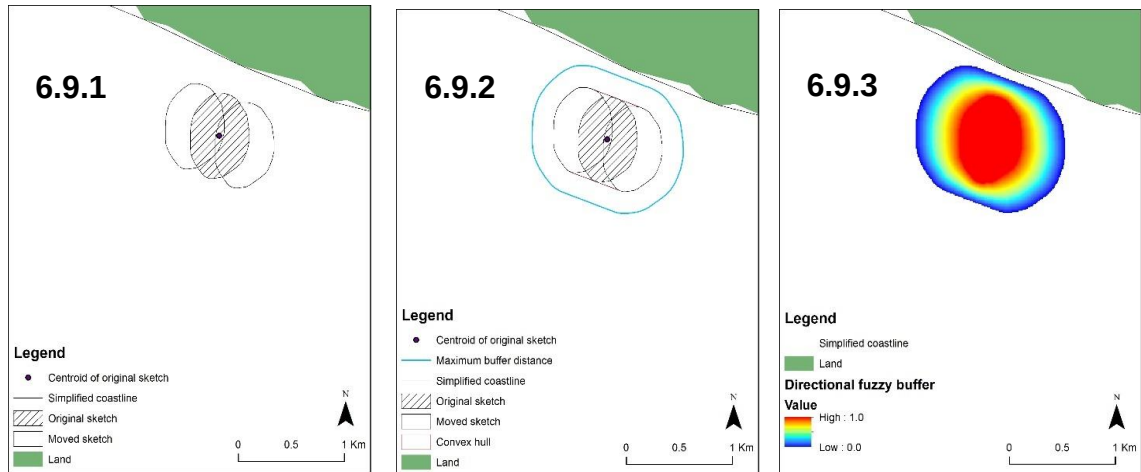


Figure 6.9: Bi-directional buffering process.

Not all practices recorded during interviews were directional in nature. Plants were typically gathered on all sides of an access route. Hunting on land also happened in many directions. Additionally, none of the relationship or non-practice-based values (factors) represented in this thesis were clearly directional in nature. In these cases, I constructed isotropic buffers using a semantic import process (Gardner, 2014). Distances for the movements associated with non-directional practices varied as outlined in Table 6.12. For relationships, I drew on distances

Table 6.12: Buffer distances associated with non-directional valued practices.

Valued non-directional practice	Use of space associated with practice	Buffer element		
		Non-directional movement	Inner buffer (m)	Outer buffer (m)
Hunting – land	Extended range of movement from access track.	Large	0	500
Collecting plant material	Typically conducted close to a track often on the way to another activity.	Small	10	50
Collecting plant material off tracks	<i>“You are looking at these tracks, you know. And then sort of working off them with a 10 to 20 m off”</i> . Dean Mathews	Very small	5	20
Fishing - boat	Large movements associated with mode of transportation. Fishing is conducted close to the shore with minimal impact from tides.	Large	0	500
Camping	Largely stationary practice. Surrounding area required for privacy and tranquillity. *	Moderate	0	200
Cooking	Largely stationary practice. Surrounding area required for safety. **	Moderate	0	150
* Participants noted that the sense of peace and tranquillity that they got from camping was central to the practice’s benefits. ** Participants observed that without adequate space around fires, there was a risk that nearby vegetation could catch, presenting a risk to property.				

established in our previous work (Potter *et al.*, 2016) and employed knowledge of the nature of the study site as outlined in Table 6.13. Again, this buffering was performed at the individual site level. Following Gardner (2014), this non-directional buffering also employed a cubed-then-inverted function as part of the index modelling process.

Table 6.13: Distances associated with relationship (i.e. non-practice based) values at the study sites

Non-Directional value	Space associated with value	Inner buffer (m)	Outer buffer (m)
Family	Site-based. Typically associated with stationary practices.	0	150
Heritage	Site-based.	0	150
Home	Site-based.	0	150
Memories	Site-based.	0	150
Other	Unspecified.	0	150
Jetty	Site-based. Limited to jetty.	0	150

6.2.2.2.1 Measures of site importance

It was more complex to spatially capture measures of site importance than other factors in the values model. Ultimately, I used a maximum operator to combine all fuzzy index models produced for a site or sketch. So, if an individual valued Site A for crabbing, fishing (line), and cooking, I combined the fuzzy buffers which had been constructed for those practices at Site A using a maximum operator. This meant each pixel recorded the maximum value a participant held for *any* practice related to that site. I then multiplied each buffered site by a weight which reflected its rating or measure of site visitation as outlined in Table 6.14.

Table 6.14: Factor weights used for measures of site importance

Rating/ Frequency	Weight	Factor justification
Low	0.6	Even sites which participants deemed to be of low importance were still significant enough to be specifically identified during sketch mapping interviews. A measure of 0.6 reflects this importance.
Medium	0.8	0.8 is the mean of the low and high weights.
High	1.0	Sites which participants described as having a high rating or rate of visitation were given a weight of 1.0, that is, their weight was unchanged.

6.2.2.2.2 Factor model collation

Following the fuzzy buffering process each buffered site was collated into individual factors. First, I collated sites for an individual factor (e.g. crabbing) for each participant using a maximum operator. This produced a crabbing (Participant X) raster which captured the highest value Participant X held for Crabbing at all locations across the study site. Next, I collated individual participants' models for factors such as crabbing to produce a collective model. Here, I used a mean operator to combine the raster produced for any participant who recorded that factor in their

interview. Once combined, I standardised each factor map such that values ranged from 0.0 to 1.0, where 0.0 indicated non-membership of that value and 1.0 indicated complete membership of that value as captured through sketch mapping and fuzzy index modelling in this study. At this point, I incorporated the standardised factor maps into further combinatory analyses to create both the sub-models and the synthesised values model produced in this study.

6.2.2.3 Combinatory analyses

Combinatory analyses, a form of analytical overlay, are often vital to multi-criteria evaluations. These analyses are used to aggregate groups of related criteria and are commonly applied in both suitability and vulnerability analyses (Carver, 1991; Geneletti, 2010; Gorsevski *et al.*, 2012; Joerin *et al.*, 2001; Moeinaddini *et al.*, 2010; Wang *et al.*, 2009). Aggregation, applied through hierarchical or non-hierarchical processes, helps researchers to identify relationships between data and is one of the most powerful elements of spatial analysis (Longley *et al.*, 2011).

In this study, I used a hierarchical series of combinatory analyses to create the sub-models and the synthesised values model. These analyses were intended to reflect the views of Yawuru participants, make use of available information and be combined in a way which maximized the utility of the model outputs.

Many techniques have been established for cartographic modelling and model aggregation (Malczewski, 2000, 2006). One of the techniques most commonly applied in this area is weighted linear combination (Carver, 1991; Greene *et al.*, 2011; Mahini and Gholamalifard, 2006; Malczewski, 2000). Weighted linear combination is a compensatory technique. It takes the weighted intersection between criteria and allows trade-off or compensation among them (Eastman, 2009). Under weighted linear combination, the more values held for an area and the greater the weight placed on those values, the higher the value of the model output for that area (Riabacke *et al.*, 2012). A second major combinatory procedure involves the use of Boolean operators, as was employed in collating the factor models. With these operators, analysts take either the maximum, minimum, or mean value of several factors for each individual (Greene *et al.*, 2011). A maximum operator, for example, assumes that the synthesised value of a pixel is equivalent to the highest individual value for that pixel. A minimum operator assumes the inverse. In this study, I used both weighted linear combinations and maximum operators in the final values model, as is outlined in Figure 6.10.

Once values have been standardised as they were in the factor models, an operator is selected to represent relative levels of compensation or non-compensation among included criteria. Then, weights are assigned to each factor in the aggregation (Malczewski, 2000). Higher weights (i.e. weights closer to 1.0) emphasise relatively more important factors in model outputs. Lower

weights (i.e. weights closer to 0.0) decrease the emphasis placed on given factors. Constraints on weight-selection are operator dependent. In weighted linear combination, the total of all weights must sum to 1.0 (Malczewski, 2000). In Boolean analyses, no constraints are placed on the sum of all weights. However, assuming all inputs are on a standardised scale, and that outputs should also fall within this range, the maximum weight which can be assigned to any input is 1.0.

Typically, one of two approaches are used to assign factor weights. In the first approach, the analyst uses their personal judgement to select combinatory procedures and allocate model weights (Malczewski, 2000). Here, the analyst is expected to account not only for the relative importance of each factor, but also for the range of values which feed into that factor.

In the second approach, participants or experts are asked questions designed to elicit factor weights (Bottomley *et al.*, 2000; Gorsevski *et al.*, 2012; Riabacke *et al.*, 2012; Scaife, 2006). The number and type of these questions vary by elicitation process. Sometimes, participants are asked to assign numeric values to factors through direct rating or point allocation (Bottomley *et al.*, 2000; Pöyhönen and Hämäläinen, 2001). Here, participants are usually expected to respond to at least N questions, where N is the number of factors or criteria to be weighted. Other weighting techniques require even more questions. For example, a review of ten weighting techniques by Riabacke, Danielson and Ekenberg (2012), found that techniques like Analytical Hierarchy Process which have semantic extraction input and a consistency check, require a minimum of $N.(N-1)$ judgments from participants. Such techniques avoid making participants apply weights directly and can facilitate careful trade-off between factors. Nonetheless, “practical techniques for elicitation are to a great extent a matter of balancing the obtained quality of elicitation with the time available and cognitive effort demand on the users for extracting all the required information” (Riabacke *et al.*, 2012:20).

The number and type of questions used to elicit weights from participants is sensitive in an Indigenous context. Weight elicitation is time-consuming (Riabacke *et al.*, 2012). It is also cognitively demanding: Moore *et al.* (2016) found that subject matter experts may hesitate when asked to place a number on the relative importance of different factors to plant growth. Finally, the pilot study for this research demonstrated that direct weight elicitation places significant cultural pressure on participants who seek to map values in a post native title context (Potter *et al.*, 2016).

In this research, neither an analyst driven approach to weight selection nor direct elicitation was appropriate for the second and third phases of aggregation. Direct elicitation was not feasible due to the demonstrated sensitivity of eliciting weights from a relatively small number of Yawuru participants (see Potter *et al.*, 2016) and the large number of factors in the values model. Analyst driven weighting was also untenable: it would violate the principle of the research design which

focused on embracing subjectivity and producing a context-grounded outcome from the research. I am non-Yawuru and non-Indigenous. My knowledge alone could not guarantee a contextually informed modelling process. Instead, as outlined below, I used qualitative analyses to address these issues and weight many factors, including those related to resource collection.

During sketch mapping interviews, participants placed value on 15 distinct factors linked to resource collection, and one collective factor (combined fishing practices). These factors included practices such as fishing with a handline which were low cost, egalitarian and used to engage community members of all ages in resource collection. They also included practices such as hunting turtle or dugong which were expensive, gendered and only conducted by a few Yawuru people or families. Using the freedom of semi-structured interview questions, participants often spatially defined valued practices and described the process of resource collection. Frequently, this included a discussion of the personal and cultural significance of these practices. At times, it also addressed perceived risks related to them. Such descriptions ultimately provided the rich body of contextual information used to weight individual factors within the practices model.

Table 6.15: Initial weights derived using qualitative weights for factors in the fishing sub-model.

Factor	Number of qualitative references	Total references (%)	Total words coded as fishing values (%)	Initial Weight (%)
Fishing (line)	119	53.60	62.23	57.92
Fishing (boat)	30	13.51	11.72	12.62
Fishing (net)	24	10.81	13.46	12.14
Fishing (drag-net)	30	13.51	6.72	10.12
Fishing (spear)	19	8.56	5.86	7.21

The qualitative weighting of resource collection factors was a multi-step process. First, I used NVivo software to descriptively code interview transcripts into the 16 factors identified in the resource-based practices sub-model. Each time a participant referred to a valued practice, I added all complete sentences referring to or discussing that practice to the relevant code. I then used two matrix coding queries to determine the initial weights allocated to these valued practices.

Table 6.16: Initial weights derived using qualitative weights for factors in the resource collection-based practices sub-model.

Factor	Number of qualitative references	Total References (%)	Total words coded as resource values (%)	Initial Weight (%)
Fishing (all)	506	43.62	44.20	43.91
Shelling	138	11.90	12.16	12.03
Oystering	50	4.31	4.68	4.50
Bait	90	7.76	5.74	6.75
Crabbing	122	10.52	7.84	9.18
Turtle Eggs	14	1.21	1.21	1.21
Hunting Turtle	53	4.57	4.75	4.66
Hunting Dugong	33	2.84	2.99	2.92
Hunting Stingray	103	8.88	7.79	8.33
Hunting (land)	12	1.03	1.33	1.18
Plants	39	3.36	7.31	5.34

I relied on two assumptions in the first stage of selecting qualitative weights. First, I assumed that the importance of a valued practice was positively related to the number of references a participant made to that practice. Thus, a valued practice discussed many times throughout the interview was assumed to be more important to the participant than a valued practice which was mentioned only once or twice. Second, I assumed that time spent discussing a practice was positively related to its importance. I measured this as the relative number of words participants spent discussing each practice included in the values model. I used matrix coding queries to measure both the relative number of references to each practice in the values model and the relative length of time (represented by word count) spent discussing each practice. I then generated base weights for a practice by taking the mean percentage value of these queries. Table 6.15 shows the base weights derived for factors in the fishing sub-model. Table 6.16 shows these weights for all other resource collection factors.

The weighting process described above did not rely solely on either my judgement as a researcher or on direct elicitation. However, it also did not account for the gendered nature of some activities practiced by Yawuru people or capture the cultural significance of certain practices. This process is likely to capture the relative value of practices such as hunting stingray or catching fish. Such practices are performed reasonably frequently. They have low cost thresholds and play an important role in the education of young Yawuru people. However, hunting turtle and dugong are high cost, low-frequency practices, often linked to important occasions, including funerals.

These practices assert native title rights and target species otherwise protected by environmental legislation. They are clearly important to Yawuru people and most often performed

by individuals who then fulfil their cultural obligations through the sharing of catch. Given the relatively low number of Yawuru people who participate in these practices, the importance of hunting turtle and dugong is not fully captured by the first round of qualitative weighting.

I used a second round of qualitative coding to refine selected weights and combinatory operators so that they reflected and drew further on participants' descriptions of these practices in interviews. I thematically coded the interview transcripts to generate a series of quotations which described each practice's frequency, yield, consistency (in terms of yield), cost, cultural significance and relative environmental impact. I then summarised this contextual evidence, which can be found in Appendix 6C, into two tables designed to influence the factor weights for the fishing sub-model and the resource collection-based practices sub-model. Table 6.17 shows the summary for fishing, while Table 6.18 shows the summary for the remaining resource collection models.

Table 6.17: Summary of qualitative information on fishing used to adjust model weights.

Factor	Frequency	Yield	Consistency	Cultural significance	Entry cost	Relative Environmental risk
Fishing (line)	Very High	Moderate	Moderate ^a	High	Low	Low
Fishing (boat)	Moderate-High	Moderate – High	Moderate	Low – Moderate ^b	Moderate	Moderate
Fishing (net)	——=	Moderate - High	——=	Moderate	Low-Moderate	Moderate
Fishing (drag-net)	Low	High	——=	High	Moderate	Moderate- High ^c
Fishing (spear)	Moderate	Low - Moderate	Moderate	Moderate – High	Low	Low
——Denotes insufficient evidence presented in interviews a) One participant remarked that when you are fishing with a line “some days you do, some days you don’t (catch anything with a line)” b) Fishing with a boat has low-moderate significance because the technique is not as traditional as onshore fishing with a line or spear. c) The risks from this practice are moderate-high if poorly managed. They reduce with appropriate management.						

For the fishing sub-model, I used contextual information to reduce the emphasis on line fishing from 57.92% to 50%. I then distributed weights across the remaining fishing practices as outlined in Table 6.19. For the synthesised resource collection model, I used qualitative information from analysis of the sketch mapping interviews to reduce emphasis on fishing and boost the relative importance of other high frequency resource collection practices such as shelling, oystering and crabbing. Here, the 40% weight allocated to fishing was still 2.86 times higher than the second highest practice, shelling, at 14% (Table 6.20).

Table 6.18: Summary of qualitative information on resource collection-based practices used to adjust model weights.

Factor	Frequency	Yield	Consistency	Cultural significance	Entry cost	Relative Environmental risk
Bait	High	High	Moderate	High	Low	Low
Crab	Moderate	Moderate	High	——	Low	Low-Moderate
Turtle	Low	High ^a	Low	Very High	High	Moderate - High
Dugong	Low	High ^a	Low	Very High	High	Moderate - High
Hunting (land)	Low	——	——	——	——	——
Stingray	Moderate ^b	Moderate	Moderate	Moderate - High	Low	Low ^c
Shelling	Moderate	Moderate	High	——	Low	Low- Moderate
Oysters	Moderate	High	High	——	Low	Low- Moderate
Turtle eggs	Low	Moderate	High	Moderate	Low	Moderate
Plant materials	Moderate ^b	High	High ^d	High	Low	Low ^d
Fishing ^e	High	Moderate	Moderate	High	Low	Low- Moderate
—— Denotes insufficient evidence presented in interviews; a) Denotes yield if successful. b) Frequency is high, but in a limited season. c) Environmental risk was not explicitly discussed by participants. However, the length of time spent discussing the practice and discussion of over exploitation in other areas indicates that participants were wary of over-exploiting this species. d) Consistency is beginning to be reduced or threatened by commercial harvest of gubinge in the area. e) All fishing risks are dependent on the exact technique employed in the practice.						

Table 6.19: Weights applied to factors in the fishing sub-model.

Factor	Initial weight (%)	Qualitative Adjustment	Qualitatively adjusted weights (%)
Fishing (line)	57.92	- 7.92	50 ^a
Fishing (boat)	12.62	+ 2.38	15 ^b
Fishing (net)	12.14	+ 1.86	14 ^c
Fishing (drag-net)	10.12	+ 1.88	12 ^c
Fishing (spear)	7.21	+ 1.79	9 ^c
a) Adjusted down. b) Rounded up to the nearest number + 2% to account for the volume of catch the practice provides and the low environmental risk it represents when performed culturally. c) Rounded up to the nearest whole number and +1% to account for increased importance relative to fishing with a handline.			

Table 6.20: Weights applied to factors in the resource collection-based practices sub-model.

Factor	Initial weight (%)	Qualitative adjustment	Qualitatively adjusted weights (%)
Fishing (all)	43.91	- 3.91%	40 ^a
Shelling	12.03	+ 1.97%	14 ^b
Oystering	4.50	+ 2.50 %	7 ^c
Bait	6.75	+ 2.25%	9 ^d
Crabbing	9.18	+ 2.32%	11.5 ^d
Turtle Eggs	1.21	Maximum operator	0.5 ^e
Hunting Turtle	4.66	Maximum operator	0.6 ^e
Hunting Dugong	2.92	Maximum operator	0.6 ^e
Hunting Stingray	8.33	+ 2.67%	11 ^f
Hunting (land)	1.18	Maximum operator	0.3 ^e
Plants	5.34	+ 2.16%	7.5 ^d

a) Reduced to reflect relative value of other practices.
 b) Rounded down to the nearest 0.5.
 c) Rounded up 0.5.
 d) Rounded up to the nearest 0.5.
 e) Maximum operator used to reflect the cultural significance of these values identified in Table 6.19
 f) rounded up to the nearest 1. All rounded values then had the remaining percentages from fishing, turtle eggs, hunting turtle, hunting dugong, and hunting on land.

The contextual information in Appendix 6C also helped justify maximum operators and higher weights for practices which were highly significant but conducted with low frequency (hunting dugong, hunting turtle, and collecting turtle eggs). Similarly, I used this information to select a maximum operator and low weights for sites with land-based hunting that is rarely spatially coincident with other resource collection practices. Where I used a maximum operator in modelling, I did so after weighted linear combination and standardisation as outlined in Figure 6.10.

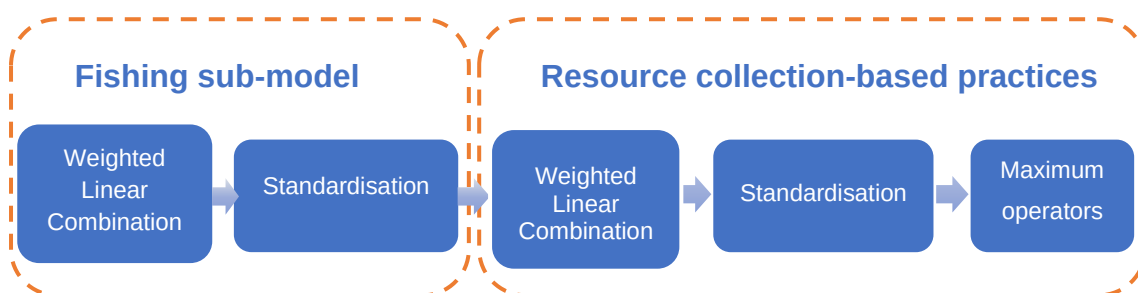


Figure 6.10: The resource-collection model weighting process.

For camping and cooking, the two non-resource-based practices included in the model, I used a similar qualitative analysis to that described earlier. While more references and time were spent discussing cooking or picnicking than camping (60% versus 40% and 66% versus 34%), closer inspection of the qualitative information collected for each of these practices revealed that

many participants felt that both camping and the process of building a fire and cooking catch were integral to their well-being. I ultimately weighted these factors equally in the non-resource-based practices model (Table 6.21).

Table 6.21: Weights applied to factors in the non-resource collection-based practices sub-model.

Factor	Number of qualitative references	Total References (%)	Total words coded as fishing values (%)	Average	Qualitative Adjustment	Qualitatively adjusted weights (%)
Camping	24	40	34	0.37	Equal weight	0.5*
Cooking	36	60	66	0.63	Equal Weight	0.5*
* Length of time discussing the practices here is not inherently representative of importance. Factors were given equal weight due to relative length of time spent on Country associated with each practice and the longer-term impact on well-being participants described from camping.						

Following initial aggregation, I standardised the combined collective models for resource-based and non-resource-based practices to range from 0.0-1.0 and then combined them into a synthesised practices model. Unlike for individual factors, relatively little direct information was gleaned from qualitative analysis which could guide this aggregation process. Given the relatively large number of resource-based practices observed here (n = 11), and the relatively lower number of non-resource-based practices (n = 2), I made the decision to give the former a weight of 0.8 and the latter a weight of 0.2 in the practices model. I then standardised the practices model to range from 0.0-1.0.

I combined eight individual factors in the relationships sub-model. These were grouped into factors related to special places; those linked to heritage; those which designated the “whole area” as perceived by the participant; and those related to views or considered unclassified. Again, I combined factors through weighted linear combinations and maximum operators and, where possible, used qualitative information from interview transcripts to guide operator and weight selection.

As discussed in Box 6.1 (p.140) participants often intertwined their descriptions of “family”, “memories” and “home” during interviews. Given this I began by using a maximum operator and equal weight of 1.0 to combine these elements into the “special places” sub-model. I also used a maximum operator and an equal weight of 1.0 to combine Broome Port linked Jetty values and old Broome-based Pearling Heritage values in the Heritage sub-model, given that these values were neither coincident in space nor time. Likewise, I used an equally weighted maximum operator to create the “other values” sub-model. Here, I combined areas valued for their views or considered to be aesthetically pleasing, with areas which were the subject of some other value not captured by the previous models, assuming that these factors were equally important.

When bringing the special places sub-model, the heritage sub-model, the other values sub-model, and the whole area indicators together in the final relationships sub-model, I used a weighted linear combination approach. Here, I prioritised special places and heritage in the weights and assumed they were equally important (Weight = 0.4). I also de-emphasised whole area indicators and other values and considered them to be of equal value (Weight = 0.1). Box 6.2 contains some quotations about the importance of special places and heritage used to justify this weighting approach.

Box 6.2: Quotations used to inform the weighting of special places and heritage in the relationships sub-model.

Example 1: Our lives are in those places

“So, there’s a lot of memories [...] That place is very special to me. [...] if they close that off, then they are closing off, like a part of our life, you know? Our lives are actually in these places.”
Rose Coffin

Example 2: I would put it highest for that

“Kennedy Hill was a beautiful Country. Lovely place. [...] A lot of people used to live there. A lot of Yawuru people and other people. [...] People can tell you now who was living there and how the place looked like. They have a lot of good memories of that place, so do I. I would put it the highest for that.” June Cattermole

Example 3: I think that’s where the real Broome is

“Old Jetty. That’s just somewhere where we grew up [...] from town to Old Jetty. That’s all pretty significant. [...] I think that’s where the real Broome is kind of thing, you know what I mean. [...] When you look at Broome that’s kind of where you think of. You know?” Holly Moore

Finally, as discussed in the section on factor selection, I combined both site rating and relative frequency of site visitation into the site-importance sub-model. Here, I considered just one of the two factors (i.e. high rating or high frequency) enough to increase the site’s importance and used a maximum operator to combine these factors into the site-importance sub-model.

The final values model was formed out of the practices sub-model, the relationships sub-model and the site importance sub-model. In this model, I considered each factor to be equally important and gave them a weight of 0.33.

6.2.3 Conclusion

My approach to modelling Yawuru values in this model illustrated how contextual information from sketch mapping interview transcripts could inform spatial analysis. It drew on principles developed in the research design to create a community-driven model which focussed on the respectful representation of Yawuru values and embraced subjectivity in the modelling process. The techniques and outputs developed in this approach became central to the analytical

modelling of concerns and the seasonal use of significant areas across Broome Town and Crab Creek.

6.3 Seasonal-use model

The second of three fuzzy index models I produced in this research focussed on capturing use of valued areas following the Yawuru seasonal calendar. Following the need for practical and technical tools outlined by the reference group and the need for a community-driven research process which created outputs that were relevant to Yawuru governance, this model drew extensively on context-driven modelling techniques established in the values model.

6.3.1 Rationale

As noted by the great Australian anthropologist W.E.H. Stanner, Indigenous peoples have intimate spatio-temporal knowledge of Country and often move across it “in tune with the seasonal food supply” (Stanner, 1979:33). This seasonal use model, which captured the seasonal use of areas significant to Yawuru participants, was primarily driven by Senior Yawuru man Patrick Dodson and other NBY staff. Yawuru have a strong interest in communicating the importance of their seasons. As an example, for a long time the Yawuru logo featured a simplified version of their season wheel. Moreover, the Yawuru Cultural Management Plan includes pictorial representations of movements traditionally associated with the Yawuru seasonal calendar (Yawuru RNTBC, 2013). However, as examined in Chapter 5, the images in the Yawuru Cultural Management Plan represent historical and idealised movements which may not align with current seasonal use patterns. Given this, Patrick Dodson and others saw potential value in a spatial model which represented the actual use of Yawuru areas.

The creation of a seasonal use model is also supported by information contained in several draft management plans. Specifically, both the Yawuru Nagulagun / Roebuck Bay Marine Park and the Yawuru Birragun Conservation Park joint management plans seek to raise awareness of Yawuru seasons among the broader community (DPAW, 2016a, 2016b). These plans aim to educate Yawuru and non-Yawuru alike to facilitate the seasonal and sustainable use of Country. While a model of valued and seasonally used areas is unlikely to capture all seasonally used areas within the study sites, it may prove to be an important step in this broader education agenda. Moreover, the seasonal use of Country is an important component of Yawuru identity (Yawuru RNTBC, 2013). Understanding how this use plays out across space is likely to offer useful insights for post native title governance.

6.3.2 Methods

In this study, I drew on techniques established in the values model to represent the seasonal use of valued sites. Unless otherwise stated, I drew all priorities and cultural parameters for this process from the relevant portion of the values modelling described in Section 6.2.

6.3.2.1 Factor selection and standardisation

Factors included in the final seasonal use model were pre-defined: spatial analyses needed to reflect the Yawuru seasons as requested by the reference group. At the reference group's request, however, participants were not specifically required to use the Yawuru seasonal calendar to temporally define their site use. This created a need to standardise diverse transcripts to facilitate the collation of participants' responses and support the production of analytically useful outputs.

The Yawuru seasonal calendar is ecological. Each season is associated with a variety of signs, such as wind patterns, temperature and the blooming of certain plants or the abundance of certain species. A season can be said to come "early" or "late", but each is linked to phenomena rather than a fixed date. During interviews, however, participants described when they visited areas using ecological, structural and qualitative measures of time. Often, when participants defined their site use ecologically, they used the Yawuru seasons, referenced the ecologically defined "wet" and "dry" seasons commonly recognised in northern Australia, or employed meteorological descriptors such as hot-time. At other times, participants' ecological definitions of site use referred to tides, or drew on the availability of certain species, or the blooming of plant-indicators such as flowering wattle. When participants defined site use structurally, they typically drew on the numeric and abstract months of the Gregorian calendar. Sometimes they did this directly by referring to specific months (e.g. June- July). Other times, they translated between ecologically defined seasons or indicators and calendar months (e.g. by defining "oyster season" as "October- November"). Finally, when participants defined site use qualitatively, they often drew on broad categories such as "all the time" and "always". To successfully model site use across the Yawuru seasons I had to convert these diverse responses to a single timescale.

In this study, I selected Gregorian months to standardise participants' responses for several reasons. First, as one of the smallest temporal units used by participants, Gregorian months had the potential to minimise loss to temporal resolution during the modelling process. Second, Gregorian months are listed alongside the names of seasons and seasonal indicators in the Yawuru seasonal calendar. They are also used to describe the timing of Broome's ecologically defined wet and dry seasons to people from temperate climes. This means that these months had potential as a *lingua franca* to support cross-cultural communication around ecologically defined seasons.

Third, several sources of evidence including interview transcripts, Yawuru management plans and Shire of Broome planning documents were available to support the conversion of participants' responses to Gregorian months. Fourth, information standardised to the Gregorian months could be used to combine the results of initial modelling into the Yawuru seasonal calendar and the tropical monsoonal calendar: two of the calendars most commonly applied to natural resource, tourism, and land management on Yawuru Country. Finally, and most importantly, Yawuru audiences recognize Gregorian months. Indeed, these months were actively used by participants to define their site use during sketch mapping interviews.

Even with the information contained in the sources of evidence listed above, the process of converting participants' responses to Gregorian months was complex and iterative. For example, there were discrepancies between some of the descriptions of Yawuru seasons provided by participants during sketch mapping interviews and the Yawuru seasonal calendar which appears in the Yawuru Cultural Management Plan. Where I noted such discrepancies, I drew on a participant's description of their site use over formal definitions in the spatial. Table 6.22 describes the processes applied in converting the diverse responses provided by participants.

6.3.2.2 Factor modelling

Defining the area used during a season both spatially and temporally was essential to generating the seasonal use model. Spatially, I assumed that total site use was captured by the models which captured maximum use associated with a site and were weighted to generate the ratings and frequencies factor models. Temporally, as outlined earlier, I deemed an area to be "used" or "not used" based on whether practices were recorded as being conducted at that site in a month of the Gregorian calendar.

I generated lists of all areas "used" in a month, then collated prepared areas for each participant using a maximum operator to capture the highest value a participant held for that area in a month. Given that all participants used at least one site in every month, I next used a mean operator to collate participants' monthly site use such that each participant had equal influence over that month. Following this, I standardised the seasonal use by dividing them by the maximum value held for any month ($n = 9.27839$, [maximum for April, May, June, and July]). Index models for the individual months represent the use of valued areas in that month relative to maximum use across all months.

Table 6.22: Seasonal conversions

Determinant	Primary descriptor	Number of references*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Yawuru seasons*</i>	Barrgana	36				x	x	x	x	x				
	Man-gala	4	x	x	x									x
	Laja	2										x	x	
	Wirlburu	4									x	x		
	Coming into Marrul	1	x	x	x									
<i>Wet/ Dry</i>	Dry season Dry times	1				x	x	x	x	x				
	Wet season	3	x	x										x
<i>Species</i>	Stingray season **, stingray time	11									x	x	x	
	<i>Walga-walga time, salmon time**</i>	8				x	x	x	x	x				
	Jelly-fish season	2				x	x	x	x	x				
	Turtle season	1*	-	-	-	-	-	-	-	-	-	-	-	-
	Oysters	5										x	x	
	When trees bloom											x	x	
<i>Weather Descriptor</i>	Hot-time, Hot season, warm	16								x*	x*	x	x	
	Cold- time,	18				x	x	x	x					
	South-easterly time	1				x	x	x						
	Hot time before the rains	1										x	x	
<i>Tides</i>	Big-tide, low tide,	7	*	*	*	*	*	*	*	*	*	*	*	*

Determinant	Primary descriptor	Number of references*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Indigenous (Non-Yawuru) Season</i>	Beagle Bay season	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Temperate seasons</i>	Summertime/ summer	8	x	x										x
	Wintertime	2				x	x	x	x	x				
<i>Months of the Julian calendar</i>	Months	14	*	*	*	*	*	*	*	*	*	*	*	*
<i>Non-seasonal</i>	Any time, all the time, when craving, year-round	52	x	x	x	x	x	x	x	x	x	x	x	x
<i>Other</i>	These six months	3				x	x	x	x					
* Participants did not explicitly employ all seasons listed in the Yawuru seasonal calendar. Note: Not all sites had references and more than one reference could be made per site. Grey filled cells indicate factors which were defined ecologically, blue cells indicate factors which were defined structurally, unfilled cells were not included in that season. Here, an x denotes use, an asterisk (*) indicates that these were the months used unless otherwise specified by the participants and a dash (-) indicates insufficient information provided in the interview to distinguish this season.														

6.3.2.3 Combinatory analyses

To fulfil the brief provided by the Yawuru reference group, index models for months (a structural measure of time) had to be aligned to the seasons of the Yawuru calendar (an ecological measure of time). Yawuru ecological seasons form the basis of Yawuru lifestyles. They are also used to frame many co-management arrangements across the estate. Consequently, once index models had been produced for each month of the Gregorian calendar, I combined these months into index models for every Yawuru season as defined in the Yawuru Cultural Management Plan and outlined in Table 6.23. This standardised and converted participants' diverse seasonal definitions within a common period.

Awareness of the Yawuru seasons is growing thanks to their inclusion in songs, performances, signs and language around Broome, and management plans. Nonetheless, many local government strategies in Broome continue to be oriented to the wet and dry seasons associated with tropical monsoonal climates. Given this, I created another seasonal use model which specifically aligned with Broome's wet and dry seasons. These seasons, like Yawuru seasons, are defined ecologically: the start of the wet season is marked by rainfall, while the dry season is marked by dry southeast winds (Bowman *et al.*, 2010). Nonetheless, they are often correlated to Gregorian months to facilitate management and cross-cultural understanding.

Table 6.23: Conversion of Gregorian months to Yawuru seasons

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Man-gala											Man-gala
			Marrul								
				Wirralburu							
						Barrgana					
								Wirlburu			
									Laja		

Table 6.24: Conversion of Gregorian months to wet and dry seasons as defined in the Shire of Broome Local Planning Strategy.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet			Dry								Wet

Given the emphasis placed on local context in this research, I made the decision to model the wet and dry seasons as they are defined in the Shire of Broome Local Planning Strategy (Table 6.24), rather than relying on definitions provided by national agencies such as Australia's Bureau of Meteorology (Shire of Broome, 2014b). This definition is practically useful in that it guides

several local management plans. It is also likely to have a high degree of ecological validity given that the wet season correlates well to *Man-gala*, the equivalent Yawuru season. Thus, for the purposes of this study Broome's wet season was defined as extending from December to March, and its dry season was considered to run from April to November.

I used a mean operator to combine the index models for Gregorian months into the Yawuru seasons and the wet and dry seasons and produced a series of maps for each study site to reflect these time periods.

6.3.3 Conclusion

The context-driven approach to spatially modelling seasonal use adopted here drew on available information to extend the values modelling process. It demonstrates how context-driven analyses can translate between structural and ecological calendars and showed how information collected from governance documents and interview transcripts can facilitate a community-driven modelling process which embraces subjectivity and can address practical constraints on data collection. It also shows how reuse of products from earlier modelling, such as the models for site ratings and frequency of visitation, can increase the efficiency of later analyses and thus the likelihood that these techniques can be replicated into the future. This latter element proved to be important in modelling concerns held for significant places.

6.4 Concerns model

The final of the three context-driven index models created in this research focussed on capturing the concerns held by Yawuru participants for places they felt were significant across the estate. Again, this model drew extensively on factor modelling and weighting techniques from the values model.

6.4.1 Rationale

Modelling concerns held for valued areas within the two study sites stemmed from several motivations. First, many Yawuru participants expected their concerns to be directly addressed by Yawuru governance bodies, even when such concerns were outside the legal purview of that organisation. This mirrors the experience of many other native title governance organisations (Hunt and Smith, 2007). Second, research has demonstrated that recording areas where participants hold concerns may provide additional intelligence for managing public health issues such as dengue outbreaks (Dickin *et al.*, 2014) and crime (Lopez and Lukinbeal, 2010). Finally, where a concern reaches the level that it negatively impacts on behaviour, that concern may be harmful regardless of its validity (Doran, 2004).

To date, concerns held by Yawuru people for areas across their estate have not been modelled spatially. Yet, understanding how concerns are distributed may help to support issues such as resource allocation in post native title governance. The concept of a concerns model received strong support in the pilot interview phase of the project. Moreover, information about concerns was among the most spatially viable to emerge from the sketch mapping interview process. Consequently, I decided with NBY staff to produce a concerns model which could be compared with, and provide a counterpoint to, the values model outputs.

6.4.2 Methods

In this study, I modelled concerns based on procedures outlined in the values model. Again, I used a context-driven approach to make the best use of available spatial data, analytic techniques, and contextual information, to embrace subjectivity and produce community-driven outputs which were practically useful for Yawuru governance. Here, I relied on minor adjustments to the values modelling process.

6.4.2.1 Factor selection and preparation

In selecting factors for the concerns model, I drew on information provided by participants in response to both the question on barriers to access at a given site, and the question on any concerns held for that site. As in the values model, these factors were not pre-defined. Instead, factors had to capture information from sketch mapping interviews and respond to key Yawuru governance needs as identified by the reference group and other Yawuru planning documents.

Table 6.25 shows the 13 concerns factors identified during iterative spatial coding. Table 6.25 also outlines the impact of each concern on Yawuru people and Yawuru Country, as well as the number of sites associated with that concern, and the number of participants who mentioned it. As in the values model, I summarised quotations from interview transcripts related to each site into key thematic elements and then lumped these elements into several broader categories or factors. Given that many of these factors relate to different aspects of Yawuru land and sea management, I did not further aggregate these factors into sub-models.

Several challenges emerged during factor selection. Some factors were hard to separate. For example, many participants referred to various elements of environmental degradation, including erosion and habitat loss, throughout the interview process. Other concerns could be seen to contribute to several categories simultaneously. Thus, concerns about needles in the sand were treated as concerns about litter and human-caused hazards. Ultimately, to produce useful outputs for Yawuru governance and facilitate a community-driven modelling process, I selected factors based on both natural clustering of participants' concerns and on their analytical utility for Yawuru governance agencies.

6.4.2.2 Factor modelling

As in the seasonal use model, I used spatial depictions of each area which captured the maximum extent of site use to form the spatial reference for each site. Again, I generated a list of all unique site identifiers associated with each concern and collated these individual sites into larger factor models. I first collated areas for a given factor by participant using a maximum operator. This captured the highest level of a concern held by the individual participant for each pixel in the raster dataset. I then collated individual factor models from all participants using a mean operator and standardised outputs to range from 0.0-1.0 for each factor model. Next, I used a mean operator to capture areas where multiple participants had expressed concerns for the same site, then standardised these combined concerns to ensure uniform inputs into the combinatory analyses.

6.4.2.3 Combinatory analyses

In the concerns model, I adopted a non-hierarchical approach to combinatory analyses as outlined in Figure 6.11. None of the concerns were especially sensitive and all were compensatory in that lower concerns in one area might be made up for by higher concerns in another. I then used weighted linear combination to combine each factor model into the synthesised output.

I assigned weights in the concerns model by drawing on the same qualitative weighting process used in the values model. Here, I used NVivo software, to descriptively code interviews such that any time a concern was mentioned, the relevant passage, including all complete sentences within that passage, was marked as being related to a particular concern. I then generated initial weights from both relative number of references and relative proportion of the interview spent discussing the concern as was outlined in Section 6.2.2.3. Weights allocated during this process are summarised in Table 6.26.

As in the valued practices model, I made qualitative adjustments to these initial weights. Here, adjustments were based on each concern's potential to impact on the physical environment or the practice of native title rights and interests as outlined in Table 6.27 and Appendix 6D. This round of qualitative adjustments was relatively minor as outlined in Table 6.28. Once weights were determined, I used a weighted linear combination to produce the collective concerns model.

Table 6.25: Concern factors, their impacts on Yawuru people, Country and native title rights, and the number of sites and participants associated with each factor.

Factor	Impact	No. of sites	No. of participants
Site development (past)	Sites where past development has blocked access to a site, changed the site's appearance, destroyed a sacred site or otherwise impacted on the values held for or practices conducted in the area.	17	9
Site development (future)	Sites where future development may block access to a site, change the site's appearance, destroy a sacred site or otherwise impact on the values held for or practices conducted in the area. Sites where worries about development have begun to impact on participant well-being.	28	10
Overuse	Sites where over-use and crowding had changed participants' use or enjoyment of a site. For example, where overuse has reduced catch per effort in an area.	25	6
Site erosion	Sites where erosion has changed the local area, reduced site use, or caused hazards to human safety in the local area.	31	9
Road quality	Sites where participants noted that poor road quality was of concern, and/or preventing access to the area.	35	10
Litter	Sites where participants expressed concerns about litter damaging the environment; being unsightly; or representing a hazard to human health.	31	8
Site closure	Sites where a closure has reduced or blocked access to a site, be that as a protective measure or part of development.	25	6
Site protection	Sites where participants expressed a need to protect culturally significant or important areas to prevent damage to these sites, prevent harm to people disturbing these sites and prevent harm to Yawuru people for failing to protect sites.	27	6
Off-road vehicle use	Sites where the use of off-road vehicles concerned participants due to threats to personal safety or damage to the site itself.	17	6
Species loss	Sites where participants were concerned about the disappearance of particular species.	3	3
Over-exploitation	Sites where over-exploitation has reduced the availability of local resources.	27	7
Hazard (human)	Sites where participants have expressed concerns about hazards due to human actions such as the threat of violence, dangerous litter such as needles, etc.	11	7
Hazard (environmental)	Sites where participants have expressed concerns about hazards in the local environment. These hazards often reduce or even stop the use of sites due to threats to personal safety and health.	6	5
Unclassified (environmental)	Sites where the local environment is subject to any of several potential pressures including, but not limited to pollution, potential disease, or site damage through other means.	17	5
Unclassified (general)	Sites which are the subject of unspecified concerns.	9	6

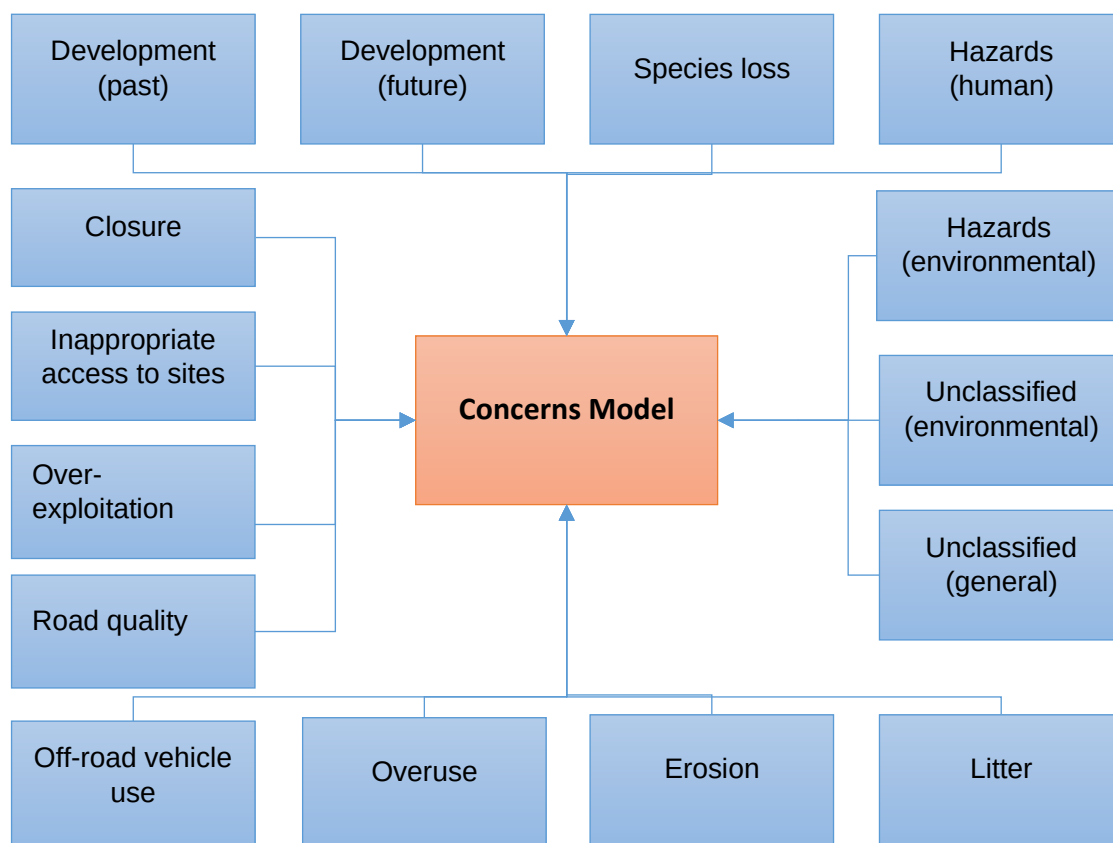


Figure 6.11: Combinatory analyses feeding into the concerns model.

Table 6.26: Initial weights derived using qualitative techniques for factors in the concerns model.

Factor	Number of references	Total references (%)	Total words coded as concerns (%)	Initial weights (%)
Development (future)	28	9.8	11.0	10.4
Development (past)	25	8.7	8.5	8.6
Closure	30	10.5	9.8	10.1
Species loss	7	2.4	2.3	2.4
Overuse	23	8.0	8.2	8.1
Over-exploitation	12	4.2	5.1	4.6
Litter	18	6.3	4.0	5.2
Inappropriate access to sites	17	5.9	5.6	5.8
Hazard (environmental)	9	3.1	5.7	4.4
Hazard (human)	14	4.9	6.6	5.7
Erosion	27	9.4	7.9	8.6
Off-road vehicle use	18	6.3	5.8	6.0
Unclassified (environmental)	17	5.9	5.6	5.8
Unclassified (general)	23	8.0	9.3	8.7
Road quality	18	6.3	4.8	5.5
<i>Total</i>	<i>286</i>	<i>100</i>	<i>100</i>	<i>100</i>

Table 6.27: Summary qualitative information on concerns used to adjust weights.

