Value and risk mapping: creating effective conservation and resource management tools

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Abstract

Coastal marine environments provide a wide range of goods and services that contribute to human wellbeing resulting in a natural connection with the environment where economic and spiritual values may be equally important. Because of these perceived values, many people have a natural inclination towards coastal marine areas, with a resultant potential for resources depletion, or degradation of areas that are highly valued. Often, research examining the value of an area considers natural capital or ecosystem services (both in economic terms), but fails to capture concepts of perceived intrinsic, social, or cultural values in a meaningful manner and rarely all values are considered together. Recently, these perceived societal values are acknowledged and incorporated into international environmental agreements as important elements that require pro-active consideration within management decision-making.

However, due to its recent inclusion into the environmental management panorama, no standardised methodology (or framework) to assess values is established. By having a common framework, it is possible to enhance dialogue between researchers that creates mutual goals and comparable results. The central aim of this research was to create a framework to identify, map and assess perceived environmental, economic, social and cultural values, and to test their validity through hazard scenarios. The thesis draws on a case study from Gladstone, a port industrial city in central Queensland, Australia, situated within the Great Barrier Reef World Heritage Area (GBRWHA).

The proposed framework consisted in three general steps: 1) the identification of societal values via a bottom-up inductive approach; 2) the spatial identification and mapping of societal values; and 3) the development and testing of a novel post-hoc weighted risk analysis. The input data for this framework was qualitative and quantitative, applying a mixed-methods approach. To identify the societal values from an individual's perspective about the Gladstone Region, a group of 30 participants from nine different stakeholder groups were interviewed. The in-depth interview questions were designed to explore

elements in the Gladstone Region environment that were perceived of as important in all four-value contexts (i.e. cultural, economic, environmental and social). The results demonstrated that respondents held a wide variety of societal values and concerns for the Region, and that different stakeholder groups in the area shared common values and concerns (Chapter 2). Some socio-demographic characteristics of the participants (i.e. time and place of residence, place of birth, income, gender and generation) statistically influenced respondent's values and concerns, but no values, commonality of concerns, norms and beliefs were statistically evident between stakeholder groups.

To elicit the perceived spatial distribution and importance of the values identified by the group of stakeholders, four surveys were designed and implemented aimed at eliciting the spatial location and perceived importance of a series of 22 cultural, economic, environmental and social values (Chapter 3). These surveys also included questions to explore the respondents' preferences about different types of urban development, as well as questions about their perception of the environmental health of the port and its spatial location within the GBRWHA. The relationship between the perceived importance assigned to values and the respondents' age, gender, level of education attained, time of residence, place of birth and place of residence was also explored. The results revealed that 23% (n = 5 out of 22) of the identified societal values had a statistically significant relationship between the respondents' socio-demographics and their perceived importance.

In general, the regression models demonstrate that respondents older than 46 years of age and living in the Gladstone Region over a mid to long-term period assigned higher importance to societal values (Chapter 3). The survey (combined with the interviews) also indicated that there is a certain acceptance of the 'industrial character of the city' and the Gladstone Region, with the associated environmental consequences this industrial character may entail.

The general spatial distribution of the 22 values occurred along the coastline and the majority of the most important places for those values coincided with the populated and accessible areas in the Gladstone Region. Additionally, the areas marked for the different types of future development covered not only the coastline but most of the Gladstone Region. Potential conflicts between these areas and the societal values were not evident. The elicitation method (i.e. face-to-face surveys), the spatial features used (i.e. unlimited number of points), the weighting method (i.e. importance in a scale of 1 to 10), and the GIS density analysis chosen, proved to be a good option for future societal values' assessment (Chapter 4). However, it is important to further explore this and other methods in order to standardise the methodology (Chapter 4).

The final societal values' data was used to develop and test a spatially weighted risk analysis. For the risk analysis, an oil spill hazard scenario was constructed based on information of consequences of previous oil spill events and the predominant currents in the Gladstone harbour. The proposed risk analysis provided herein adds an extra step to the conventional risk analysis process by incorporating the perceived importance of societal values with their spatial distribution (Chapter 5).

Identifying and attempting to understand the environmental, economic, social and cultural values in a given area, can help to improve how we manage our coastal marine environments. Our understanding of societal behaviour towards coastal marine environments is relatively limited, which influences how we can effectively make environmental management decisions in these ecosystems. The information and approach developed in this thesis aimed to provide a standardised framework that managers and decision-makers can use to pro-actively acknowledge and include community concerns, views, and values within local, regional, national, and international projects.

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Glossary and Acronyms

Assigned value	The value given to a thing or place by an individual. It can be expressed in economic or non-economic terms
Beliefs	Facts as an individual perceives them
Bequest value	The value given to preserve biodiversity and ecosystems for its use by future generations
Coding	a) Categorisation of qualitative information in themes; b) assignation of numbers to the categories created to be easily analysed
Concerns	A belief that something important might be at risk
Consequence	The impact or magnitude of an adverse event or hazard
Cultural values	The attributes that contribute to any kind of spiritual experiences that would award meaning(s) to symbolic goods
Deductive mapping	Societal values' mapping method where the respondents have a list of pre-defined values
Economic values	The attributes or goods that contribute to society's capacity to generate economic