Concern	Impact on use of site	Impact on physical environment	Impact on cultural values or native title rights	Creates barriers to site access	Associated with “destruction” of site or values held for site	Negative Emotional impact	Physical Danger
Off-road vehicle use	Moderate	Moderate	Low - Moderate	N/A	N/A	=====	Moderate
Proposed or potential development	High	High	High	Moderate- High	High	High	=====
Inappropriate access to site	N/A ^a	Low - Moderate	Moderate – High ^b	N/A	Moderate	Moderate- High	Low
Hazards (Human)	Moderate – High ^c	Low - Moderate	Low - Moderate	Moderate - High	Low – Moderate ^d	High	High
Hazards (Environmental)	Moderate – High ^c	Low	Low	Moderate	Low	=====	Moderate – High ^c
Uncategorised (general)	=====	=====	=====	=====	=====	=====	=====
Uncategorised (environmental)	=====	Low - Moderate	=====	=====	=====	=====	=====
Erosion	Moderate ^c	Moderate	Low	Moderate ^c	Low- Moderate	Low	Moderate- High
Development (past)	High	High	High	Moderate - High	High	High	Low
Litter	Low	Moderate	=====	Low	=====	Low -Moderate	Low - Moderate
Over-exploitation	Moderate	Moderate	Low- Moderate	N/A	N/A	=====	N/A
Over-use	Low- Moderate	Low- Moderate	Low	Low	N/A	Low	N/A
Closure	High	Low – Moderate ^c	Moderate -High	High	Moderate ^e	High ^c	N/A
Species loss	Moderate	Moderate	Moderate	N/A	Low	Moderate	N/A
Road quality	Moderate - High	Low	Low	High	Low	Low - Moderate	Low - Moderate
a) Sites often not used by participants out of respect/ for other reasons. b) Does not inhibit transmission or access but is problematic. c) The relative impact of closure is site dependent. d) Human hazards are often associated with the destruction of a site, but rarely causal (e.g. litter and uncleanliness are often key issues in areas associated with human hazards). e) Dependent upon mode of closure. ===== Evidence from interviews highly variable or inconclusive							

Table 6.28: Weights assigned to factors in the concerns model.

Factor	Initial weights (%)	Qualitative adjustment (%)	Qualitatively adjusted weights (%)
Development (future)	10.4	+ 0.1	10.5 ^a
Development (past)	8.6	- 0.1	8.5 ^b
Closure	10.1	+ 0.4	10.5 ^a
Species loss	2.4	+ 0.6	3.0 ^c
Overuse	8.1	- 0.1	8.0 ^b
Over-exploitation	4.6	+ 0.4	5.0 ^a
Litter	5.2	+ 0.3	5.5 ^a
Inappropriate access to sites	5.8	+ 0.2	6.0 ^a
Hazard (environmental)	4.4	+0.1	4.5 ^a
Hazard (human)	5.7	+ 0.3	6.0 ^a
Erosion	8.6	+ 0.4	9.0 ^a
Off-road vehicle use	6.0	0.0	6.0 ^a
Unclassified (environmental)	5.8	+ 0.2	6.0 ^a
Unclassified (general)	8.7	- 2.7	6.0 ^d
Road quality	5.5	0.0	5.5 ^a
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>
<i>a) Held constant or rounded up to the nearest 0.5;</i> <i>b) Rounded down to nearest whole number to adjust for relatively high weights;</i> <i>c) Rounded up to the nearest whole number to adjust for emotional impact of species loss;</i> <i>d) Rounded down by 2.7% to adjust for undefined nature and lower importance.</i>			

6.4.3 Conclusion

In the context-driven approach to concerns modelling outlined above, techniques which had been established in the values and seasonal-use models were readily applied to additional information in the spatial database. This process demonstrated how, once established, context-driven modelling techniques can readily be transferred to a range of scenarios. A technical log for all models can be found in Appendix 6E.

6.5 Preparation of model outputs

Following spatial analysis, I prepared the models for presentation to NBY in several formats. As outlined below, I overlaid individual factors, sub-models and final models on aerial imagery. I also used the cartographic overlay of certain models on key planning and tenure documents to prepare sub-regional and regional maps. Finally, I prepared animated geo-visualisations to facilitate factor comparison.

6.5.1 Maps

Maps of the factor models, sub-models and synthesised models in this research generally use the spatial extent of base maps used in sketch mapping interviews. They did not extend beyond areas where participants had opportunities to record valued areas. I used a cool to warm colour

scheme for the models. Cooler hues were used to represent lower values, while warmer hues were used to represent higher values. Outputs were not stretched. I rendered each model semi-transparent and overlaid them on aerial imagery to thoroughly link the map outputs to the data elicitation process. I then used alphanumeric labels to draw the reader's attention to points of interest in each map.

As mentioned earlier, I affixed the collective values map with a prominent disclaimer which noted that it did not include *Bugarrigarra* or Dreaming sites which represent metaphysical and spiritual values within the area. It responded to discussions with key participant and Yawuru analyst Dean Mathews as well as the decision to exclude metaphysical values from the final model.

Additionally, I designed maps to show the relationship between values or concerns and how these values varied over space. Where possible for these maps, models were typically displayed side-by-side for a given study site to facilitate visual analysis.

6.5.2 Cartographic Overlay

The pilot study for this research demonstrated the potential value of cartographic overlay techniques in a Yawuru governance context (Potter, 2013; Potter *et al.*, 2016). There, we overlaid a preliminary values model of Broome's in-town foreshore over several documents. These included documents showing native title recognition within the area (National Native Title Tribunal, 2018a); maps relating to Broome's Chinatown Development Strategy, a guiding document for the revitalisation of Chinatown as Broome's social and commercial centre (Hassell Limited, 2012); and over the Shire of Broome Local Planning Scheme Number Six, a zoning map to guide Broome's development for the coming ten years (Shire of Broome, 2014a), also referred to as Local Planning Scheme Six.

I adopted a similar approach to overlay in this research and constructed overlays for six planning and tenure documents and datasets. These freely available, online documents covered a range of scales and were created for a variety of purposes, as shown in Table 6.29. To prepare these documents for overlay, I downloaded information on native title and Indigenous Land Use Agreement information from the National Native Title Tribunal and extracted determinations within the Broome area from the larger dataset. I also converted key maps from the remaining documents to image files, then georeferenced and digitised them into four separate shapefiles.

Table 6.29: Documents incorporated into overlay analyses, their purpose and scale.

Document or Map Name	Purpose	Coverage and Georeferencing
Native title determinations ^a	“Reflects the boundaries of claimant and non-claimant native title applications that have been determined in part or in full, together with attribution about that determination” (National Native Title Tribunal, 2016a).	National – Georeferenced
Indigenous Land Use Agreements ^b	“A dataset which reflects the boundaries of [Indigenous Land Use Agreements] that have entered the notification process or have been registered and placed on the Register of Indigenous Land Use Agreements” (National Native Title Tribunal, 2016b)	National – Georeferenced.
Shire of Broome Local Planning Scheme Number Six ^c	Sets out the local government’s planning aims and intentions for the Scheme area; sets aside land for public purposes; zones land within the Scheme area; control and guide land use and development, etc.	Regional
Broome Coastal Reserves Master Plan ^d	“The first of a series of report and plans required by the Shire to guide its contribution to an effective multiparty management plan for the town’s coastal reserves” (CCS Strategic <i>et al.</i> , 2013:3).	Broome Townsite
Yawuru Birragun Conservation Park draft management plan 2015 ^e	“Describes proposed management of the Yawuru Birragun Conservation plan for adoption in a final management plan after consideration of public submissions” (DPAW, 2015b:2). The period for public comment on the plan closed in late 2015.	The out of town Yawuru conservation estate
Proposed Yawuru Nagulagun / Roebuck Bay Marine Park Indicative joint management plan 2015 ^f	“The indicative joint management plan identifies key cultural, ecological and social values of the area, seven management programs to be applied, and targets and performance measures to track progress against the stated management objectives over the life of the plan” (DPAW, 2015:6). The period for public comment on the plan closed in late 2015.	The Yawuru conservation estate

Source: a) National Native Title Tribunal (2016a), b) National Native Title Tribunal (2016b), c) Shire of Broome (2014a), d) CCS Strategic *et al.* (2013), e) DPAW (2015b), f) DPAW (2015a)

I produced several overlays for each of these documents. To do this I rendered spatial models produced in this research 35% transparent, overlaid them on the management plans and native title determination documents which I also rendered 35% transparent and overlaid on aerial imagery. I then visually analysed these overlays and produced tables outlining key strategic insights from each of these documents.

6.5.3 Geo-visualisation

Geo-visualisation “is used to describe the fusion of visualisation and cartography” (O’Sullivan and Unwin, 2010b:58). It produces outputs which extend beyond the paper-bound outputs of traditional cartographic maps and “frequently attempts to create photo-realistic scenes that display as much data as possible” (O’Sullivan and Unwin, 2010b:59). This diverse practice has been applied to feminist geography, land use planning, forestry, the modelling of movement and the identification of spaces of creativity (Brennan-Horley and Gibson, 2009; Krygier, 2002; Kwan, 2002; Lewis and Sheppard, 2006). It has resulted in the creation of ‘time-space GIS

movies' which "draw on the emotional power of moving images to tell visualised stories" (Travis 2013:1160-1161, referring to Kwan, 2007). It has also been used to produce animated series which show change in vegetation and rainforest landscapes over time (Mäki and Kalliola, 2000) and fly-through animations which demonstrate the likely visual impacts of particular environmental changes (Chias and Abad, 2013).

Geo-visualisations have considerable power. They can trigger reflexes, generate emotions and facilitate communication (Al-Kodmany, 2002; Kwan, 2007; Sheppard, 2005). In one example provided by Sheppard and Cizek (2009) at a community meeting of over 300 citizens in September 2005, a visualisation of proposed logging areas led to "a gasp from the audience" which "electrified the room" (Dicum, 2006 in Sheppard and Cizek, 2009:2112). Visualisations have the potential to challenge norms (Pearce and Louis, 2008), to objectify (Kwan, 2002), and to empower (Al-Kodmany, 2002). They have been used to support peace negotiations (Wood, 2000, based on work by Johnson, 1999) and can literally change perspectives, clarify relationships between map elements and "allo[w] users to explore, synthesize, present and analyse their data more thoroughly than was possible hitherto" (Longley *et al.*, 2011:327).

As outlined in Chapter 2, several researchers have demonstrated the power of geo-visualisation in Indigenous contexts. Pearce and Louis (2008:123) showed how geo-visualisation techniques could be used to challenge cartographic norms and visually depict Hawai'ian landscapes as "embodied, situated, fluid and experienced". In British Columbia, Lewis and Sheppard (2005, 2006) worked with the Cheam First Nations Band of the Sto:lo Nation in the Upper Fraser Valley, British Columbia to evaluate various land management scenarios and work to protect cultural values in forestry. Their research demonstrated that presenting "various landscape management scenarios in the form of simple GIS maps and photo-realistic images" (Lewis and Sheppard, 2006:291) could enhance community discussion about scenario selection and facilitate cross-cultural communication in forestry operations.

In this research, I used geo-visualisation to challenge the disembodiment common to many planimetric maps, including those of the Broome Town site. I prepared fly-through animations to facilitate comparison of values and concerns across the Yawuru landscape, considering potential users, the level of realism appropriate for the purpose, and any important messages arising from the data. These fly-throughs had to be legible to Yawuru people who may have varying levels of familiarity with geospatial technology. They also had to enhance understanding of the relationship between model elements and have the potential to facilitate cross-cultural communication within a settler colonial planning context. Finally, values and concerns being modelled were continuous and difficult to capture through changes in hue. Consequently, fly-throughs had to show the relative intensity of concerns and values and relate them to the ground.

Given the need to use resources readily available to Yawuru governance agencies, I used ArcScene, an element of Esri's broader ArcGIS for Desktop package, to construct the fly-through models. I imported the synthesised concerns model, values model and digitised Local Planning Scheme Six into ArcScene and stretched these models to 2.5D using a custom elevation of 500m. I then inverted the concerns model and used a vertical offset of 1005m. Given the limited variations in elevation across the study site and the need to emphasise any similarities and differences between the two key variables, I did not drape the aerial imagery to replicate local topography more closely. This decision reduced both the realism of the scene and the likelihood that too many features in the visualisation would confuse readers and viewers (Kostelnick *et al.*, 2013). It also mitigated the potential that excessive realism would inhibit Yawuru people critiquing the models' outputs.

Once the models had been prepared in 2.5D, I digitised, offset, and tested several flight paths to focus viewers' attention and limit change blindness. I selected the final flightpaths presented to Yawuru people through an iterative process. The first fly-through for the Broome Town site looked in-land from an area outside the model along the coast. This was designed to highlight key coastal areas where many values were concentrated. The second flythrough looked outwards from the centre of the Broome Town site. It was designed to focus the viewers' attention on *nagula* or Yawuru sea country. The third fly-through looked inland at the Crab Creek site. I did not include any audio in the visualisations at the time of their presentation to NBY CEO Peter Yu and members of NBY's Native Title and Environmental Services Unit. Screenshots from these fly-throughs and other cartographic models are included in Chapter 7 of this work.

6.6 Qualitative analyses

The previous section of this chapter described how I used analytical modelling to generate collective, continuous and spatial outputs, capturing elements of Yawuru participants' relationship to their Country. This section describes how I used qualitative analysis of the rich non-spatial data collected from the sketch mapping interviews to complement and contextualise these spatial outputs by generating insights for Yawuru governance bodies and examining the ways participants' responded to concerns and complexities within their estate.

As detailed in Chapter 5, sketch mapping interviews from this research generated both sketch maps and audio-recordings which were later transcribed. These recordings consisted of responses to a series of spatially grounded questions delivered in a semi-structured format. They contained stories, anecdotes and even commentary on the mapping process itself.

I used thematic analysis to explore non-spatial data collected from the sketch mapping interviews. Thematic analysis is "a [widely used] method for identifying, analysing, and reporting

patterns (themes) within data. It minimally organises and describes your data set in (rich) detail [and often] interprets various aspects of the research topic” (Braun and Clarke, 2006:79). Thematic analysis is thus a rigorous and flexible technique which can be applied and adapted to a range of theoretical viewpoints, as well as to hybrid or mixed methods approaches, including qualitative GIS.

I employed several qualitative data organisation and management strategies as part of my thematic analysis. First, as outlined earlier, I transcribed the audio-recorded interviews and interview notes and coded them into the factors included in the context-driven GIS-based representations and spatial analyses. Then, I loaded interview transcripts into NVivo 10, a form of computer-assisted qualitative data analysis software which permitted the querying, organisation, and interactive coding of data. Additionally, I printed transcripts and nodes for hand coding at various points during the analytical process to help me to perceive the data from different angles during qualitative analysis.

Initially, when examining the non-spatial elements of sketch mapping interviews, I read the interviews multiple times and undertook first pass, line-by-line inductive coding designed to generate broad insights into the data using manifest codes (Saldaña, 2013). This included descriptive codes linked to initial themes recorded in the field (Saldaña, 2013) and codes which linked to the questions posed to participants. During this phase, individual passages of text could be coded one time, no times, or multiple times.

Some of the themes identified in first pass coding directly related to the questions posed to participants (e.g. concerns were a theme which had a variety of sub-themes, as was barriers). Other themes identified at this stage included references to Yawuru governance bodies, family relationships, recurring concepts such as “home” and loss, and narratives of resilience. This included the code “nothing stops me”, which was a comment made by one participant in relation to site visitation, and was echoed by others as they expressed continued efforts to access and care for valued areas in their living cultural landscape.

I used many of the themes produced in this initial coding phase to generate pragmatic insights for Yawuru governance. These themes have been included in a separate report to NBY. They are not presented in this thesis and are thus not discussed in detail here.

As I used thematic coding to generate insights for NBY and other Yawuru governance bodies, I noted how many of the concerns raised by participants reflected or were exacerbated by the impacts of settler colonialism in and beyond the Yawuru estate. I also observed that participants frequently responded to the concerns they raised by highlighting the ways that they or Yawuru governance organisations were directly addressing challenges within their estate. As an example, Rose Coffin expressed concern about rubbish on the beach at Crab Creek, then

described how she was lobbying NBY for bins to be installed in the area. Likewise, Mark Parriman observed how he had responded to the development of Demco and surrounds by changing the location where he butchered meat. Similarly, Judy Edgar noted that she engaged with social tensions in one area of town by participating in community clean-ups of the area and chatting to locals on the street.

Informed by a conversation with Patrick Dodson, I viewed such responses as expressing participants' agency and resilience, as well as reflecting the ways that Yawuru people have adapted to challenges across their estate. Drawing on Pratt's concept of the contact zone, I saw these responses as reflecting how participants engaged with, or avoided, structurally inequitable contact zones within a settler state.

Given that this thesis presents spatial analysis and GIS-based representations as "arts" Indigenous peoples may use to engage in contact zones following native title recognition, I then engaged in a second round of thematic coding designed to contextualise the GIS-based representations produced earlier in this chapter. Here, I undertook deductive coding which drew on settler colonial theory and Pratt's concept of the contact zone to examine how Yawuru participants engaged with the complexities of life following native title recognition.

First, I used manifest thematic codes to explicitly identify concerns and complexities raised by participants during the interview process. Then, to explore the ways participants grappled in and around the contact zones of Broome following native title recognition, I re-coded the interviews using both latent and manifest codes to identify how participants described responding to these challenges. Next, I split these responses to identify fourteen strategies and practices participants used to engage with these issues. Finally, I grouped these strategies and practices into three themes which focused on how participants continued cultural practices, moved in time and space, and directly engaged with complexities within their estate.

In Chapter 8, I report on these strategies and practices and outline how they facilitate Yawuru persistence and support respectful cohabitation of the Yawuru living cultural landscape. I also reflect on how this information contextualises the GIS-based representations produced in this research.

Chapter 7: Results (Spatial analysis)

This chapter presents key results from values, seasonal use and concerns modelling from interviews conducted in 2015. It then displays some cartographic overlays used to derive additional strategic intelligence from core modelling outputs. Finally, this chapter presents factor comparisons facilitated by geo-visualisations and fly-throughs.

Given the large number of models generated during spatial analysis, only GIS-based representations relevant to post native title governance are shown here. Each model is presented with limited contextual information on locations with high and low values. Factor models and sub-models representing values and concerns are also accompanied by one or more quotations drawn from the spatial coding which informed these models. Results for the remaining models are summarised in Appendix 7A.

7.1 Preliminary spatial distributions of key values across significant areas

7.1.1 Factor models for key values from a management perspective

Figure 7.1 to Figure 7.5 shows the spatial distribution of values for drag-netting, hunting dugong, hunting turtle, collecting oysters and cooking catch within areas Yawuru participants noted were significant to them across the two study sites.

7.1.1.1 Drag-netting

When it's a funeral or a big celebration coming up, then we'd use a net."

Mr Gregory

"I know there's a few local boys that take massive nets, um, out in various locations along here and sort of catch way too much fish. [...] To take a massive haul like that is sort of a bit, a bit overdoing it." Yawuru Custodian

Figure 7.1 shows areas valued for drag-netting for fish. While drag-netting often occurs in the lead up to cultural celebrations and funerals, it is also likely to be spatially constrained under

co-management to respond to concerns around over-exploitation. In the spatial models, areas valued for drag-netting primarily concentrate on Simpson's Beach (A) in the Broome Town site. This beach is sandy, with some rocks. It is also more popular with locals than it is with tourists. Lower values for drag-netting extend just north of Town Beach (B). They are also recorded in the area in front of Kunin Flats (C). In Crab Creek, low values for drag-netting are found in the site's western foreshore (D).

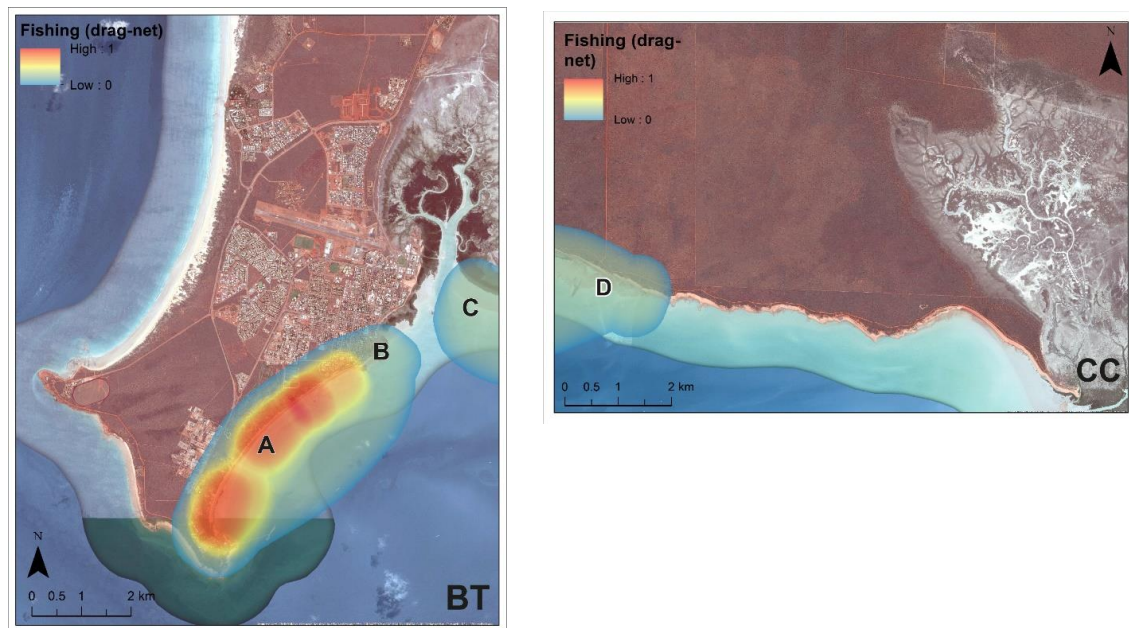


Figure 7.1: Drag-netting model for Broome Town (BT) and Crab Creek (CC).

7.1.1.2 Hunting turtle and dugong

“If I’m going with a friend, then we’ll just do fishing, but if I go with my family, we do like hunting for turtle, or do the rest [...] we all help each other when we are going for big stuff.”

Johnathan Pearson

“Mainly with my cousins, my brothers, and my dad, my uncles. Just all boys [...it’s] the law bad luck, you know, to take women out on the boat.” Mark Parriman

Figure 7.2 shows the distribution of values for hunting dugong, which is a culturally significant activity performed by the men in certain Yawuru families. Yawuru governance and co-management agencies recognize a need to facilitate sustainable dugong catch within the Yawuru estate to protect this culturally and ecologically significant species (DPAW, 2016a).

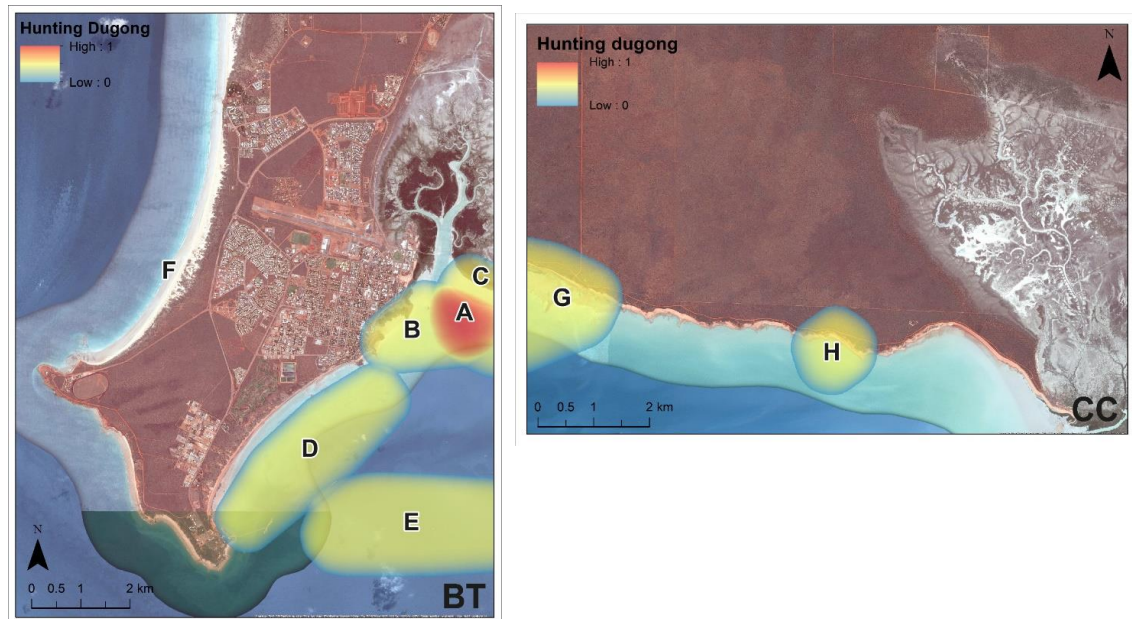


Figure 7.2: Model showing the distribution of values for hunting dugong in areas significant to participants across the Broome Town site (BT) and Crab Creek (CC).

Figure 7.2 shows high values for hunting dugong concentrated in the area just west of Marala (Buccaneer Rock) and near the mouth of Dampier Creek (A). These high values are surrounded by moderate values which extend along the northern shoreline of Roebuck Bay from Town Beach (B) to Kunin Flats (C). Moderate values were also recorded for Simpson’s Beach (D) and the “sandbank” east of Broome Port (E). No values for hunting dugong were recorded on Cable Beach (F) or outside of the Roebuck Bay area.

At Crab Creek, moderate values for dugong hunting were recorded for Kunin Flats (G) and adjacent to Fall Point (H).

Yawuru governance bodies also recognize a need to ensure that turtle hunts are culturally appropriate and sustainable. Figure 7.3 shows high values for turtle hunting adjacent to the jetty of the Broome Port (A) which is close to boat launching facilities. Modelled values were moderate for Simpson’s Beach (B), the sandbank (C), Entrance Point (D), the area north of the rocks on Cable Beach (E), Kunin Flats (West and East) (F&G) and in a bay at the centre of the Crab Creek site adjacent to Fall Point (H).

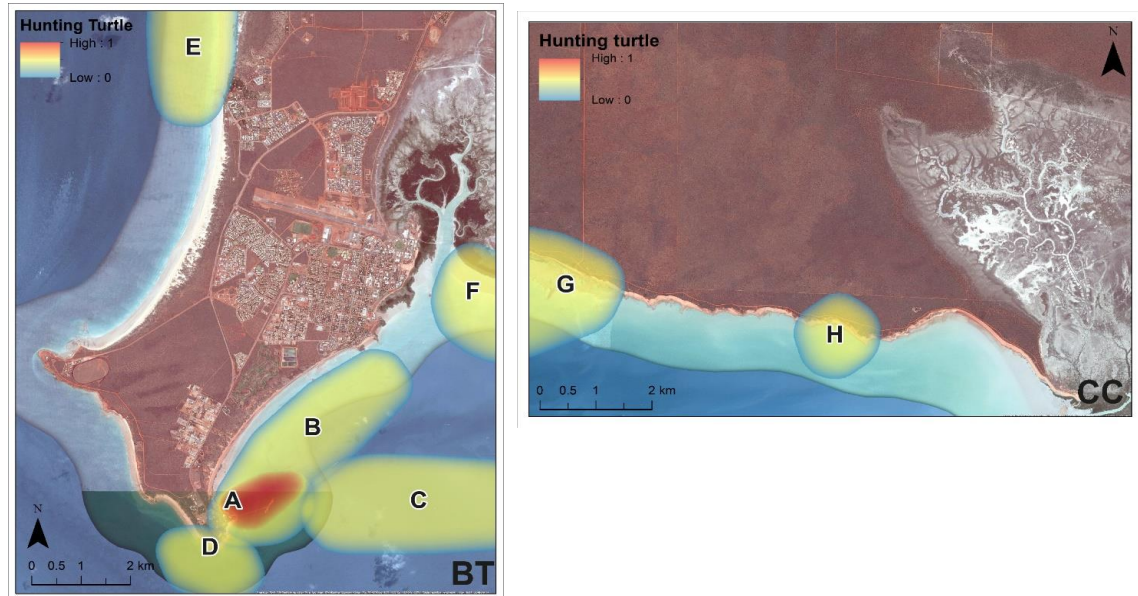


Figure 7.3: Model showing the distribution of values for hunting turtle in areas significant to participants across the Broome Town site (BT) and Crab Creek (CC).

7.1.1.3 Collecting oysters

“It was a source for everybody. You get shell, um, shell meat on certain times, like oysters on certain times.” Judy Edgar

“I reckon it just probably needs more oysters.” Johnathan Pearson

“If you are going for oysters, which is pretty rare there now because they’re all gone and you know, people eat them.” Yawuru Custodian

During sketch mapping interviews, anecdotal evidence suggested that there had been a local decline in oyster populations which may require management. Figure 7.4 shows that the highest concentration of values for collecting oysters was found in the Minyirr area of Broome Town (A). Moderate to low values were found for much of Reddell Beach (B) and the area around Broome Port (C). At Crab Creek, moderate values were recorded from the south of Crab Creek Road (D) and towards Black Ledge (E). Lower values were recorded at Sabu Rock (F) and near the mouth of Crab Creek (G).

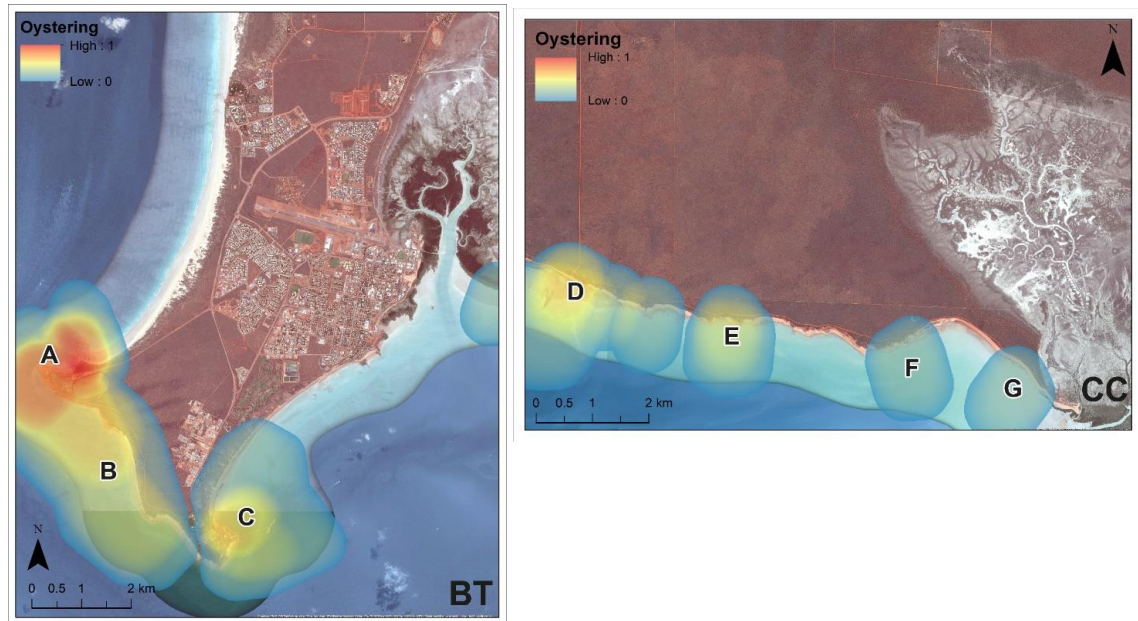


Figure 7.4: Collecting oysters model for Broome Town (BT) and Crab Creek (CC).

7.1.1.4 Cooking catch

“Bring driftwood from the top of the beach [...] bring it to the rocks, where the oysters are.”

Johnathan Pearson

“We prefer to make our fire on the beach. So that when we finish, we’ve got easy loose sand and we just cover the fire up. And there’s no chance of it catching off into the scrub.”

Mr Gregory

Cooking catch on a fire is culturally important to many Yawuru people. It is also prohibited in certain areas within the Broome Town site. Nonetheless, Yawuru governance bodies have stated their intention to seek exemptions from restrictions on lighting such fires for cultural reasons within the Broome Port reserve (Yawuru RNTBC, 2013). As shown in Figure 7.5, the highest values for cooking are near Demco Beach (A) and along Simpson’s Beach (B). Again, these areas are more used by locals than they are by tourists. Lower values were recorded for Minyirr (C), Minyirr Park (D) and on the Kennedy Hill foreshore (E). At Crab Creek, areas valued for cooking catch were distributed along the site. The highest values for cooking catch within Crab Creek were recorded at the Sabu Rock/ Blackberry Tree area where Yawuru people were able to drive cars with gear down onto the beach at the time of interviews (F).

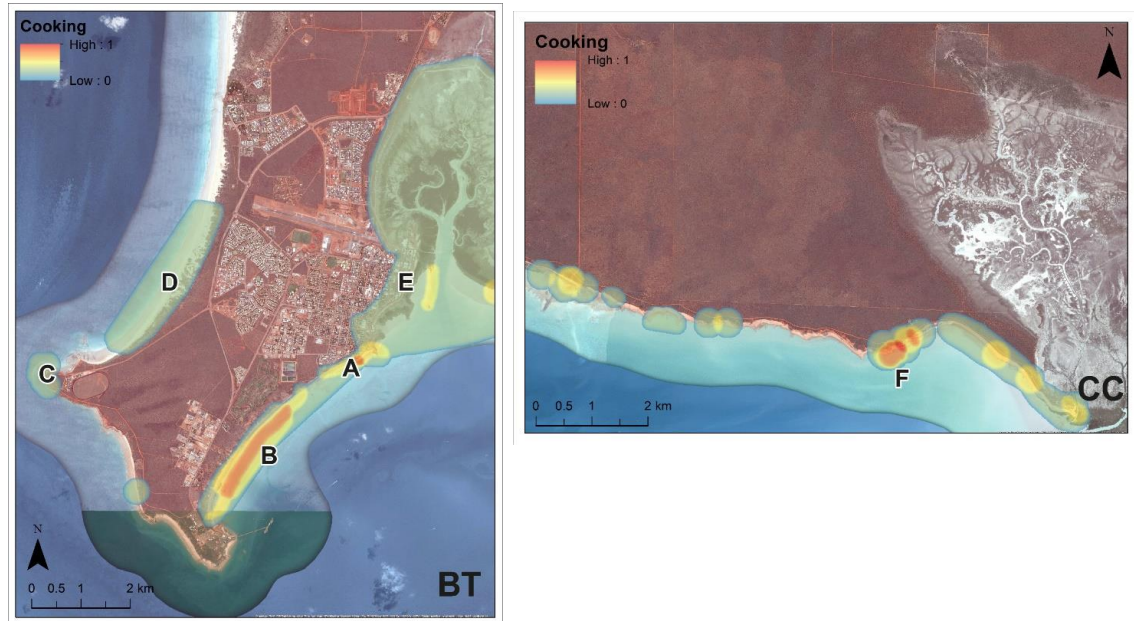


Figure 7.5: Cooking catch model for Broome Town (BT) and Crab Creek (CC).

7.1.2 Key sub-models

Synthesised sub-models which focus on special places, heritage, practices and relationships also have implications for Yawuru governance.

7.1.2.1 Special places

“I used to just go fishing there and after mum died we used to go to, still used to go back there and fish there and have memories of mum and have our memories of our childhood.”

June Cattermole

“If they close that off, then they are closing off, like a part of our life, you know? Our lives are actually in these places.”

Rose Coffin

Retaining Yawuru people’s access to special places: areas valued for childhood memories, association with family, or their status as “home” may be important for maintaining the perceived legitimacy of Yawuru governance bodies. Figure 7.6 displays that, at Broome Town, special places appear to be spatially concentrated across individual sites. In Broome Town, the highest values for special places were recorded at Burgurrgun or Morgan’s Camp which is associated with several Yawuru camps and families (A), Town Beach, which was the site of the town’s old jetty (B), Broome Port (C) which is the location of the new jetty and Entrance Point which was

visited by people and their families (D). Moderate values were recorded for areas of Reddell Beach (E), parts of the in-town foreshore of Roebuck Bay (F) and parts of Dampier Creek (G). Low values were recorded for some areas of Minyirr Park (H) and Reddell Beach (I). No special places were recorded at Cable Beach North (J).

At Crab Creek, values held for special places were more continuous than at the Broome Town site. Moderate values were recorded across much of the foreshore with high values spatially concentrated at Gabanyanya (K), Sabu Rock/ Blackberry Tree (L), and Lalsa Rock (M) which are popular and accessible fishing spots, or strongly associated with a family group.

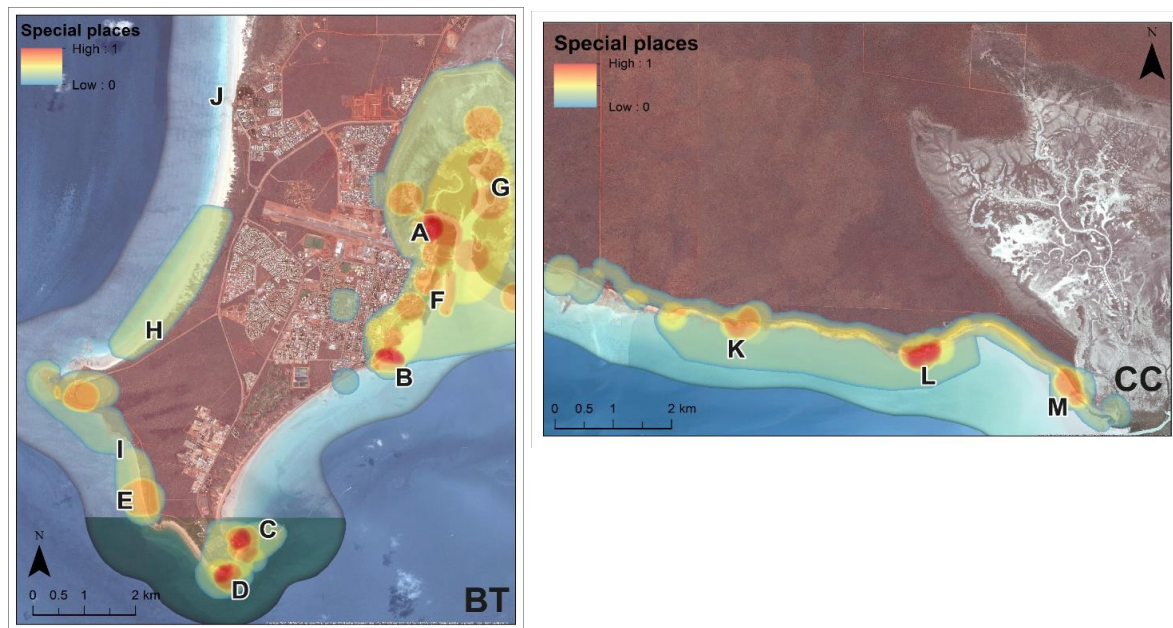


Figure 7.6: Special Places model for Broome Town (BT) and Crab Creek (CC)

7.1.2.2 Heritage

“It was more tidy, people were more pleasant, you know. Yeah. It was a better place in the old days, you know.” Martha Lee

“You think ‘My God. This is not the, this is not the hill where I used to live. This is not the place where I used to live.’ It makes your heart feel sad.” June Cattermole

Yawuru governance agencies have recorded their determination to protect the town’s heritage as part of their Four Pillar Knowledge Vision. In this study, heritage values were taken to incorporate Broome’s pearling heritage and the long associations many Yawuru people had with the jetty at Broome Port. Figure 7.7 records heritage values across the two study sites. Here, high values were largely concentrated in Chinatown (A) an area at the heart of the pearling industry, Kennedy Hill (B), a cultural place and home to many Yawuru people, Town Beach (C)

– which held the town’s old jetty and the Broome Port jetty (D) where many participants had strong memories of fishing with their families.

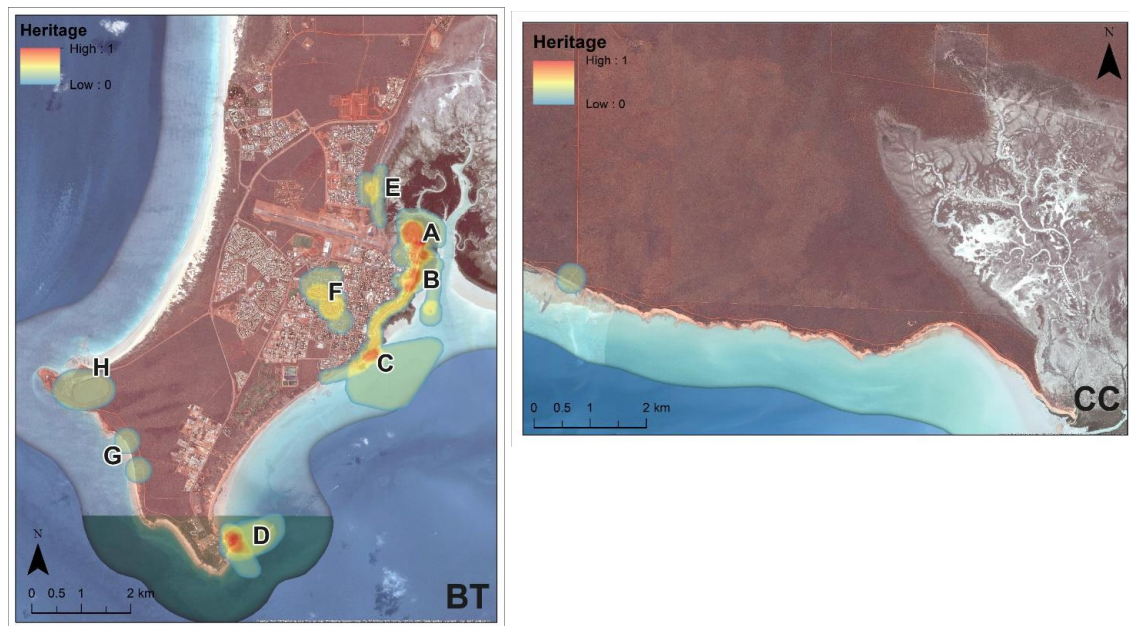


Figure 7.7: Heritage model for Broome Town (BT) and Crab Creek (CC)

Moderate values were recorded for the entire in-town foreshore area, the town camp One Mile (E) and the Back Hospital which at one time was the only hospital in town which could be accessed by Aboriginal people (F). Low values were held for the old “Sisters’ Place” and “Fathers’ Place” (G) and the Broome Racecourse (H), areas historically associated with picnics and gatherings of Indigenous peoples from across the Kimberley.

7.1.2.3 Practices and relationships

“I’ve got that feeling sometimes that they’ll say ‘no fishing on the jetty’ and then I’m like ‘oh god’. You know? I love the jetty. I mean my parents was always on the jetty fishing, you know.

We take our children now, you know?” Martha Lee

“And the hot time, before I used to get dropped off here and walk to here. Wait ‘til, tell my family to wait for me here, like I’d walk with the boys, same time. Teaching. Look and learn off what I’m doing, remember which places that we are picking up all these stingrays, or whatever.” Mr Gregory

Maintaining connection to Country is essential for maintaining native title recognition in the long term (Glaskin, 2003). Given this and their role as a way of maintaining connection to place, practices are highly relevant to Yawuru governance. Figure 7.8 displays areas associated with valued practices across the two study sites. Valued practices were distributed along the foreshore

of Roebuck Bay. Moderate to high values were recorded all along the bay. They were particularly concentrated in Dampier Creek (A), adjacent to Bedford Memorial Park and Catalina's (B), Town Beach and Demco (C), some of Simpson's Beach (D) and Broome Port (E). Many of these areas have easy foreshore access. Moderate values were recorded for Reddell Beach (F), Minyirr (G), and parts of Cable Beach (H).

At Crab Creek, values for practices were present across the whole foreshore, but strongest at specific sites. Very high values for practices were recorded for Sabu Rock/ Blackberry Tree (I). Some low values were also recorded in an area in the north-east of the site which was accessed from Old Broome Road.

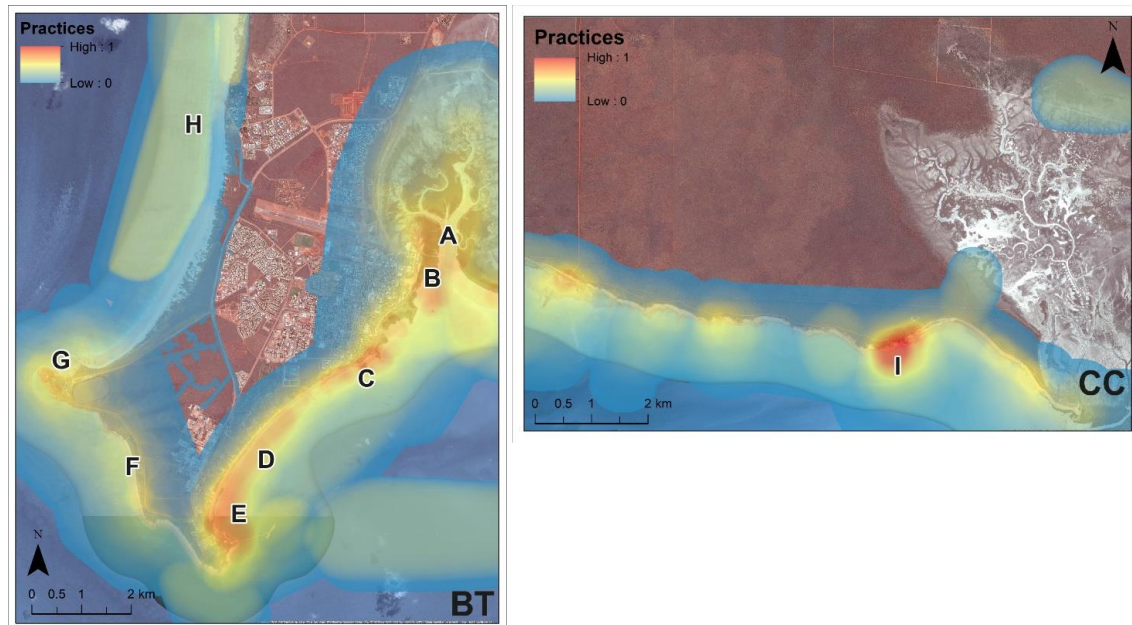


Figure 7.8: Practices (general) model for Broome Town (BT) and Crab Creek (CC)

In this study, the relationships model synthesized all areas valued for heritage, special places, or as part of the broader “background” values held for the study site. Again, this model was relevant to demonstrating continued connection to Country as part of the post native title context. Figure 7.9 shows areas valued for relationships across the two study sites. At Crab Creek, moderate values were recorded for the entire site with the site's highest values again found at Sabu Rock/ Blackberry Tree (A). In Broome Town, high values were held for the in-town foreshore (B), Marala (C) and the Broome Port (D). Moderate values were found at One Mile (E), the Back Hospital (F), Minyirr (G), Reddell Beach (H) and areas of Dampier Creek (I). Low values were recorded for the remainder of the Broome Town site.

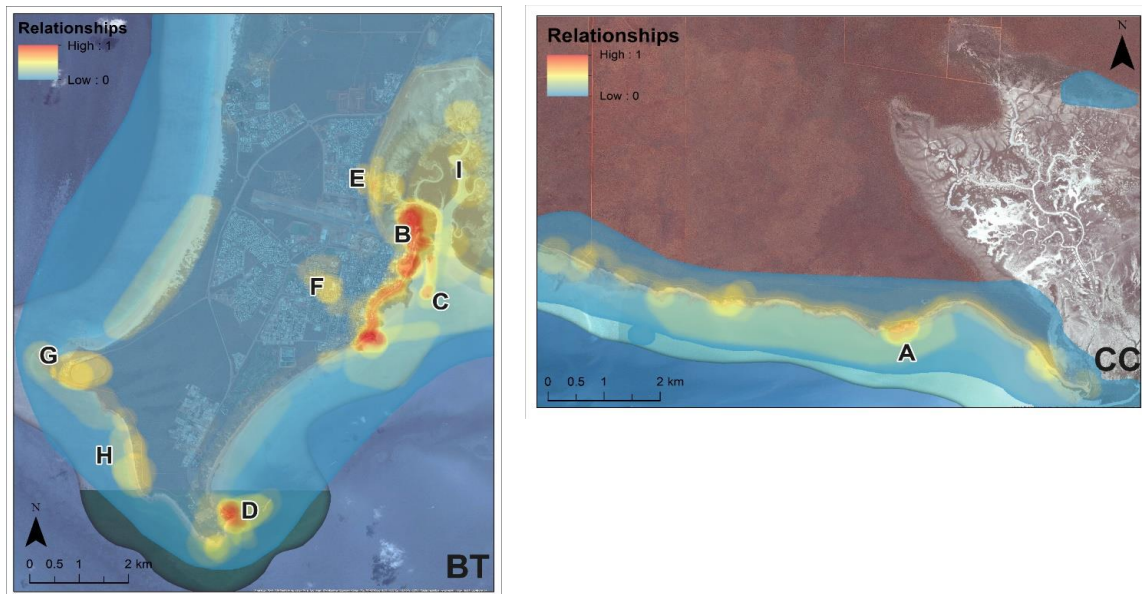


Figure 7.9: Relationships model for Broome Town (BT) and Crab Creek (CC)

7.1.3 The synthesised model: a preliminary representation of the distribution of Yawuru values across space

Figure 7.10 shows the synthesised values models for Broome Town (BT) and Crab Creek (CC). Again, for clarity and as stated in the maps, this model is indicative and based on interviews conducted with twelve Yawuru people in 2015. It does not include *Bugarrigarra* (Dreaming) sites. In Broome Town values were recorded for the entire site. The highest values for this site were recorded for the in-town foreshore (A), Town Beach (B) and Broome Port (C).

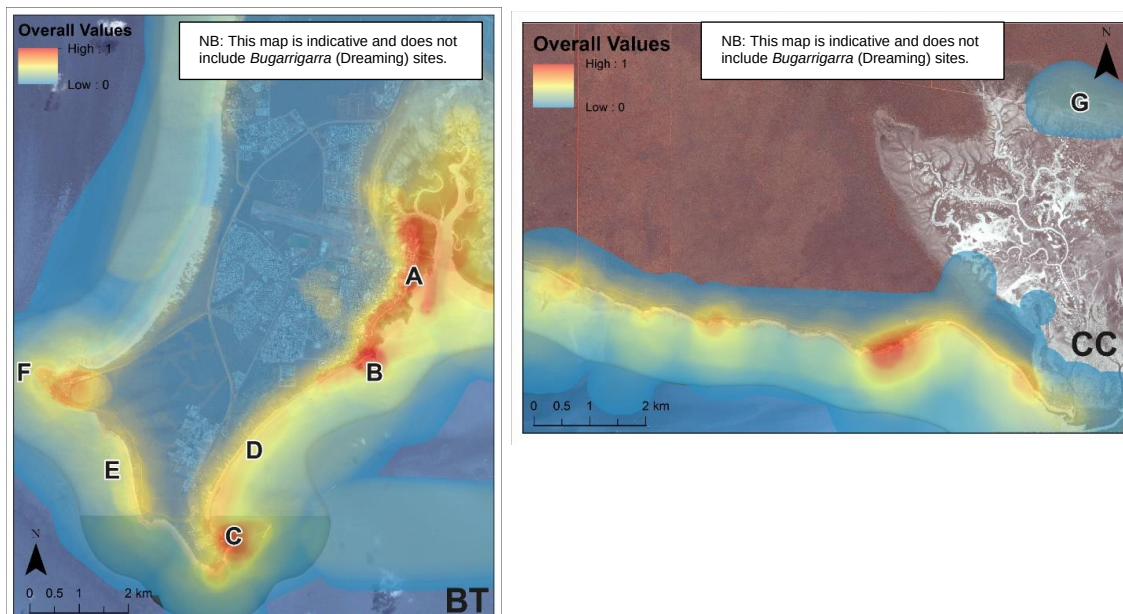


Figure 7.10: Synthesised Values model for Broome Town (BT) and Crab Creek (CC)

Moderate to high values were distributed along Simpson's Beach (D) and clustered at Reddell Beach North (E) and Minyirr (F). At Crab Creek, distinct clusters of moderate to high values punctuate distributed low to moderate values along the foreshore. Low to moderate values were also recorded for one area in the north east of the site adjacent to Old Broome Road (G).

7.2 The spatio-temporal distribution of site use across three calendars

The following presents a sequence of site use models for the months of the Gregorian calendar, the Yawuru seasons and Broome's wet and dry seasons. Results here are presented by study site to highlight the shifts in use across time.

7.2.1 The spatio-temporal distribution of the use of significant areas across the months of the Gregorian calendar

Figure 7.11 and Figure 7.12 show use of valued areas for Gregorian months at both sites. Shifts in use across time are evident for both sites, but more pronounced at Crab Creek. In Broome Town (Figure 7.11), the Roebuck Bay shoreline, which is close to town and includes many houses occupied by Yawuru people, has consistent moderate to high use peaking from April to August. Minyirr (A) and Dampier Creek (B) have greater seasonal variation in use. The peak in use of Minyirr coincides with times when the stingray and oysters targeted in the area are fat. The peak in use of Dampier Creek coincides with the seasonal availability of creek fish such as *walga-walga* which are targeted in the area. Certain sites within Broome Town were only recorded as being used at particular times of year. For instance, the area to the north of Cable Beach (C), which is very popular with tourists in the dry season, is only marked as used in September to October, a time which leads up to the harvest of turtle eggs from the area.

At Crab Creek (Figure 7.12), use of the whole site peaks from April to July when the area is comparatively dry and many creek fish are "fat", or good to eat. From September to November, when creek fish are less abundant but shellfish are "fat", use of the entire site is low to moderate. At Crab Creek, areas of use are distributed along the foreshore. However, the area from Sabu Rock to Crab Creek (A) has the highest site use. At Sabu Rock, a popular picnic and boat launching spot for many Yawuru families, cars could be driven onto the beach at the time of interviews. Towards Crab Creek at the east of the site, several Yawuru participants mentioned areas that they felt were important for their immediate family.

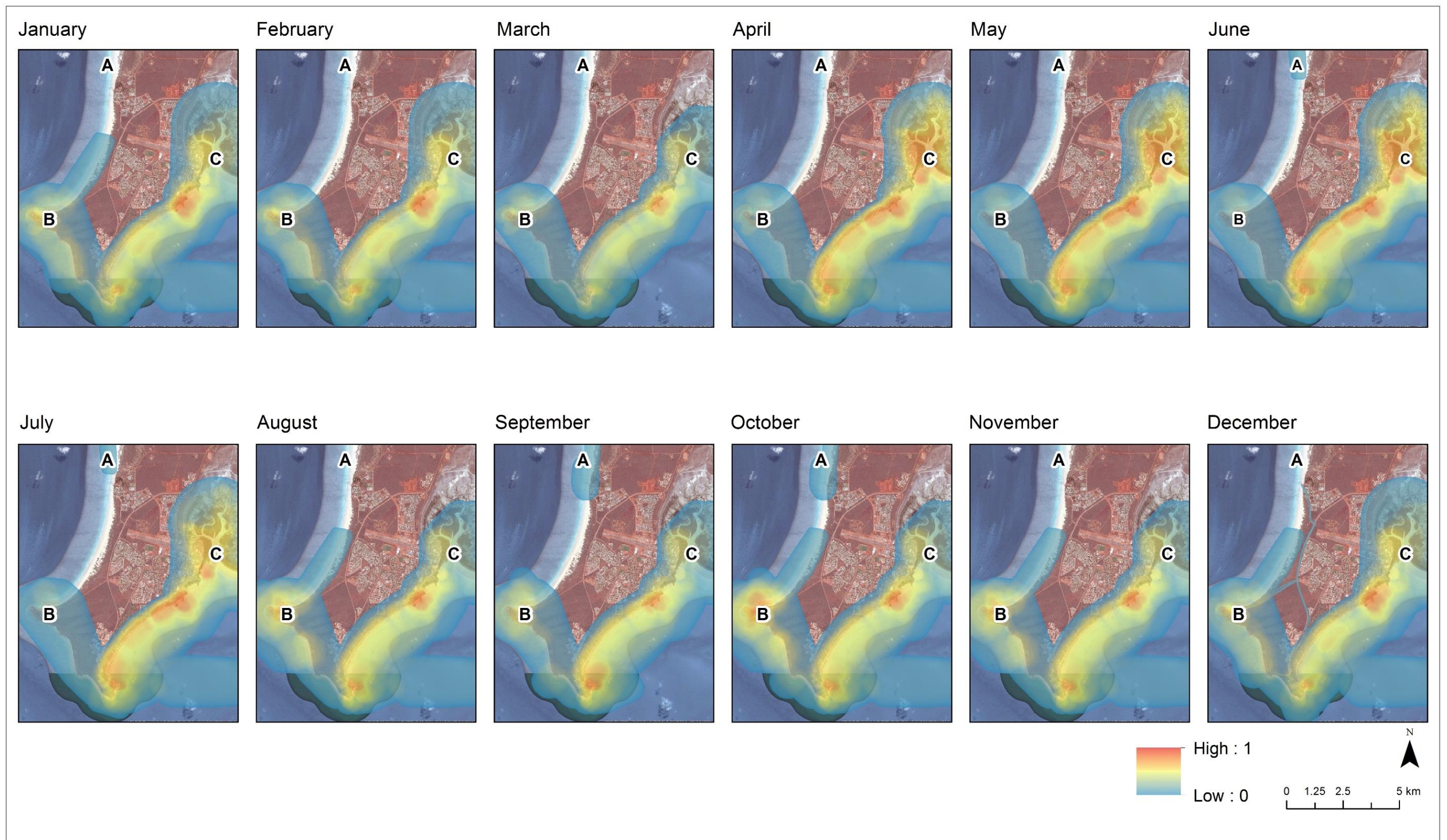


Figure 7.11: Site use at Broome Town over the twelve months of the Gregorian calendar

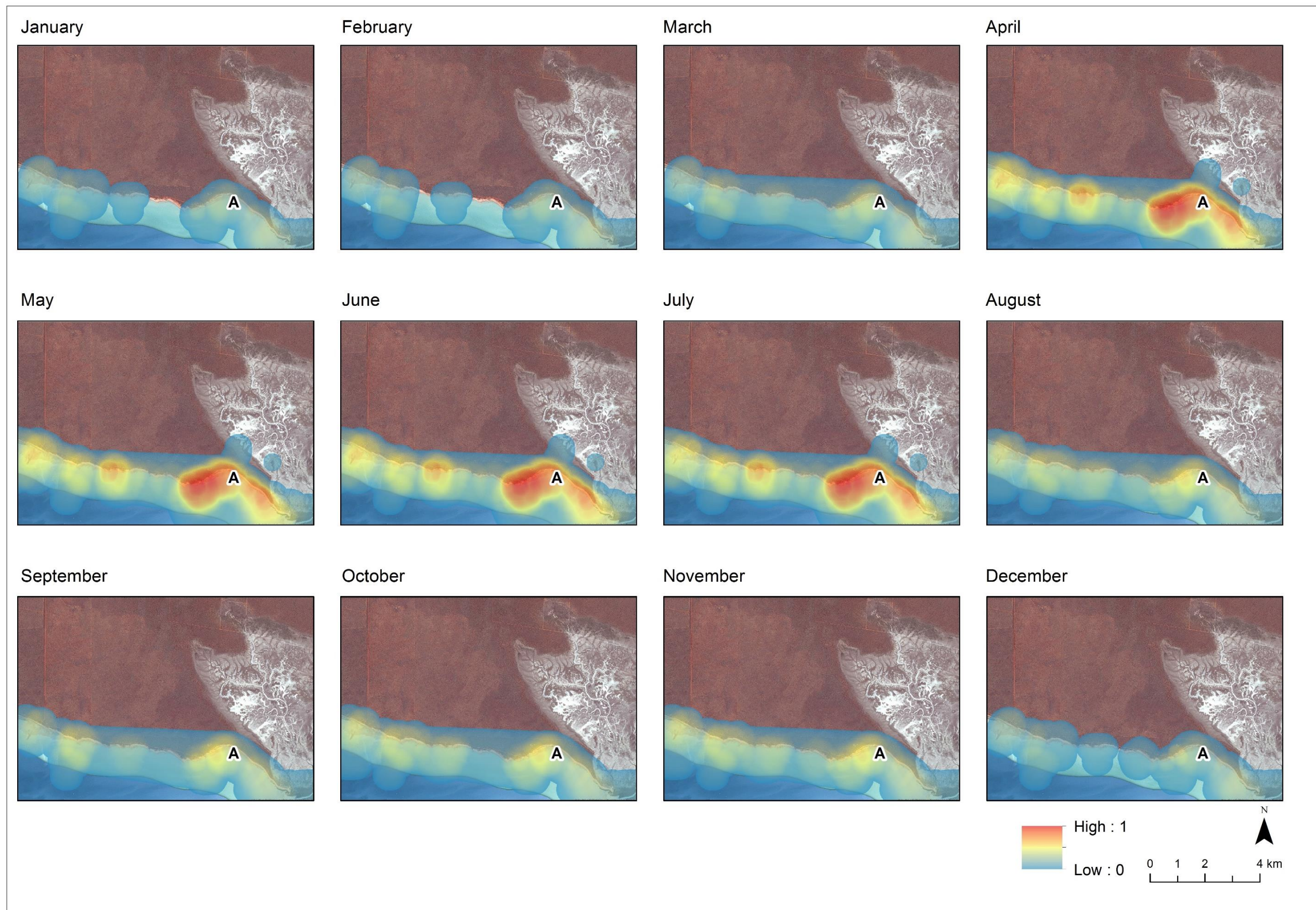


Figure 7.12: Site use at Crab Creek over the twelve months of the Gregorian calendar

7.2.2 The spatio-temporal distribution of the use of significant areas across the Yawuru seasons

Figure 7.13 shows the shifting use of valued areas over the Yawuru seasons for Broome Town. Here, seasonal shifts are more evident than in the 12 months of the Gregorian calendar. This model displays high seasonal variation in the use of Cable Beach (A), Minyirr (B), and Dampier Creek (G). It also displays comparatively consistent moderate to high use of areas which are easily accessed and have resources year-round such as the Broome Port (D), Simpson's Beach (E) and Town Beach (F). Use of Reddell Beach, a popular area for collecting shells most seasonally productive in the wet but hard to access due to the quality of dirt roads in the area, is comparatively low but consistent (C).

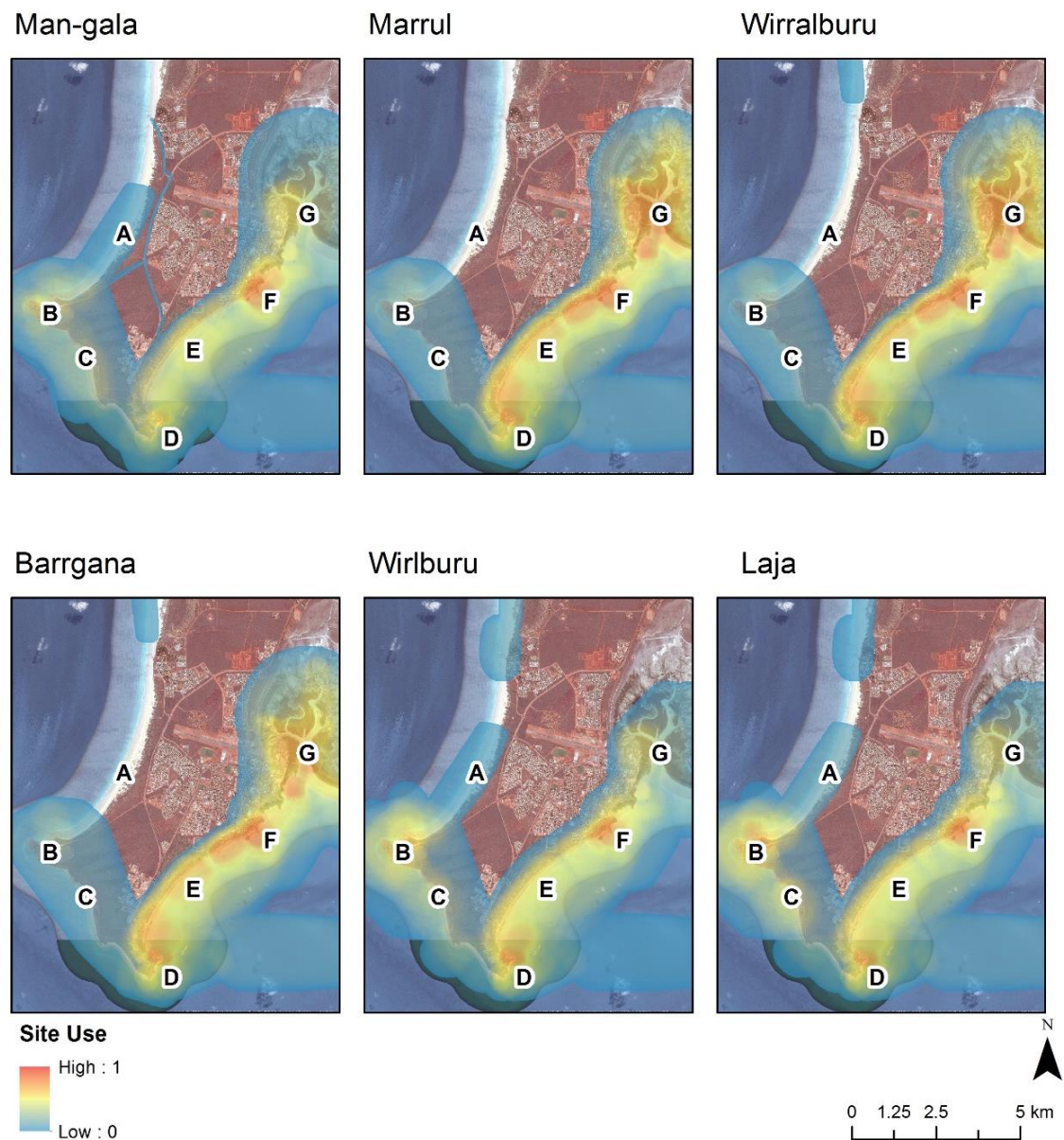


Figure 7.13: Site use at Broome Town over the six seasons of the Yawuru calendar

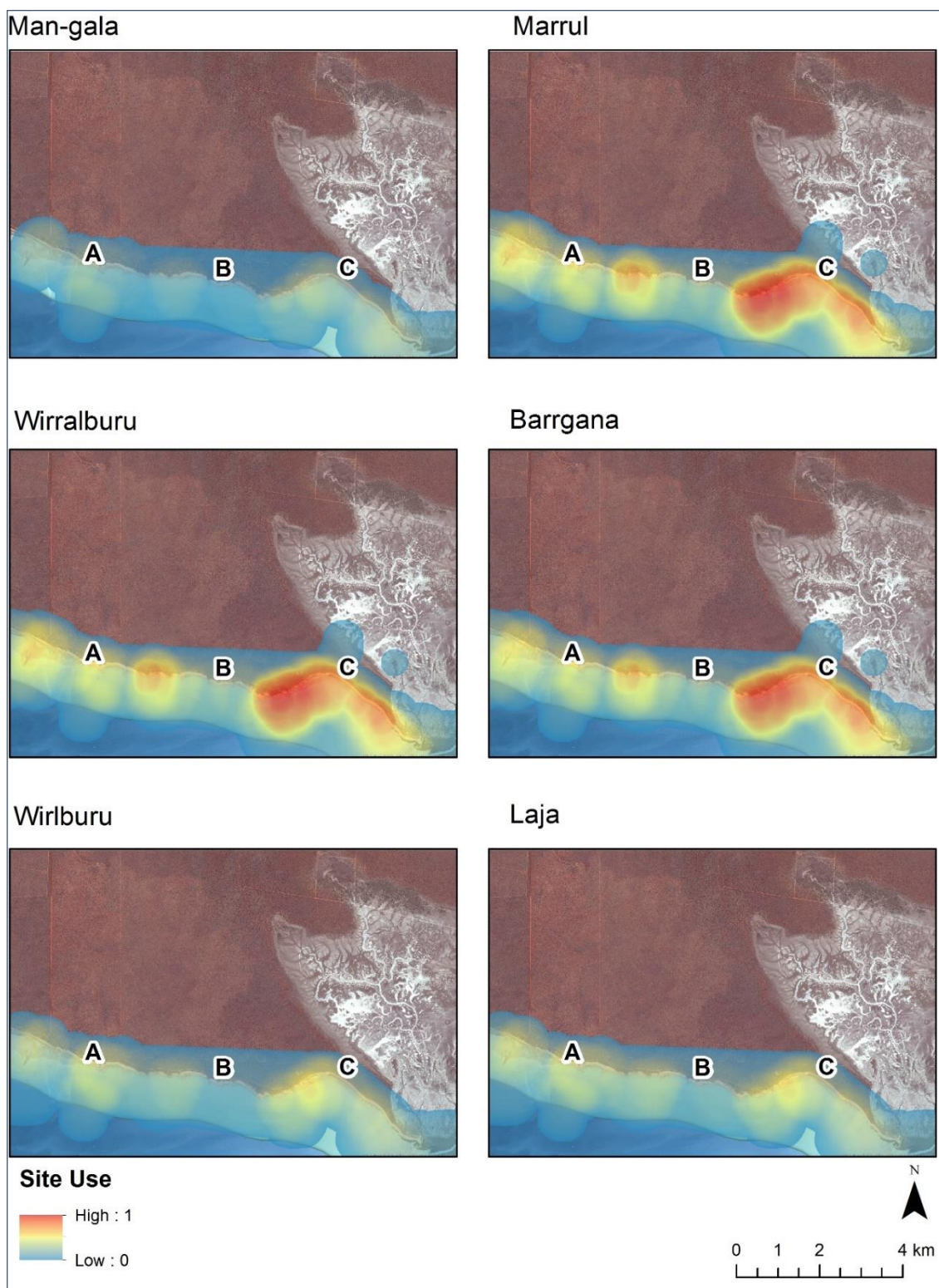


Figure 7.14: Site use at Crab Creek over the six seasons of the Yawuru calendar

Figure 7.14 shows use of the Crab Creek site across the six Yawuru seasons. As with the observations made for the Gregorian calendar, many of the shifts in seasonal use recorded in this

model appear to occur at the whole site level with the highest use at areas which are comparatively easy to access or favoured by particular Yawuru families. The area around Buga Wamba/ Gabanyanya (A) and the area at and beyond Sabu Rock (C) show higher fluctuation while the area between Black Rock and Fall Point (B) shows lower and more consistent use.

7.2.3 The spatio-temporal distribution of the use of significant areas across Broome's wet and dry seasons

Figure 7.15 and Figure 7.16 show the shifting use of valued areas correlated to Broome's wet and dry seasons as identified in the Shire of Broome Local Planning Strategy. Figure 7.15 shows that use of Town Beach (E), Catalinas (F) and the Broome Port Jetty (D), which are boat launching sites targeted for resources, continues through the wet and dry seasons. By contrast, use of Dampier Creek (H) is semi-consistent: low to moderate in the wet and moderate to high in the dry. The area north of the rocks at Cable Beach (A) was marked as being used in the dry season only. Use of Minyirr (B) and Reddell Beach (C), which are often targeted either for shellfish or for wet season species but only accessible by dirt roads subject to seasonal closures, was highest in the wet, but relatively constant all year round. The mangroves close to Chinatown (G) are close to the residences of many Yawuru people and often targeted for bait. These showed moderate to high modelled year-round use.

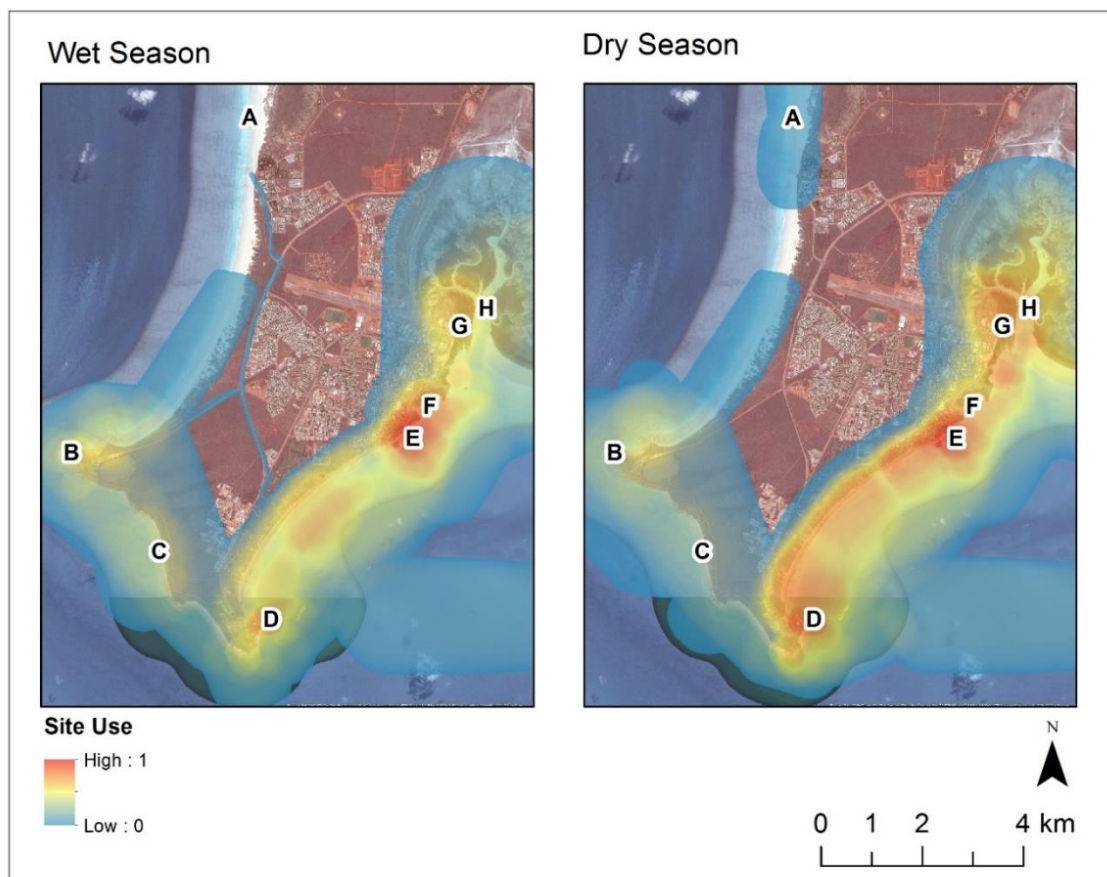


Figure 7.15: Site use in Broome Town over the wet and dry seasons of Broome's Tropical monsoonal calendar.

Figure 7.16 also shows a large difference between wet and dry season use of Crab Creek. Use of the site was low during the wet, but moderate to high in the dry. Again, this use concentrated on the area from Sabu Rock to Crab Creek (A).

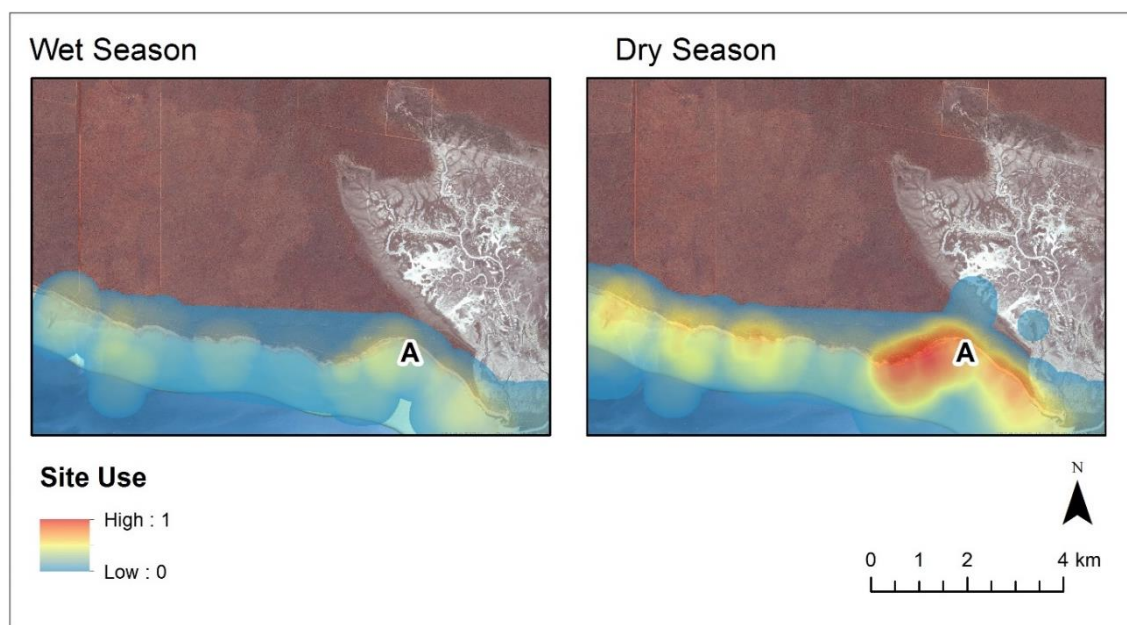


Figure 7.16: Site use at Crab Creek over the wet and dry seasons of Broome's Tropical monsoonal calendar.

7.3 Preliminary spatial distributions of key concerns across significant areas

7.3.1 Factor models for key concerns from a management perspective

Below are presented the results from four concerns factors relevant to Yawuru governance. As in the models above, these results capture only locations where these concerns coincided with areas significant to participants.

7.3.1.1 Future development

“I don’t want to be destroyed. That was, they cut that off we have no life for ourselves, or for our children futures. Fishing and hunting. You know? [...] We don't want people to tell us “You can't go down there. You can't do what you like there”. That's not the place, you know. We don't want that to happen.” June Cattermole

“We know that for a fact that [...] all around the world [...] where there is development, and people grow [...] build out they, they potentially close that areas that were once accessed, frequently accessed, by the Indigenous people. [...] I'm just concerned that, you know, these areas could potentially, you know, not there for the next generation.” Dean Mathews

Concerns about future or proposed developments were often raised by NBY staff and participants during data-collection. Figure 7.17 shows that these concerns were most concentrated in the Broome Port area (A). At the time of interviews, blocks of land in this area were advertised for industrial sale and lease. Moderate concerns were also recorded for Dampier Creek (B), the foreshore below Kennedy Hill (C) and Minyirr (D). Many of these locations have either been put forward for inclusion in marina proposals, been subject to past development, or explicitly mentioned in other development proposals which may or may not be proceeding. Low level concerns were distributed across much of the remainder of Broome Town.

Figure 7.17 also shows concerns about future development at Crab Creek. These concerns were low and site specific. They were found south of Crab Creek Road (E), from Buga Wamba to Gabanyanya (F), at Sabu Rock/ Blackberry Tree (G) and at an area near Old Broome Road in the north of the site (H). To my knowledge, no development proposals other than the installation of infrastructure to support visitation have been made for these sites.

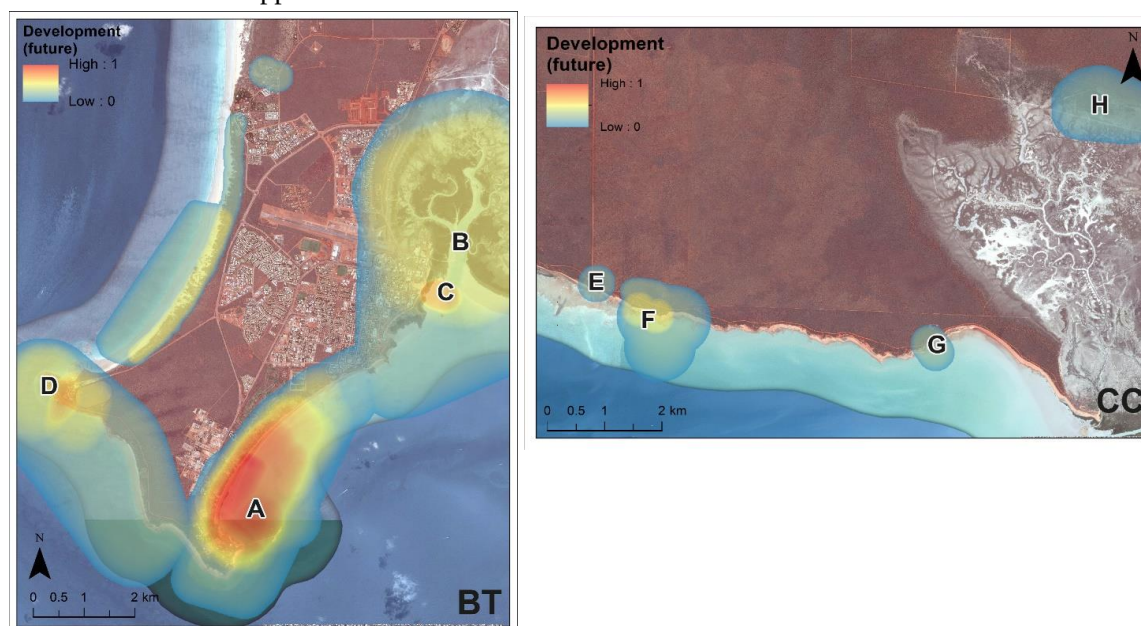


Figure 7.17: Modelled concerns about future development for Broome Town (BT) and Crab Creek (CC).

7.3.1.2 Closure

“We were fishing on both sides you know? And, then right up to the point here, you know? But we can't do that anymore now. We can't go on the jetty, we only just fish along the side of the jetty now.” Martha Lee

“Yeah, we can't fish off the Jetty on... how we used to. Especially at the end, see. That's where all the fish are holding up!” Mr Gregory

Maintaining access to Country is a key issue in the Yawuru Cultural Management Plan. In Figure 7.18, it can be seen that concerns about closure in Broome Town were largely clustered near Entrance Point and the Broome jetty at the south of the site (A). These areas controlled by the Port of Broome have been subject to temporary and permanent closures in the past. Low levels of concern about closure can also be seen at Minyirr (B), Reddell Beach (C) and Dampier Creek (D).

Figure 7.18 also displays Yawuru participants' concerns about closure for Crab Creek. It shows low to moderate concerns about closure along the foreshore of this site. This area had unregulated spur roads at the time of interviews. Under proposals made in the joint management plans for this area, many of these roads are likely to be closed.

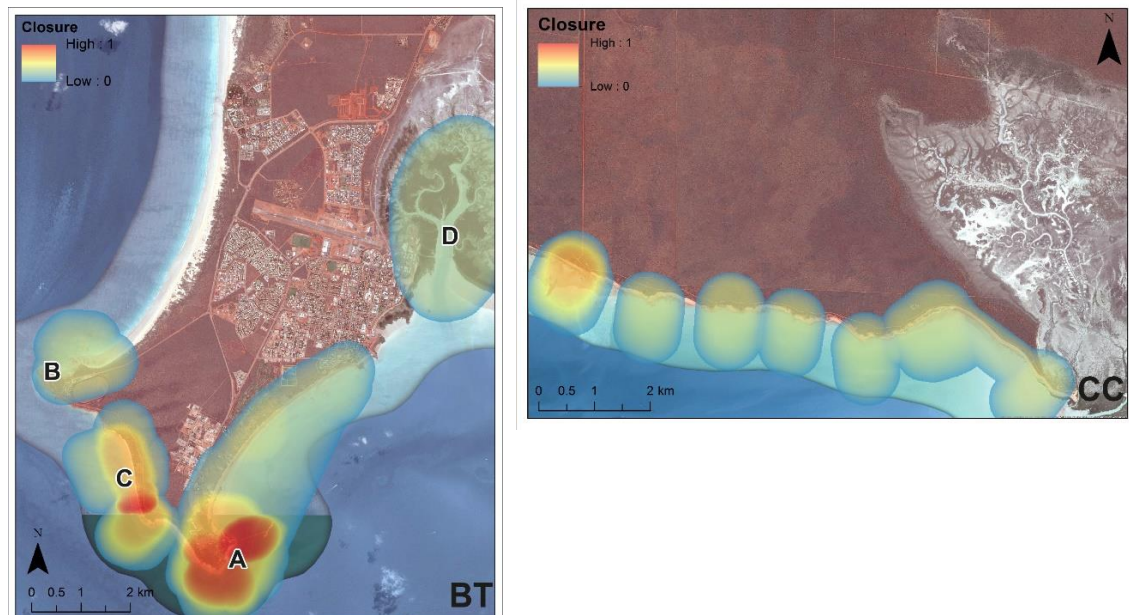


Figure 7.18: Modelled concerns about closure for Broome Town (BT) and Crab Creek (CC).

7.3.1.3 Erosion

“Sometimes people don't go fishing at places because the road is messed up, when you travel down or walk down.” Johnathon Pearson

“[I don't go] as an older person. Too hard for the legs and the knees, deary, to go over the rocks.” Judy Edgar

“So, a lot of the cliff faces are eroding away rock structures that are of cultural significance, are being degraded, I suppose. By natural processes.” Yawuru Custodian

Erosion has potential to limit Yawuru people's capacity to access their Country and is a core management issue in much of the Yawuru conservation estate. Figure 7.19 shows participants' concerns about erosion at Broome Town and Crab Creek. At Crab Creek, low concerns about erosion were recorded at sites all along the coast. High concerns were concentrated in the Sabu Rock/ Blackberry Tree area (A) where erosion had greatly degraded access down to the beach at the time of interviews. In Broome Town, low to moderate concerns about erosion were recorded for the in-town foreshore of Roebuck Bay. Moderate concerns were also recorded for Reddell Beach (B) and moderate to high concerns recorded for Minyirr (C) where erosion of the Broome sandstone is rapidly changing the shape of the cliff line and, for some older Yawuru participants, impacting on their willingness to access the site due to concerns about their personal safety.

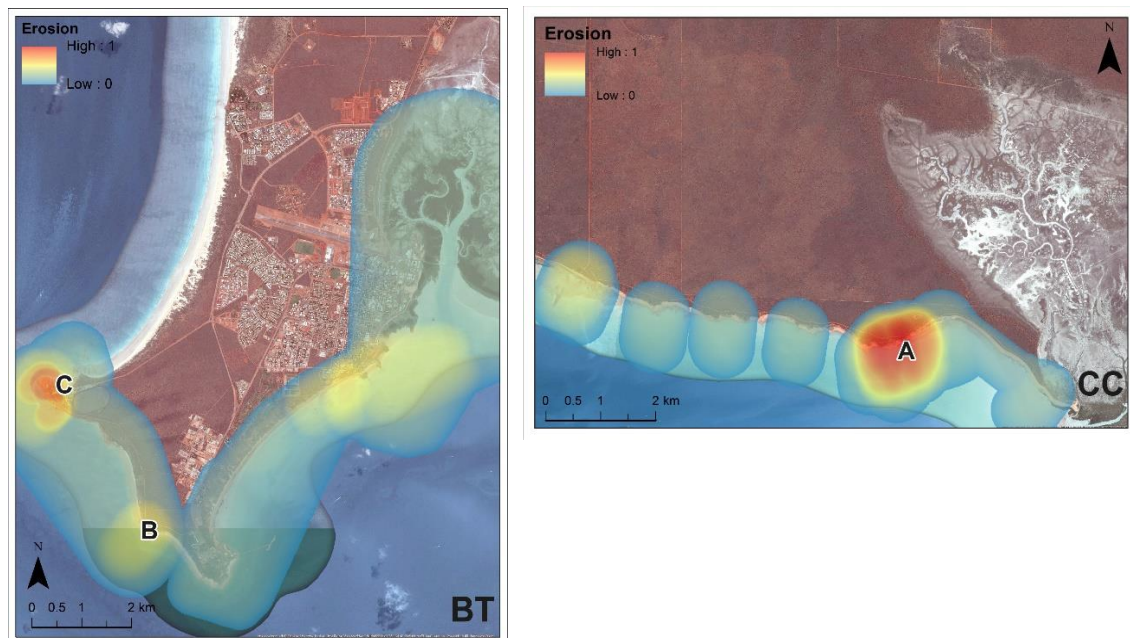


Figure 7.19: Modelled concerns about erosion for Broome Town (BT) and Crab Creek (CC).

7.3.1.4 Off-road vehicle use

“[I’ve] actually, seen some car tracks. You know, just close by the rock, the actual rock, just cruising past the rock on the beach.” Yawuru Custodian (when referring to very significant men’s site)

“You go out there, so you don’t have to keep a close eye on them for cars and stuff like that. And it’s slowly becoming, you know, you have to watch them a bit more now.” Holly Moore

“Because they park there. Daytime, night-time, the old girl can’t get up and do her thing.”

Mr. Gregory, referring to how cars interfere with turtle nesting.

Echoing comments contained in the Yawuru Cultural Management Plan, several Yawuru people expressed concerns about off-road vehicle use and cars on the beach. Figure 7.20 shows concerns about off-road vehicle use at Broome Town and Crab Creek: these concerns are clustered in both study sites. In Broome Town, concerns about off-road vehicles were moderate to high for “the rocks” at Cable Beach (A) and moderate at Minyirr (B). At “the rocks”, vehicles drive immediately adjacent to sacred structures as shown in Figure 7.21. At Minyirr, cars drive onto the beach to fish, launch boats, picnic and watch the sun set. At Crab Creek, moderate to high concerns were recorded for Sabu Rock/ Blackberry Tree east (C) and very high concerns recorded from Lalgā Rock to the Crab Creek waterbody (D). Here, participants noted that off-road vehicles interfered with turtle nesting and affected the way that they used the area. Moderate

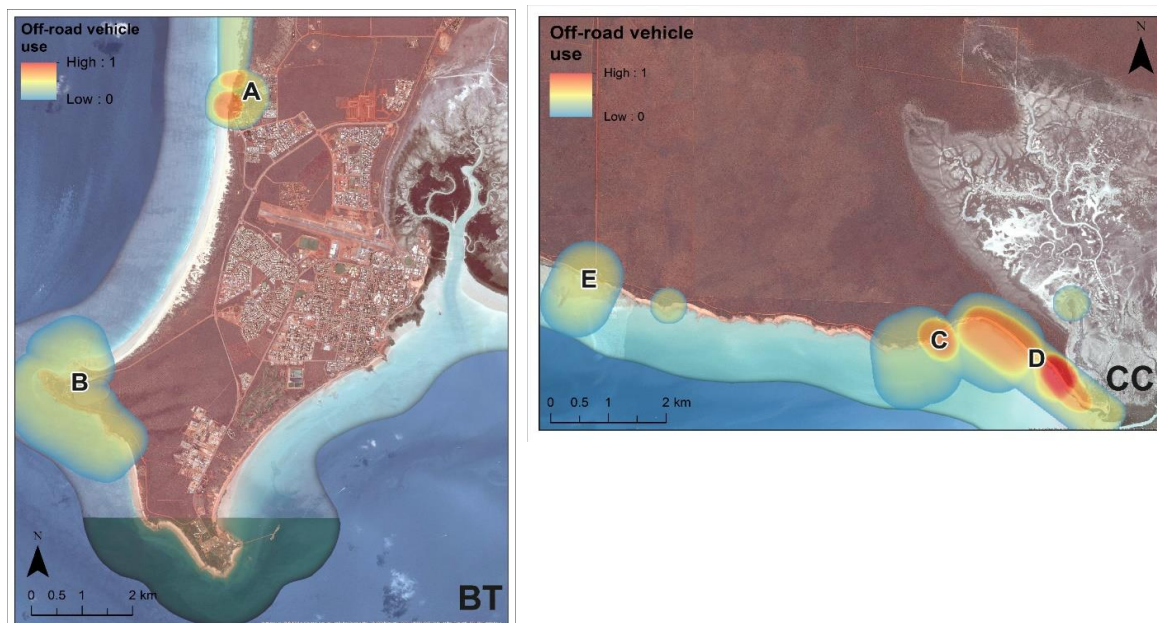


Figure 7.20: Modelled concerns about off-road vehicle use development for Broome Town (BT) and Crab Creek (CC).

concerns were south of Crab Creek Rd and near Buga Wamba where driving on the beach was occurring near sacred structures (E).



Figure 7.21: Image of off-road vehicle use near a sensitive area at Cable Beach North.

7.3.2 The synthesised concerns model: a preliminary representation of the distribution of Yawuru concerns for valued areas across space

Figure 7.22 presents the final outputs from the combinatory procedures: the synthesised concerns models for Broome Town and Crab Creek. It can be seen in Figure 7.22 that moderate concerns were recorded for the entire in-town foreshore of Roebuck Bay and the Reddell Beach area (A). It can also be seen that low to moderate concerns were recorded for much of the Cable

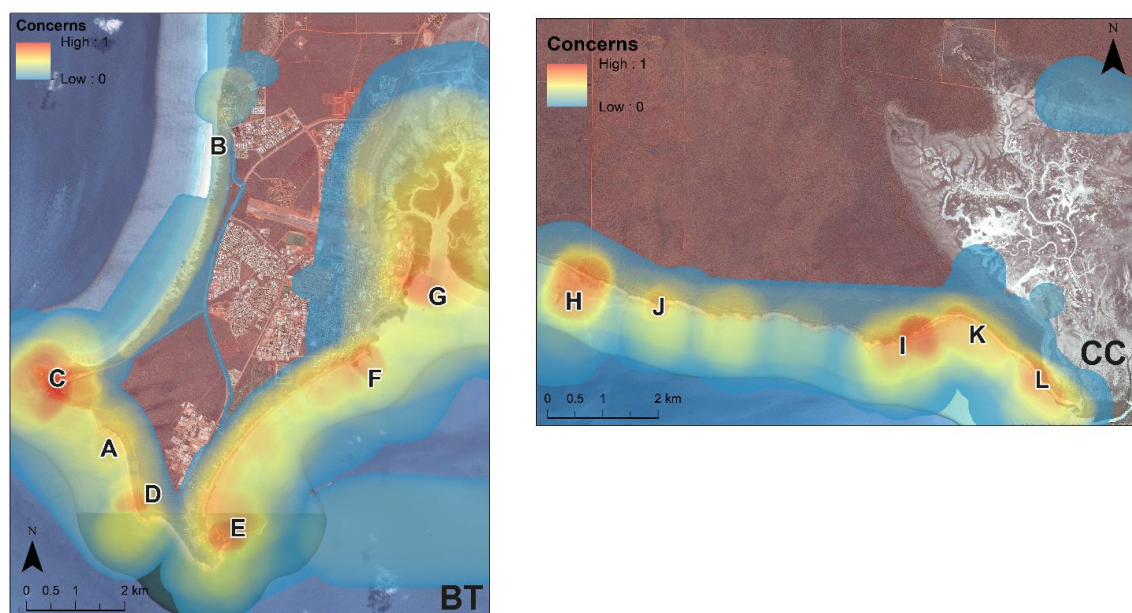


Figure 7.22: Synthesised concerns model for Broome Town (BT) and Crab Creek (CC).

Beach foreshore (B). Moderate to high concerns were spatially concentrated in Minyirr (C), Yilagun (D) which is an area adjacent to Reddell Beach south, and Broome Port (E). They were also recorded for Demco Beach (F) and the Kennedy Hill foreshore (G).

As shown in Figure 7.22, low to moderate level concerns were registered for the entire foreshore area of Crab Creek as well as one area to the north of Old Broome Road at the north east of the study site. High levels of synthesised concerns were spatially concentrated south of Crab Creek Road (H) and adjacent to Sabu Rock and Fall Point (I). Moderate concerns were also observed for Buga Wamba (J), the Broome Bird Observatory (K), or Crab Creek (L).

7.4 Identified conflicts and synergies between project outputs and planning documents

In this project, tenure, zoning and management documents were overlaid on values and concerns for Broome Town and Crab Creek to provide location specific contextual intelligence for the two sites. Results for these overlays are presented by study site.

Figure 7.23 to Figure 7.25 show overlays of tenure, zoning and management documents on the Broome Town site. Here, I used visual analysis to prepare tables which compare the relative intelligence provided by the documents for ten heterogeneous locations. The relevance of these locations to Yawuru governance bodies and some general responsibilities for the management of these sites are in Table 7.1.

Figure 7.23 shows the intersection between recognised Yawuru native title rights and modelled values and concerns in the Broome Town area.

As can be seen in Figure 7.23, there is a clear discrepancy between the fuzzy, continuous modelled values and concerns and the Boolean overlays which record native title recognition across Broome Town. At Gantheaume Point Beach (D), for instance, as concerns transition from high to moderate, there is an abrupt change from an area where native title does not exist to an area with non-exclusive native title. Similarly, around the fringes of Dampier Creek (J) as values and concerns gradually transition from moderate to low moving away from the creek, there are two abrupt transitions from no native title recognition to exclusive native title recognition and back again (J).

Figure 7.23 and Table 7.2 show that native title recognition and high values or concerns are not necessarily spatially coincident. For example, Table 7.2, which compares values, concerns and native title recognition across the ten locations outlined above, shows that Hidden Valley (C) has low modelled values and concerns, but exclusive native title recognition. At the same time, native title does not exist in Broome Port (G) which has very high modelled values and concerns. At Minyirr (E) moderate to high modelled values and high concerns about erosion, closure and

the potential for future development only coincide with exclusive native title rights at the fringes of the area. The same is true for Town Beach (I).

Table 7.1: The importance of ten locations within Broome Town to Yawuru governance

Site	Location	Responsibility for management	Relevance to Yawuru governance
A	Cable Beach North	Shire of Broome, DPAW, Yawuru Park Council	An area of significance to northern Yawuru people. A number of spiritually important sites are contained in this area which is included in the Yawuru conservation estate, but also regularly accessed by off-road vehicles (Yawuru RNTBC and Shire of Broome, 2016).
B	Cable Beach South/ Minyirr Park	DPAW, Yawuru Park Council	Minyirr Park was one of the first locations in the Yawuru estate to be incorporated into a co-management arrangement (Indigenous Studies Program The University of Melbourne, 2011). Much of Cable Beach South is incorporated into the Minyirr Park area (Shire of Broome, 2014a).
C	Hidden Valley	DPAW, Yawuru Park Council	Linked to an important songline and ecologically significant dunes which are incorporated into the Yawuru conservation estate (Yawuru RNTBC and Shire of Broome, 2016). Not a commonly accessed area.
D	Minyirr / Gantheaume Point	Shire of Broome, DPAW, Yawuru Park Council	A popular fishing location, the outer fringes of which are included in the Yawuru conservation estate (Yawuru RNTBC and Shire of Broome, 2016).
E	Reddell Beach	DPAW, Yawuru Park Council	A minor to major day-use area which is part of the in-town Yawuru conservation estate and commonly used by Yawuru people to access Reef Fish and shell fish (CCS Strategic <i>et al.</i> , 2013). Contains some of the only reef Country in the Yawuru estate.
F	Broome Port/ Jetty/ Entrance Point	The Port of Broome	An area commonly accessed by Yawuru people to fish. Adjacent to spiritually significant sites (GHD and Kimberley Ports Authority, 2017). This area is under the management of the Broome Port Authority (CCS Strategic <i>et al.</i> , 2013). It is not included within the Yawuru conservation estate.
G	Simpson Beach	DPAW, Yawuru Park Council	An area commonly accessed by Yawuru people for resource collection. Incorporated into the Yawuru conservation estate (Yawuru RNTBC and Shire of Broome, 2016).
H	Demco	Shire of Broome, DPAW, Yawuru Park Council	A commonly used fishing site adjacent to expensive residential developments and incorporated into the in-town Yawuru conservation estate (Yawuru RNTBC and Shire of Broome, 2016).
I	Town Beach	Shire of Broome	An area commonly used as a meeting point by Yawuru people (Yawuru RNTBC, 2013). Not part of the in-town Yawuru conservation estate.
J	Outer edges of Dampier Creek	Shire of Broome, DPAW, Yawuru Park Council	A culturally significant area both in, and adjacent to, the Yawuru conservation estate (DPAW, 2016a).

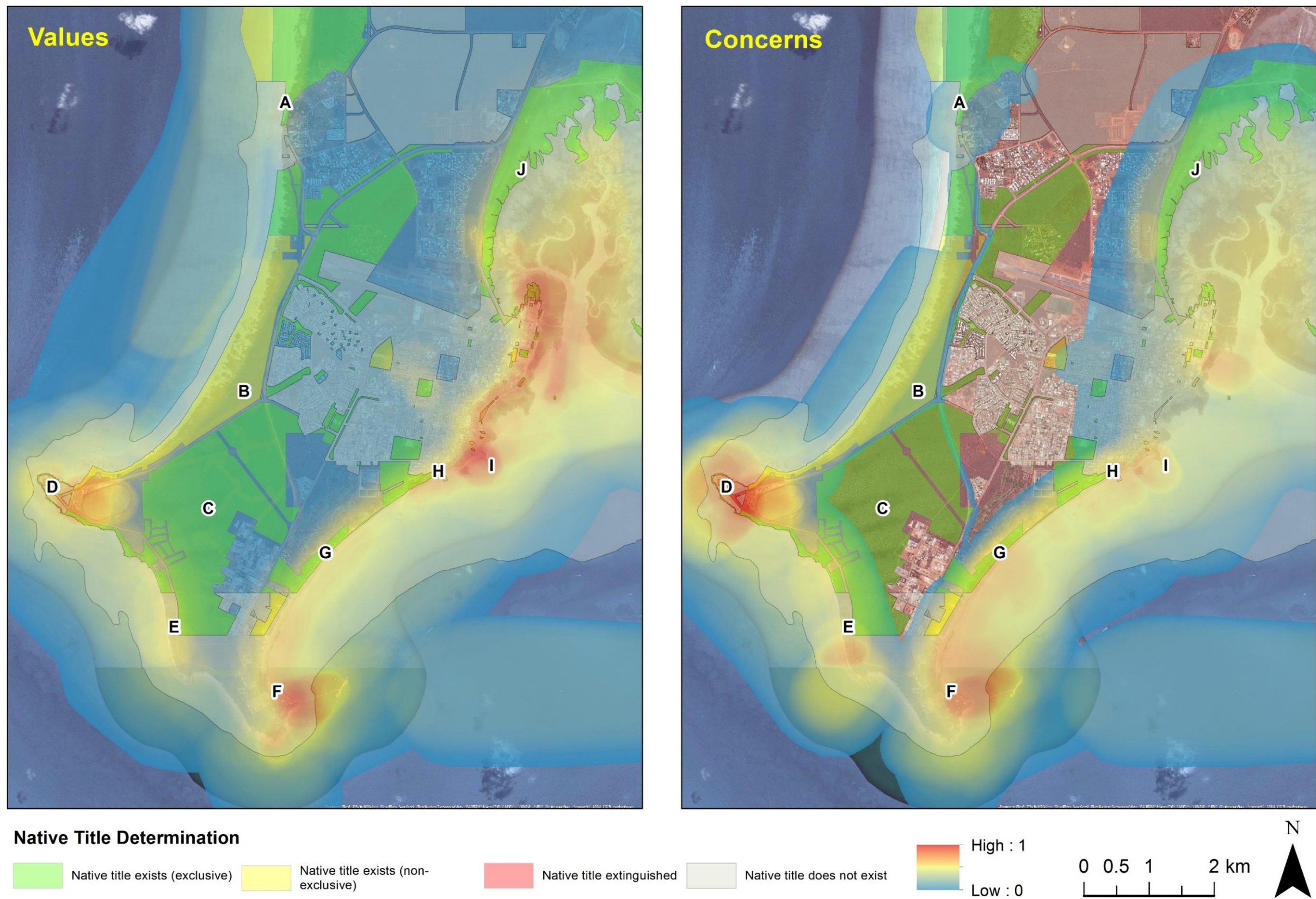


Figure 7.23: Modelled values and concerns overlaid on native title recognition in Broome Town

Table 7.2: Modelled values and concerns compared to native title recognition across ten key locations in the Broome Town site

Site	Location	Modelled value (excluding metaphysical sites)	Modelled concerns	Native title
A	Cable Beach North	Low	Low	Exclusive and Non-exclusive
B	Cable Beach South/ Minyirr Park	Low- Moderate*	Low	Largely Non-exclusive
C	Hidden Valley	Low*	Low- none	Exclusive
D	Minyirr/ Gantheaume Point	Moderate- High	High – Very High	Does not exist/ Non-exclusive/ Minimal Exclusive
E	Reddell Beach	Low- Moderate	Moderate	Exclusive/ Native title does not exist
F	Broome Port/ Jetty/ Entrance Point	Very High	Very High	Does not exist (Extinguished)
G	Simpson's Beach	Moderate- High	Moderate - High	Exclusive/ Native title does not exist
H	Demco	Moderate- High	Low - Moderate	Exclusive/ Native title does not exist
I	Town Beach	Very High	Moderate	Does not exist (Extinguished) / Small areas non-exclusive
J	Outer edges of Dampier Creek	Moderate	Low	Exclusive

The protection of Yawuru interests will also require Yawuru governance agencies to be aware of how zoning or local planning schemes may impact on Yawuru people's values and concerns across the estate. The Shire of Broome Local Planning Scheme Number Six uses zones, reserves, and special control areas to regulate development across the Shire of Broome (Shire of Broome, 2014a). This scheme creates varying levels of potential threat to Yawuru values from development as outlined in Appendix 7B and summarised in Table 7.3. It also creates special purpose zones which place restrictions on development as outlined in Table 7.4. Figure 7.24 presents an overlay of digitised maps from this planning scheme on top of modelled Yawuru values and concerns. Table 7.5 identifies the zones, reserves and special control areas present in each of the ten locations to be examined across the Broome Town site and assesses their implications for development in the area. Table 7.5 then compares this assessment of Local Planning Scheme Six zoning to modelled values and concerns at these locations to identify potential synergies and conflicts between these values across Broome Town.

Using examples from Figure 7.24 and Table 7.5 it can be seen there are potential synergies between the Local Planning Scheme Six and Yawuru values at Cable Beach North (A) and South (B), Reddell Beach (E) and Simpson's Beach (G). At these sites, modelled values overlap with

Table 7.3: Zones and reserves from the Shire of Broome Local Planning Scheme Number Six, their purpose and likely threat to Yawuru values.

Reserve or Zone	Purpose	Risk from development
Coastal Reserve	“To recognise and protect the environmental integrity, Aboriginal culture and landscape significance of the coastal foreshore and immediate hinterland” (Shire of Broome, 2014a:7).	Low
Parks, Recreation and Drainage Reserve	“To serve the active and passive recreation needs of the local community and allow [...] recreation buildings, car parking, and to provide for drainage areas that incorporate water sensitive urban design principles” (Shire of Broome, 2014a:7-8).	Low
Port Reserve	“To provide for industrial uses and activities which are associated with the Port of Broome, in addition to administration facilities and recreational uses” (Shire of Broome, 2014a:9).	Moderate-High
Residential Zone	“... to provide for residential development at a range of densities with a variety of housing to meet the needs of different household types” (Shire of Broome, 2014a:11).	Moderate – High
Rural Residential Zone	“...to provide for residential use in a rural environment” (Shire of Broome, 2014a:12).	Moderate
Culture and Natural Resource Use Zone	“... to provide for the use of natural resources, preservation of Aboriginal heritage and cultural areas and the conservation of natural environmental values including significant landscapes and environmental areas” (Shire of Broome, 2014a:15).	Low
Development Zone	“... to identify areas requiring comprehensive planning prior to subdivision and development; to coordinate subdivision, land use and development in areas requiring comprehensive planning” (Shire of Broome, 2014a:16).	Moderate-High
Public Purposes Reserves	To set aside land for specific public purposes (Shire of Broome, 2014a).	Variable

coastal reserves which are designed “to recognise and protect the environmental integrity, Aboriginal culture and landscape significance of the coastal foreshore and immediate hinterland” (Shire of Broome, 2014a:6). Here, many of the modelled values also overlap with Special Control Areas which place further restrictions on development. For example, at Cable Beach South (B) a Landscape Protection Area (SCA7) places stringent controls on development as outlined in Table 7.4. In these areas, Local Planning Scheme Six zoning may help to preserve rather than threaten values held by Yawuru participants. Indeed, it is possible that with caution, the synergies visible in this overlay may be used to allay some of the concerns about future development expressed by Yawuru participants.

In some locations, Yawuru values may be threatened by zoning and reserves under the Local Planning Scheme Six. At Broome Port (F), only a small portion of the very high modelled values and concerns overlap with a coastal reserve. The rest of the Port is reserved for “industrial uses and activities [which] are associated with the Port of Broome, in addition to administration facilities and recreational uses” (Shire of Broome, 2014a:8). These uses and activities may conflict with high modelled Yawuru values and exacerbate Yawuru people’s existing concerns around development in the area.

Table 7.4: Special Control Areas from the Shire of Broome Local Planning Scheme Number Six, their purposes, and the restrictions that they place on development.

Special Control Areas	Purpose	Additional Restrictions on development
Existing Broome International Airport Environs (SCA1)	“...to control development within close proximity to the airport to ensure the ongoing safe operation of the airport” (Shire of Broome, 2014a:49).	Low
Essential Service Buffer Areas (SCA3)	“...to control development within close proximity of a site which may be considered a nuisance or offensive by virtue of noise, odour, health concerns and visual amenity and to control development so that it does not jeopardize or conflict with the ongoing operation of the essential services” (Shire of Broome, 2014a:50).	Low- Moderate
Flood Prone Land (SCA 4)	“...to minimise flood damage, ensure off-site impacts on adjoining land and receiving water bodies is limited, and to manage drainage for development” (Shire of Broome, 2014a:51).	Moderate
Drainage Aquifer Recharge Areas (SCA 6)	“...to control the extent of development to ensure that drainage provisions are adequately accommodated, and that any off-site impacts of development do not adversely affect the recharge area” (Shire of Broome, 2014a:53).	Moderate- High
Landscape Protection Areas (SCA 7)	“...to ensure that landscape protection areas are preserved and conserved in recognition of their environmental and ecological importance. This includes Monsoon Vine Thickets and Ramsar sites” (Shire of Broome, 2014a:53).	High

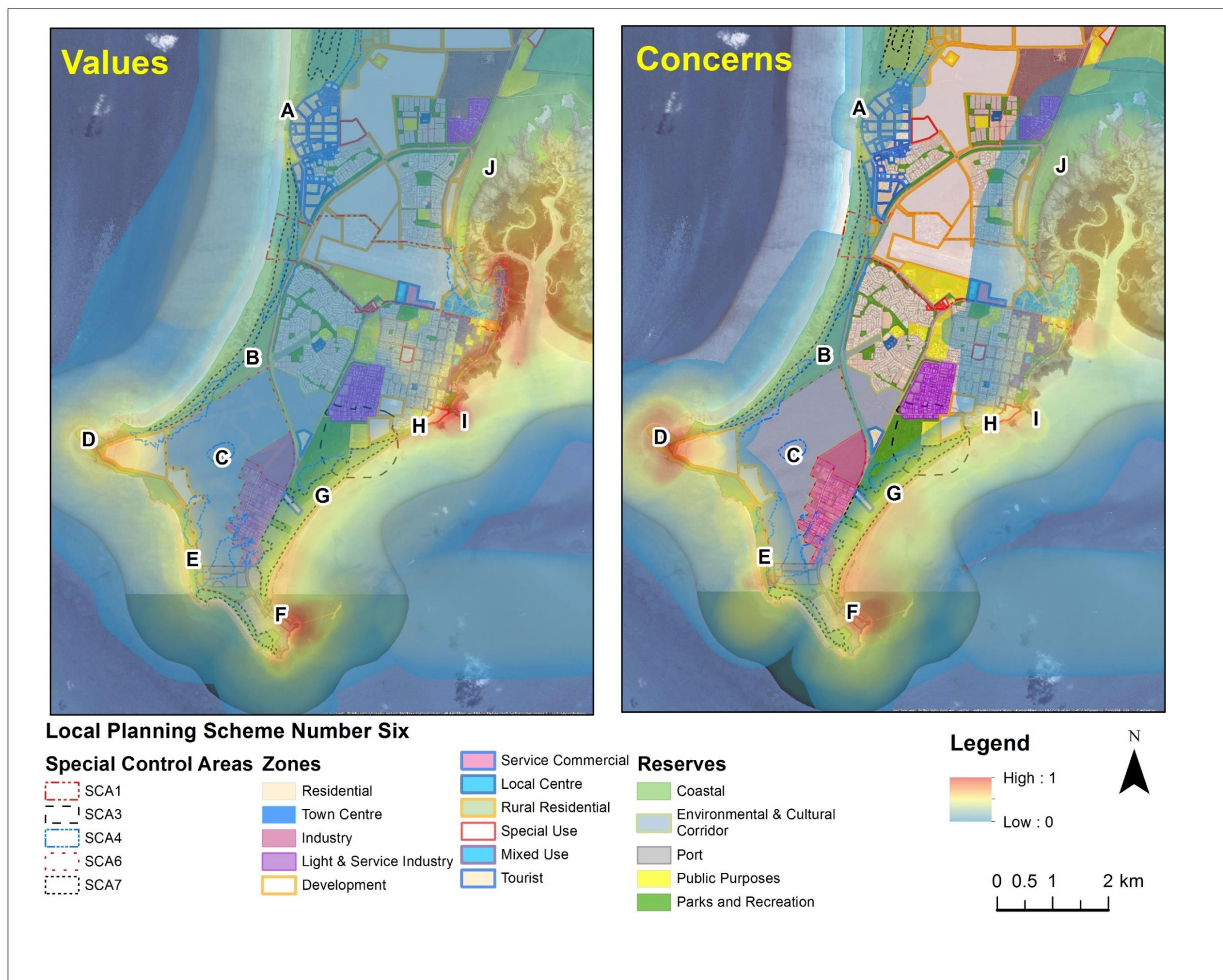


Figure 7.24: Modelled values and concerns overlaid on zones, reserves and special control areas from the Shire of Broome Local Planning Scheme Number Six

Table 7.5: Assessment of the threat to Yawuru values from zones, reserves and special control areas at ten key locations.

Site	Location	Local Planning Strategy Zones and Reserves		Special Control Areas (SCAs)		Modelled values*	Modelled concerns
		Zones/ Reserves	Development	Special Control Areas within region	Development Restrictions		
A	Cable Beach North	Coastal Reserve	Low	Landscape Protection Areas	High	Low	Low
		Tourist	High				
B	Cable Beach/ Minyirr Park	Coastal Reserve	Low	Existing Airport Environs	Low	Low- Moderate	Low
				Flood Prone Land	Moderate		
				Landscape Protection Areas	High		
C	Hidden Valley	Culture and Natural Resource Use	Very low - Low	Drainage Aquifer Recharge Area	Moderate- High	Low	Low- None
D	Minyirr/ Gantheaume Point	Coastal reserve	Low	Flood Prone Land	Moderate	Moderate- High	High- Very High
		Development	Moderate - High				
		Public Purposes	Variable				
		Residential	Moderate - High				
E	Reddell Beach	Coastal Reserve	Low	Landscape Protection Area	High	Low- Moderate	Moderate
		Rural Residential	Low	Flood Prone Land	Moderate		
		Port	Moderate- High				
		Development	Moderate- High				
F	Broome Port/ Jetty/ Entrance Point	Port	Moderate- High	N/A	N/A	Very High	Very High
		Coastal Reserve	Low				
G	Simpson Beach	Coastal Reserve	Low	Landscape Protection Areas	High		Moderate - High
H	Demco	Development	Moderate - High	Essential Service Buffer Areas	Low- Moderate	Moderate- High	Low- Moderate
		Coastal reserve	Low				
I	Town Beach	Parks and Recreation	Low	N/A	N/A	Very High	Moderate
J	Outer edges of Dampier Creek	Coastal Reserve	Low	N/A	N/A	Moderate	Low

In several instances, zoning under Local Planning Scheme Six appeared to support the level of concern recorded by Yawuru participants. In Minyirr Park (B) and Hidden Valley (C), Yawuru people's relatively low concerns are reinforced by various reserves, zones and special control areas likely to preserve Yawuru values in those areas. At Broome Port/ Jetty /Entrance Point (F), Yawuru participants' high concerns are likewise reinforced by the Port Reserve. In other instances, the overlay suggests that participants concerns were not proportionate to zoning. For much of Simpson's Beach (G) participants expressed moderate concerns about future development. Yet, much of this area overlaps with coastal reserve. This implies, for the time being, a lower threat to Yawuru values from development in the area. In coastal areas, higher Yawuru values were often spatially coincident with reserves or zones, such as coastal reserves, which could be leveraged to protect these values.

The zoning of Local Planning Scheme Six shows only permitted developments and uses, not site-specific plans. In this research, overlays were also prepared at the sub-regional level. Figure 7.25 shows the overlay of synthesised values on a composite of several maps found in the Broome Coastal Reserves Master Plan. These maps provide an opportunity to examine synergies and conflicts between site specific plans and modelled values and concerns as further outlined in Table 7.6. In this overlay, moderate to high values at Minyirr (D) are spatially coincident with plans to improve access and amenities. While portions of Entrance Point along the south-west protected by the Yawuru in-town conservation estate, very high values for the Jetty and Broome Port (F) neither overlap with the conservation estate, nor coincide with any specific plans under that plan. Moderate to high values for Simpson's Beach (G), a popular area for stingray hunting, coincide with a recognised need for fire management and further management plans. At Demco Beach (C) which Yawuru people valued as a fishing area, proposed facilities and amenities overlap with moderate to high modelled values.

Figure 7.25 also shows the overlay of the synthesised concerns model on these same maps. During interviews, several participants expressed concerns about access and off-road vehicle use at Cable Beach South (B). Information from the Broome Coastal Reserves Master Plan, which notes a need to improve access to the beach and create separate access for horses, suggest that this issue may remain a concern for Yawuru people for some time to come. High Yawuru concerns for Minyirr (D) also overlap with a major day-use area where access arrangements will be altered and a site-specific development plan prepared. The high levels of concern recorded by Yawuru participants for Broome Port (F) were some of the only areas within the site not to be included within the Yawuru conservation estate.

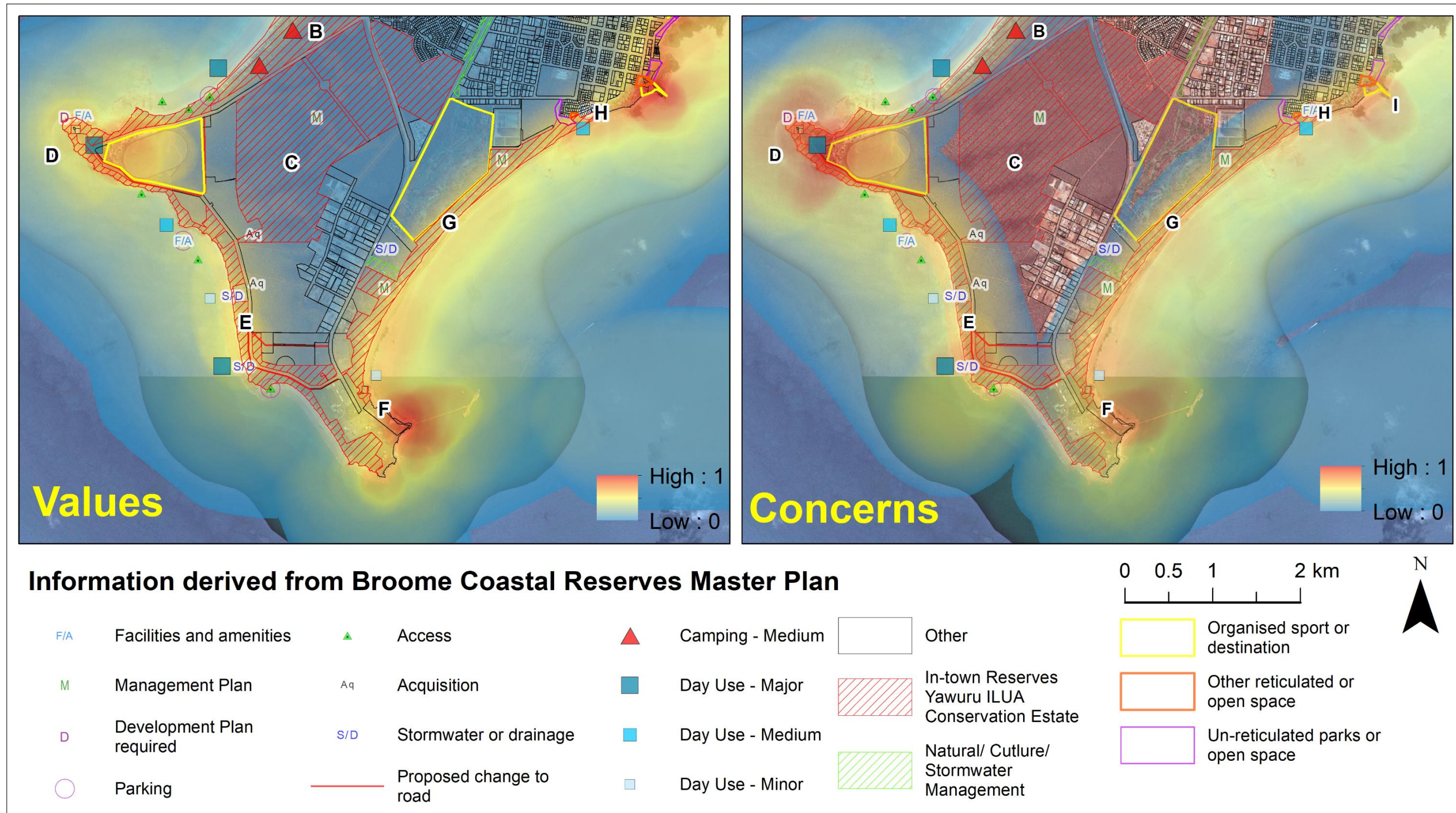


Figure 7.25: Modelled values and concerns overlaid on information derived from the Broome Coastal Reserves Master Plan.

Table 7.6: Comparison of synergies and conflicts between modelled values and concerns and proposals included in the Broome Coastal Reserves Master Plan. Excludes observations for Cable Beach North, Town Beach and Crab Creek.

Site	Location	Equivalent Locations Coastal Reserves Master Plan	Actions to be taken within the Broome Coastal Reserves Master Plan area	Use Description in the Broome Coastal Reserves Master Plan	Normative assessment of likely impact of actions on concerns
B	Cable Beach South / Minyirr Park	Gantheaume Point Beach (1,2)	Improve access Create car park Create Youth/ School camping areas	Day Use - Major	Improved access and parking are likely to allay many Yawuru concerns about closure. Continued access to the beach will exacerbate concerns about off-road vehicle use in the area.
C	Hidden Valley	Un-named	Seek to acquire two blocks to be added into conservation estate	N/A	Expanding the Conservation Estate will provide additional protection against development in the area.
D	Minyirr/ Gantheaume Point	Minyirr/ Gantheaume Point (3)	Create development plan Improve access Increase facilities and amenities Create parking	Day Use - Major	Improved access and parking will benefit Yawuru people. The development plan is likely to exacerbate concerns about future development in the area.
E	Reddell Beach	Reddell Beach (North) (4)	Improve access at various points Provide parking and increase facilities and amenities at specific point	Day Use - Moderate	Will improve access and mitigate concerns about closure.
		Yilagun (5)	Provide for stormwater and/ or drainage	Day Use - Minor	Will help address erosion.
		Reddell Beach (South) (6)	Provide for stormwater and/ or drainage	Day Use – Major	Will help address erosion.
F	Broome Port/ Jetty/ Entrance Point	Un-named	N/A	N/A	Exclusion from the Broome Coastal Region Management Plan reduces the predictability of management impacts on the area.
G	Simpson Beach	Simpson Beach (7)	Management Plan for Inter-tidal Region Manage cattle lot within reserve Dunes: create fire access, strategic breaks	Day Use- Minor	Dependent on the management plan, this is likely to result in little change for Yawuru people.
H	Demco	Demco Gardens (10)	Increase facilities and amenities, increase parking	Local Park	Addresses participants' requests for additional parking in the area.
		Demco Beach (9)	Manage illegal camping	Day Use - Medium	May address concerns held by some Yawuru people but also has the potential to negatively impact any Yawuru people sleeping rough in the area.

Table 7.7 Examines synergies and conflicts between the overlaid documents and modelled values and concerns at ten key locations.

Site	Location	Modelled values*	Modelled concerns	Local Planning Scheme Six Zones and Reserves	Special Control Areas*	BCRMP Plans	Native title	Synergy / Conflict
A	Cable Beach North	Low	Low	Coastal Reserve, Tourist	Landscape Protection Area	N/A	Exclusive and Non-exclusive	Potential Synergy
B	Cable Beach South/ Minyirr Park	Low-Moderate*	Low	Coastal Reserve	Existing Airport Environs, Flood Prone Land, Landscape Protection Area	Improve access, create car park, create youth and school camping areas	Largely Non-exclusive	Synergy
C	Hidden Valley	Low*	Low - none	Culture and Natural Resource Use	Drainage Aquifer Recharge Areas	Add land to conservation estate	Exclusive	Synergy
D	Minyirr/ Gantheaume Point	Moderate-High	High – Very High	Coastal Reserve, Development, Public Purposes, Residential	Flood Prone Land	Create development plan, improve access, increase facilities and amenities, create parking	Does not exist/ Non-exclusive/ Minimal Exclusive	Synergy and conflict**
E	Reddell Beach	Low-Moderate	Moderate	Coastal Reserve, Rural Residential, Port, Development	Landscape Protection Area, Flood Prone Land, Essential Service Buffer Areas	Improve access, provide parking, facilities and amenities at specific sites. Improve storm water and drainage.	Exclusive/ Native title does not exist	Potential Synergy
F	Broome Port	Very High	Very High	Port, Coastal reserve (small)	N/A	Not included.	Does not exist/ (Extinguished)	Potential Conflict
G	Simpson's Beach	Moderate-High	Moderate - High	Coastal Reserve	Landscape Protection Areas	Create management plan, manage cattle lot, create access for fire management along dunes.	Exclusive/ Native title does not exist	Potential Synergy
H	Demco	Moderate-High	Low - Moderate	Development, Coastal Reserve	Essential Service Buffer Areas	Increase facilities and amenities, increase parking, manage illegal camping.	Exclusive/ Native title does not exist	Unclear
I	Town Beach	Very High	Moderate	Parks, Recreation and Drainage	N/A	N/A	Does not exist (Extinguished) / Small areas non-exclusive	Potential Synergy
J	Outer edges of Dampier Creek	Moderate	Low	Coastal Reserve	N/A	N/A	Exclusive	Potential Synergy

Table 7.7 examines synergies and conflicts between the overlaid documents and modelled values and concerns. It is important to remember that values included in this table do not incorporate known metaphysical sites within these key locations. This table highlights that there are some potential synergies between Yawuru values and these planning and zoning documents. At Hidden Valley, where modelled values are low but the area is of high ecological significance and associated with a songline, such values are likely to be protected both by zoning of the area for Culture and Natural Resource use, and by Hidden Valley's status as a Special Control Area for Aquifer drainage (Shire of Broome, 2014a).

Indeed, Shire of Broome actions outlined in the Broome Coastal Reserves Master Plan suggest an intention to expand the area protected on this portion of the estate. Should any threats to Yawuru values in this area arise, Yawuru governance bodies should also be able to leverage the exclusive native title recognition which covers much of the area. Clearly, the relationship between Yawuru values and local government plans for Hidden Valley are highly synergistic.

There is, however, potential for conflict at Broome Port, Entrance Point and Minyirr. At Broome Port and Entrance Point, very high values and concerns are not coincident with native title rights due to the way the Port was declared in 1889 (Kimberley Ports Authority, 2018). At Minyirr, proposed development plans for the area intersect with development zones, a private residence and some portions of the Yawuru conservation estate. Native title is only recognised around the very fringes of this area, and the desire expressed in the Coastal Reserves Management Plan to alter access and parking in this area plays into the fears of some participants. Given this disparity in scale, it is likely that in Broome Town Yawuru governance agencies will need to conduct a range of further overlays to generate the site-specific intelligence necessary to support post native title governance, decision making and assertion of the right to negotiate included in the *Native Title Act*.

Despite considerable variation in Broome Town many of the documents used for overlay were largely homogenous across the Crab Creek site. For example, in Figure 7.26 and Figure 7.27, locally variable values and concerns for Crab Creek are overlaid on an area where much of the land, except that of the Broome Bird Observatory, is covered by exclusive native title rights. The recognition of these rights, combined with co-management arrangements supported by the

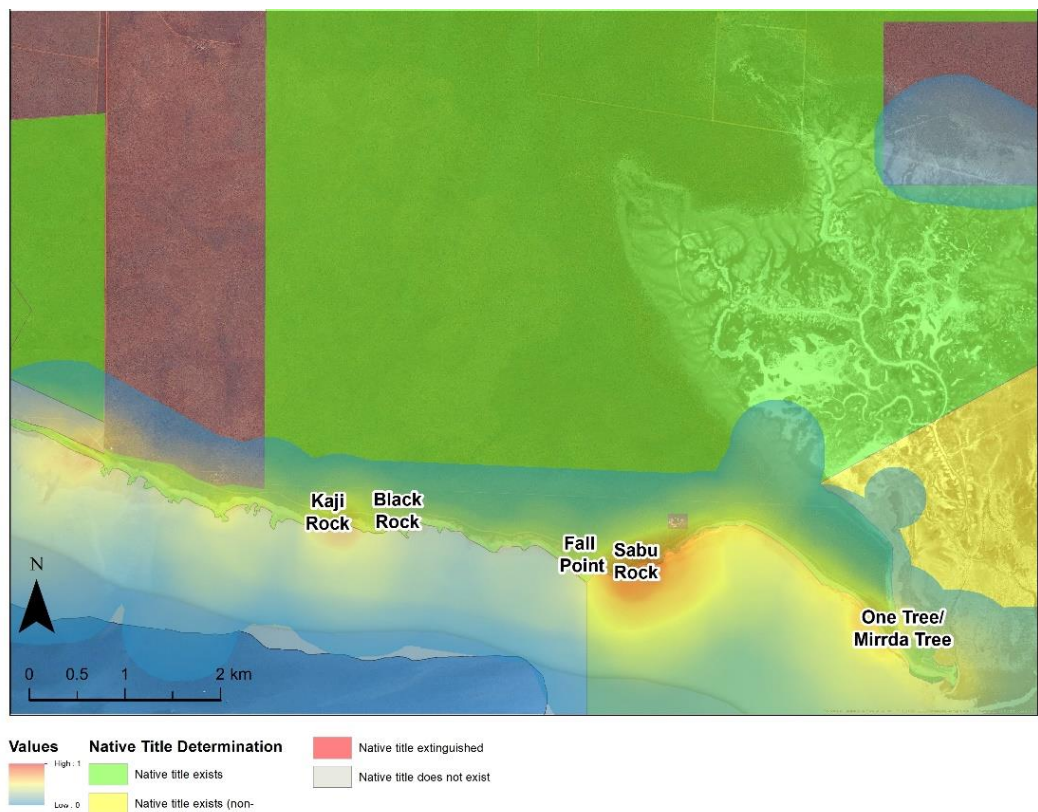


Figure 7.26: Modelled values overlaid on native title recognition within the Crab Creek site.

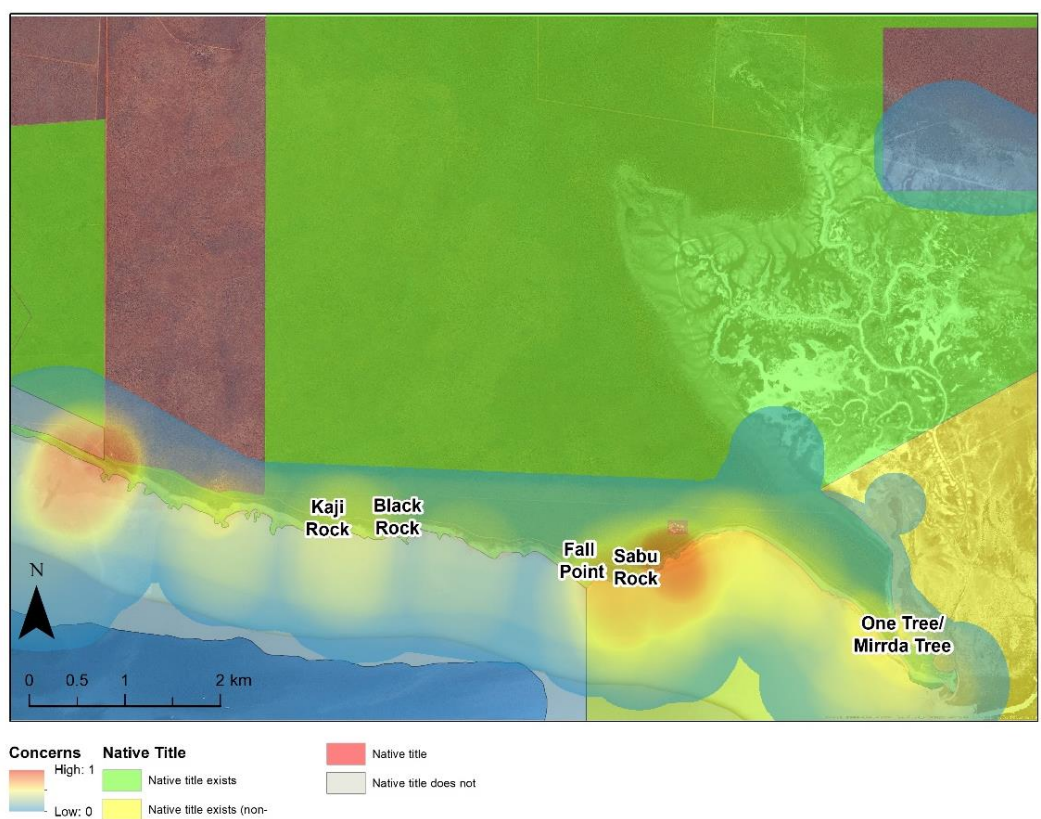


Figure 7.27: Modelled concerns overlaid on native title recognition within the Crab Creek site.

inclusion of these areas as Yawuru conservation estate, provides a strong opportunity for Yawuru governance agencies to help guide the management of valued areas within this site. This is particularly the case east of Fall Point, where the intertidal zone is also subject to non-exclusive rights.

As for native title recognition, Figure 7.28 and Figure 7.29 show that zoning under the Local Planning Scheme Six is both moderately consistent for Crab Creek and likely to protect Yawuru rights. Most of the Crab Creek site is either a coastal reserve, or freehold land zoned for Culture and Natural Resource Use. Exceptions to these rules are only found for the Settlement Zone adjacent to Kunin which “identifies existing or proposed Aboriginal settlements and plans for the orderly and proper development of those places” (Shire of Broome, 2014a:16) and the Special Use Zone used to create the Broome Bird Observatory. Given this, site-specific management plans are more likely than zoning changes to impact the values and concerns held by Yawuru people for the Crab Creek site.

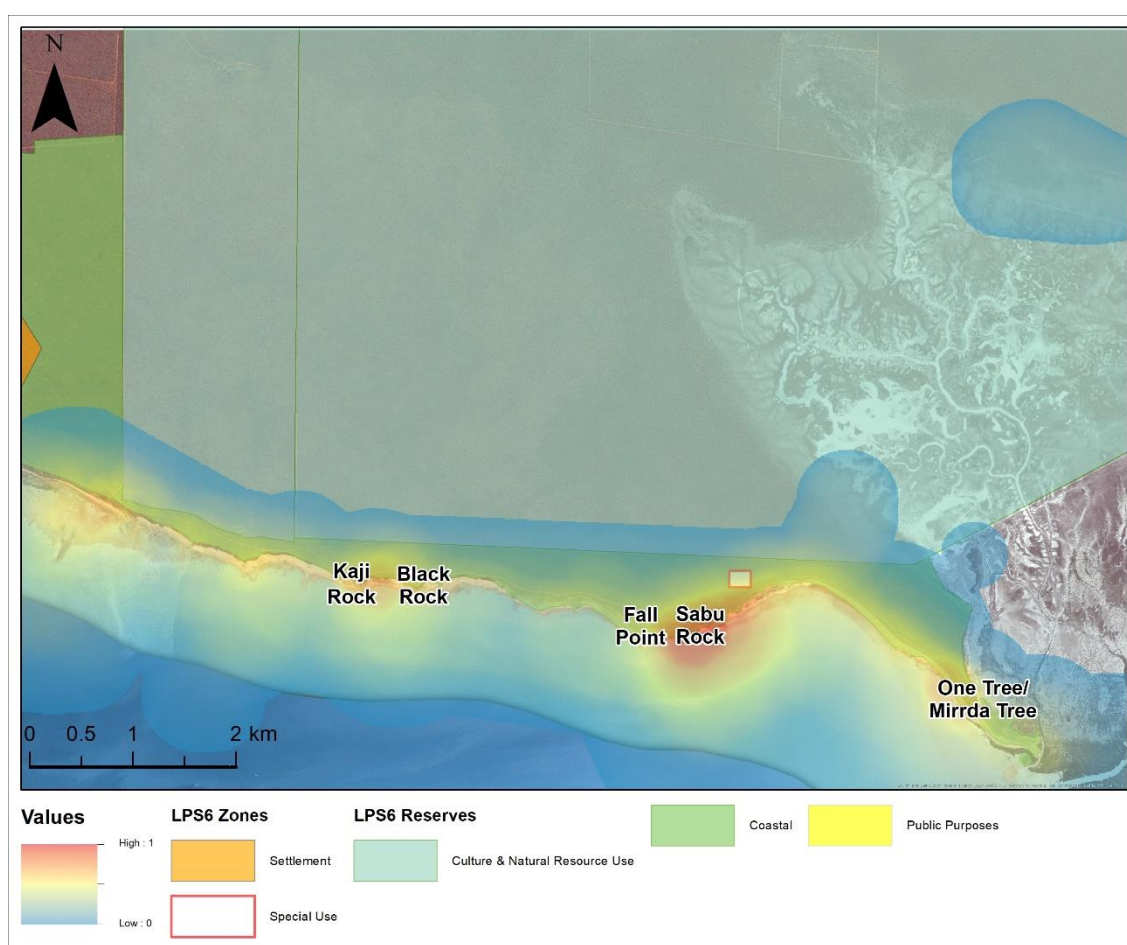


Figure 7.28: Modelled values overlaid on zones, reserves and special control areas from the Planning Scheme Number Six within the Crab Creek site.

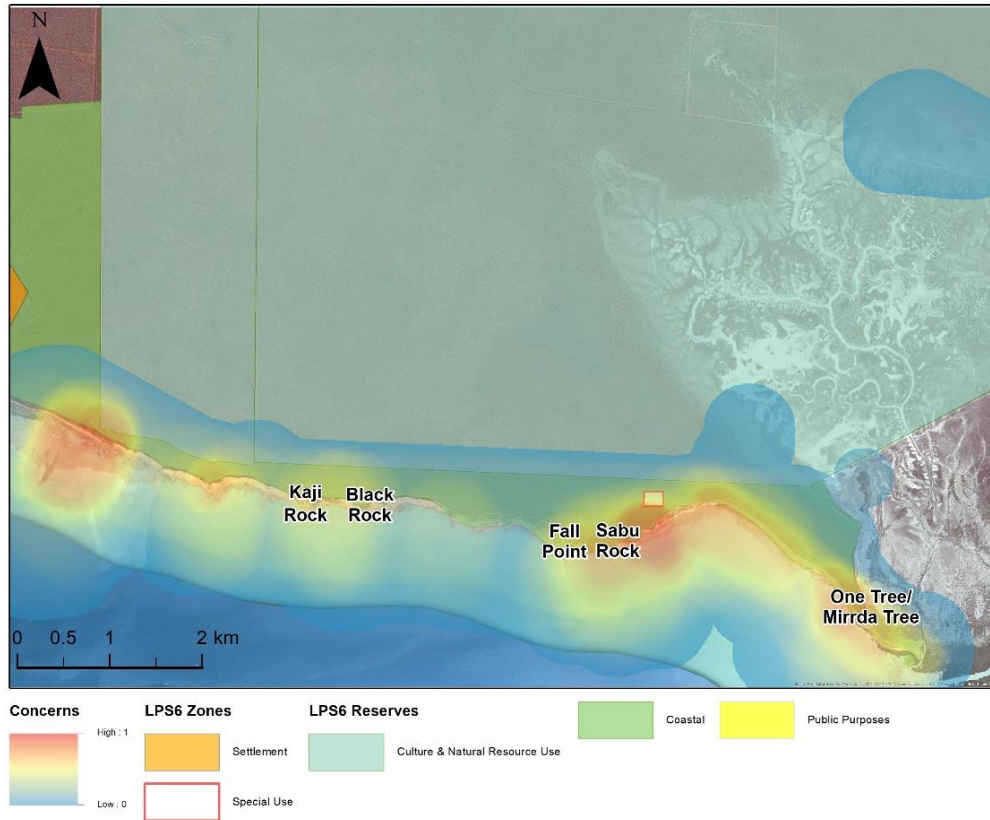


Figure 7.29: Modelled concerns overlaid on zones, reserves and special control areas from the Planning Scheme Number Six within the Crab Creek site.

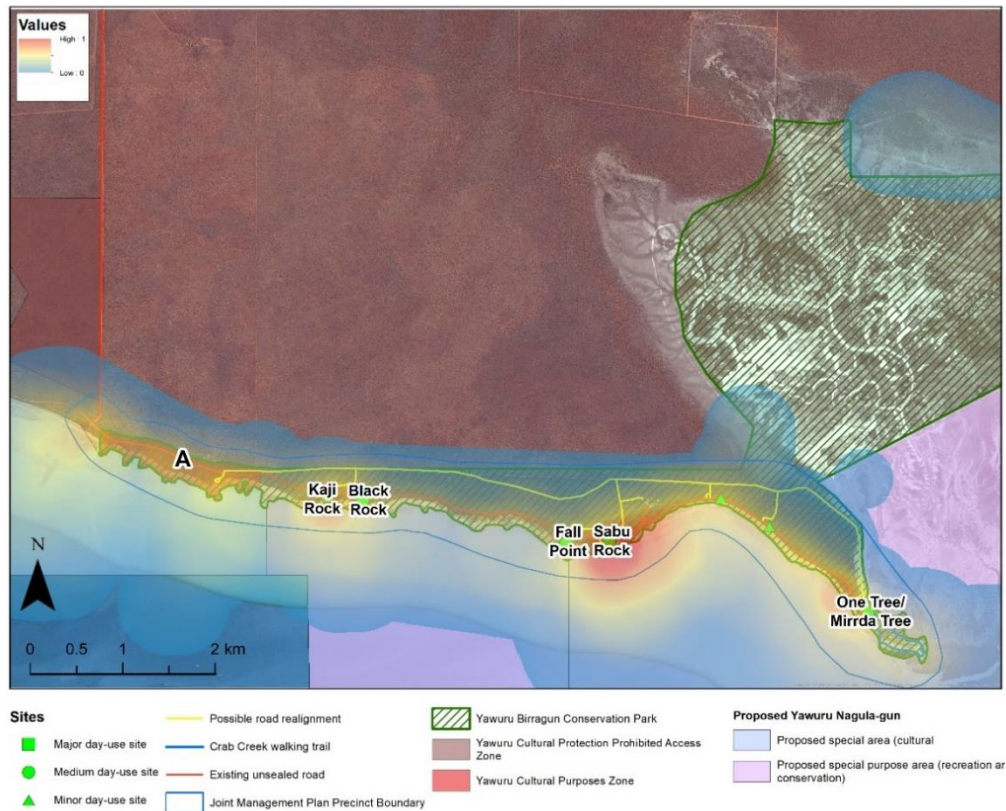


Figure 7.30: Modelled values overlaid on proposed joint management access arrangements within the Crab Creek site.

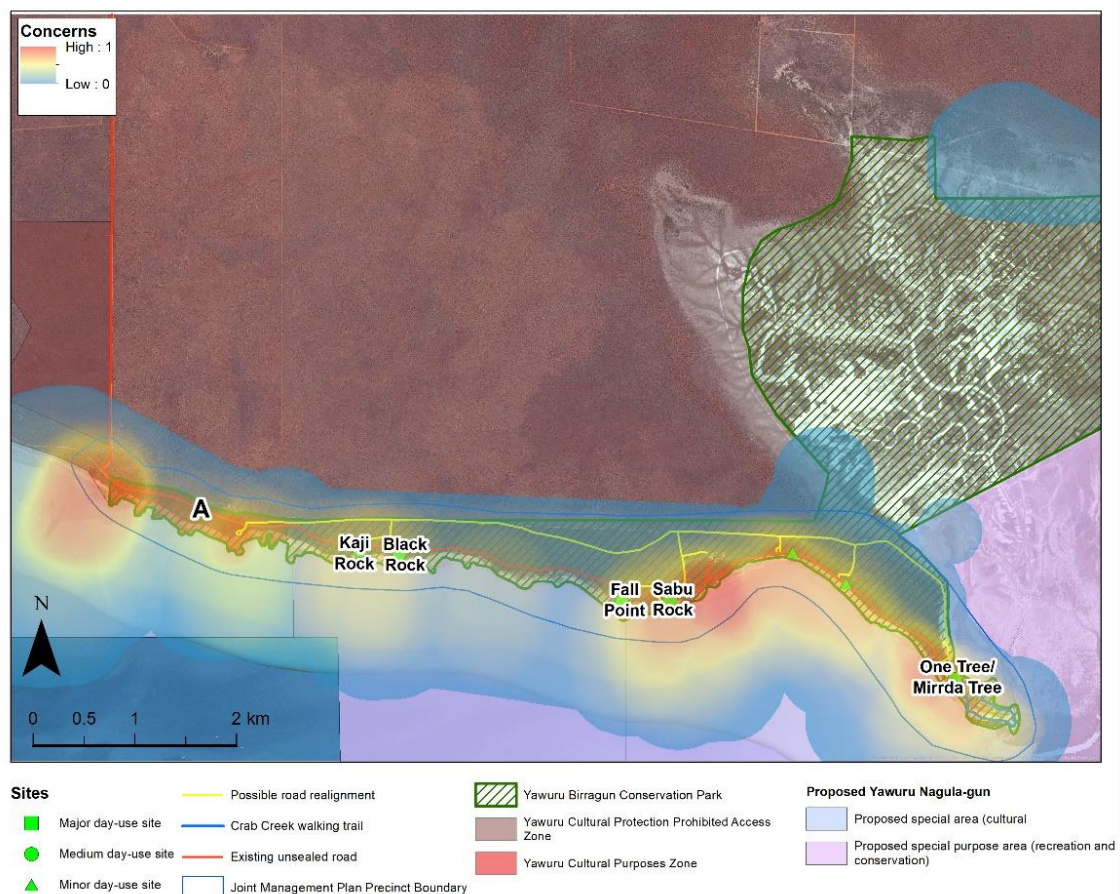


Figure 7.31: Modelled concerns overlaid on proposed joint management access arrangements within the Crab Creek site.

The Yawuru Birragun Conservation Park and the Yawuru Nagulagun / Roebuck Bay Marine Park joint management plans describe aspirations for Crab Creek and other marine or out-of-town portions of the Yawuru conservation estate (DPAW, 2016a; 2016b). Figure 7.30 overlays modelled values on the access arrangements proposed under these joint management plans for Crab Creek. Figure 7.31 overlays concerns over these same areas. These two figures offer some of the most spatially specific information available for these sites. Under the management arrangements proposed in these figures, vehicular access would be closed to all areas except those serviced by spur-roads in the proposed road realignment. As outlined in Figure 7.30, access is provided to most areas viewed as moderate or high value within the Crab Creek. Exceptions can be found between Fall Point and Black Rock, and at the area immediately south of Crab Creek Road. Modelled concerns about closure at these sites were low and moderate, respectively. The former will be closed, while arrangements for access to the latter are unclear in the plan. Should this latter access be lost, it could negatively impact the moderate modelled values held for shelling, collecting oysters and hunting stingray in the area.

Additionally, a Yawuru-only cultural purpose zone would also be established at adjacent to Buga Wamba and Gabanyanya (A). This zone protects two well-known sacred sites and provides a modicum of privacy for Yawuru people. This could, in turn, increase the use of these areas by Yawuru participants.

7.5 An examination of the relationships between key factors and models using geo-visualisation

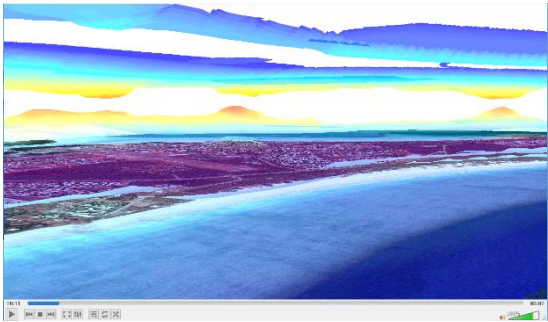
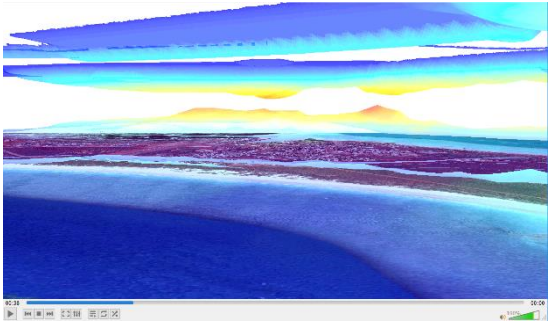
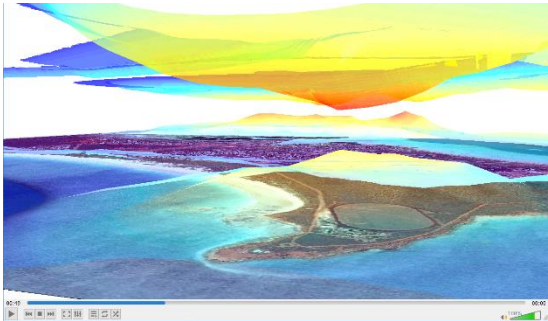
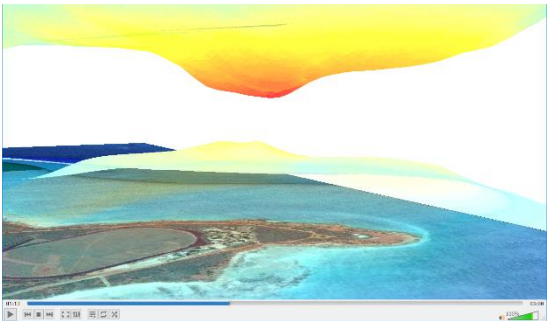
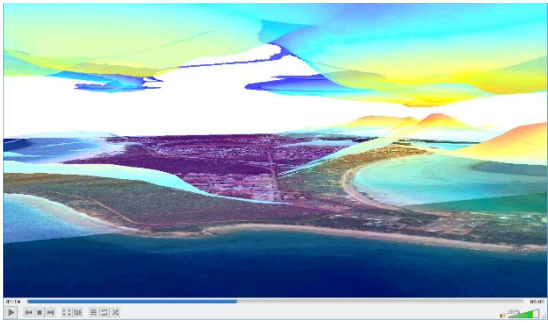
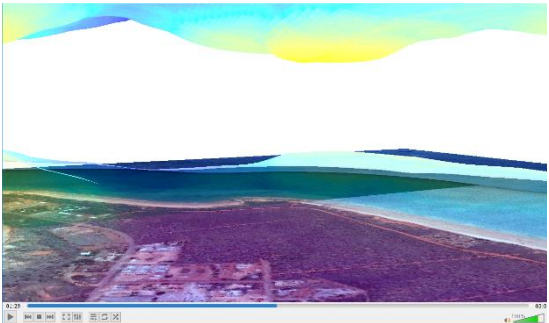
This research also created visualisations designed to facilitate a comparison of values and concerns across the two study sites. As shown in Table 7.8 and Table 7.9, while these visualisations deviate from the planimetric viewpoint often adopted in typical 2D modelling exercises they were also deliberately exploratory, without a high degree of realism.

Table 7.8 displays a series of screenshots from a video-based visualisation of values and concerns created looking inward and then outwards from the coast of the Broome Town site. As shown in Table 7.8.1A and 7.8.1B, the visualisation looking in from the coast emphasises relatively low and consistent values and concerns for the north and south Cable Beach areas. At Minyirr, this visualisation juxtaposes relatively concentrated and high levels of concerns with spatially diffuse moderate to high values (7.8.1C), while at Reddell Beach (7.8.1D) relatively constant low-moderate concerns and moderate values in the north of the site are juxtaposed with moderate to high concerns in Reddell Beach south. Values for Reddell Beach south then diminish rapidly as land is blocked off by industrial developments and concerns increase dramatically over the Broome Port area (7.8.1D).

At Broome Port (7.8.1E), the 3D animation fly-through emphasises the high yet distributed values centred on the jetty and accompanied by moderate to high concerns for the same area. As shown in this visualisation, much of Simpson's Beach (7.8.1F) is covered by consistently moderate values and concerns.

At Town Beach (7.8.1G), which is a declared and popular recreational space, very high modelled high values are accompanied only by low-moderate levels of concern. Indeed, values remain moderately high while concerns diminish even further over the Catalina's area (the right of image 7.8.1G). Values increase to high again toward the in-town foreshore, while concerns for the area appear to peak in the vicinity of Kennedy Hill, a sacred site which is immediately adjacent to both Aboriginal Land Trust blocks and hotels. Values remain high over much of the Dampier Creek foreshore. Here, concerns remain moderate but diminish further to the north of the Kennedy Hill site (7.8.1H).

Table 7.8: Sequence of visualisations prepared of values and concerns overlaid on aerial imagery. Values ascend from the bottom of the site while concerns are offset, inverted and suspended from the top of the site.

Visualisation 1: View looking in from the coast	Visualisation 2: View looking out to the coast
1A) Cable Beach - North 	2A) Cable Beach - North 
1B) Cable Beach – South 	2B) Cable Beach - South 
1C) Minyirr/ Gantheaume Point 	2C) Minyirr/ Gantheaume Point 
1D) Reddell Beach – South 	2D) Reddell Beach - South 

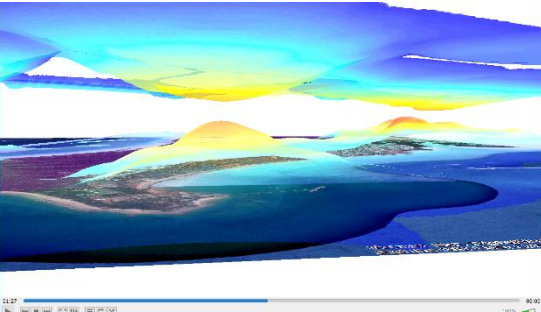
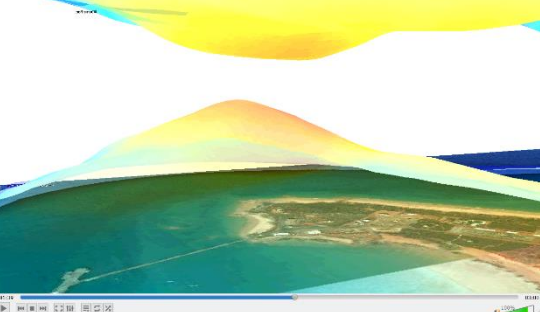
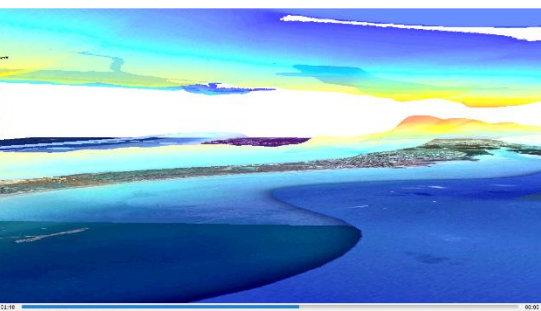
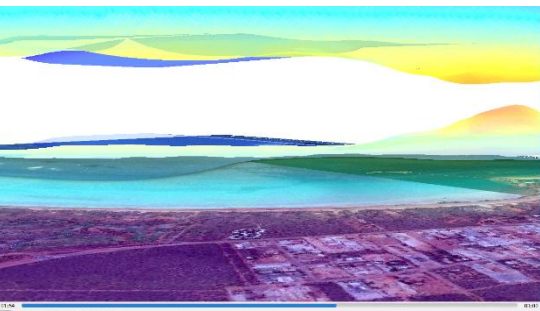
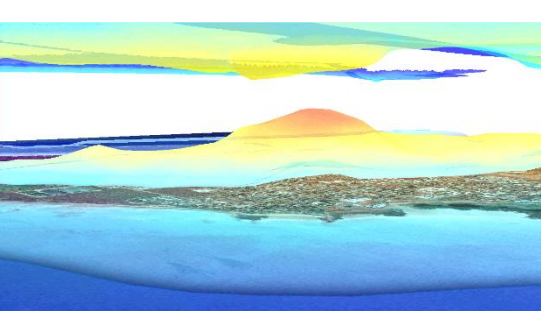
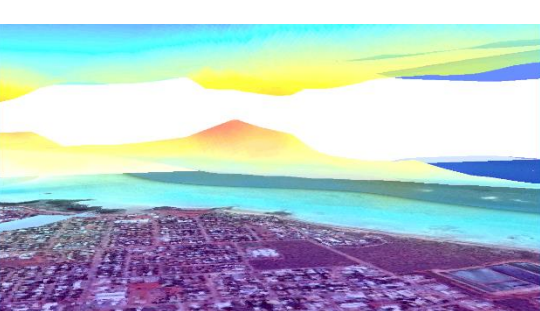
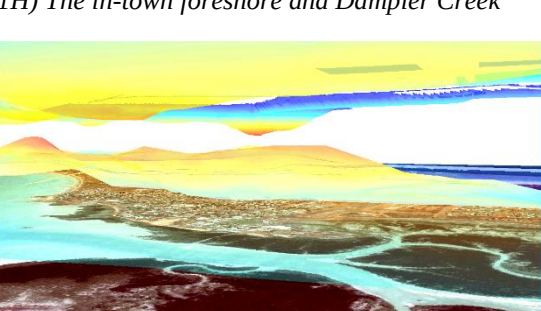
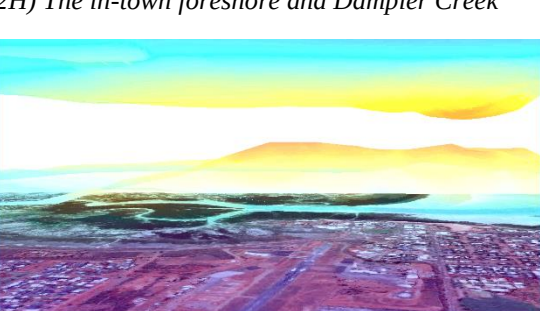
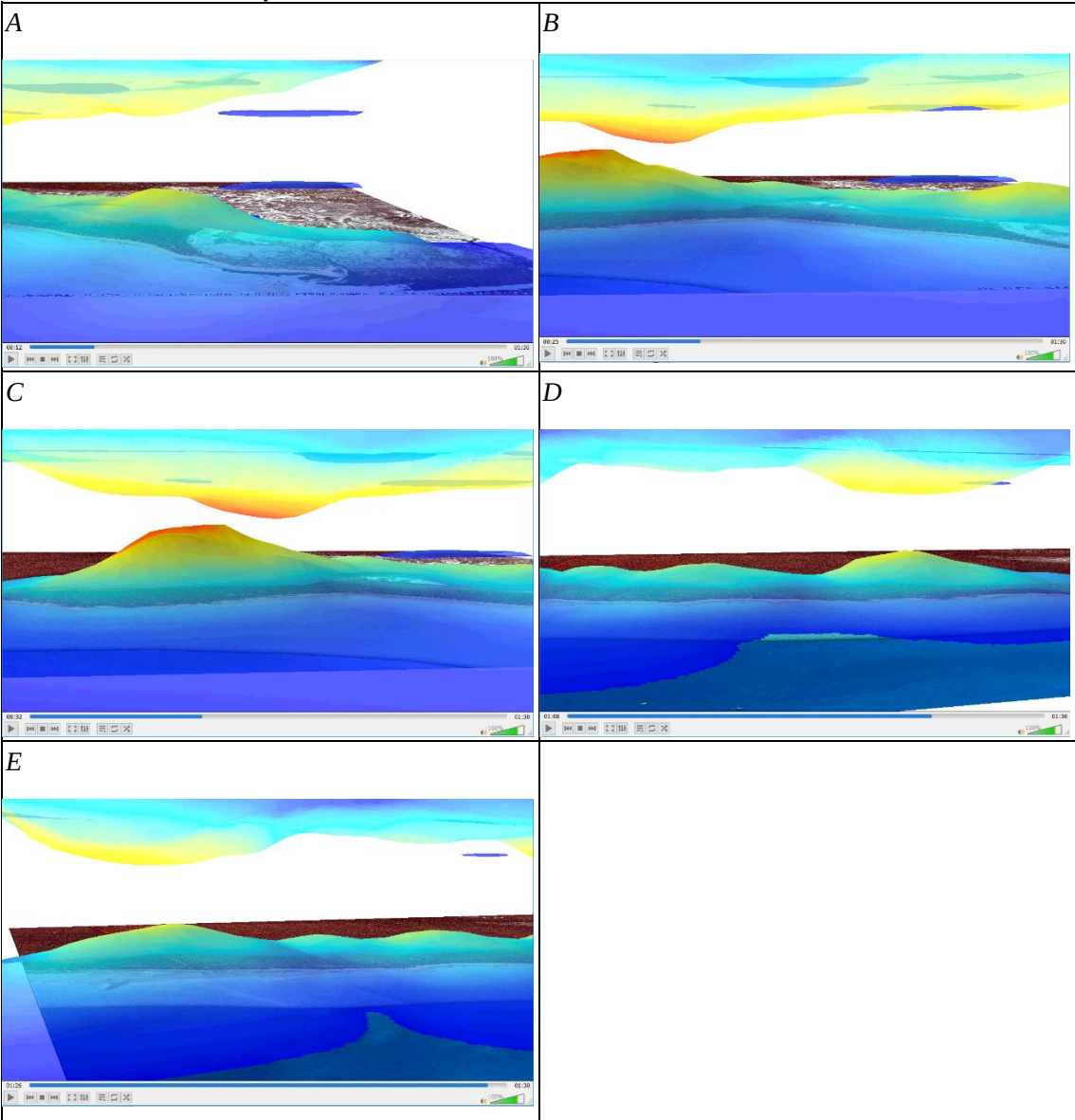
Visualisation 1: View looking in from the coast	Visualisation 2: View looking out to the coast
1E) Broome Port and Jetty 	2E) Broome Port and Jetty 
1F) Simpson's Beach 	2F) Simpson's Beach 
1G) Town Beach 	2G) Town Beach 
1H) The in-town foreshore and Dampier Creek 	2H) The in-town foreshore and Dampier Creek 

Table 7.8 also displays screenshots from a visualisation which compares values and concerns across the Broome Town site, but looks from inland toward the coast. Here, a series of three separate passes emphasise the presence of lower values for the Cable Beach area (7.8.2A, 7.8.2B). This series emphasises acute spatial concerns for Minyirr (8.2C). The view from inland out displayed in the second column of screenshots above emphasises spatial variation along the coastline and effectively displays the concentration of values on the Broome jetty (7.8.2E). It also displays the low values and concerns held for the Broome sandbar when looking out from Simpson's Beach (7.8.2F, in the background). Finally, this view emphasises the distribution of moderate values around Dampier Creek and contrasts them to the more spatially diffuse low to moderate concerns for the same area (7.8.2H).

Table 7.9 presents a series of screenshots from the visualisation prepared looking in from the coast for Crab Creek. In this visualisation, values and concerns vary and are not always spatially coincident. For instance, 7.9.A both shows low to moderate values and concerns for the mouth of the Crab Creek waterbody peak in moderate values and highlights low to moderate concerns for the Lalsa Rock area. In B high concerns commence at the Broome Bird Observatory and are contrasted with moderate to high values for the same area. Additionally, C shows that concerns peak between the Broome Bird Observatory and Blackberry Tree, while values peak immediately west of there at Sabu Rock where they rapidly taper off into low to moderate values for Fall Point. In D, two peaks in moderate values and concerns can be observed for areas near Black Rock and Kaji Rock with both values and concerns diminishing between these locations. Immediately south of Crab Creek Road (E) the visualisation shows distributed moderate values coinciding with moderate to high concerns which remain high for a considerable area before rapidly dropping off. This visualisation demonstrates, despite the consistency of Crab Creek's vegetation and the constant zoning, reserves and native title recognition described earlier values and concerns vary across the site. It suggests that for Crab Creek it is site specific phenomena rather than regional influences which determine values and concerns across the area.

Table 7.9: Visualisation of values and concerns for the Crab Creek area. Values ascend from the bottom of the site while concerns are offset, inverted and suspended from the top of the site.



7.6 Conclusion

This chapter has presented a sequence of maps and visualisations which display the results of the analytical modelling described in Chapter 7 of this thesis. The following chapter (Chapter 8) presents the results of qualitative analyses which contextualise these representations and the Yawuru geospatial program by examining ways participants are already addressing concerns and complexities across their estate. Discussion of these results, their implications for Yawuru governance, and an assessment of the analytical modelling process, can be found in Chapter 9.

Chapter 8: Results (Qualitative Analysis)

The previous chapter presented GIS-based results from context-driven analyses which combined index modelling with fuzzy logic to represent Yawuru values, concerns and seasonal uses of Country in Broome Town and Crab Creek, sometimes including one or two quotations to contextualise those representations in the thesis. This chapter focuses on contextualising both the Yawuru geospatial program and approach to GIS developed in this research. It highlights the ways participants actively addressed their concerns and engaged with the complexities of life in Broome following native title recognition.

Drawing on my conceptualisation of valued sites as contested contact zones and sites of resistance, the first part of this chapter identifies a series of strategies and practices participants described using to navigate contested environments and respond to complexities across their estate. This section highlights participants' agency and resilience by outlining the personal and collective benefits such practices bring to Yawuru people.

The second part of this chapter uses settler colonial theory to further analyse the strategies and practices identified in part one. It shows how these responses to complexity facilitate Yawuru persistence and support efforts to respectfully co-habit their post native title landscape. This section argues that such strategies and practices go some way to undermining the logic of elimination presented by settler societies. It situates the production and use of GIS-based representations as one of many Yawuru responses to protecting protect culture and Country following native title recognition.

8.1 Strategies and practices for engaging in a post-native title environment

As outlined in Chapter 6, many participants responded to questions on their concerns for valued places by outlining the ways that they and Yawuru governance bodies were addressing these challenges within their estate. Informed by the theoretical frameworks which frame this thesis, I viewed these responses as revealing ways participants were *already* engaging in and around contested contact zones within their estate. During qualitative analysis, I consequently drew on deductive thematic coding informed by Pratt's conception of the contact zone to explore how participants responded to the complexities and concerns they identified in interviews. In this, I sought to contextualise the approach to GIS developed in this research and briefly explore some of the complexities of Yawuru life and governance following native title recognition.

This section presents the results from this coding and highlights the strategies and practices participants used to engage in this space (Table 8.1). First, it highlights the diverse ways

Table 8.1: Strategies for engaging in the post native title environment

Strategy or practice	Description
Practicing culture	
A Performing traditional activities	Participants described continuing traditional activities including resource collection, storytelling, practicing language and more.
B Facilitating intergenerational knowledge transfer	Participants often described both their efforts to educate younger generations of Yawuru people, and their experiences as an inter-generational learner, learning from family, friends, and respected Yawuru people.
C Sharing	Participants described sharing food and transport with friends and family.
D Deferring to others' cultural authority	Participants often actively deferred or described how they would defer to others' cultural authority to speak for Country, or particular locations.
E Calling out	(Several) participants described how they would call or sing out to ancestors and spirits when visiting or collecting resources from Country.
F Cleaning and caring for Country	Participants described how they would try to leave Country in as good, if not better, condition than when they arrived.
G Practicing conservation	Participants often described their efforts to actively conserve Country's resources including bush fruits, fish, and other animals.
Moving in time and space	
H Racing	Participants described how, when resources or sites were scarce, they often aimed to be "first in, best dressed".
I Shifting	Participants often described shifting their use of Country both spatially and temporally to avoid competition or take advantage of particular conditions.
J Avoiding	Participants sometimes noted how they avoided particular conditions, people or places as they used Country.
K Visiting	Participants sometimes described how they would actively visit or look out for areas which were historically significant to them, but which they no longer used for any activities.
Directly engaging with challenges	
L Educating	Participants described how they made a direct effort to share Country and accommodate non-Yawuru people. Often, they tried to facilitate peaceful co-habitation through cross-cultural education.
M Asserting	Some participants described efforts to assert their rights as they perceived them. At times this was done by confronting other site users.
N Advocating	Some participants described their efforts to engage in longer term advocacy and negotiations over various issues across their estate.

participants explicitly continued Yawuru cultural practices, exploring how these practices support individual and collective Yawuru identities (practicing culture). Then, it outlines how four practices participants employed to align with or avoid phenomena facilitate personal well-being and maximise collective benefit from Country (moving in time and space). Finally, it reflects on how participants used a combination of education, advocacy and assertion to protect Country and defend their rights (directly engaging with challenges).

8.1.1 Practicing culture

The first set of strategies and practices identified through thematic analysis in this research related to actively practicing Yawuru culture. As shown in the following sections, these practices facilitated connection to family and community through shared experiences. They reinforced customary and cultural ties through intergenerational knowledge transfer and acts of deliberate respect. They supported Yawuru culture while actively caring for the material and metaphysical elements of Yawuru Country. In sum, these practices provided a strong individual and collective foundation for engaging in the complexities of Broome life following native title recognition.

8.1.1.1 Performing traditional activities (A)

Participants described continuing traditional practices including resource collection, storytelling, practicing language and more.

The first of the seven strategies and practices for continuing culture which was identified from participants' interviews is performing traditional activities. Traditional activities, which were taken to include customary resource collection, storytelling, ceremonies, and practices associated with resource collection, are an important element of continuing and transmitting Yawuru culture (Yawuru RNTBC, 2013:113). These traditional activities facilitated participants' connection to family, community, and Country. They supported participants nutritionally, provided opportunities for exercise and contributed to participants' sense of well-being (Box 8.1).

Box 8.1: Quotations on continuing traditional practices.

Examples 1 - 3: Childhood memories

“Kid-time we used to go, um, down here to get our crab, our bait, like bombshell, niwad.”

Anita Dean

“When I was a little girl my father used to always go fishing for whiting. Take me fishing for whiting. And me and my family always go fishing all around this area. Everywhere. All around this part of the area. All round.” June Cattermole

“If I sit on the rock and it just brings back memories like how my mother used to actually sit on the rock [...] you look back and then you see the grandchildren running around, the kids, [...] it's a really good feeling. Because now we're actually doing that with our children, what our mother did with us.” Rose Coffin

Example 4: Fish and rice

“We'd just all have fish and rice for about a week or something like that. Till we get sick of it. And then we'll go back to fresh beef [from Roebuck Plains], or turtle or sea cow or something like that. Or [...] meat from the shop.” Johnathan Pearson

8.1.1.2 Facilitating intergenerational knowledge transfer (B)

Participants often described both their efforts to educate younger generations of Yawuru people, and their experiences as an inter-generational learner, learning from family, friends, and respected Yawuru people.

Box 8.2: Quotations on facilitating intergenerational knowledge transfer.

Examples 1-3: Kids

“I go with my little cousins. Like, teaching them. Showing them what's right from wrong.” Johnathan Pearson

“I'll take the kids for a walk in the bush just to listen to the sounds of the birds to try and identify it [...] it's so nice to go along there and tell Dreamtime stories.” Judy Edgar

“We've got to teach our kids to keep that culture [...] and not to lose what we have”. Rose Coffin

“I said: “Go on, give your grandmother”, this massive big salmon. And it's just a sign of respect [...] and hopefully my son takes that on too, you know, when he gets a bit older and shows that respect to the old people too, you know. Because they probably gave us the luck.” Yawuru Custodian

Inter-generational knowledge transfer is a core concern of many Indigenous peoples around the world including Yawuru native title holders. As became clear in the interviews, participants perceived instilling respect and cultural knowledge in younger Yawuru people as vital for both community well-being and the health of Country (Box 8.2). This transfer emphasised respect for elders, other site users, and indeed, all elements of a living cultural landscape. It taught specific practices including deferring, calling out, cleaning, seasonal and conservative resource use, and sharing of resources.

8.1.1.3 Sharing (C)

Participants described sharing food and transport with friends and family.

The third of the seven strategies and tactics for practicing culture I identified from participants' interviews is that of distributing catch or sharing transport with other Yawuru people. Participants in this study described and justified the practice of distributing catch among the community (Box 8.3). In this, they continued the practice of *janyba* (Yawuru RNTBC 2013:16) and fed elders who are no longer able to easily access Country. Some also helped supplement the diets of Yawuru families who are unable to consume red meat during mourning. Participants described sharing transport to reduce fuel use, care for children and provide extra labour to speed to the collection of resources. Many viewed this sharing as a respectful and equitable act which provided access to Country for those without vehicles and created opportunities for social interaction in a relaxing, low pressure environment.

Box 8.3: Quotations on sharing.

Examples 1-2: Out of those twenty...

"[E]ven when someone says they got twenty [fish]. I'll tell you now, that out of those twenty, they might be lucky if they got two or one. The rest will be gone to other members of the family who can't, who didn't make it out there or didn't get any." Judy Edgar

"Forty salmon don't go home to one bloke's fridge. That forty salmon gets distributed and, um, shared out amongst the community" Dean Mathews

Example 3: So you can send it...

"We've got a brother in Melbourne and I've got a sister and niece in Perth [...] you're only catching fish [...] so you can send it to them" Rose Coffin

8.1.1.4 Deferring to others' cultural authority (D)

Participants often actively deferred or described how they would defer to others' cultural authority to speak for Country, or for particular locations.

In Yawuru society, like the societies of many other Indigenous peoples, certain individuals are associated with and given authority to “speak for” certain areas of Country (Sullivan, 2014). During the sketch mapping interviews conducted in this research, participants often deferred to others’ authority to speak for Country or explicitly described how they would do so in certain contexts (Box 8.4). One participant clearly deferred to the (somewhat disputed) authority of a smaller clan over a portion of the estate. Other participants deferred to “greater” cultural authority by allowing others to make decisions for Country. In a post native title environment, deferring to others’ cultural authority continued to reinforce Yawuru socio-cultural structures and eased social relationships following a divisive native title claim.

Box 8.4: Quotations on deferring to others' cultural authority.

Examples 1-2: Deferring when visiting

“I wouldn't go there at all. Um, unless I was with, with somebody. Say a law boss or an elder. Um, and obviously that would be for some important stuff. [...] if I had someone with me I would say: "stay away from that area". Yawuru Custodian

“One old chap told me don't let your children climb on the rocks. And, well, I don't let them. If I, if they want to, then I say "No that old chap said 'no'. So, don't go". Mr Gregory

Examples 3-4: Deferring on plans for Country

“I've got to speak to the top mob. Got to ask them [...]” Mr Gregory

Another participant described how she wanted an artefact to be preserved but ultimately deferred to the authority of her brother who had gone through law and said it should be returned to the original site despite potential dangers.

8.1.1.5 Calling out (E)

(Some) participants described how they would call or sing out to ancestors and spirits when visiting or collecting resources from Country.

During interviews, some participants described how they would actively call or sing out to spirits or ancestors when visiting or collecting resources from Country (Box 8.5). This practice reflects the general Yawuru principle of “ask first” (Yawuru RNTBC, 2013:124). It was mostly, although not exclusively, described by older Yawuru participants. In what can be a high stress post native title environment, calling out enhanced participants’ “good *liyan*”, or sense of well-being and helped them to connect with Country. This fulfilled a cultural obligation, increased catch, and reduced the likelihood of harm from metaphysical beings who might be angered by disrespect. It served as an important cultural function for some participants in a post native title landscape.

Box 8.5: Quotations on calling out.

Example 1: Sing out for them

“I just think about the people who used to be fishing here [...] and call out for them to give me luck, to give me fish. Sing out for them. They give me fish. [...] I feel really good about it and I talk to people who have been passing away. My uncles my... sing out for them, give me fish and they give me fish and a good feeling, good feelings.” June Cattermole

Example 2: You gonna give me fish today?

“Yeah, it’s a good liyan. Good liyan. You just sit there and Country gives you whatever you want, you know. Give you fish. Some days it will, some days it doesn’t. Then it wants you to go back again. (laughs) and then you sit there again ‘Are you going to give me some fish today?’ you know? (laughs). So, you’ve always got to talk to people, ancestors, and, you know, spirits and that. Yeah. ‘You gonna give me fish today?’ Yeah.” Martha Lee

8.1.1.6 Cleaning and caring for Country (F)

Participants often described how they would try to leave Country in as good, if not better, condition than when they arrived.

For many participants, cleaning and caring for Country demonstrated respect for both others and for Country itself (Box 8.6). For some participants, the act of cleaning and caring for Country helped to facilitate respectful relationships with other site users, and, in some cases, provided opportunities for peaceful interaction in a post native title environment. For other participants, the act of cleaning helped to undo some of the damage that others had wrought on the living cultural landscape. It reinforced respect for Country as a practice and helped to support the health of that Country into the future.

Box 8.6: Quotations on cleaning and caring for Country.

Example 1: Close all the gates

“We go through the gates and close all the gates and make sure that no cattle gets out, like, and no rubbish left.” Anita Dean

Example 2: Always cleaned up

“It was never a mess. It was always cleaned up, you know? Old people used to clean up that area. And you’d have respect, you know?” Judy Edgar

8.1.1.7 Practicing conservation (G)

Participants often described their efforts to actively conserve Country's resources including bush fruits, fish, and other animals.

The final group of cultural practices which were explicitly identified by participants was related to the conservation of Country's resources (Box 8.7). Throughout sketch mapping interviews, participants often discussed the seasonal harvest of resources for both conservation and to ensure ongoing access to resources into the future. Additionally, participants often outlined their efforts to actively avoid both waste and the over-exploitation of any given species. For many participants, it was clear that conservation was intimately linked to both continuing culture and respectfully sharing their home with other Yawuru families and other members of the Broome community.

Box 8.7: Quotations on practicing conservation.

Examples 1-2: Seasonal harvesting

"When it's hot time, I wouldn't go and target salmon because [...] when we start looking for stingrays, the salmon are spawning" Mr Gregory

"I mean, we hardly ever went there because then we go reef fish. [...] So, don't you think that's like preservation of the sites as well?" Judy Edgar

Examples 3:-4 Conservation in harvest

"We don't eat all the eggs. You can leave some to reproduce and some to, just to get that taste" Anita Dean

"I just go out and just hunt for [...] good causes, I guess. Try and not to hunt them out [...] it's very hard, [...] other people come and ... just can't keep track." Mark Parriman

Example 5: Whole fish

"[You can eat fish] from the cheek, to the tail, to the head to the eyeballs (laughs). It's just so fantastic!" Martha Lee

Example 6: Conservation and governance

"We need to uphold and keep instilling as a management and protection and sustainable, um, use of marine resources. But also, sustainable development of Country as well." Dean Mathews

8.1.2 Moving in space and time

The second group of strategies and practices revealed by qualitative analysis were those that used moving in space and time to maximise their enjoyment of Country. As will be shown below, in general these strategies maximised the personal and community benefits that Yawuru participants received from their Country. They enhanced participants' perceived control of their post native title environment, facilitated respectful interactions with other site users and avoided placing undue pressure on certain areas within Country. They enabled participants to continue traditional practices and make the most of their Country despite Broome's rapid growth. In sum, these practices helped participants adapt to some of the complexities of holding native title rights in a multi-cultural and rapidly growing town.

8.1.2.1 Racing (H)

Participants described how, when resources or sites were scarce, they often aimed to be "first in, best dressed".

Throughout interviews, many participants noted how Broome's growth placed pressure on limited resources. They responded to such pressures by aiming to be "first in, best dressed"; they raced other site users for limited resources (Box 8.8). For participants, racing maximised personal and familial access to preferred locations and culturally significant resources such as *walga-walga*. It carved out space for family and community in an increasingly crowded environment. Yet, it was a practice tempered by cultural norms and respect for other site users; should another manage to secure a preferred location or resource, Yawuru participants respected their right to use the space. Usually, they did so by shifting their use of Country across time and space.

Box 8.8: Quotations on racing.

Example 1: Beat everyone else to it

"[Y]ou've just gotta more or less beat everyone else to it [...] otherwise we'll have to move". Mr Gregory

Example 2: First in, best dressed

"Crabs is always there, you know. First in best dressed. [...] And if you've got a female, you put it back. Them's the Law!" Judy Edgar

Example 3: Clean-ups and a big race

"[E]verybody wants to get through the [...] week for the weekends [...] you go there and do big clean-ups [...] everybody is just catching fishes before the season runs out. [...] So, it's basically a race". Johnathan Pearson

8.1.2.2 Shifting (I)

Participants often described shifting their use of Country both spatially and temporally to avoid competition or take advantage of particular conditions.

Participants described shifting practices across time and space to maximise their benefits from Country (Box 8.9). Often, shifting responded to various stimuli including tides, activity costs and resource yields. Participants shifted to conserve resources, to distribute personal and collective impacts across Country and to enjoy new experiences or places. Some participants shifted the way they visited Country with better access to vehicles and most used the practice to minimise encounters with hazards or negative stimuli across the estate. Ultimately, like other spatio-temporal practices, shifting was used to maximise the likelihood of positive actions and encounters across Country.

Box 8.9: Quotations on shifting.

Example 1: Avoiding areas targeted by others

“I don't want to invade someone else's space. Because it is no good if I go there and somebody is already looking around there for stingrays and I go there. Well, he's already been here. Most probably taken them all out. So, I move to the next spot.” Mr Gregory

Examples 2-3: Shifting in response to a range of stimuli

“It's not that often that I go there, but like when they close down the Jetty, like when the fuel boat is in. Then that's when we go there.” Rose Coffin

“Like and if someone say ‘Oh, we've been lifting here.’ Well, everybody will go there, you know? So, so it's not like it's only these spots. [...] if somebody says ‘Oh, we were lifting there yesterday’ then we'll all end up there, you know? So, we're going to end up in all the turnoffs.” Rose Coffin

Example 4: Shifting for safety

“I am very wary of the rocks there. But I fish from, like, up top. But um, it's got to be a safe spot. And I tell my sister, ‘Okay, which way are you going? Okay bring me over here. Leave me there’. I can't go where they go now, I just go sort of in the safe area.” Martha Lee

8.1.2.3 Avoiding (J)

Participants sometimes noted how they avoided particular conditions, people or places as they used Country.

Like shifting, the spatio-temporal strategy of avoiding certain areas, people or authorities helped many participants to minimise the potential for negative interactions in a post native title context. It also helped participants to avoid culturally inappropriate or sensitive areas across their

estate (Box 8.10). Additionally, some participants actively avoided the gazes of locals and tourists during practices such as collecting turtle eggs or butchering turtle and dugong which can be controversial in a post native title environment.

In general, Yawuru people actively avoided crowded areas to “get away from it all” and seek mental space out on Country. They complied with cultural norms, minimised the potential for surveillance of or interference in cultural practices and often reduced potential for conflict by minimising the impact of their activities on other site users.

Box 8.10: Quotations on avoiding.

Example 1: Avoiding an area targeted by fisheries

“It's low at the moment. It's only because the fisheries got their eye very close on that spot, because they know there's a lot of locals that actually go for that thing. So, like I mean you can spend like a good couple of hours getting them and then the fisheries come and then you have to chuck it all back. You know what I mean? And that's the only thing that stopping us from getting those things.” Rose Coffin

Example 2: Avoiding tourists when collecting turtle eggs at Cable Beach

“But with the amount of tourists now, see. So, what we do is, what I do, go there and go and rub out all the tracks. So, they can't see where the turtle went up. Then I used to leave a... See where they've gone up, leave a spear or go back in my car and take the speedo. Take it back to this, uh, car ramp here where it comes down. So, when I come back in the afternoon, while everyone is watching the sunset. I go and get the eggs. Well, what they don't see... Out of mind, out of sight.” Mr Gregory

Examples 3-4: Avoiding others when butchering turtle and dugong

“We'll go and cut it up there or go cut it up halfway between. Just away from all the beaches and the people. [...] they [other people] don't want to see, you know, well they shouldn't have to see that, you know? Blood and guts.” Mark Parriman

Mark also described how one of the sites he now uses to butcher catch has historic associations with a meatworks which he believed would desensitise visitors to the slaughter of animals in the area. He observed that he hides any visual trace of the practice by taking all the meat and then dragging shells out and sinking them in the bay to feed local life.

8.1.2.4 Visiting (K)

Participants sometimes described how they would actively visit or look out for areas which were historically significant to them, but which they no longer used for any activities.

For many participants, a fourth spatio-temporal strategy, the act of deliberately visiting Country, was central to their sense of well-being and connection to place. Often, participants detailed their attachment to sites as part of the sketch mapping interview process (Box 8.11). Participants used visitation to keep an eye on significant areas. They employed this practice to relive memories, reinforce their attachment to place, and monitor or look after areas they no longer used on a regular basis.

Box 8.11: Quotations on visiting.

Example 1: Our lives are in those places

For Rose Coffin, visiting “the Jetty” helped her “*feel the presence, you know, especially the old people*”. For her, “*our lives are actually in these places*”.

Example 2: Family and memories

“I can remember, you know, camping at Blackberry Tree and that. And um... Just, just that whole area is sort of, just takes me back to memories with my grandmother and as a kid running around. [...] Been there that many times it’s ridiculous.” Yawuru Custodian

8.1.3 Directly engaging with challenges

This final section discusses the strategies and tactics which participants used, at times, to directly grapple in contact zones and engage with challenges or concerns following native title recognition. As will be shown below, participants engaged in this environment by educating non-Yawuru people about Yawuru traditions and culture; by asserting their rights and the rights of their Country; and by engaging in various acts of advocacy which sought to achieve long term changes to particular issues or locations in a post native title environment. This section will demonstrate how these engagements support and challenge co-habitation of Yawuru Country. It will also show how these practices facilitate the persistence of Yawuru participants and their culture.

8.1.3.1 Educating (L)

Participants described how they made a direct effort to share their Country and accommodate non-Yawuru people. Often, they tried to facilitate peaceful co-habitation through cross-cultural education.

The first of the three categories of strategies that Yawuru participants used for direct engagement was that of educating: some participants sought to enjoy their Country by interacting with outsiders and taking the opportunity to educate them about Yawuru culture when out on Country (Box 8.12).

In general, educating outsiders helps create a place of understanding in an otherwise tense post native title environment. By sharing their knowledge with non-Yawuru people, participants raised awareness of Yawuru culture and values. They reduced the likelihood of conflict over accidental violations of space which might result from ignorance or an inability to read the Yawuru living cultural landscape.

Box 8.12: Quotations on educating.

Example 1: Answering questions

“And we’ve got, when we do go, especially when we go stingray hunting, you’ll have people come up and ask questions. ‘Oh, what’s that? What are you hunting?’ and all that. Then... yeah. Tell them: ‘It’s in season. This is the time of year to get it.’ Explain, to them. Yeah.” Mr Gregory

Example 2: Guiding

“If I was to show someone around town, I’d say don’t go there.” Yawuru Custodian

Example 3: Engaging tourists

“They just go there for walks on the beach. And, yeah, when we go there, we show them. Like ‘You should go to this spot and use this bait’, and next day we’ll find them tourists there and they’ll be catching their own fish and having fun with it.” Johnathan Pearson

8.1.3.2 Asserting (M)

Some participants described efforts to assert their rights as they perceived them, sometimes by confronting other site users.

The second of the three strategies that participants used to engage in a post native title landscape is that of asserting their rights and interests. To assert is to “cause others to recognise (one’s authority or a right) by confident and forceful behaviour” (Oxford, 2018b:1 of 1). In the contact zones of settler states, assertion often serves as an important mechanism for the recognition of rights. Indeed, the act of applying for native title recognition asserts rights over space. During sketch mapping interviews, participants often described how they and other Yawuru people used various strategies to assert their rights and actively engage with others in space (Box 8.13).

Often, but not always, the acts of assertion described by participants aimed to directly discourage any behaviours which might damage Country and impede Yawuru people’s (perceived) right to use their Country as they saw fit. In asserting, participants sought to control

an area of Country to secure immediate change to the spaces around them, and to preserve their culture and presence in the landscape.

Box 8.13: Quotations on asserting.

Examples 1-2: Asserting authority

“And I’ve spoken to elders that have, you know, chased down people on motorbikes and told them to piss off ...” Yawuru Custodian

“So, Mum got up and said [...] ‘Then you guys remove you guysself, because my husband made this road and you guys are not going to tell my grandchildren to move away’, you know? ‘We are the T.O.’s here and you guys should know that’.” Rose Coffin

Example 3: Resisting authority

“Someone stopped me before. Wanted me to get off the, get off from here. I was parking my car next to the rock here. They wanted me to move from there. I said ‘Nah.’ [...] I didn’t care. They might check out or they might be looking for somebody else. Not the local.” June Cattermole

8.1.3.3 Advocating (N)

Some participants described their efforts to engage in longer term advocacy and negotiations over various issues across their estate.

Box 8.14: Quotations on advocating.

Examples 1-2: Advocacy for policy

“And that was one of the arguments that we actually had with Land and Sea is that, you know, are you going to put bins out there, you know, that’s why you have the Rangers there, to remove these things.” Rose Coffin

“And I like to have it, if I could have it there and have a lock and keep it for one person. If anybody want to come, I’ll say you can go there, I’ll give you the key, you know. But not everybody can go. Because they’ll make mess there and I’m not going to be cleaning up after their mess.” June Cattermole

Example 3: Influencing policy balance

“I think because we got a take it from the perspective now of, um, what is the cultural, ecological, but also [...] the third component is the, is the economic side of things [...] So it’s the cultural sites of significance, but also the cultural value that that the coastline brings. [...] But something like this could sort of... it allows to identify one with those, I suppose, those areas of significance, or the cultural attachment and value that coexists.” Dean Mathews

The final strategy which participants displayed for directly engaging with challenges, advocacy, can be defined as “public support for or recommendation of a particular cause or policy” (Oxford, 2018a:1 of 1). The advocacy described by participants in the sketch mapping interviews was often less confrontational and more focused on long-term results than the vocal assertion needed to gain momentary protection or control of a site (Box 8.14).

Ultimately, advocacy had a long-term focus and was designed to protect elements of Yawuru rights and Country. At times, advocacy was leveraged by participants to protect what could be perceived as personal rights to place within a post native title context. In this, it undermined erasure and the logic of elimination which can pervade settler policies. Advocacy provided opportunities for the interactions, negotiations, and compromises necessary to protect a living cultural landscape.

8.2 Complementing the Yawuru geospatial program and undermining settler colonial narratives

To contextualise the Yawuru geospatial program and GIS-based representations in the previous chapter, this section has presented a series of strategies and practices employed by Yawuru participants to engage with the complexities of their post native title environment. It has highlighted how these practices maximise participants’ personal and collective benefit from this space. During sketch mapping interviews, participants described continuing culture; adapting their use of Country across time and space; and directly engaging with the challenges of a post native title landscape. Where the GIS-based representations presented in the previous chapter provide a contrasting narrative to entity-based models of space which so often underpin settler property and management systems, these strategies and practices undermine settler colonial logics of elimination by supporting Yawuru persistence and resisting efforts to transfer Yawuru people away from their traditional lands (Veracini, 2011).

The strategies and practices presented in this chapter both pre-exist and complement the GIS-based representations presented in Chapter 7. To begin, where the GIS models developed in this study were intended to inform and support Yawuru governance, the strategies and practices outlined in this chapter physically and emotionally sustain Yawuru people. These strategies provide access to traditional foods which help to meet Yawuru people’s nutritional needs (A-C) and give opportunities for physical exercise (A). They protect participants and other Yawuru people from physical or spiritual harm (E-G) and reinforce traditional social structures (A-D, H). They also support individuals’ and families’ mental health by providing opportunities to escape what can be a tense or crowded in-town environment (H, I, K). In physically sustaining Yawuru people, these strategies and practices “maintain [Yawuru] customary life” (Yawuru RNTBC,

2013:116) and contribute to collective Yawuru visions of *mabu liyan* (good *liyan* [well-being]) and *mabu ngarrungunil* (strong community) (NBY, 2018d).

To continue, where overlays in the previous chapter show synergies and conflicts between modelled values and planning documents intended to support Yawuru decision-making, the strategies and practices outlined in this section actively protect Yawuru landscapes. They enable participants and others to continue customary practices while conserving resources, minimising their impact on Yawuru Country and physically cleaning Country (F, G, I). These practices align with the vision of *mabu buru* (healthy Country) outlined in the Yawuru Cultural Management Plan and complement Yawuru governance bodies' aspirations "to protect and manage our Country" (Yawuru RNTBC, 2013:116) including through their geospatial program.

Additionally, while the GIS-based representations presented in Chapter 7 are intended to reflect Yawuru spatial ontologies and demonstrate connection to Country, the strategies and practices presented in this chapter actively continue this connection. Through these strategies and practices, participants "nurture [Yawuru] culture" (Yawuru RNTBC, 2013:116) (A-G), comply with cultural rules (J, K) and maintain connection to areas which may no longer be used on a day-to-day basis (K). They also enforce, protect and create collective and individual rights (M, N). Through these strategies and practices, participants demonstrate connection to culture and Country. In doing so, they protect against the extinguishment of native title which could result from failing to defeat third party challenges to that title (Pearson, 2003). They complement Yawuru governance bodies' use of GIS to assert control over Country while supporting these bodies' goals to "provide [and protect] opportunit[ies] for Yawuru people" (Yawuru RNTBC, 2013:116).

In addition to complementing the Yawuru geospatial program, the strategies and practices described by participants resisted dominant settler colonial narratives in that they supported respectful and equitable co-habitation of the Yawuru living cultural landscape. These strategies and practices did not work towards the return of a precontact state as would align with the palindromic settler colonial narratives which contend that colonisation can only end with complete elimination of the settler or the Indigenous Other. Instead, they focused on enhancing Yawuru control over shared Country to reduce structural inequities following native title recognition. In this, they aligned with Yawuru governance bodies' work to "foster understanding and respect from others" (Yawuru RNTBC, 2013:116), including "respect at the interface of change and development" as required by *Bugarrigarra* (the Yawuru Dreaming) (Dodson in Yawuru RNTBC, 2013:13).

As described in interviews, the strategies and practices employed by participants often facilitated respectful co-habitation with other Yawuru people, non-Yawuru people and non-

human or metaphysical elements of their Country. In terms of cohabitation with non-Yawuru people, many of these strategies and practices show clear respect for non-Yawuru site users (I-L) and go some way to minimising opportunities for conflict. Several participants, for example, used movement to minimise surveillance of controversial customary practices and reduce the potential for conflict which might arise from such surveillance. This tactic has been noted elsewhere, Lea and colleagues observed how Aboriginal people use movement in regional towns to facilitate use of public space (Lea *et al.*, 2012). Participants also sometimes described how they made efforts to co-occupy a site and facilitate connection or interaction with non-Yawuru people by sharing cultural knowledge or engaging in collective care of a place (L-N).

In terms of respectful co-habitation with other Yawuru people, participants deployed strategies designed to give each other space. They also used strategies that reinforced socio-cultural structures and thus had potential to reduce friction within their community. Finally, participants employed strategies including avoidance and singing out, to increase respectful cohabitation with the metaphysical or non-human beings who occupy the Yawuru landscape (E, G, J).

Not all the strategies and practices participants described applying in various contact zones of the post native title environment are likely to minimise conflict. Indeed, some may temporarily undermine respectful cohabitation. Racing for limited sites or resources (H), for example, can mean that other people, including other Yawuru people, miss out on using those resources or areas. Likewise, many participants described asserting individual and collective rights through interactions (M) which can involve short-term conflict. While participants race, they also trade-off with others, using the practice of shifting (I) to increase collective benefit from cultural practices and avoid invading others' space. Moreover, short term conflicts from the assertion of rights can create space for dialogue and may enhance respect for Yawuru people and culture over time.

Ultimately, the sketch mapping interviews conducted with twelve Yawuru participants in this research focused primarily on informing and contextualising GIS-based representations presented in Chapter 7. They did not explicitly examine the ways that participants navigated life following native title recognition. As such, the strategies and practices described here do not capture the full diversity of participants' efforts to address the complexities of the post native title space. They also cannot be characterised as strategies and practices employed by all Yawuru people.

Nonetheless, the diverse strategies and practices presented in this chapter demonstrate that participants do not simply rely on Yawuru governance bodies, or the Yawuru geospatial program to protect their collective interests. Where Chapter 3 outlined the multiple strategies employed by

Yawuru governance bodies to engage in the complexities of their environment, this chapter highlights how Yawuru individuals work to support their families, Country and community. It reinforces that the Yawuru Geospatial program forms just one strand of diverse Yawuru efforts to facilitate *mabu liyan*, *mabu buru* and *mabu ngarrangunil* following native title recognition.

8.3 Conclusion

This chapter facilitated critical reflection on the production and use of GIS based practices and representations within the context of broader Yawuru efforts to protect culture, look after Country and support community following native title recognition. It drew on the rich non-spatial information conveyed in sketch mapping interviews to describe the ways that Yawuru participants, as individuals within a broader collective, engaged in their post native title environment. It also took advantage of the non-spatial information conveyed in interviews, juxtaposed the voices of individual Yawuru people with the collective models in the previous chapter, and explicitly recognised the diverse ways that Yawuru participants are working to protect culture and Country. Ultimately, it positioned the development of context-driven GIS-based representations within the GIS partnership as one among an array of contemporary Yawuru efforts to support community, culture, and Country in a complex and contested space.

Chapter 9: Discussion

The previous two chapters presented core results from this research. This chapter discusses these results with specific reference to the four clustered research questions posed in the introduction to this thesis:

- I. How can outputs from context-grounded spatial analysis which draws on qualitative analysis and fuzzy logic help support Yawuru governance in a post native title environment?
- II. What do settler colonial theory and Pratt's conception of the contact zone suggest about the likely impacts of this approach and its outputs for Yawuru engagement in a post native title environment? How are these insights contextualised by information drawn from sketch mapping interviews with Yawuru participants? What does this imply for Yawuru governance?
- III. How did this research extend on earlier work modelling values in a Yawuru context? What were the strengths of these extensions? What were their limitations? What implications does this have for adapting, refining, and further contextualising these techniques in future research?
- IV. To what extent can techniques and approaches to spatial analysis developed in this research be transferred beyond the context in which they were created?

The first section of this chapter addresses the primary research question by exploring how models from this research can be applied across two locations in and around Broome following the recognition of Yawuru native title in the area. It argues that the GIS-based representations produced in this research can help to inform Yawuru decision making, improve internal communications and support external negotiations across a range of issues and scales. The second section of this chapter draws insights from qualitative analysis, settler colonial theory, and Pratt's conception of the contact zone. It highlights the importance of Yawuru efforts to exercise critical contextual awareness while retaining in-house control of data and outputs from this research.

The third section of this chapter argues that this research extended on previous work in this area by actively incorporating the contextual qualitative information from open-ended questions in sketch mapping interviews into the modelling process. It highlights the values-driven approach to directionally buffering a small number of polygonal features and the qualitative weighting techniques developed in this study. This section argues that these extensions enabled project outputs to align with Yawuru people's use of their living cultural landscape and reduced the need for direct elicitation of factor parameters and weights. The third section of this chapter also identifies limitations to this approach and highlights areas for future refinement. The final section of this chapter contends that the extent to which the techniques and principles adopted in this

research are transferable is largely a function of context and scale. It demonstrates that general principles can be more widely applied from the research than exact replication of all techniques used in the study. In general, this chapter seeks to provide nuanced and reflective responses to the questions which underpinned this research.

9.1 Applications to support Yawuru governance

Indigenous peoples and their governance bodies face information asymmetries, something that Dodson (2012) has termed “information democracy deficits”, as they engage in the “uncomfortable, messy reality of coexistence” following native title recognition (Howitt, 2001:237). As argued by Yu (2011) and Taylor *et al.* (2014), much of the information which is collected by settler groups is either unavailable to Indigenous organisations, or not in a scale or format relevant to their governance needs. In line with the Yawuru knowledge vision, analytical models in this research have been designed to reduce this asymmetry in a way that supports Yawuru governance and reflects participants’ relationship to their living cultural landscape, presenting space not as divided into Boolean notions of valued or not valued, but integrating complexity and continuity into the models which show different relationships to Country.

Yawuru governance bodies are some of the best funded in Australia (Australian Government Office of the Registrar of Indigenous Corporations, 2015). However, their human and financial resources are not without limit. Efficiently and effectively allocating these resources across diverse roles and responsibilities to community-determined ends is a core element of Yawuru post native title governance (NBY, 2013) which requires both internal governance and external negotiation.

As established in Chapter 1, post native title governance is challenging. Yawuru people have diverse needs and they expect their representative bodies to reflect their personal and collective interests in negotiations with external stakeholders. Yawuru people also want to be involved in the governance of their Country and expect developments on their land to bring tangible benefits for their community (Yawuru RNTBC, 2013). At the same time, while Yawuru governance bodies often secure a seat at the table for external negotiations and aim to be “on the front foot” in them (Dean Mathews, Field Notes, 2017), they don’t have a statutory right to veto external developments (McGrath, 2016). Instead, they seek to secure the best possible outcomes for their people, whilst retaining sufficient social and financial capital for long term engagements. To be effective, well-designed spatial analysis should support Yawuru governance in at least one of the areas outlined above.

As described in previous chapters, in this study I adopted a context-driven approach to spatial analysis in an effort to capture values, concerns for significant areas, and seasonal use of those areas across two key sites selected by a Yawuru reference group within the Yawuru estate. I drew on semi-structured interviews with open-ended questions to support a flexible and respectful interview approach (Chapter 5) and applied fuzzy logic to capture the relational ways Yawuru participants connect to their dynamic living cultural landscape (Chapter 6). I also used qualitative analysis of interview transcripts to reflect Yawuru mobilities and ground factor modelling and weighting in the voices of Yawuru participants. This produced diverse cartographic outputs including index models, cartographic analyses, difference models and fly-through geo-visualisations. It also highlighted the agency of Yawuru participants within the post native title landscape (Chapter 8). This section establishes that an approach to spatial analysis which is guided by qualitative analyses and draws on fuzzy logic can help to support Yawuru governance in a post native title environment. It examines two areas in urban Broome Town and peri-urban Crab Creek where analytical models produced in this research can be used to support management of Country and negotiation with third parties across the Yawuru living cultural landscape (Figure 9.1).

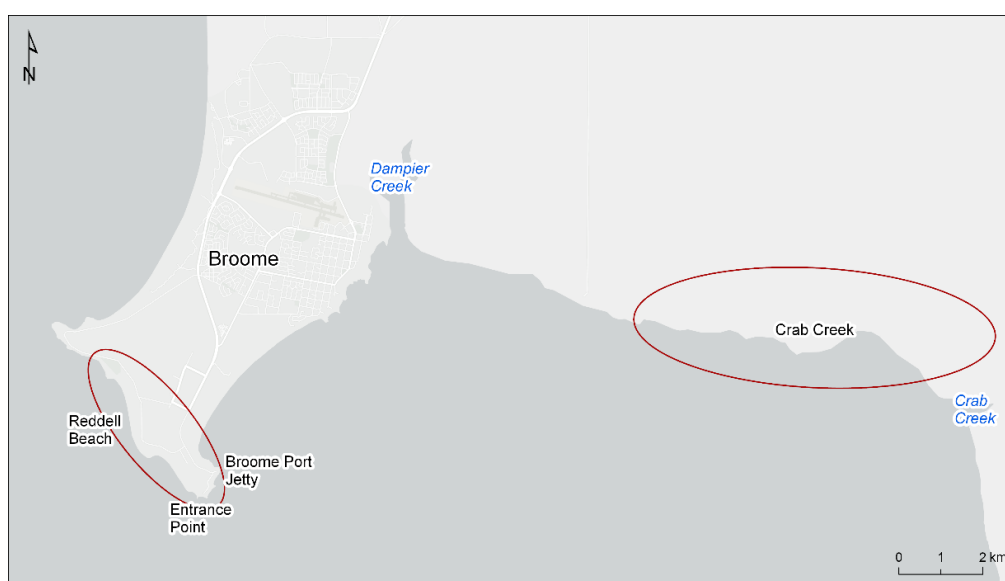


Figure 9.1: Map indicating the location of areas where models produced in this study can support Yawuru governance.

9.1.1 Supporting negotiations over boating facilities at Entrance Point and Reddell Beach

The first area where analytical models have produced strategic intelligence for Yawuru governance relates to proposed boat harbour developments for Reddell Beach and Entrance Point (Figure 9.2). In mid-2016 to early 2017, the area between Entrance Point and Reddell Point was one of four locations where Yawuru governance bodies were asked to carry out heritage surveys



Figure 9.2: Views of Reddell Beach from May 2015 showing the area's beauty and isolation (top left, top right), issues with gully erosion (bottom left), and a sign depicting unstable cliffs (bottom right).

for a proposed safe boat launching facility, more commonly interpreted as a marina by Yawuru people. In March 2017, as outlined on the NBY website, Yawuru declared the area between Entrance Point and Reddell Point (Reddell Beach South) to be the only one of these areas where such a facility could be acceptable from a Yawuru heritage perspective. Reddell Beach South is one of the most isolated beaches near town in Broome. It also includes one of the only portions of reef Country within the Yawuru estate, and is known to contain dinosaur footprints (Salisbury *et al.*, 2016).

In February 2019, research by Romilio, Salisbury and colleagues (Romilio *et al.*, 2017; Salisbury *et al.*, 2016), which showed significant dinosaur trackways between Entrance Point and Reddell Point, led the Broome Boat Harbour Advisory Group to suggest an area between Broome Port and Entrance Point as an alternate preferred location for the facilities (Figure 9.3) (Broome Advertiser, 2019; Shire of Broome, 2019). Detailed site plans for the proposed boat harbour location at Entrance Point had not been prepared at the time of writing and are not assessed here. Nonetheless, this area has fewer dinosaur footprints than Reddell Beach South and areas nearby are already used for boat launching by Yawuru and other people. At any location, a boat harbour is likely to increase traffic and involve considerable alteration to the local landscape (Broome Marina Ltd., 2017). This alteration is, in turn, likely to result in the feelings of loss and destruction

which participants described feeling for other areas within their estate. Given that proposed sites for this marina continue to move, this section assesses both the Reddell Beach South and the Broome Port/ Entrance Point locations relative to analytic models produced in this study.



Figure 9.3: Picture by the author showing the change in preferred location for the boat harbour as described in the Broome Advertiser (2019).

This research offers several insights at Reddell Beach. Models from this study show that Yawuru people hold moderate values and moderate to high concerns around development for Reddell Beach South and that these values are unprotected by native title (Figure 7.23, p. 213). They also reveal that unregulated tracks and drainage problems contribute to deep gully erosion in some areas along Reddell Beach South (Figure 9.2, bottom-left and bottom-right). This aligns with anecdotal evidence from interviews which suggests that portions of the dirt road used to access Reddell Beach South are inaccessible to Yawuru people during *Man-gala* (Broome's wet season). In general, models from this research suggest that Reddell Beach South is more likely to be an appropriate location for the boat harbour than Reddell Beach North. There, high values and exclusive native title would likely be impacted by construction of a harbour. Nonetheless, these models make clear that Yawuru people held significant concerns about development in this area at the time of interviews in 2015.

At the Entrance Point site, analytic models produced in this research also provide insights for Yawuru governance bodies. First, these models show generally high values for much of the Broome Port and Entrance Point areas (Figure 7.10, p.196). They also show that the area between Broome Port and Entrance Point contains special places for a number of Yawuru people (Figure 7.6, p.193) and that this area is used comparatively consistently throughout the year (Figure 7.13, p.201). This suggests that any closure of the area would likely have a large impact on Yawuru people's daily lives. Second, models for this area show high levels of concern around future development (Figure 7.17, p.205) and site closure (Figure 7.18, p.206). While data on the concerns held by Yawuru people was collected in 2015, many of these concerns now appear to be justified. These concerns suggest that Yawuru governance bodies should seek to actively

protect this area or at a minimum negotiate to ensure that Yawuru people retain access to these sites.

Third, the overlays of these models on zoning and native title documents (Figure 7.23, p.213) reveal that, while Yawuru people hold high concerns for these areas, the Entrance Point site is zoned for Port-related purposes and NBY have fewer native title-based points of leverage in the area as native title was extinguished in much of the area by the declaration of the Broome Port. In practical terms, Yawuru governance bodies may struggle to assert control over Entrance Point unless they can demonstrate how issues like run-off, bilge pumping, and other potential pollutants may impact the adjacent Yawuru conservation estate. Here, flow modelling from digital elevation models may be combined with overlays produced in this research to help inform some of this debate. Additionally, Yawuru governance bodies could draw on the GIS-based representations and contextual qualitative information collected in this research to develop a *liyan*-based argument which demonstrates how development in this area may impact on the contemporary well-being of Yawuru people.

To be clear, NBY do have a presence on the advisory group for the safe boat harbour (marina) and they have been able to initially rule out some locations through cultural heritage surveys. Indeed, the NBY website notes that NBY “loo[k] forward to participating in the ongoing process [of assessment] which will adhere to best practice standards” (McDowell, 2017). Additionally, at the time of submission they were actively using models from this research in negotiations around developments proposed for the Entrance Point area. Moreover, it is possible that a marina with environmentally sensitive design which avoids closure and enhances access to the area for Yawuru people could function like the Broome Port – an area avoided by some Yawuru people due to crowding, but valued by many others because of the access to Sea Country and fishing opportunities it provides. Nonetheless, other members of the boat advisory group include settler government bodies such as the Shire of Broome, the Western Australian Department of Transport, and the Kimberley Port Authority. They also include recreational interests such as the Broome Fishing Club, and industry representatives including the Kimberley Marine Tourism Association and Kimberley Development Commission. While NBY are major landholders in Broome, a seat at the negotiating table does not create a level playing field in this area and the impact of models from this study remains to be seen. It is my hope that the strategic intelligence provided by models in this study may play a role alongside the broader Yawuru knowledge vision in shaping best practice and helping to ensure that the practice facilitates free, prior and informed consent within this space.

9.1.2 Informing access management at Crab Creek

This section examines how regional information can support the allocation of resources for joint management within the Crab Creek area. Crab Creek is part of the Yawuru Birragun Conservation Park and the Yawuru Nagulagun/Roeback Bay Marine Park. It is managed collaboratively by a range of partners including DPAW and the Yawuru Park Council. The terrestrial portion of Crab Creek is now covered by exclusive and non-exclusive native title, as are parts of its intertidal zone. Traditionally viewed as a retreat from the town, Crab Creek contains a Ramsar site for significant wetlands. It is also under increasing pressure as Broome expands.



Figure 9.4: Deep gully erosion at Crab Creek. The image on the left shows the top of deep gully erosion adjacent to an area used by vehicles to access the beach. The photo on the right shows the same gully, but taken from the beach.

Management issues in Crab Creek, including erosion of the pindan cliffs, continue to be exacerbated by formerly unregulated access and poor alignment of the east-west road. The effects of this erosion are clearly demonstrated in Figure 9.4 which shows a deep, eroded gully adjacent to a spur road and Figure 9.5 which demonstrates the change in erosion of the track down to the beach at Sabu Rock from May 2015 to June 2017. Nonetheless, joint managers currently lack the necessary funding for road realignment.



Figure 9.5: Erosion of the Sabu Rock access track. The image on the left was taken in May 2015, the image on the right was taken in June 2017. Considerable erosion took place over that time.

Efforts to mitigate erosion in the Crab Creek area should address the priorities of Yawuru people. Models produced in this research suggest that participants' concerns are most acute directly south of the Crab Creek Road and at Sabu Rock (Figure 7.19, p.207). Not only do these models demonstrate the location and magnitude of these concerns, they also allow for relative prioritisation of mitigation measures among these sites. If NBY combined this prioritisation with an assessment of erosion risk which uses the Revised Universal Soil Loss Equation and takes vegetation into account, they could model how revegetating particular areas or employing other land cover types which reduce soil loss further up-stream in Crab Creek might reduce the likelihood of erosion in priority areas. Combined with DPAW's other collected data on vehicle traffic in the area (Field Notes, 21 May 2015) this could guide the placement of future interventions including rocks to prevent soil loss and sumps to capture water run-off (Figure 9.6).

Maintaining access to areas along the foreshore is vital to Yawuru people's cultural and physical well-being (Yap and Yu, 2014) and allowing appropriate recreational access to the Yawuru conservation estate is a key element of joint management (DPAW, 2016a). However, joint management plans aim to close, and where possible rehabilitate, several of the informal spur roads within that site which can cause the gully erosion visible in Figure 9.4. Comparing the synthesised values model and the seasonal use model with modelled concerns about erosion and closure may help joint managers to assess proposed and newly implemented access regimes across Crab Creek.



Figure 9.6: Erosion mitigation measures at Crab Creek. Rocks placed to prevent vehicle access and slow erosion in a high erosion area (left). Sumps installed adjacent to the east-west road to prevent run-off and water pooling on the road (right).

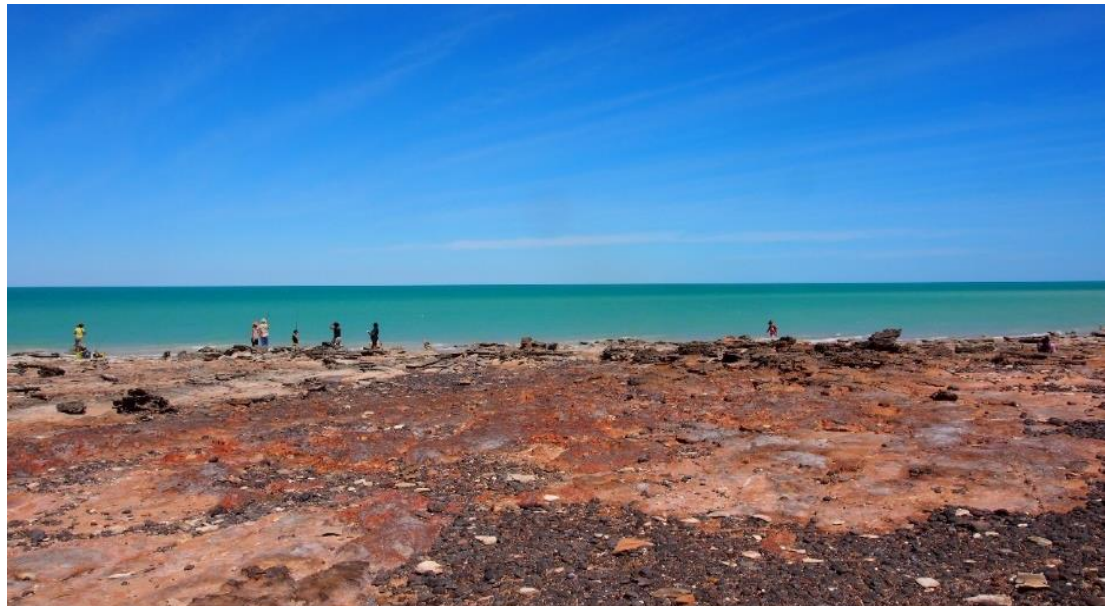


Figure 9.7: Yawuru and other families fishing at Sabu Rock in the Crab Creek site.

GIS-based analytical models offer several pieces of strategic intelligence for both erosion management and proposed closures. First, models comparing Yawuru participants' concerns about erosion (Figure 7.19, p.207) and closure (Figure 7.18, p.206) show these concerns are spatially coincident across Crab Creek. Given that weights applied for closure and erosion were similar, efforts to combat erosion through closure may not reduce participants' synthesised concerns in the area. Nonetheless, overlaid on proposed access regimes at Crab Creek, the synthesised values model (Figure 7.30, p.228) suggests that access arrangements proposed in the joint management plan may be adequate from a participants' perspective: high values in the model coincide with proposed access routes. Moreover, pedestrians will continue to have shore-based access to the entire site. Second, models of significance and concern reinforce the importance of

the Sabu Rock area (Figure 9.7) and highlight the important role this area plays within the broader region (Figure 7.10, p.196 and Figure 7.22, p.209). These models provide a strong justification for additional recreational facilities and infrastructure planned for this site.

Finally, the analytical models may inform temporary or seasonal closures across Crab Creek. For example, the seasonal site use model suggests that some Yawuru people continue to access Crab Creek via the east-west road during Man-gala, Broome's wet season (Figure 7.16, p.204). This access may be problematic given that driving on wet, unsealed roads can contribute to degradation and that many participants have expressed concerns about road quality in this area. Indeed, seasonal movements described in the Yawuru Cultural Management Plan do not give precedent for access to Crab Creek during the wet season (Yawuru RNTBC, 2013). In fact, these models suggest that it may be appropriate to temporarily close land access to the Yawuru conservation estate between Kunin and Crab Creek at this time of year. Overall then, the overlay of context-driven models of Yawuru values and concerns on joint management plans for Crab Creek has the potential to offer Yawuru governance bodies and co-managers considerable strategic intelligence for managing this area.

9.1.3 Concluding comments on proposed applications of spatial outputs within the Yawuru estate

This section has used two examples to demonstrate how a context-grounded approach to spatial analysis guided by qualitative analyses and fuzzy logic might support Yawuru governance and decision-making in a post native title environment. While not exhaustive, it has illustrated how such analyses can support joint management in and out of town; inform negotiations with third party developers and managers; and guide the allocation of resources within the Yawuru estate.

That the outputs of this research have distinct potential to support Yawuru governance is a testament to the Yawuru strategic knowledge vision. Yawuru governance organisations have invested in overcoming information asymmetries and, where at all possible, maintaining data sovereignty across their estate. They have sought out and negotiated research partnerships, built their in-house capacity to store and adapt the products of that work, and provided the information needed to tailor research towards their governance needs. They have used their vision and leadership, and the research partnership, to facilitate context-driven GIS which can inform governance of their living cultural landscape. The capacity of GIS models produced in this research to support Yawuru governance is, in large part, underpinned by the hard work, determination and resourcing of Yawuru governance bodies.

9.2 Hypotheses and implications from theory and qualitative research

As outlined in section 9.1, NBY is likely to apply products from this research, with their emphasis on analysis and ontological alignment, to support internal decision-making and external negotiations as part of post native title governance. The context in which NBY is likely to apply these models is important. NBY governs in Australia - a settler state which was slow to recognise a limited form of native title (Forbes, 1998; Herne, 2001); in Western Australia, a state which fought hard against the recognition of land rights (Mercer, 1993); and in Broome, a coastal hub (Australian Government, 2015), service centre (Shire of Broome, 2013b) and staging point for settler Australia's national defence (Hawke and Smith, 2012) which has a strong history of oppression and resistance since settlement (Jackson, 1997b; Yu, 1999). To return to the theories which frame this thesis, this means that Yawuru governance bodies negotiate in multiple highly asymmetric environments which share key characteristics with Pratt's conception of the contact zone.

I have not been able to assess the long-term impact of outputs from this research on Yawuru engagement in the contact zones of a post native title environment. Such an assessment would require years of additional study and is beyond the scope of this research. Instead, in this section I combine field observations with hypotheses generated from settler colonial theory and Pratt's conception of the contact zone to illustrate how certain strategies employed by Yawuru governance bodies are likely to remain important elements of their governance following native title recognition.

9.2.1 Settler colonial theory: revisiting structural challenges and the power of narrative

To recap, settler colonialism is a circumstance where one group of individuals (the settlers) aim to secure territory through the deterritorialisation of another group (the Indigenous Others) (Wolfe, 1999). Chapter 2 drew on settler colonial theory to highlight how settler colonialism is not a discrete event relegated to the past, but rather an ongoing structure where a deeply entrenched "logic of elimination" continues to pervade dominant cultures, laws, policies and development (Wolfe, 2006). It showed how territory-based narratives sat at the heart of the settler project and suggested a need to explore alternatives to the cadastral model of space which better aligned with Indigenous worldviews. That chapter also suggested that techniques which undermine entrenched settler narratives can be powerful in this space.

Clearly, Yawuru governance bodies already see the potential of field-based narratives which emphasise complexity, connection, and continuity to support governance and negotiation across their estate. This was reinforced in meetings with NBY staff around this research. Dean Mathews,

for example, suggested that models from this study could be used to communicate elements of this landscape more clearly to non-Yawuru staff at NBY (Dean Mathews, pers. comm., June 8, 2017). Likewise, Rodney Nichole, the then Yawuru in-house counsel, noted in 2017 that the visualisations of values and concerns could be used to enliven negotiations and dry legal proceedings by offering an interactive, spatial alternative to the verbal and written interchanges which occur in such places (Rodney Nichole, pers. comm., June 7, 2017). Finally, Peter Yu argued that, for him, the models captured *liyan* in a way that could communicate that concept more clearly to non-Yawuru audiences (Peter Yu, pers. comm., June 7, 2017).

Like settler colonial theorists, Yawuru governance bodies also recognise the diverse and entrenched challenges they face following native title recognition. This is important, as settler colonialism remains unfinished business in Australia (Hocking, 2005; Veracini, 2007) and settler colonial theorists contend that reforming settler societies will not be easy (Strakosch and Macoun, 2012). In this sense, settler colonial theorists underscore the challenges faced by Yawuru governance bodies following native title recognition.

If settler colonial theorists suggest that GIS-based representations produced in this research may have local impacts without resulting in widespread structural change, the contextual qualitative information from sketch mapping interviews makes it clear that such a “cure-all” is simply not necessary in a Yawuru context. Yawuru governance bodies do not just rely on their geospatial program to manage Country (Chapter 3) and Yawuru participants do not solely rely on Yawuru governance bodies to protect their values and rights (Chapter 8). Instead, they continue culture, move in time and space, and directly engage with challenges in ways that both subvert settler logics of elimination and support respectful cohabitation of their living cultural landscape. Thus, settler colonial theory reinforces what Yawuru people already know: GIS is not a panacea, but one of many potential tools for engaging with complexity across their estate.

9.2.2 Pratt’s contact zone and the importance of retaining in-house control over the products of this research

Pratt’s conception of the contact zone and the arts transculturated by Indigenous peoples also has implications for Yawuru governance and the use of products developed in this research. As outlined in Chapter 2, Pratt argues that contact zones are high stakes environments where groups separated by time and space “meet, clash, and grapple with each other, often in contexts of highly asymmetrical relations of power, such as colonialism, slavery, or their aftermaths as they are lived out in many parts of the world today” (Pratt, 1991:34). According to Pratt (1991), in these environments Indigenous and other subordinated peoples often adapt and appropriate technologies which are visited upon them to intervene in dominant understandings. However, the products of such appropriations often have different meanings to different groups. At times, they

can encourage mutual understanding and comprehension by bridging worldviews - producing some of the joys of the contact zone. At other times, they can result in dead letters, miscomprehension, and absolute heterogeneity of meaning. This can lead to frustration and increased potential for conflict for the subordinated group who employs them, invoking the perils of writing and communicating in the contact zone.

Pratt's understanding of contact zones and their arts implies that the approach to GIS and spatial analysis and their outputs developed in this research will be perceived differently by different audiences in high stakes environments. It highlights a need to actively manage risk related to both the approach and its outputs. In part, NBY already manage risk through their Four Pillar Knowledge Vision and in-house GIS capacity. They have also set up importantly stringent conditions for research partnerships in this area. As shown in the following two examples from fieldwork in June 2017, Yawuru governance bodies' emphasis on data sovereignty through their knowledge vision has facilitated Yawuru access to, and control over, use of GIS technology, including outputs produced in this research. It has enhanced risk management and given Yawuru the ability to critically apply, adjust, and withhold information from these products to their best advantage.

9.2.2.1 Example A: Control over outputs during a State Administrative Tribunal hearing

This first example outlines how Yawuru considered using and then ultimately withheld outputs from this research from a State Administrative Tribunal hearing. The possibility of Yawuru using outputs from this research in the State Administrative Tribunal was first raised in a meeting which presented these outputs to NBY CEO Peter Yu on June 7th, 2017. Specifically, Yu suggested that the synthesised values model, the concerns model and the 2.5D visualisation of values and concerns for the Broome Town site be applied to support Yawuru negotiations within that space. As outlined earlier, Yu viewed the models as having potential to communicate key ideas around the Yawuru concept of *liyan* (roughly translated as well-being) which was a key point of contention in the Tribunal Hearing as Yawuru governance bodies were arguing that in certain circumstances the best benefit for Yawuru people would come from *not* developing portions of their freehold land.

A subsequent meeting with the Yawuru in-house counsel at Yu's request led me to prepare several key outputs and a summary of the research methodology to be adduced as evidence in the Tribunal process. The method and outputs would function as my expert testimony in the case, due to be submitted less than two weeks from the initial meeting. At the time, the in-house counsel noted the animations might be particularly important given that those hearing the claim were unlikely to have appropriate cross-cultural training. Here, the animations gave a sense of

dynamism and embodiment to the living cultural landscape – whilst remaining legible to a non-Yawuru audience.

There were several implications to being called as an expert witness in the high stakes contact zone of the State Administrative Tribunal. These are discussed in greater detail in Appendix 9A. It is possible that, as observed by Jarvis and Stearman (1995:58), the visualisations and maps may have functioned as an “island of calm and reason” within the tribunal setting. However, the description of the tribunal process included in the Guide For Experts Giving Evidence provided by the State Administrative Tribunal (State of Western Australia, n.d.) suggested a more adversarial environment where my expertise as a witness, the method used to create the models, and the model outputs could be contested by both parties and perhaps used to undermine the Yawuru case.

Two days before all evidence adduced by NBY needed to be submitted to the Tribunal, the barrister representing NBY decided to strategically withhold my testimony from the hearing based on his detailed understanding of the legal system. He argued that it was too risky to employ the models as they did not include *Bugarrigarra* (Dreaming) or metaphysical values for the in-town areas. He also noted that few values appeared to have been recorded in some sites relevant to the hearing. In this, he recognised the potential for the maps and visualisations to be used in ways that run counter to Yawuru interests. In the end, NBY was able to successfully negotiate a “without prejudice” settlement addressing all matters currently before the State Administrative Tribunal on July 27th 2017, several days before the intended hearing.

To be clear, this research was not intended to produce evidence for the State Administrative Tribunal. Instead, it was meant to trial methods for modelling values and concerns which could be adapted and replicated across the Yawuru estate. The mapping outputs from this study were an important element of testing these methods, but not considered to be definitive representations of Yawuru people’s relationships to Country. Nonetheless, both Peter Yu and the Yawuru in-house counsel displayed considerable faith in the approach and its outputs. In his email discussing the barrister’s response the then in-house counsel Rodney Nichole argued that this approach “has utility [in] so many other ways” external to the tribunal proceedings (Rodney Nichole, pers. comm., 7 June 2017). In part, this utility may be further explored through mapping of *Bugarrigarra* or Dreaming sites as outlined in Example B.

9.2.2.2 Example B: Proposed extension of the approach to incorporate previously excluded values for Bugarrigarra (Dreaming) Sites

A second key issue raised in the meeting where outputs from the research were presented to NBY CEO Peter Yu was the exclusion of *Bugarrigarra* (Dreaming) sites from the synthesised

values model. In this meeting, Yu expressed a desire to build out a “cultural” layer based on these *Bugarrigarra* sites. He suggested that as a member of the ANU Council he could talk to the ANU Vice-Chancellor, Professor Brian Schmidt, about both my research and the broader Fenner School-NBY GIS partnership, as part of what he perceived as the University’s broader role in northern Australia. At Yu’s suggestion, I prepared a summary of the partnership and my work, along with a request to fund post-doctoral research to map *Bugarrigarra* sites as part of the cultural layer (Appendix 9B). In a meeting with Peter Yu, Professor Schmidt and Bruce Doran on July 21st 2017, Professor Schmidt expressed genuine interest in the research and how the models were compiled. He described potential funding avenues for a post-doctoral fellowship – none of which had eventuated at the time of writing this chapter.

As discussed in Chapter 6 and described to Peter Yu during our meeting, *Bugarrigarra* sites were originally excluded from the values model. Many of these sites were poorly covered in sketch mapping interviews. While some participants strategically recorded them to ensure their protection, others did not – often because they felt they lacked the appropriate knowledge and cultural authority to do so. This was exacerbated by some senior men declining to participate at the time of interviews. It was also impacted by some participants’ knowledge that in-house Yawuru databases already held many of these sites. At the time, recording these sites was viewed as more complex and riskier than recording areas which were associated with family members or activities.

Nonetheless, as argued by Peter Yu there are strong imperatives to extend the values model by creating a spatial record of *Bugarrigarra* and sacred sites. To begin, as recognised by the barrister for NBY in the tribunal example, the value of areas which are sacred but used infrequently due to their significance is likely to be underestimated in the present synthesised values model. This is problematic because settler governance bodies and organisations may be more likely to negotiate over proposed developments or zoning changes when an area is viewed as sacred. That is, GIS models of sacred sites may be a more effective art of the contact zone than a model which focuses on areas valued for practices and relationships. Moreover, as examined in Chapters 4 and 6, protective measures which allow graded access which echoes the fuzzy logic employed in this research are likely to be considerably more appropriate than the placement of fences around areas which is often the result of existing Boolean or sites-based discourses. Representing these sites with fuzzy logic may help Yawuru to secure appropriate protection for these areas as part of co-management or other negotiations within their estate.

Finally, the mapping of *Bugarrigarra* and sacred sites would provide additional opportunities for senior men to become involved in a GIS mapping project, albeit in a way that demonstrated particularly high levels of respect for their cultural authority. Although the research partnership had been running for nearly three years at the time of the sketch mapping interviews

used to build the models, previous values mapping exercises had covered only a limited number of values over a small portion of the larger Yawuru estate. The death of a senior Yawuru woman immediately prior to the values mapping conducted during the 2013 pilot study meant that, at the time, senior men had had relatively little exposure to such an approach and its outputs.

9.2.3 Drawing hypotheses from Pratt's conception of the contact zone to inform Yawuru governance

Linking back to the hypotheses offered by Pratt's conception of the contact zone, both the State Administrative Tribunal example and the *Bugarrigarra* mapping example demonstrate the ongoing importance of managing potential risk and rewards related to the products of this research. The potential use of outputs from this research in the State Administrative Tribunal is a clear example of Yawuru governance bodies considering the use of a GIS model which has been deliberately designed to convey Yawuru worldviews to a non-Yawuru audience in a highly asymmetric, contested environment regulated by the settler state. Where Yu and Nichole hoped that these outputs would encourage mutual understanding and bridge worldviews, the barrister for NBY ultimately decided that the risk of miscomprehension and conflict around the models outweighed their potential for reward within this space. The barrister was able to make the decision *not* to adduce these models as evidence because NBY had been active in their risk management, working hard to maintain their GIS capacity and assert data sovereignty by keeping these models in-house.

Similarly, in the *Bugarrigarra* mapping example, the demonstrated outputs of this research and the recent success of other GIS projects within the partnership were instrumental to increasing Peter Yu's knowledge of the project and faith in the analytic approach. This trust was also enhanced by the knowledge that Yawuru governance bodies would be able to manage risk by holding all such outputs in-house as part of the partnership. Here, Yu stated and demonstrated his willingness to expend some political capital both within the ANU community and with senior Yawuru men over this new mapping because he perceived its potential to reward NBY and Yawuru people more generally for such an investment. Again, it is highly unlikely that such trust would exist without Yawuru capacity to dictate the terms of cultural clearance or store the new approach and its outputs in-house. In that respect, Peter Yu's proposal was as much an endorsement of the Yawuru approach to GIS mapping as it was of this individual exercise.

It is clear from the examples outlined above, as well as the strategic decision to apply certain models to negotiations around proposed developments at Entrance Point, that Yawuru governance bodies are already drawing on their contextual understanding as they choose to apply and withhold arts of the contact zone produced in this study. Ideally, the contextual knowledge held by Yawuru governance bodies would include a firm grasp of the models themselves as well as an

intimate understanding of the Yawuru governance context. In interviews, for example, Yawuru people were best able to influence the research when they understood both how collected information might be employed by NBY and how it complemented existing information in-house. This suggests that Yawuru agencies' capacity to employ these models is likely to be enhanced through furthering their grasp of GIScience beyond the geospatial unit. It may especially be supported by enhancing Yawuru decision makers' conceptual understanding of the models' construction and outputs. Presentations and reports made to NBY throughout the research go some way towards this, as does the broader GIS partnership and data hand back in July 2019. Nonetheless, retaining both control over, and critical understanding of GIS technology and its potential is likely to be central to the success of the Yawuru geospatial program into the future. In this context, it is essential that Yawuru governance bodies fully understand the strengths and limitations of analyses conducted in this research.

9.3 Evaluation

This section evaluates the techniques and approaches to GIS modelling developed in this research relative to earlier work in this space. As a starting point, many of the strengths of this research come from its use of and extensions on techniques developed in a pilot study conducted during my Honours year where I worked as part of the GIS partnership to model three values held by Yawuru people for Broome's in-town foreshore (Potter, 2013; published in Potter *et al.*, 2016). For simplicity, and to distinguish between the pilot study and my evaluation of the current work, I refer to the 2013 study as "the pilot study" or "the 2013 pilot study" and use the third person to describe that study throughout this evaluation.

In the 2013 pilot study, the partnership demonstrated the potential of "using a fuzzy index modelling approach as a common language to communicate Indigenous values and facilitate negotiation" (Potter *et al.*, 2016:17). It showed that "analytical models can be adapted to improve their cultural relevance to Indigenous peoples", particularly as part of research partnerships. It also demonstrated that "fuzzy logic may produce spatial representations which are more congruent with Indigenous perceptions of space than traditional Boolean models" (Potter *et al.*, 2016:17). That work demonstrated how "overlay techniques may equip Indigenous peoples to engage with settler documents in a way which may reduce the asymmetry of information" (Potter *et al.*, 2016:17). In sum, that study was able to show how the technical apparatus of GIS could contribute to post native title governance rather than just dispossession.

The 2013 pilot study was also subject to several limitations. As a pilot study, it was limited in scope. It used data from three participants to represent a subset of values held by Yawuru people for Broome's in-town foreshore – a small area of the Yawuru estate. It also made untested assumptions. For example, it assumed that isotropic fuzzy buffers with a linear decrease and

distance thresholds based on my understanding of the study site were adequate to capture the spatial extent of these values. Finally, the approach to factor weighting adopted in that study needed to be adjusted to accommodate a larger number of participants.

In this study, I continued to use sketch mapping and fuzzy index modelling to represent values for the Yawuru living cultural landscape. I also drew on Indigenous methodologies, critical GIScience and qualitative GIS to ground my engagement in this GIS partnership. I worked with a reference group of NBY staff to extend the scope of the 2013 work; grounded fuzzy index modelling in semi-structured sketch mapping interviews; incorporated additional analytic techniques and used complementary analyses to accompany and guide the use of analytical products. Each of these extensions and the strengths that they brought to the analyses are examined in turn below. They are followed by sections addressing the compromises and limitations of this approach.

9.3.1 Further extending the research scope

From the outset, this study was intended to build on the 2013 pilot study by extending the spatial and qualitative foci of that research. Whereas the pilot study focused on three values identified in sketch maps by three participants along Broome's in-town foreshore, overlaid on three management documents, in this study I used sketch mapping interviews with twelve participants to identify nineteen unique values across two study sites, as well as to model concerns for and seasonal use of those sites. I then produced a variety of visualisations from these models and overlaid them on local planning documents, joint-management plans, and native title recognition across Broome Town and Crab Creek.

While simple in some respects, these extensions to the pilot study were important. The inclusion of additional values in this study, for example, combined with related concerns and seasonal use patterns provided greater scope for Yawuru governance bodies to consult with their constituents in these areas. This produced tangible outputs which could be applied to engage with key management and governance issues in various spatial contexts across the two sites. Additionally, the presence of twelve Yawuru participants in this study increased my capacity to qualitatively weight sites identified in sketch mapping interviews and enhanced the diversity of views presented in this research relative to the pilot study. These extensions helped demonstrate how GIS-based representations which draw on index modelling and fuzzy logic might be applied with more Yawuru people in other parts of the Yawuru estate.

9.3.2 Further grounding spatial analyses in context

As outlined earlier, the pilot study worked to support the Fenner School-NBY GIS partnership by drawing on GIScience and Yawuru spatial ontologies or worldviews as identified

in discussions with NBY staff. That study described discrepancies between Yawuru ontologies and the Boolean logic which underpins the entity-based models that have dominated Indigenous GIS use for repossession to date. It also used rasters and fuzzy logic to reflect continuity and complexity in modelled values.

In this study I also used fuzzy logic to align with Yawuru worldviews. Further, I worked with NBY staff to balance our earlier use of contextual information with critical GIScience and a need for pragmatic and tangible outcomes from the research partnership. Where I used three pre-defined factors which had been selected by Yawuru staff in the earlier study, in this study participants identified values, concerns and times associated with the seasonal use of sites. I then descriptively coded participant-identified factors to define feature attributes and used information from Gardner (2014) to parameterise the membership function.

I also worked to carefully adjust for local context in capturing and representing seasonal landscape use. Although the reference group wanted information on contemporary use according to the Yawuru seasons, settler policies in Broome had historically discouraged Yawuru language use, making it inappropriate to force participants to define site use in this way (Dean Mathews, pers. comm., 4 May 2015). Responding to this complexity, I had participants self-define when they used valued sites, then used contextual information from both the sketch mapping interviews and the Yawuru Cultural Management Plan to convert these responses to Gregorian months. I then drew on locally published documents to translate these responses into both Yawuru seasons and the wet and dry seasons of Broome's tropical monsoonal calendar. This process filled the reference group brief. It enabled participants to define site use according to their lived experience and retained temporal resolution in Gregorian months. Finally, it facilitated translation to the widely understood wet and dry seasons which are highly relevant to tourism management in Broome.

I also drew on contextual qualitative information from the sketch mapping interviews in factor modelling. Here, I used qualitative coding to select distances associated with fuzzy buffering. This led me to identify a need to capture directionality in modelling foreshore-based practices. Prior to this research, anisotropy, or directionality, had already been incorporated into geostatistical interpolations (Shen *et al.*, 2009; Unwin, 2008), the representation of wind vectors (Skene *et al.*, 2010), and some cost paths for route planning (Saha *et al.*, 2005). However, such directional interpolations, including inverse distance weights and splines, rely on a large number of point-based inputs (Boisvert *et al.*, 2009; Esri, 2018; Longley *et al.*, 2011). These techniques would not have worked with the relatively few polygons drawn by participants. They also would have reduced polygons to their centroids and would not have preserved polygon shape. These were key considerations when working with spatial data from free-form sketch mapping interviews.

Given the limited utility of external approaches to anisotropy in this study, I ultimately developed an innovative technique to directionally buffer a small number of polygonal features relative to a second feature representing the coast. Here, I used Python scripting, buffering and directional displacement to create uni- or bi-directional buffers which captured site use associated with anisotropic practices. These buffers were a key element of representing the daily practices and Indigenous mobilities which have often been heavily policed by settler states. They provided a response to Howitt's argument that "exploration of new spatial metaphors needs to displace the naïve spatial certainties suggested by the notions of frontiers and boundaries that have so dominated the geographical imaginaries of many Australians" (Howitt, 2001:242). These buffers captured elements of relationality which were grounded in Yawuru participants' own descriptions of how they moved through, used, and related to Country. In that respect, they "confront[ed] the ambivalence and openness that is part and parcel of the complex, contingent and uncertain reality of co-existence" (Howitt, 2001:242).

From a technical standpoint, the directional buffering developed in this study can be extended to incorporate any number of distances and directions. Indeed, I am working to release this technique as a toolbox available to other users of ArcGIS and to expand the script for use in a QGIS environment. In this case, an emphasis on grounding the analytical process in local context has led directly to the development of tools which may have broader spatial applications as detailed in Section 9.4.

The final tool or approach I developed in this research incorporated contextual information in modelling through the qualitative weighting of values and concerns. As a reminder, in this process, I first assigned weights based on the relative number of words participants used when discussing practices or concerns included in the modelling process. I then adjusted these weights based on individual comments about the broader cultural significance of those activities made by participants. This approach enabled me to produce relative weights for more than 19 individual practices without the need for direct elicitation. It negated the need for approximately 90 [10.(10-1)] questions which would have been required for a pairwise comparison of all ten resource collection based factors (Riabacke *et al.*, 2012). This technique both minimised the cognitive burden placed on participants and reduced the potential for interview fatigue which is a key issue in Indigenous contexts (Smith, 2012).

To conclude this section, as outlined in Chapter 6, I extended on the earlier study by integrating contextual qualitative information throughout spatial modelling in this research. In doing so, I "ground[ed] technological advancements in social and political contexts" (Sieber, 2006:492). As Walker and Hanchette (2015) found with their three-pronged approach to grounded visualisation around public housing issues in Louisville, Kentucky, this approach encouraged NBY staff to trust modelling outputs. Certainly, both the directional buffering and qualitative

weighting techniques adopted in this research were preliminary and thus likely to be subject to some revisions in later work. Indeed, limitations of these techniques are discussed in greater detail in Section 9.3.9. Nonetheless, these examples demonstrate how a combination of contextual awareness, critical GIScience and pragmatism can lend additional nuance and rigor to spatial analyses and the production of GIS-based representations in an Indigenous context.

9.3.3 Incorporating additional GIS tools and coding techniques

Beyond grounding GIS analyses in context, I extended on the pilot study by incorporating Python scripting and fly-through geo-visualisations into this study. Python is a scripting language which is both comparatively easy for novices to learn and well-integrated into ArcGIS. Thus, Python scripting “has become a fundamental tool for GIS professionals to extend the functionality of ArcGIS and automate workflows” (Zanderbergen, 2013:5). Here, I employed Python scripting to “connect diverse existing components [of ArcGIS software] in order to accomplish a new, related task” (Zanderbergen 2013:4). This dramatically reduced model processing times and facilitated greater iteration in index modelling and directional buffering. It also extended the functionality of GIS and reduced the likelihood of human error in this research by automating workflows and facilitating many of the innovations described in Section 9.3.9.

Drawing on the foundation of the pilot study, I used a series of continuous and complex rasters underpinned by fuzzy logic to represent the values and concerns held by Yawuru participants in this work. As outlined earlier, these rasters can be directly compared to plans for Country through overlay (e.g. Willow, 2013) in a way which may facilitate discussions around a negotiating table (e.g. Engle, 2001; Lewis and Sheppard, 2006; Talen, 2000). These rasters also have potential to be integrated into further analytical modelling (e.g. Moore *et al.*, 2016). Nonetheless, these simple overlays were subject to limitations in that they were static and planimetric, representing a “gods-eye view” of Country which has little to do with embodied landscape experience (Pearce and Louis, 2008). In this study, fly-through visualisations of values and concerns formed important extensions to the earlier pilot.

Often “[v]isualisation is crucial in a public participation process because it is the only common language to which all members of the community – young people and adults, poor and rich, powerless and powerful – can relate” (Al-Kodmany, 2002:328). This has particular relevance given observations made by Howitt (2001:237-238) that even among comparatively progressive resource extraction companies “the ability to genuinely listen to Indigenous people is rare [and t]he ability to understand what is said in negotiations is even rarer” (see Altman, 2009; O’Faircheallaigh and Corbett, 2005; O’Faircheallaigh, 2006, for similar arguments).

In this study, I used visualisations to overlay, drape and invert the values and concerns models, then combine them with movement from fly-throughs. Following observations from Sheppard and Cizek (2009) about the power of visualisations to inhibit critical analysis of underlying data, these fly-through visualisations were not fully realistic. Instead, I used a low oblique perspective to overcome the disembodied space of the conventional map (Pearce and Louis, 2008) and adopted varying hues and inversion to facilitate clear analysis at a site level. Despite efforts to avoid flashy details in the visualisation which might imply a greater level of confidence in the models than is genuinely warranted, it is possible more polished elements of the visualisations may suppress debate about the modelled values (Krygier, 2002; MacEachren, 1995). Additionally, these prototype visualisations did not capture local topography or changes in values and concerns over time, nor do they yet capture stories and more explicitly human elements of these landscapes which may act as more truly decolonising elements in the work (Palmer, 2012; Pearce and Louis, 2008).



Figure 9.8: The author (right), Yawuru Country managers and Honours students with the Yawuru drone at Roebuck Plains (Photograph by Bruce Doran, 2017)

Even with these limitations, Native Title and Environmental Services Unit staff, Yawuru in-house counsel Rodney Nichole and Yawuru CEO Peter Yu viewed these visualisations as offering a valuable perspective on the Yawuru landscape for a State Administrative Tribunal hearing. This may reflect confidence in visualising aspects of the Yawuru living cultural landscape as part of a suite of communication techniques rather than indicating these outputs were definitive spatial

products representing the estate. Nonetheless, Yawuru governance agencies have in-house video-editing capacity and drone capabilities to improve the visualisations and further adapt them to suit their needs (Figure 9.8). As an example, NBY may record stories to be included alongside the visualisations. They may also record appropriate caveats to be played upon their commencement. In this sense, the visualisations, like many of the maps prepared in this research, have potential to support understanding when used as a spatial *lingua franca* and discussion point in negotiations.

9.3.4 Complementary analyses

As a final extension on the pilot study, I drew on complementary qualitative analyses to contextualise the GIS-based representations produced in this research. First, I used qualitative analyses to generate a series of insights for Yawuru governance bodies included in a separate report and presented quotations alongside some values and concerns models in Chapter 7. Then, in Chapter 8, I further contextualised Yawuru GIS use and highlighted the agency of Yawuru participants by presenting a series of strategies and practices those participants used to address their concerns and respond to the complexities of life in Broome following native title recognition.

This analysis offered an important counter to pervasive deficit discourses that often problematically position Indigenous peoples as being passive victims of, or worse responsible for, the challenges which confront them (Fforde *et al.*, 2013; Fogarty *et al.*, 2018). It also took advantage of the rich, non-spatial information conveyed in sketch mapping interviews to acknowledge the myriad ways Yawuru participants were already acting in this space. This analysis ultimately reinforced that GIS is not a panacea to the myriad challenges faced by Yawuru people, but rather one among many arts which may be used to engage with the complexity of life and governance following native title recognition.

9.3.5 Challenges of spatial analysis in Indigenous contexts

Despite extensions on the pilot study, this research remains subject to certain limitations. To begin, there are risks any time spatial analysis is used to reflect indigenous ontologies and relationships to Country (Hi'iaka Working Group, 2011; Reid and Sieber, 2019; Willow, 2013). GIS technologies involve selective empowerment and disempowerment (Elwood, 2002). They can also reify, or inappropriately fix, phenomena under study (Elwood, 2006b; Leitner *et al.*, 2002). This has led some authors (e.g. Agrawal, 2002; Rundstrom, 1995) to argue that any Indigenous engagement with GIS technologies represents a form of epistemological and ontological violence. It has also led Palmer (2012) to argue that storytelling is often a vital decolonising element alongside maps.

Yawuru governance bodies have decided to engage with, not within, the constraints of GIS technologies. This mitigates, but does not eliminate, the risk of ontological assimilation in the

Yawuru geospatial program and this research (Reid and Sieber, 2019). Any modelling involves abstraction (Monmonier, 2014) and GIS models cannot capture the totality of any individual's or community's relationships to landscape, let alone traditional owners' relationships to Country (Barber and Jackson, 2012). Indeed, while this study used directional buffering to reflect the tidal nature of foreshore-based activities and drew on fuzzy logic to represent elements of continuity and complexity inherent to Indigenous ontologies (Berkes and Berkes, 2009; Mark and Turk, 2003; Munn, 1992), it still privileged sight above other modes of perception. For example, the modelling techniques I adopted in this study did not capture the sounds, smells, and the feeling of the wind or sun that may be associated with tidal changes (Pearce and Louis, 2008:123). Also, while this research was firmly grounded in the GIS partnership, I am not a Yawuru person and I have not been raised with a Yawuru worldview.

Often, "Indigenous peoples and "others" [experience an] ongoing clash between their own ontology and the governing societal understandings[, and this clash] illuminates ontological boundaries" (Walter and Andersen, 2013, p.53). However, I rarely encounter such ontological challenges in my day-to-day life. In this research, I understood and sought to reflect Yawuru spatial ontologies as they were described or defined to me within the context of the partnership. The use of fuzzy logic to represent Yawuru values, for example, came from extensive conversations between Patrick Dodson, Bruce Doran, and later Dean Mathews, and was well-accepted by Yawuru governance bodies in the pilot study. I also continued to discuss the use of fuzzy logic to reflect Yawuru views of space with Dean Mathews and other members of the reference group during this study. Moreover, I carefully drew on the Yawuru Cultural Management Plan, as well as the descriptive coding of sketch mapping interviews with Yawuru people, to help reflect Yawuru uses of Country in this space. Nonetheless, my "racially white and Euro-colonizer origins", including my training in GIScience, have "shaped the methodological and cultural assumptions" which underpin this research (Walter and Andersen, 2013, p.43).

There are flaws to the ontological translations included in this study, as there are any time local knowledge is incorporated into a reductionist, spatially oriented system (Harris, 2016). There are also risks to this approach given that outputs from this research may be applied in diverse negotiations, including in legal settings, where the challenges of cross-cultural knowledge translation may be called into question (McGrath, 2017). Nonetheless, giving automatic precedence to tradition can be "essentializing and epistemologically and ontologically restrictive" for Indigenous peoples (Walter and Andersen, 2013, p.68).

Yawuru governance bodies recognise the power of GIS technologies in general, and the value of the GIS partnership in particular (NBY, 2018c). They have assessed the risks and benefits of GIS and decided to invest financial and human resources in this area. What is more, the reference group acknowledged, and accounted for, many of the sensitivities involved in operating

in this space. Rather than immediately mapping *Bugarrigarra* sites with an outside researcher, the reference group chose to extend earlier uses of fuzzy logic to map contemporary Yawuru values and concerns in this study.

In that sense, the approach to modelling developed here was risk averse. It explored the potential of GIS technologies to reflect *elements* of Yawuru spatial ontologies in ways that remain “ontologically translatable to state actors” (Walter and Andersen, 2013, p.73), without assimilating deeper cultural knowledges, including those explicitly related to *Bugarrigarra*. This approach also gave an opportunity to prototype spatial methods on less sensitive Yawuru values and equipped Yawuru governance bodies with additional information to determine whether they wished to apply these techniques in areas where their values may have more poorly aligned with the ontological restrictions imposed by GIS.

Ultimately, this research was intended to support future mapping of the Yawuru estate, not produce definitive representations of this relationship. With this in mind, Section 9.3.6 examines the strengths and limitations of data collection which focused on supporting spatial analysis and facilitating Indigenous modes of communication. Section 9.3.7 discusses recruitment and sampling considerations in this study, while Section 9.3.8 examines some of the challenges related to translating between seasonal calendars. Section 9.3.9 outlines the limitations of the qualitative weighting and directional buffering techniques. Finally, Section 9.3.10 outlines more general limitations to this work.

9.3.6 Evaluating data collection

As described in Chapter 5, I used semi-structured sketch mapping interviews with twelve Yawuru participants to inform and contextualise the GIS models produced in this study. These interviews were designed to be courteous and flexible. They were also designed to produce the points, lines, polygons, and attributes that form the constituent components of a GIS (Kitchin, 1996). That is, they were an attempt to accommodate some Yawuru epistemologies in data collection designed to support Western science.

Like Davis (2008), I found courtesy and flexibility to be essential for navigating the power dynamics associated with collecting data from Yawuru participants in this work. In terms of courtesy, participants responded well to being treated as experts on their Country and many relaxed after I had prepared tea and offered home-made baked goods at the start of the interview. The interview structure meant that participants had time to reflect on a site before responding to more probing or evaluative questions (Giesecking, 2013), while the ‘tick-boxes’ developed from the pilot interview minimised any need to interrupt participants’ train of thought around a given site (Vajjhala and Walker, 2010).

Open-ended questions and free-form sketch mapping also worked well in the interviews with Yawuru participants. Free-form sketch mapping enabled participants to mark their maps organically (Brennan-Horley and Gibson, 2009; Giesecking, 2013) and allowed several participants to create “background” sketches marking the whole study area as important (see Brennan-Horley, 2010 for similar observations in a creative arts context). Likewise, open-ended interview questions helped keep interviews relaxed and flowing (Brennan-Horley, 2010). These questions enabled participants to determine if and how they disclosed culturally sensitive information (Meadows *et al.*, 2003). They also provided space for storytelling which aligned well with Indigenous modes of communication (Smith, 2012; Soucy, 2000). This storytelling was particularly important when a participant’s child arrived during his interview, creating an opportunity for intergenerational knowledge transfer (see Tobias, 2009 for similar observations).

In terms of flexibility, I tried to adapt interviews to suit participants as much as possible in this study. Some participants were interviewed over multiple sessions. Others were interviewed in pairs for mutual support. These shared interviews increased the potential for recall as the actions or memories of one participant often prompted those of the other (Davis, 2008). Flexibility was also enhanced by the portability and durability of the base maps which spatially anchored data collection in this study (Brennan-Horley and Gibson, 2009).

In general, participants were eager to engage with the maps in this study (Kemp and Brooke, 1995). These maps simplified georeferencing, digitisation and overlay in a GIS environment (Bryan, 2009; Vajjhala and Walker, 2010). They also reduced the reliance on verbal communication in the interview, as when one participant used aerial imagery in Broome Town to highlight the area’s rapid development. Finally, they evoked specific memories of place (Giesecking, 2013) including childhood memories of close family members.

There were some challenges to the use of base maps in interviews, particularly as base map size and content can influence the sketch maps produced in research (Downs and Stea, 1973; Gillespie, 2010; Kitchin, 1996; O’Neill *et al.*, 2015; Pocock, 1976). First, while aerial imagery in the maps reflected the colours of the Yawuru landscape, it did not capture how a site appeared in different times, tides and seasons. One participant observed that areas he accessed on a regular basis were under water in the map imagery. As Rundstrom (1995) experienced with Inuit in Nunavik, this may have impacted Yawuru participants’ ability to locate valued areas during interviews.

Second, although participants could distinguish between beaches and buildings in the base maps and one participant described the maps as providing a “good overview”, most struggled to differentiate vegetation at map scale. This led one key informant to request that techniques from Gardner (2014) be adapted to capture his access to fruit along tracks in Minyirr Park. It is consequently likely that the sketch maps under-represent the importance and quantity of bush-

resources (e.g. fruits and medicines). Finally, the gap between the study sites was confusing for some participants. One participant erased a site from one map after marking it in the other, while another noted that he had drawn a bigger sketch to make sure that a site was included giving his challenges orienting to this gap.

There were also trade-offs to flexibility in data collection. Free-form sketching resulted in considerable variability within and between participants maps (Brown and Pullar, 2011; Curtis *et al.*, 2014) and required standardisation. Likewise, open-ended questions required descriptive coding of responses which is valid, but atypical in values modelling (Besser *et al.*, 2014; Boschmann and Cubbon, 2014). Participants' answers to an open-ended question on the frequency of visitation were also difficult to quantify. They resulted in measures which were valid within, but not between, participants. However, as Jung (2012) experienced working with migrant women in South Korea, many participants also abandoned the pre-defined low, medium, high scale for site importance by giving answers such as 'high', 'very high' and 10. This suggests that a written multiple choice response to such questions may be more appropriate for eliciting measures of frequency and site importance, as argued by Brown and Pullar (2011).

Finally, while the sketch mapping protocols developed in this study were relatively inexpensive in terms of materials, time required of participants, and fuel to visit sites (Smith, 2012; Tobias, 2009), this traded off against *in situ* experience and the time required for data analysis (e.g. Beilin and Reid, 2015). All interviews took place in Broome Town, either at the NBY Offices or a participant's home which offered other, unprompted, insights into their life. Nonetheless, participants did not consider interviews to be on Country in the physical sense.

Many participants talked out loud as they mentally moved through the landscape, trying to align the imagery with body scale and this difficulty in orientation may reduce the accuracy of sketches relative to site visits. For example, while a DPAW field trip to Crab Creek with Yawuru Rangers, DPAW staff and several senior Yawuru people was not explicitly designed to check the interviews' content, this trip revealed the disputed location of a site at Crab Creek. It also provided an opportunity for further, informal, discussion with participants about some sites as we visited them. Given this experience, and that "environmental knowledge is largely obtained through processes of moving through an environment" (Golledge *et al.*, 2000:94) on Country exercises may be an important element of future work in this area (Vajjhala and Walker, 2010).

9.3.7 Recruitment and sampling considerations

Recruitment is often a vital component of conducting respectful and grounded research with Indigenous peoples (Smith, 2012). Recruitment in this study was designed to be collaborative, flexible, and adapted over time in consultation with reference group members. Participants were selected by the reference group, then invited by NBY staff or other Yawuru people to participate

in interviews at their convenience, which allowed participants to perceive the research's potential benefits to themselves and their community from the outset of this research (Louis, 2007). This approach also avoided over surveying by using collaborative decisions to halt recruitment among certain demographics following the emergence of repeat themes and saturation (Bailey *et al.*, 2005; Glaser and Strauss, 1967). Finally, and most importantly, it respected people's right to decline or withdraw from involvement in the research.

Despite the flexibility of the recruitment process, including multiple attempts to fit in with existing field trips and adapt interviews to focus solely on their concerns for Country, no senior men chose or were able to participate in the project. It is possible that several factors were at play in this space. To begin, while I was trusted by NBY staff, I was also an outsider in this research. At times, this status was beneficial. Some participants appeared to value the interviews being conducted by a trusted outsider who was introduced by NBY staff but distanced from intra-community dynamics (Sixsmith *et al.*, 2003). Nonetheless, it may have presented a disadvantage for working with senior Yawuru men.

Indigenous knowledges are often held by individuals, passed to others through specific customary, familial, and gender-based relationships, and brought together through song, ceremony and place (Nakata, 2002; Ross *et al.*, 2011; Watson and Huntington, 2008). This makes it very possible that these men were not comfortable sharing their knowledge with a young, white, settler woman who could not drive them out onto Country at the time of interviews.

It may also be that senior men declined to participate in this research because the research design ultimately separated knowledge from individuals in a collective GIS. While collective outputs may be useful for decision making and negotiation, they do not necessarily align well with relational and experiential Indigenous epistemologies (Moreton-Robinson, 2000, 2013; Nakata, 2002). There can also be tensions associated with the shifting power and governance structures following native title recognition (Bauman *et al.*, 2013b) and new technologies, like GIS, have been known to exacerbate tensions in similar contexts (Elwood, 2002). Finally, like many elites, these men were busy. Their knowledge was in high demand during the interviews and it is possible that some simply did not have time to participate in the research (Morris, 2009). It will be important to have more senior Yawuru men involved in future modelling of these areas, perhaps with additional protections for the knowledges they hold in this space.

In addition to the dearth of senior men involved in this study, the sample size used in this research remains small. The twelve people who participated in this research were deliberately selected by the reference group to generally reflect or represent elements of the broader Yawuru community. Nonetheless, no community is homogenous (Labonte, 1989). Many remain divided over particular issues, including native title claims (Burke, 2011a; Vincent, 2017). While Yawuru people share elements of their heritage and culture, the values and concerns captured in this study

cannot fully reflect those held by up to two thousand Yawuru people (NBY, 2019b) of different ages, genders, and backgrounds. Instead, they reflect the view of twelve Yawuru adults who were willing to contribute to collective GIS-based representations in the Yawuru geospatial program. This may be problematic given the relative importance of consensus for marginalised or disenfranchised groups (Minkler, 2004). As described earlier, this study was intended to trial techniques for modelling Yawuru values. It did not aim to establish a definitive values model for the study areas. Nonetheless, it remains unclear whether the methods adopted in this project will be successful if replicated with all Yawuru people, rather than just those with an NBY affiliation.

9.3.8 Translating temporal ontologies in the seasonal calendar

Beyond issues of recruitment, there were challenges to translating between calendars in the seasonal use model. As outlined in Chapter 6, I standardised all participants' responses about when they used areas which were significant to them within the study sites to Gregorian months in the spatial database. This process had several advantages as outlined in Section 9.3.2. It also introduced uncertainties into the modelling process as participants did not always describe their site use in terms of months or use months to translate descriptions made in other time frames. It is thus possible that the information used to standardise site use does not necessarily reflect an individual's definition of that use.

Gregorian months are abstract, numeric, inflexible, predefined and uninfluenced by ecology (Munn, 1992). Instead, they rely on structural notions of time (Prober *et al.*, 2011). By contrast the Yawuru seasonal calendar, and tropical monsoonal calendar are ecological. They are tied to meteorological or phenological events which shift subtly over time (Lewis, 2009; Prober *et al.*, 2011). Using Gregorian months in the spatial database required translating between three calendars founded in distinct worldviews, or ontologies, two of which were structural and one ecological. Translating between these calendars required compromise, including a loss of meaning and nuance which was inevitable in converting diverse responses to a single time frame (Clarke, 2009).

When preparing the seasonal use models, I translated participants' responses between calendars at least once, and sometimes twice (Figure 9.9). In stage one, I prioritised information and translations conveyed by participants above translations contained in official documents. This grounded the spatial database in participants' experiences and created binary models marking each site as used or unused by the participant in a month. In stage two, I used definitions taken from the Yawuru Cultural Management Plan and the Local Planning Strategy to maximise output utility. As examined earlier, translation loss is inevitable with culturally bound phenomena (Jakobson, 1959). Thus, the seasonal use models in this research are utilitarian approximations of participants' meanings intended to facilitate dialogue between diverse worldviews.

All three seasonal models show changes in the use of valued areas across time and, to a degree, align with the use patterns described in the Yawuru Cultural Management Plan (Yawuru RNTBC, 2013). However, none of the seasonal use models provide a complete representation of all areas used by Yawuru people within the study site. Finally, the seasonal models presented in this research do not capture variations in use on a less than one-month timescale. Such temporal variation is relevant for practices such as crabbing which often occur year-round but are closely tied to lunar phases (Field Notes 2015), or fishing which relies on particular tides (Sullivan 2014, Field Notes 2015).

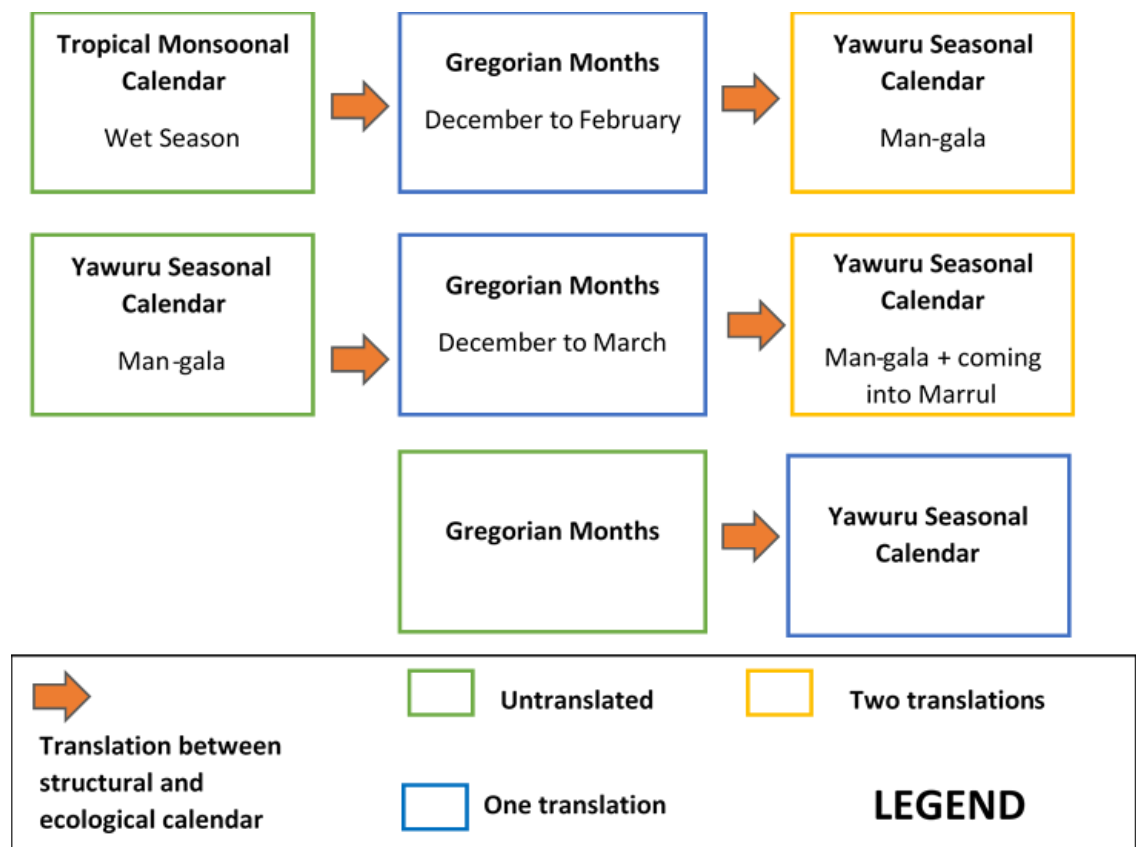


Figure 9.9: Figure showing translations between structural and ecological calendars when outputs are to be in the Yawuru calendar based on two forms of ecological and one form of structural input.

Given the challenges outlined here, I have varying levels of confidence in the three seasonal use models. The apparent familiarity of all participants with the clear meteorological distinctions between Broome's wet and dry seasons and the coarse temporal resolution of these models give me greatest confidence in the models prepared for Broome's tropical monsoonal calendar. I also have moderate to high confidence in the models of Gregorian months. These required at most one translation between ecological and structural systems during standardisation.

Ultimately, the seasonal use modelling aimed to capture use of sites following the Yawuru seasons. There are fine temporal distinctions between some of these seasons and many modelled sites were translated from ecological calendars to structural months, then back again. There were also differences in the definition of Barrgana described by participants, and that in the Yawuru Cultural Management Plan. Although the Yawuru seasonal calendar shows the greatest variation in use across the two sites, these limitations mean that I have the lowest level of confidence in this, the primary focus of seasonal modelling in this research.

9.3.9 Limitations to directional buffering and qualitative weighting

As outlined earlier, this study produced new directional buffering and qualitative weighting techniques which drew on contextual grounding and critical GIScience. Despite the novelty of these techniques, each was subject to limitations. Directional buffering, for example, relied on a simplified linear feature (shapefile) to determine the dominant direction of the local coast. It did not incorporate depth or the localised width of the inter-tidal zone in modelling. Additionally, shifting the centroid of a polygon by even a few meters could result in entirely different directional buffers (Figure 9.10). Moreover, the approach to directional buffering I adopted in this research may not always be practical in post native title environments. This approach required individually buffering more than two hundred features which necessitated the use of Python, a programming

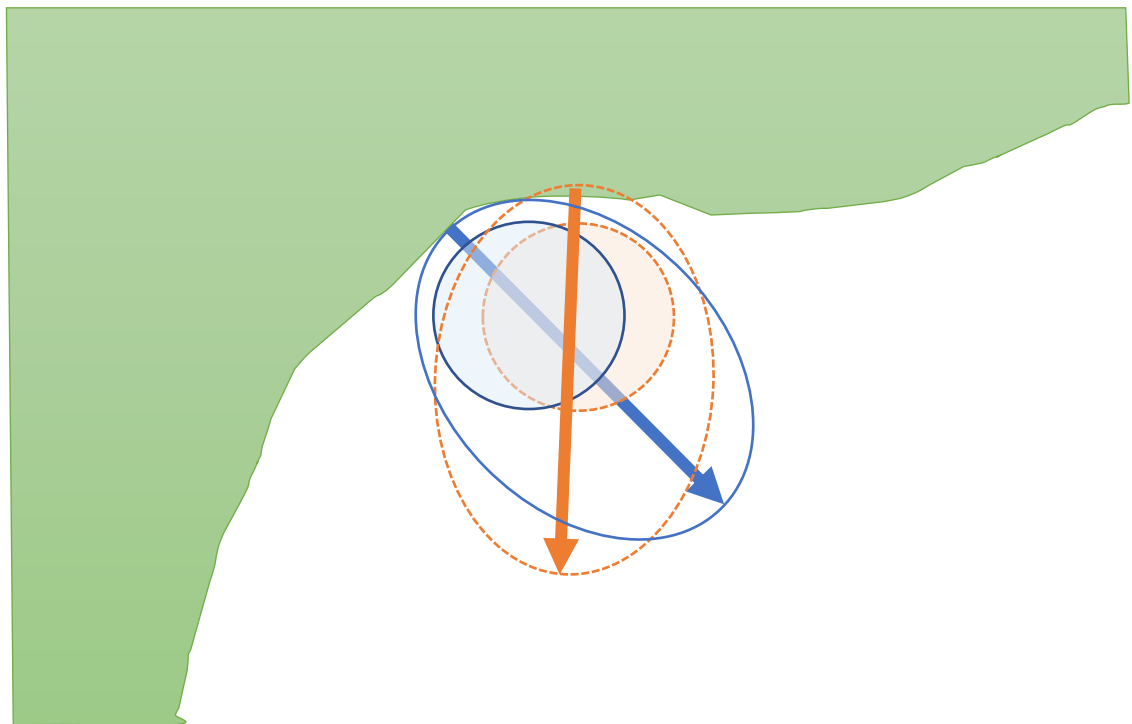


Figure 9.10: Figure showing the discrepancy in angle which can result from a small difference in distance. The orange circle represents one original sketch and the blue the other. The dashed lines are symbolic of their anisotropic buffers and the arrows the dominant angle from the coast for those buffers.

language, to reduce human error in this process. Ens (2012) noted that few Indigenous organisations in Arnhem Land possessed adequate in-house knowledge of Excel and other software to conduct analyses in house and this may also be true of Python. Conversely, Indigenous peoples and community groups often use analytic toolboxes where available: many organisations have adopted and adapted both the Cyber-tracker and I-Tracker tools (NAILSMA, 2014). Hence, a customised directional buffering toolbox may make this technique more accessible to Indigenous organisations.

The approach to qualitative weighting I adopted in this research was also subject to limitations. This approach was grounded in contextual qualitative information from sketch mapping interviews but relied on how I converted this information to model weights. Using content analysis and thematic coding to create and adjust these weights was pragmatic. It reduced the response burden on participants and did not solely rely on my discretion to weight values and concerns. It also assumed weights derived from content analysis and adjusted by a non-Yawuru researcher interpreting interviews with Yawuru people could provide a proxy for informed knowledgeable Yawuru observers. In that respect, there is potential to further ground model weights in the Yawuru context.

Additionally, it is unclear whether this approach adequately addressed participants' need to feel a sense of ownership and active control over the research process. This approach required little direct interaction with participants beyond initial interviews and a final presentation following the research. This gives rise to the potential that, despite their heavy influence over the work, participants may not feel a sense of ownership over the research outputs. It is also possible that weights generated from interviews with twelve participants may not reflect the relative emphasis placed on values and concerns by the broader Yawuru community. As with sample size more generally, this may present a risk if the models generated in this study are applied in a legal context rather than in less formal negotiations that allow for relationship building. As such, an interactive approach to post-modelling parameterisation, such as that adopted by Yap and Yu (2016c), may be important for future work (Smith, 2012).

Finally, there were practical and technical challenges with weighting in this research. From a practical perspective, the weighting was grounded but also complex and time-consuming which delayed presentation of results to Yawuru people and could have been problematic had the models been intended to address pressing issues within the estate. From a technical perspective, I initially allocated weights based on both the relative number of words participants used talking about activities, and the number of unique times an activity was referenced. Given that participants were asked which species they caught at a site, weights may be inflated for activities involving diverse species (such as fishing and collecting bait), especially relative to activities like collecting mud

crabs and harvesting dugong. Hence this approach may be more suited to cases where participants are asked to discuss valued practices, without providing information on individual species.

9.3.10 General limitations

There were also some general limitations to modelling in this research. Certain questions in the interviews neither supported analytical modelling, nor added much to contextual qualitative analyses. The question on species caught when doing activities or practices at a site produced highly variable, incomplete responses. Participants also had trouble distinguishing between the questions on feelings associated with visiting or thinking about a site. Additionally, the question asking with whom a participant visited a site was unsuccessful from a cultural standpoint. This question had the potential to create tensions with taboos around naming the dead. It failed to produce analytically useful information and should be removed in future research.

Finally, none of the questions in the interview guide focused on the tidal nature of activities or practices. This is a potentially serious oversight given that Broome's large tidal range has a profound influence on how space is assessed, accessed and used by Yawuru people (Sullivan, 2014). Such questions are likely to offer a deeper and more dynamic insight into Yawuru connections to Country in the inter-tidal zone. Given similar foci in other studies, (Pearce and Louis, 2008; Rundstrom, 1995) questions on tides should be incorporated into future research in this area.

Often, GIS analyses are "complex, even tedious, the first time they are done" (Barndt, 2002:351). In this research, there were trade-offs between producing timely outputs and ensuring the rigour of those outputs with minimal need for additional elicitation. Future research may need to compromise between these approaches.

The descriptive coding of interview transcripts also presented some problems around factor completeness in this study. Some potential factors in the values model, including *Bugarrigarra* sites, were excluded due to poor capture. These limitations are somewhat mitigated by labels on the synthesised values map which highlight the absence of metaphysical values from map outputs. Nonetheless, the models do not incorporate all possible values and concerns for the modelled sites.

Additionally, descriptive coding distinguished between factors based on the needs of Yawuru governance agencies. This meant it was neither feasible, nor desirable, to maintain complete factor independence in the modelling. For example, concerns about erosion of Minyirr reflected an environmental hazard to human health and an erosion issue, and this is shown in these sub-models. Such double allocation of concerns in sub-models may distort relative weights in the synthesised model (Brown and Brabyn, 2012), but it also ensures that related issues are captured in all relevant sub-models.

As a final point on factor modelling, throughout this study I used a cubed-then-inverted function in modelling the distribution of factors across space. This function, which was selected by a single Yawuru participant on the basis that it matched lines-of-sight when hunting (Gardner, 2014), retains high values for extended distances. It may not mirror the exact distribution of each practice. Guesgen, for example, has suggested that “[i]n the absence of other objects, humans reason about proximity in a geometric fashion. Furthermore, the relationship between distance and proximity can be approximated by a simple linear relationship” (Guesgen, 2002:267). It is consequently possible that fuzzy buffers using this function may be over inclusive. Likewise, features buffered in the standardisation process may be over-generalised (Brown *et al.*, 2015). In future research, Yawuru governance bodies will need to consider using small focus groups to parameterise buffers for each value or concern. They should also weigh the risks of over-generalisation against any constraints on participants’ capacities to direct the interview process resulting from forced polygonal responses (Curtis *et al.*, 2014).

This research has been subject to some limitations. It has also developed and evaluated an important proof of concept for cultural values, concerns and seasonal use modelling which may be transferred to other parts of the Yawuru estate. Ultimately, Yawuru efforts to integrate analytic techniques from this study into their geospatial program will be most successful where they harness the strengths outlined in sections 9.3.1-9.3.4 and address the limitations examined in sections 9.3.5-9.3.10.

9.4 Research Transferability

Drawing on the evaluation in Section 9.3, this section explores the extent to which analytic techniques and approaches to spatial analysis developed in this research are transferable beyond the context in which they were created. Here, transferability of the analytical approach is assessed within the Yawuru estate; to other Indigenous governance contexts; to non-Indigenous governance contexts, and finally, beyond the governance sphere.

9.4.1 Transferability within the Yawuru estate

As evaluated in the previous section, in this research I aimed to trial a variety of approaches to capturing values, concerns and seasonal use across two study sites which cover a relatively small portion of Yawuru Country (Chapter 3). This trial was conducted with the express aim of creating and testing GIS modelling techniques which might be replicated across the Yawuru estate. As outlined in the previous section, while the approach to GIS modelling in this research was largely successful, it was subject to limitations.

Several minor adaptations to this approach could increase its potential to be transferred across the Yawuru estate. As a starting point, questions on emotions, co-visitors, species, and the

mode of transport used to access sites could be removed, except where they are relevant to land management and governance. Additionally, sketch maps could be standardised during data collection by forcing participants to use polygons to draw their sketches of significant areas. This would constrain participants' capacity for spatial expression during the interviews. However, it would also eliminate the need for time-consuming standardisation following data collection. In terms of geographic scale, data could be collected to provide both more general (estate-wide) and more site-specific information. Additionally, participants could be surveyed on just seasonal use of sites, or values, or concerns held for those sites. This would increase the total number of interviews necessary to model all three phenomena. However, it would also considerably reduce interview length and increase the completeness of capture within these areas.

With appropriate caveats, training, and familiarisation, data collection could occur using tablet-based sketch mapping surveys. Such tablets could reduce or even eliminate the need for data digitisation (Gill *et al.*, 2014). They could also reduce processing costs and increase the number of people able to participate in the research, particularly if combined with a forced-choice survey response. Using tablets for a large-scale survey is a major shift from blueprints established in this work. It may produce tensions in terms of attracting Yawuru people into the research, and for some people, the technology may act as a barrier to deep engagement relative to a more tangible paper-based approach (Boschmann and Cubbon, 2014; for a counter-argument, see Yabiku *et al.*, 2017). However, grounded in blueprints established in this research, such a survey could also help to establish baseline values, concerns and seasonal data across a broader section of the Yawuru population than was possible using semi-structured paper-based sketch mapping interviews.

Perhaps the greatest potential for transferability within the Yawuru estate comes with the adoption and adaptation of specific analytical modelling techniques established here. Techniques such as directional buffering, the use of qualitative information to inform factor weights, and the use of qualitative information to guide factor modelling are major innovations in this research. They have considerable potential to be used and adapted by NBY GIS technicians on a range of issues from species movements to the construction of additional index models to support multi-objective land use allocation analyses. This may be relevant for Roebuck Plains Station (NBY, 2017), an area which Mick Dodson described as the “jewel in the crown” of the Yawuru estate in a lecture to ENV3040 Solving Complex Environmental Problems on August 23rd 2012. As the direct products of a context-driven approach to modelling which has used fuzzy logic and spatial analyses grounded in the voices and experiences of Yawuru participants, these techniques, and their associated Python scripts, are most likely to be transferable within the Yawuru estate.

As outlined earlier, the directional buffering and qualitative modelling techniques developed in this research have potential to be further grounded in the Yawuru context. To a degree, they

are also reductionist in that they continue to rely on spatially oriented systems (Harris, 2016) to reflect the multi-faceted “person-land-ancestral inter-relationship” (Rumsey [2001, p.19] in Kenny, 2013) which lies at the heart of Indigenous ontologies. In this sense, it remains unclear whether techniques developed in this study could adequately reflect more dynamic, metaphysical values held by Yawuru people, including those held for *Bugarrigarra sites*.

NBY have recently begun to explore the use of online story maps and controlled cyber-cartography in their geospatial program. They have so far kept these maps in-house, choosing when and where to display these outputs. This development is exciting, especially as technologies continue to evolve in this space. Integrated with online maps and controlled cyber-cartography, the fuzzy logic and qualitative modelling techniques developed in this research could offer opportunities for “deep mapping” which enacts place (Springett, 2015). Together, these techniques would “allow multiple spatial stories to be interlaced through a rich weave of local knowledge about community place and the powerful GIS representations of space” (Harris, 2016:318). Such integration may be especially important as Yawuru governance bodies look to map *Bugarrigarra sites* within their estate.

9.4.2 Transferability to other Indigenous governance contexts

Given the challenges facing Indigenous peoples in Australia following native title recognition, it is important to assess the extent to which techniques and approaches developed in this study may be transferred beyond the Yawuru context. As it stands, many Indigenous peoples are already using GIS to support elements of their land management and governance in Australia. They are employing this technology to support Indigenous Protected Areas and drawing on its potential to support cultural heritage management. Some Indigenous peoples are also employing GIS and I-Tracker technologies to maintain accountability to external management partners. This work formed part of this growing agenda. It developed a context-grounded approach to representing Yawuru Country with fuzzy logic, developing innovative approaches to factor modelling and weighting, and balancing these models with a qualitative analysis of sketch mapping interviews.

In this study, in line with conversations with the reference group I placed a strong emphasis not simply on importing existing GIS techniques wholesale, but instead adapting them to Yawuru Country, to Yawuru spatial ontologies, and to the resource and political contexts in which Yawuru governance bodies operate. This focus on context was important and should be replicated in GIS performed by and with other Indigenous peoples. In the Yawuru case, these adaptations and customisations reduced the need to over-survey Yawuru participants in the research. They ensured that analytic outputs from the research were grounded in Yawuru people’s descriptions and

understandings of their Country as conveyed in interviews. They also meant that outputs from the research could be integrated into the Yawuru geospatial database and knowledge vision.

Context grounding, however, may look different for other Indigenous peoples. In some cases, context-driven modelling may simply involve the recognition that a group, community or governance organisation only has the resources to support use, and perhaps minor adaptation, of a pre-existing tool. As an example, non-sea country groups may not feel a need to incorporate directionality into their representations of Country. In other cases, context-grounding may involve similar in-depth consideration of, and technical innovation around, GIS techniques. Whatever the local context, it is vital that these decisions are consciously made and influenced by the people who will use and be affected by them.

Certain analytic techniques developed or adopted in this research are likely to be relevant for other Indigenous peoples. First, this research has extended earlier work in the GIS partnership showing how the use of fuzzy logic to represent values held by Yawuru people for their Country can align with Yawuru spatial ontologies. As outlined in the pilot study, this supports “the potential of using a fuzzy index modelling approach as a common language to communicate Indigenous values and facilitate negotiation” (Potter *et al.*, 2016:17).

This study has also shown how the size, function and direction of fuzzy buffers can be customised for local contexts. Such customisation of fuzzy buffers may be particularly relevant for Indigenous organisations who seek to represent directionally influenced native title values or practices. While the fuzzy directional buffering developed in this study responded to the large tides of Roebuck Bay, much of northern Australia also has a large tidal range (Caton and Harvey, 2010) and thus these directional buffering processes are likely to be relevant to many coastal native title holding groups across northern Australia. Additionally, these techniques could be adapted for hunting practices which are conducted relative to certain vegetation, or other practices which are directionally linked to local topography and mountain ranges.

Second, both the approach to qualitative weighting adopted in this research and the use of contextual qualitative information to guide parameterisation of the membership function are likely to be valuable in situations where a small number of participants (twenty or fewer) have been able to self-identify factors and relate short stories pertaining to these models through semi-structured sketch mapping interviews. This may permit Indigenous governance bodies to conduct individual or group interviews with a small number of people and reduce interview fatigue among the relevant peoples, while also generating the information necessary to compile initial models and weights.

Certain techniques and approaches developed in this research are likely to be relevant for other Indigenous groups. Nonetheless, many of these techniques were originally customised for

use by Yawuru governance bodies within their estate. This is important because, to a certain degree, Yawuru governance bodies are uniquely positioned to operate and use GIS. As was outlined in Chapter 3, they are among the best resourced PBCs in Australia. They have invested significant effort into their strategic knowledge vision and work hard to retain data sovereignty over GIS models and their outputs. Yawuru governance bodies also have significant human and political capital (ANU, 2017a; Keeffe, 2003; NAILSMA, 2012c), including a range of external partnerships such as the GIS partnership which underpins this study (Western Australian Marine Science Institution, 2017). They have been able to effectively draw on these partnerships, while using their political momentum and leadership to support various activities across their estate.

In general, considerable investment is necessary to resource in-house GIS capacity in any organisation and there are significant barriers to successful implementation of community-based GIS (Elwood, 2002, 2006a; Leitner *et al.*, 2002). These barriers include data quality and accessibility, organisation and stakeholder engagement, and the need for technical training and support (Anderson *et al.*, 2009:2087-2088). While Yawuru governance bodies hold and have made a decision to invest their financial, human and political capital in GIS, many Indigenous governance bodies are chronically under-resourced relative to their existing responsibilities (McGrath, 2017; Smith and Morphy, 2007). Without intervention, these resource disparities may limit the potential for in-depth techniques developed in this research to be transferred beyond the context in which they were created.

Second, the extent to which techniques and approaches maybe transferred from this study is likely to depend on geographic context. In part, Yawuru governance bodies are financially well-resourced because a portion of native title was illegally extinguished within their estate. This spatial circumstance provided a solid foundation for Yawuru leaders and their legal team to negotiate a strong global agreement with state and local governments (Government of Western Australia, 2010). Not all native title holders, however, will possess similar legal and political leverage as they engage with settler entities.

Additionally, Yawuru people identify as saltwater people and their estate includes areas which have, to Western eyes, a clear demarcation between land and sea (Jackson, 1996; Mulrennan and Scott, 2000). This is relevant because in the eyes of settler governments, the cadastral grid stopped at the shoreline making water "to an extent [...] a neutral unsegregated zone" within the settler state (Byrne 2003:179). In Broome, much of the shoreline is zoned as a coastal reserve (Shire of Broome, 2014a) which has facilitated ongoing access to sea country and may have facilitated associated practices which supported Yawuru people's identification as saltwater people. This zoning has enabled Yawuru people to claim native title over much of this area and created expectations around freedom of travel within an entity-based Torrens titling system. It is rare, however, that as many reserves are created in freshwater or desert Country.

There, freehold title, which settler governments view as extinguishing native title rights, and pastoral leases, which often diminish those rights and lead to non-exclusive native title recognition, are more likely to hold sway (Holmes, 2010).

Finally, from a geographic perspective, Yawuru Country sits in northern Australia, where settler societies were more reliant on the exploitation of Indigenous labour than they were in the country's south (Veracini, 2011). This reliance on the exploitation of Indigenous labour in Australia's north enabled many Indigenous peoples, including Yawuru people, to live on or close to their traditional lands. Thus, it is likely that Yawuru people have been able to retain comparatively greater cultural continuity, cohesion and capacity to claim native title than some Indigenous peoples in Australia's south-east (Veracini, 2010). While this does not inherently limit the potential for Indigenous governance bodies to use GIS in southern Australia, the presence or absence of native title recognition may influence the resources and legislative leverage available to Indigenous governance bodies.

Ultimately, to paraphrase Harris and Weiner, "not all [indigenous] communities would want, nor indeed warrant, a GIS" (Harris and Weiner, 1998:74), let alone the particular techniques and approaches to GIS adopted in this study. As outlined above, techniques such as fuzzy index modelling, directional fuzzy buffering, and qualitative parameterisation of model weights do have potential to be useful in some Indigenous modelling contexts. However, it is most important that techniques developed in this research are transferred beyond the Yawuru estate with adequate respect for local cultural, geographic, social, and political contexts.

9.4.3 Transferability to non-Indigenous contexts

More generally, the focus on context-driven GIS modelling developed in this research may be relevant to local governments and community groups who require support for decision making at a range of spatial scales (Masser *et al.*, 2008; Ting and Williamson, 1999). With adjustments, techniques established in this research should be relevant to most values or concerns modelling contexts which rely on free-form sketch mapping and have limited numbers of participants. Here again, it is important that these groups focus on adopting and adapting specific techniques such as directional buffering, qualitative weighting and the explicit grounding of models in the local context, rather than completely replicating the sketch mapping interviews and associated Python scripts developed in this research. As is likely to be the case in Indigenous contexts, levels of blueprint transferability will ultimately depend on available resources, the presence of in-house GIS, and the spatial context of issues faced by these governance agencies.

Additionally, as outlined in the evaluation, the directional fuzzy buffering techniques developed in this research can be applied to a range of modelling contexts which need to represent directionality from a small number of polygon-based inputs. Similarly, qualitative approaches to

weighting may be applicable to a range of land use planning and research contexts which focus on the elicitation of information from communities (Elwood, 2002, 2006a, 2009; Hessel *et al.*, 2009; Kyem, 2000, 2004). This work also reinforces previous efforts to have participants define the factors included in any values or concerns modelling exercises (e.g. Besser, 2014) and supports the use of qualitative analysis to ground spatial analysis in participants' voices (e.g. Giesecking, 2013). On the whole, context remains relevant to the rigour, reliability, transferability and viability of any given approach to community-driven GIS.

9.5 Conclusion

This chapter has responded to the four research questions which underpin this thesis. Section 9.1 showed that outputs from context-grounded spatial analysis which draws on qualitative analysis and fuzzy logic can be applied to a range of issues across the Yawuru estate from informing negotiations around boat facilities at Reddell Beach, to informing access regulation at Crab Creek. While these examples are not exhaustive, they combine with the State Administrative Tribunal experience to demonstrate some of the ways that context-grounded GIS analyses can help support Yawuru governance following native title recognition.

Section 9.2 drew on settler colonial theory and Pratt's conception of the contact zone to provide insights for Yawuru governance bodies' use of GIS within their estate. It drew on settler colonial theory to highlight the importance of the diverse strategies Yawuru governance bodies use to engage in this environment and reinforce these bodies' cautious optimism and healthy scepticism concerning the impacts of their geospatial program. It also used Pratt's conception of the contact zone to underscore the need to manage risk around context-driven modelling and GIS-based representations. This section used field examples, including a meeting with Peter Yu and the ANU Vice-Chancellor around the mapping of *Bugarrigarra* sites and a proposal to use outputs from the research in a State Administrative Tribunal, to argue that Yawuru governance bodies should retain control over GIS outputs into the future. It highlighted the power that Yawuru investments in their strategic knowledge vision and control of GIS have offered in this space.

Section 9.3 clearly outlined how this work extended on previous values modelling in a Yawuru context. It highlighted the strengths and limitations of these extensions, while outlining their potential to be adapted into the future. Finally, Section 9.4 reflected on the extent to which techniques and approaches to spatial analysis developed in this research could be transferred within and beyond the Yawuru estate. It examined how minor adaptations to these techniques might be used within the Yawuru estate and highlighted the importance of contextual awareness in efforts to transfer these techniques to Indigenous organisations in Australia and around the globe. In sum, this chapter reflected on how specific outputs and techniques developed in this

project might be applied within and beyond the Yawuru estate. The next chapter concludes this thesis, examining its implications for policy and future research.

Chapter 10: Conclusion

The preceding chapter responded to the primary research questions with underpin this thesis, highlighting how context-driven fuzzy index modelling aligned with Yawuru ontologies, provided insights for Yawuru governance and produced technical innovations which remain subject to some limitations but have potential to be applied within and beyond the Yawuru estate. This chapter concludes this thesis by examining the policy implications of this research, outlining potential contributions to academic debate, discussing areas for further investigation in future research, and reflecting on the role that GIS might play in reconciliation and nation building in post native title Australia.

10.1 Policy implications

In earlier research, we demonstrated how “[t]he technical apparatus of GIS can contribute to post native title governance” by supporting PBCs instead of just being “an instrument of dispossession” (Potter *et al.*, 2016:17). This research has further shown that ontologically aligned GIS and cultural values mapping may facilitate decision-making and function as a spatial *lingua franca* for contact zones of the post native title environment. Given this, there remains a need to extend access to this GIS capacity beyond the Yawuru context.

This section outlines the role that a spatial information policy aimed at facilitating Indigenous geospatial capacity and supporting cultural values base mapping could play in the Kimberley region and across Australia’s north. It also briefly explores two models: “the peer-tutoring fee-for-service model” and “the research partnership model” as complementary mechanisms for facilitating such a roll-out.

In outlining these models, this section draws on arguments for enhancing Indigenous geospatial capacity across northern Australia made by Peter Yu in 2013 at the World Indigenous Network Conference in Darwin. As outlined in the guiding document for the first North Australian Indigenous Experts Forum:

“Northern Australia is economically, ecologically, socially and culturally different from the rest of Australia. It is home to the world’s oldest living culture, with Indigenous people continuing to live on or near their ancestral lands. The region is also home to immense biological and cultural diversity that has become recognized as unique in world standards. This uniqueness requires protection, respect and to be managed sustainably into the future” (NAILSMA, 2012c:2).

In his speech, Peter Yu outlined visions for a set of comprehensive Indigenous-led GIS maps which could guide northern development in Australia. He argued that “the development of comprehensive maps [which integrate Indigenous knowledge, practical observations and Western

scientific data] for northern Australia will help planning and decision-making regarding development and demonstrate to all parties where development can and cannot proceed”.

The policy implications in this section also extend on the vision Patrick Dodson set out for Yawuru in 2012. At the time, Dodson argued that:

“We need to have a clear cultural map of our own customary estate and our usages as well as where the water is, where the grass is, where the terrain is, what kinds of things live in these habitats, so that we not only just protect the rights and interests of the Yawuru people in this instance but we also work out ways to be to enable the environment, nature to be resilient and to survive.”

Dodson also noted that with geospatial capacity “we can highlight where some of the systemic issues are as opposed to simply having a social awareness of where the problems are being repeated.” Moreover, he outlined how “In the future any land-use that is alien to the Yawuru, we’ll be able to correlate that to our own customary and social usages of our lands, and highlight the impacts these usages will bring to us.”

One clear example Dodson gave in 2012 was how the use of GIS might play out in negotiations with mining companies. There he argued:

“then the company can come back to us and say ‘Okay, this is now the blueprint of where we want to locate our infrastructure on this land, or where we want to go and drill holes, do seismic surveys, 3D surveys’, whatever it is.

We can put that on top of the map and then basically on the desktop rearrange things or negotiate shifting of the preferred locations that the company’s got against our flora and fauna surveys and our cultural heritage surveys. Ultimately, then there’s a need to go out onto the land and physically locate where the infrastructure is going to go and to set up a monitoring process in relation to that. Now that’s not a big change, but it requires companies to come to the table with a lot more than just simply complying with what the law requires of them from a Western position.”

In practical terms, this section advocates for a 3-5-year plan to facilitate the rollout of a policy which closely replicates Peter Yu’s and Patrick Dodson’s visions. It argues for a need to extend geospatial capacity to Indigenous groups across Australia’s North, to respond to the Northern Australia White Paper.

10.1.1 Shifting northern Australia’s development paradigm through Indigenous geospatial capacity and mapping cultural values

In 2015, following ostensible consultation with the North Australian Indigenous Experts Forum, industry working groups and others, the Commonwealth Government released a white

paper outlining their twenty-year vision for expansion of land sector development of Australia's North (Australian Government, 2015). As outlined by Joe Morrison, Peter Yu and Melissa George, despite consistent court wins for Indigenous peoples seeking to protect their lands, this white paper failed to adequately account for well-clarified Indigenous interests in the region (Morrison *et al.*, 2018). Instead, it was designed to facilitate substantial and rapid growth in food and agribusiness, resources and energy, tourism and hospitality, international education, and healthcare, medical research and aged care, while also tackling what settler governments across Australia's north perceived as the biggest barriers to such development, including the complexity of land arrangements.

While the Northern Australia White Paper argued that “[n]ative title should not be seen as a barrier to development, but essential to it”, it also outlined how “the costs associated with unduly long native title negotiations can be an impediment for some developments” (Australian Government, 2015:20). The paper thus proposed efforts to simplify and modernise land arrangements in the north to “create more certainty for investors and increase the value of land for all Australians” (Australian Government, 2015:15). Underpinning this rhetoric is the idea that secure, tradeable, and alienable native title rights may help to clear the way for significant development in the North.

Land arrangements in Australia's native title system are in clear need of reform (see, for example, Morrison *et al.*, 2018; Wensing, 2016; Wensing and Taylor, 2012). Yet in the White Paper, this focus on reform is countered by emphases on risk-neutral rather than risk-averse investment and removing “needless red-tape” (Australian Government, 2015:7), which can include important policies designed to protect Indigenous rights. Despite Commonwealth rhetoric, the policies outlined in the white paper have significant potential to both rapidly transform northern Australia and undermine Indigenous interests in the region.

Writing on the potential for inclusive, equitable and prosperous development in northern Australia, Morrison, Yu and George have advocated for five development pillars for northern development which reflect Indigenous aspirations for the area. These include: land tenure reforms (albeit of a different style to those proposed by the Commonwealth), planning reforms, fiscal reforms to encourage development investment on Indigenous properties, a comprehensive social advancement strategy, and comprehensive investment in all forms of northern governance as outlined in Box 10.1.

Box 10.1: Five pillars for the development of northern Australia. Adapted from Morrison *et al.* (2018).

Five Pillars for Development (Morrison *et al.*, 2018)

1. Overhaul of the land title system, including a need to create fungible land titles which do not extinguish Indigenous rights.
2. Indigenous agencies in the planning wheelhouse, able to plot the course of their own development.
3. A fiscal policy framework to encourage development investment on Indigenous properties in the North including rebates, subsidies and tax incentives.
4. Comprehensive social advancement strategy developed by the Commonwealth and State and the Territory, in partnership with Indigenous people, local shires and industry.
5. Comprehensive investment in governance across northern Australia. This includes improving the capacity of Indigenous corporate governance, but also the broader development of North Australia's governance systems.

As was alluded to briefly by Peter Yu in 2013, a plan to extend GIS capacity to interested Indigenous groups across northern Australia, including the generation of regionally designed and dynamic cultural values models, may have a valuable role to play in supporting Morrison *et al.*'s five pillars for northern development. As Patrick Dodson outlined in the Yawuru case, with information like the cultural values base-mapping and in-house GIS capacity Indigenous groups across Australia's north may be able to integrate development plans with Indigenous produced and controlled datasets representing cultural values for the region. Thus, the development of local, Indigenous geospatial capacity among interested groups across northern Australia may both support the data sovereignty aspirations of many Indigenous peoples and increase their capacity to provide free, prior and informed consent to developments proposed for their customary lands.

Additionally, where Indigenous peoples hold properties, and developments are incentivised through rebates, subsidies, and tax incentives, Indigenous governance bodies may draw on Indigenous knowledges, practical observations, and Western science in a GIS to facilitate their own planning and development. Yawuru people, for example, are already drawing on their geospatial capacity to inform management of a commercial cattle operation and Indigenous Protected Area at Roebuck Plains Station (Belcher, 2014). Additionally, they draw on internal maps when considering various property developments within the town site. Overseas, as was outlined in Chapter 2, some tribes in the United States are so spatially enabled that GIS has become an essential element of both day-to-day reservation management and specific development projects.

Enhanced Indigenous geospatial capacity also has potential to contribute to the social advancement strategy outlined by Morrison and colleagues as the fourth pillar of northern development. Here, this capacity could help Indigenous peoples to recommend appropriate spatial

targeting of this strategy across northern Australia. It could also help to inform the overhaul of the land title system to include fungible titles which do not extinguish Indigenous rights. For example, cultural values base maps at a regional level might be employed alongside other media, stories and songs to help demonstrate the depth of connection Indigenous peoples hold to their customary lands across Australia's North. Finally, an extension of geospatial capacity to interested Indigenous peoples and groups across Australia's North would represent a clear and dynamic investment in Indigenous governance, which may help PBCs and other Indigenous governance bodies engage with the challenges outlined in Chapter 1. Such an investment would also ensure greater interoperability with data held by local, state and national governments, as well as third parties. When and where Indigenous peoples deemed this to be appropriate, they could use this interoperability to support more general efforts to develop governing capacity across northern Australia.

10.1.2 Extending local Indigenous geospatial capacity and the native title system

In addition to its potential to contribute to efforts to develop Australia's north sustainably and equitably, enhancing Indigenous peoples' GIS capacity may also bring benefits for their engagement with Australia's native title system. Detailed and substantive reforms to the native title system have been proposed elsewhere (e.g., Brennan *et al.*, 2015a; Wensing, 2014a; Wensing and Taylor, 2012). Three areas are proposed below where extending geospatial capacity to Indigenous groups might help support and perhaps even facilitate some of these reforms.

First, local Indigenous geospatial capacity and a cultural values map may be used to demonstrate the potential impact of proposed developments. This is important, because the National Native Title Tribunal continues to rely on Western style evidence of "how the *enjoyment* by the native title party of the bulk of its registered rights and interests *in the area of the proposed tenement* will be affected in an immediate and real manner by the proposed future act" (*Bissett v Mineral Deposits*, above n 137, 65 [emphasis added], in Sumner and Wright [2009]) during arbitration. Indeed, the National Native Title Tribunal has an in-house GIS expert and GIS continues to remain an important part of decision-making within the Tribunal. Equipped with spatial evidence of the impact of proposed development on their values and the exercise of their native title rights, Indigenous peoples are more likely to be successful during arbitration. Indeed, even the potential for Indigenous peoples to successfully appeal via the Tribunal may keep natural resource extractors, such as miners, and others who would benefit from proposed development at the negotiating table.

Second, as was outlined earlier, where native title holders can demonstrate advanced geospatial capacity, natural resource extractors and others may be more willing to share detailed,

spatially specific information on the nature of proposed developments. In the Yawuru case, a sequence of maps displayed during a meeting with Buru Energy led that company to share additional information about their proposed plans for fractured shale gas mining within the Yawuru estate. Such sharing has the potential to facilitate enhanced decision making by reducing information asymmetries between the parties. It may also go some way to facilitating a relationship of exchange, rather than antagonism, between native title holders and developers.

Third, spatial models of Indigenous values and practices typically demonstrate how Indigenous interests extend beyond the patchwork of native title recognition. Hence, developing local geospatial capacity may enhance Indigenous peoples' ability to demonstrate the potential impacts of development on customary lands where native title is not recognised. In this, it could facilitate negotiations beyond the spatial constraints which presently shape the native title system.

Finally, as was alluded to in Chapter 1, the issue of compensation for native title extinguishment is increasingly important following the payment of compensation, including a solatium payment for non-economic loss including loss or diminution of connection or traditional attachment to land as in the *Timber Creek* case. Here, Indigenous geospatial capacity could be used to help demonstrate how values and practices may have changed following construction or the extinguishment of native title, and perhaps inform the amount of solatium or financial compensation provided to that group by the courts. As outlined in Chapter 1, while compensation for loss does not erase the inter-generational trauma visited by settler colonialism, it can provide important resources to support native title holder aspirations into the future.

To be clear, while there may be significant benefits to the extensions outlined above, a plan to extend geospatial capacity to local Indigenous groups across Australia's north is not without risk. Under any roll-out, Indigenous peoples would need to retain data sovereignty and intellectual property over their knowledges in the outputs. They should also have the capacity to control when, how, and where such information is released, as well as to whom. Second, as with all efforts to map Indigenous lands and values, there is the risk that these values and territories may become reified or 'stuck' as part of this process. This risk highlights the importance of the creation of dynamic models, which can be regularly updated as part of using and maintaining that capacity. Such updates could include adaptation of the models for operation at a range of spatial scales from, say, a single beach, to a much broader and more negotiated region. A final challenge exists here around those Indigenous peoples who choose, as is their right, to not engage with, or actively avoid, the mapping process. As was outlined in Chapter 2, there are risks associated with any form of GIS mapping. If, however, the majority of Indigenous peoples choose to adopt GIS technologies and a small minority remain without them, there is a possibility that those in the minority will face significant disadvantages in negotiations, particularly if faced with external expectations that they "should" map their lands. This last element is, perhaps, the greatest

challenge associated with a potential GIS roll-out. Here, I would aim for Indigenous peoples to co-opt GIS technologies, rather than the other way around.

Experiences in or related to this research suggest two potential models for mitigating this risk while extending access to GIS and, where appropriate, context-aligned values mapping among Indigenous groups which are described in the following sections. The first is a peer-education or peer-tutoring model which uses regional networks and employs experienced PBCs to educate other interested groups on a fee-for-service basis. The second is a model which takes advantage of cross-institutional research partnerships, such as was the case in this research.

10.1.3 The peer-tutoring fee-for-service model

Peer learning and tutoring are well-accepted concepts in education (Bowman-Perrott *et al.*, 2013; Damon, 1984) and often used in Indigenous contexts (see for example Adams *et al.*, 2016; Smith, Trinidad and Larkin 2015). Yet, even the resources of comparatively large PBCs must often be stretched among a range of social, cultural and environmental programs as these groups engage in service delivery (Bauman *et al.*, 2013b). Here, government policy makers have an opportunity to take advantage of the relative experience of Yawuru and some other Indigenous peoples to diffuse strategies and innovations around GIS use (Longley *et al.*, 2011:45). Specifically, governments could capitalise on Kimberley and Top-End based reference groups such as NAILSMA and the North Australian Indigenous Experts Forum which was a series of large forums of 40-60 Indigenous experts which aimed “to build a future for northern Australia that is inclusive of the wide range of Indigenous values, interests and aspirations” (NAILSMA, 2012c:10). National and state governments could pay innovators in this sector, including Yawuru people, to communicate their knowledge and experience, something that these groups have already begun to do through forums such as the National Native Title Conference (Kennett *et al.*, 2015; Mathews *et al.*, 2018) and the World Indigenous Network conference (Yu, 2013a). This could assist Yawuru and others to support their peers through a fee-for-service model which would enable groups who engage as peer educators to convey their experiences to others (Potter *et al.*, 2016). It could also continue to support programs that are effectively ongoing but may only receive short term funding.

To elaborate, governments could employ groups like Yawuru and, where appropriate, their academic partners to co-design a series of short courses to introduce PBCs to GIS, GIScience and their capacity to support Indigenous governance. Gonzalez (2002), for example trialled a similar approach with isolated rural farmers in Ifugao, northern Philippines, designed to pick up lessons from the successful past and work for a perceived desirable future. Peer-tutoring courses could teach specific tools and techniques which may be used by Indigenous peoples, as has been done in the roll-out of the I-Tracker program facilitated by NAILSMA. More importantly, it could

further extend on such training by equipping communities with the critical cartographic literacy and understanding of GIScience recommended by Louis (2004) and Johnson *et al.* (2005). Indeed, part of the GIScience training could include an introduction to Pratt's conception of the contact zone should that prove useful to Indigenous research partners. Under this arrangement, responsibility for the storage of geographic information and technical innovations sits with groups, perhaps with an information hub with a small number of paid or dedicated staff to co-ordinate training and connect groups to appropriate peers and resources.

The peer-education fee-for-service model has several strengths. Peer-education has been successful at transferring innovations in many areas and this model takes advantage of existing political capital and regional connections between groups. NAILSMA, for example, has been able to leverage peer education as a key component of their I-Tracker program (NAILSMA, 2014). Similarly, the Garl Garl Walbu support network has generated positive change signs around addiction and substance misuse in the Kimberley (Australian Government Office of the Registrar of Indigenous Corporations, 2017). Finally, the AIATSIS National Native Title Conference often provides an important mechanism for peer-to-peer education where native title holders exchange ideas, presenting what is and isn't working within their own estates (e.g. Kennett *et al.*, 2015).

Beyond its potential to transfer innovation, peer-education provides appropriate remuneration for groups who are rendering services to government and providing in-demand skills which can support governance, resulting in employment at the regional level. The information hub suggested as part of this strategy could also take advantage of elements of the Bureau of Indian Affairs model (Bond, 2002) by helping connect communities to freely available or otherwise subsidised spatial resources which can further support their decision-making. Such a hub would need to be careful, however, to avoid the colonialist overtones associated with the Bureau of Indian Affairs model of GIS diffusion (Palmer and Rundstrom, 2012).

There are still some limitations to the peer-education model. In many respects, it relies on PBCs or, at a bare minimum, regional service providers such as Native Title Representative Bodies having access to the hardware, software and internet connections necessary to support GIS analyses. Moreover, this model depends on good working relationships between individual PBCs which are sometimes forced into competition for limited resources that can generate lateral violence and mistrust between groups as described in the second chapter of the Aboriginal and Torres Strait Islander Social Justice Commissioner's 2011 report (Aboriginal and Torres Strait Islander Social Justice Commissioner, 2011). It also requires trust between regional or representative bodies, such as the Central, Northern, and Kimberley Land Councils and PBCs or other native title holding bodies which operate at a more "grass roots" level (Langton and Frith, 2010). Such trust can be hard to come by when overlapping rights to land are not formally recognised in a native title claim and groups are forced to compete for funding and other limited

resources (Edgar, 2011). Additionally, without adequate government funding and payments for those who are completing the courses, this model may result in financial redistribution from comparatively resource-poor communities to relatively resource rich ones. While this is preferable to considerable funds leaving the Indigenous domain entirely through external consultants, it remains an important consideration which will need to be addressed. Finally, should the peer-tutoring fee-for-service model be rolled out too quickly, it could be viewed as yet another settler colonial project designed to render Indigenous peoples and their connections to land legible in a way that confines their rights to a minimum area. Here, the Australian Government could take advantage of the ‘learn and adapt as you go’ (adaptive learning) approach already being employed in the Empowered Communities model (Wunan Foundation, 2015).

The ultimate success of a peer-tutoring, fee-for-service model would rely both on the people involved in it and the resources provided for it. This model is more likely to be successful if culturally appropriate representatives from respected and innovative Indigenous governance bodies are selected as peer educators. Similarly, uptake will likely increase where groups involved in the program are provided with adequate resources to support their engagement beyond initial training. Under the model, Indigenous governance bodies could be introduced to a range of GIS tools which are likely to be useful in the challenges which face them and then shown how it is possible to tailor and adapt those tools to local contexts. Here, as in the Yawuru example, communities may be best to start with small projects to build confidence in the models and software over time. Such an approach would enable them to develop contextually appropriate short-, medium-, and long-term agendas for GIS use.

10.1.4 The research partnership model

An alternate, yet complementary option for policy makers in this area is to encourage the adoption of partnership research models similar to the Fenner School-NBY GIS partnership which underpins this study. Here, individual PBCs, or again, regional service providers including Native Title Representative Bodies such as the Kimberley Land Council could establish relationships with individual researchers or small groups within institutions. Given the relative emphasis on creating contextually and culturally appropriate local impacts in such partnerships, these are likely to be best supported by a separate government grant process and more flexible funding guidelines which give these partnerships the opportunity to create adaptable and applicable research outputs. In this scenario, short courses to train Indigenous staff and volunteers could be conducted as part of the research process.

Like the peer-tutoring model, the research partnership model also has strengths for diffusing innovation in Indigenous contexts. In this model, the combined technical knowledge of the researchers and cultural knowledge of key collaborators within PBCs may lead to greater

innovation and more cultural alignment than could be achieved by many PBCs (who have historically been under-trained and under-resourced) alone. Where this model is conducted as part of a Doctoral program and supervised by academics who are attuned to the sensitivities of engaging in such partnerships, it may produce dedicated and focused outputs while minimising personnel costs.

As shown here, research partnerships may facilitate the creation of blueprints designed to make GIS more tailored, efficient and effective in particular applications. They may also provide opportunities to “record cultural and economic values associated with land tenures in a consolidated manner that addresses the management demands of traditional owners and other stakeholder groups” (Kennett *et al.*, 2015:17). Furthermore, where supported by appropriate data management agreements, they may reduce pressure on PBCs to house all software and hardware necessary to support GIS analyses in-house, while providing greater continuity than would be possible by simply contracting external consultants to conduct the mapping work. Finally, the research partnership model may create opportunities for collaboration and research dissemination, as well as wider recognition of a PBCs engagement in this area through academic publications, working papers or reports, conferences and blogs. Such recognition can be important for PBCs who are more likely to be able to secure funding and be perceived as legitimate third parties to negotiations where they are seen as proactive and tenacious actors in this space.

There are still limitations to the partnership model. As discussed extensively by Smith (2012) and others, research generally, and geography specifically, have long been associated with the colonial project. Additionally, as indicated above, at present it can be difficult to secure funding for culturally appropriate and slow research given that many of the more typical grant application processes require academics to produce written outputs, usually journal-based, within tight working deadlines which rarely accommodate flexibility (McLean *et al.*, 2016). More generally, partnership research often entails work at a variety of paces which may or may not align with academic teaching schedules or other research work.

Ultimately, several factors may increase the likelihood that the partnership model will succeed into the future. First, given the efforts that go into establishing relationships and trust in partnership research, it is essential that personnel consistency is supported and maintained wherever possible. Potentially, this could be facilitated by key academic anchors within one or more institutions who operate as the pivot points and a continuous point of contact for broader networks. Second, given the colonialist history of research, it is vital that there is an equal relationship within the research or, even better, that the community partner holds control over the research. This can and should include early negotiation and where necessary renegotiation of procedures for ethical work as well as data-storage and publication, as is typified by the GIS Partnership Principles recently signed by NBY and Dr Bruce Doran who provides the anchor for

the partnership at ANU. The San Code of Research Ethics, which is “the first ethics code developed and launched by an indigenous population in Africa” (Schroeder *et al.*, 2019, p.73) might also serve as a model here, in that it emphasises fairness, respect, care and honesty, as well as community approval (South African San Institute, 2017). Third, partnership research is most likely to be successful where it provides useful data for Indigenous peoples’ aspirations while deliberately fostering Indigenous peoples’ understanding of GIScience and critical cartographic literacy. Finally, any partnership research needs to establish an exit strategy that will leave Indigenous peoples well-equipped, rather than disenfranchised or unable to replicate work at the end of the partnership. One such strategy may involve equipping and supporting Indigenous peoples to engage in the peer-tutoring fee-for-service model which was outlined in section 10.1.3.

10.1.5 A final comment on the need for broader policy reforms

Beyond the suggested extension of local GIS capacity to Indigenous peoples outlined here, there is a clear need for reform in Commonwealth and state approaches to Indigenous affairs in Australia. The first area for obvious reform is Australia’s *Native Title Act*. As was outlined in Chapter 1 of this thesis, Australia’s native title system is yet to secure self-determination even for those groups who have been relatively politically and economically empowered by it. Without substantial reforms to the native title system, it is unlikely to truly facilitate Indigenous political and economic empowerment. Second, as outlined by Morrison, George and Yu (2018), there is a need to substantively reshape the focus on developing northern Australia to fully account for the vitally important roles of Indigenous peoples within that region.

Finally, as relates to other relevant legislation in the Broome region, there is a need to update the *Aboriginal Heritage Act 1972 (WA)* (*‘Aboriginal Heritage Act’*). The *Aboriginal Heritage Act*, unlike the *Native Title Act*, applies to all forms of title and tenure. It serves as the principal legislation for protecting and managing places of significance in Western Australia (Vaughan, 2016). At 46 years old the Act is now “cumbersome and ineffective” and there is a considerable backlog of sites waiting for processing and registration (Vaughan, 2016:254). Moreover, of the 646 applications made to destroy sites from 2008 to 2013 only one was refused under the current system (Wyatt, 2014). The West Australian Labour Government’s current review of the *Aboriginal Heritage Act* (Government of Western Australia, 2018) provides an opportunity for the West Australian government to require deeper consultation with Indigenous peoples as part of the heritage approvals process. At a bare minimum, any reforms of the Act should ensure that traditional owners and native title holders are notified and given an opportunity to respond to developments proposed for their traditional lands (Tan, 2016). Better still, reforms should incorporate Aboriginal definitions of sites, and include provisions that define a statutory role for the voice of Aboriginal people in legislation as was recommended in a 1995 senior review of the

legislation, as well as numerous submissions received by the government in relation to proposed reforms of the Act in 2014 (Vaughan, 2016).

These reforms are ambitious and likely to take time. They extend far beyond the extensions of local GIS capacity to Indigenous peoples that were outlined earlier. Moreover, despite the level of input Indigenous peoples have had in shaping these suggested reforms, many require further consultation and negotiation, especially around the specifics of their implementation. Given that broader policy reforms may help to protect negotiated agreements facilitated by GIS, and that context-driven GIS may function as a spatial *lingua franca* for communicating the importance of land, systemic realignment should not replace the strategies outlined in sections 10.1.3-4. Instead, GIS rollout and policy reform are complementary mechanisms to support Indigenous governance and perhaps even move towards broader goals of Indigenous self-determination in Australia.

10.2 Implications for academic debate

This next section reflects on how Pratt's art of the contact zone concept may further understandings of Indigenous GIS use. Specifically, it contends that this concept may provide a functional vocabulary and conceptual framework to communicate the strengths and limitations of GIS technologies when used by Indigenous peoples. It also argues that such a vocabulary and framework may help to shift academic debates in this area by providing a simple conceptual mechanism to discuss the technology's potential impacts in a way which is neither paternalistic, nor naïve.

GIS is now being used by a range of indigenous peoples from across the globe. This use of GIS by indigenous peoples has garnered both praise and critique, as outlined in Chapter 2. Thanks to these vocal debates, academics are increasingly aware of GIS technology's potential and foibles. Many contemporary papers which introduce indigenous GIS applications dedicate substantial portions of both their literature reviews and their discussions to detailing the potential strengths and limitations of the technology (e.g. Olson *et al.*, 2016). Others call for encouraging critical cartographic literacies to increase discerning indigenous engagement with GIS as a technology and a science (Bauer, 2009; Johnson *et al.*, 2005; Pyne *et al.*, 2009).

Despite this, there has been little substantive progress in how these ideas are described at a conceptual level. Academics reference the empowerment/ disempowerment nexus (Chambers, 2006; Kyem, 2000), concepts of playing in versus changing the system (Palmer and Rundstrom, 2012), issues of ontological or epistemological alignment and misalignment (Veland *et al.*, 2014), and the challenges of facilitating visibility or avoiding surveillance (Craig and Elwood, 1998) in relation to indigenous GIS use. However, they often do so without a solid conceptual framework or metaphor to facilitate a simultaneous understanding of both sides of these debates. It is here

that Pratt's "art of the contact zone" concept, and the joys and perils Pratt associates with these arts, may find most use in an academic context.

As outlined in Chapter 2, there are clear parallels between indigenous peoples' GIS use and Pratt's art of the contact zone concept as described in her 1991 paper. First, indigenous peoples often selectively adapt and appropriate technologies which have long colonial associations, including GIS and other mapping technologies, to intervene in the dominant society's understandings (Harmsworth, 1998; Pearce and Louis, 2008; Peluso, 1995). In doing so, they engage in transculturation whereby they control and adapt technologies which have been visited on them by those in the majority (paraphrased from Pratt, 1991). Second, indigenous peoples also often use these technologies as parts of concrete partnerships with consultants, researchers, corporations and even government departments such as the Bureau of Indian Affairs in the United States (Taylor *et al.*, 2012).

Third, as Pratt acknowledges, the products or arts of the contact zone are often directed to internal, "Other" and cosmopolitan audiences. This is also true of indigenous uses of GIS targeted at both "internal" and "external" decision making. In the Yawuru case, for example, GIS modelling has helped to communicate how proposed fracking sites might impact on cultural values on Roebuck Plains to both community members and staff of Buru Energy during a community meeting (NBY, 2015b). Fourth, and perhaps most importantly, there is a clear parallel in that arts of the contact zone and outputs of indigenous GIS use and mapping are both heterogeneously received by different audiences and even different people within communities. As is widely documented in the literature, outputs produced through indigenous peoples' use of GIS have both supported successful negotiations (Bauer, 2009; Veland *et al.*, 2014) and been used against the interests of those who created them (Scassa *et al.*, 2015; Thom, 2009).

There are clear parallels between Yawuru people's use of GIS and Pratt's art of the contact zone concept in that this partnership has applied and adapted critical GIScience as a spatial *lingua franca* designed to communicate values, concerns, and seasonal landscape use across worldviews. The contact zone concept has also provided an important framework for conceptualising and communicating the potential and perils of the Yawuru approach to GIS.

In this study, understanding the post native title environment as a contact zone has helped me to better perceive and conceptualise the structurally inequitable spaces where NBY and other indigenous governance bodies engage on a regular basis. It also has drawn my attention to challenges experienced in the contact zone and to the difficulty of shifting the structural dynamics of that space. Perhaps most importantly, the art of the contact zone concept has enabled me to rapidly communicate both the strengths and limitations of the technology to diverse audiences both personally and professionally. This has allowed many in those audiences to perceive the complexities of GIS technology, alongside its potential power.

Given the utility of the art of the contact zone concept in my own research, and its widespread use as a communication mechanism across a range of disciplines (Barry and Porter, 2012; Bruckner and Johnson, 2005; Chidester, 2008; Dibley, 2005; Guarracino, 2009; Kelly, 2012; Manathunga, 2009), this thesis contends that this concept may help to engender the critical cartographic literacy encouraged by Johnson and colleagues (Johnson *et al.*, 2005). It also contends that describing indigenous peoples' uses of GIS as an art of the contact zone may provide a more concrete conceptual framework for engaging with their use of the technology than has been available previously.

In many respects, the advantages of Pratt's art of the contact zone concept stem both from its parallels with indigenous GIS use, and its capacity to place that use in a broader colonial or post-colonial context. Rather than narrowing the focus of arguments to GIS alone, Pratt's concept of the contact zone positions GIS use among broader indigenous engagements in this space. This concept is also helpful in that it may enable academics and, if useful, their research partners to conceptualise the heterogeneity associated with such applications. The art of the contact zone concept accommodates the full range of "participatory" research associated with indigenous GIS, including situations where indigenous peoples adapt the technology without collaboration with third parties. Finally, this concept has potential to offer greater insight into the multiple layers of negotiation which may be associated with the technology both within and beyond research partnerships.

To my knowledge, this thesis is one of the first to position indigenous GIS use as an art of the contact zone. Consequently, there is considerable room for further research in this area. In particular, it would be practically useful to understand if and how understanding GIS use through the art of the contact zone metaphor encourages critical cartographic literacy or shifts the tone of broader debates. I hypothesise that the concept is likely to have a small but meaningful impact. It is likely to subtly shift the tone of broader academic debates by providing a simple conceptual framework which incorporates much of the nuance associated with indigenous GIS use.

10.3 Future GPS field checking and areas for research

Future research could help to refine and extend blueprints and techniques developed in this study in several ways. First, field-checking could be used to verify buffer distances and adapt them, as necessary. As part of this, with the consent of Yawuru individuals, movement trackers and small GPS units could be used to investigate and further refine parameterisation of the directional buffering for practices including line-fishing, spearing stingrays and collecting crabs. Field checking could also play a valuable role in investigating whether adaptation of sketch maps is sufficient to facilitate identification of bush-fruit areas from the air, or whether this form of data needs to be collected on the ground. Another alternative to field-checking, given the relative

difference in bathymetry between Roebuck Bay and Cable Beach, would be developing techniques which are further grounded in geographic context in that they are able to incorporate depth and directionality into the fuzzy buffering process. Second, Yawuru governance bodies could extend the modelling conducted here by exploring seasonal use of the whole estate, rather than just of valued sites. They could also expand the blueprints to deal with larger numbers of participants following the initial trial, perhaps using tablet computers and associated surveys.

Beyond the Yawuru context, it will be important to trial the directional buffering and qualitative weighting techniques developed in this research in a range of other scenarios including with other native title holding groups. Additionally, it will be important to directly compare the spray-can tool developed by Carver and colleagues (2009) and the fuzzy buffering process developed in this research to measure their comparative ease and alignment with the spatial ontologies of Indigenous peoples. This may be crucial when various techniques developed in this research are trialled with native title holding groups who hold significantly fewer resources than Yawuru governance bodies. Finally, from a theoretical perspective, future research could investigate whether introducing GIS as an art of the contact zone does indeed encourage critical cartographic literacy and pragmatism among both Indigenous peoples and academics. This could help to ascertain what, if any, further work is necessary in this sphere.

10.4 Reflections on a role for context-driven GIS in post native title Australia

Australia needs to address the practical challenges and unacceptable realities facing Indigenous peoples (Yu, 2018). It needs to support Indigenous peoples in their efforts to tackle issues around well-being, healthcare, high incarceration rates, education, intergenerational knowledge transfer, employment, lateral and family violence, and caring for Country. At the same time, however, Indigenous peoples are resilient: they have adapted to a vast continent since time immemorial and survived more than 200 years since European invasion. They have engaged with governments, industry, community groups and academia throughout this process. They have also deftly retained, invented, adopted, and adapted numerous tools and techniques as part of this endeavour. For an increasing number of groups, this has included the adoption of GIS technologies as part of land management and post native title governance.

This research has not produced a definitive approach to values mapping, but arguably there should not be one. Instead, this thesis has shown that contextually-driven GIS can be applied across diverse local issues and contact zones. It has demonstrated that contextually-driven GIS can produce representations of Country which harness the technology's analytic potential and align with the relationality inherent in many Indigenous spatial ontologies. Moreover, this thesis

has illustrated how these models can be used to contrast with the discrete modes of possession and division associated with Boolean models of space.

At its core, GIS is a fundamentally practical and multi-scalar technology. Given this, context-driven GIS and fuzzy index modelling have potential to be employed by Indigenous peoples in local, regional, state and national contexts. This is reflected in Peter Yu's call for cultural values mapping across Australia's North to assist in negotiations around that region's development (Yu, 2013a).

As has been examined throughout this thesis, GIS use is not without its perils and it is not a panacea. That this research has succeeded as far as it has is due, in large part, to the guidance offered by the Yawuru Four Pillar Knowledge Vision outlined in the Aboriginal and Torres Strait Islander Social Justice Commissioner's 2012 report. It is also due to the concepts of *mabu liyan*, *mabu buru*, *mabu ngarrungunil* which outline the aspirations that guide Yawuru governance and were often central to guiding the next steps for the partnership and the research.

Ultimately, it is vital that, as Yawuru have done, Indigenous peoples are able to choose if and how they engage with GIS technologies. It is also crucial that they control the outputs of this engagement. Nonetheless, with appropriate resourcing, grounding, and training, this art of the contact zone has clear potential to facilitate cross-cultural communication and Indigenous decision making. In this, continued refinement and adaptation of GIS and GIScience has great potential to help support Indigenous peoples' self-determination in post native title Australia.

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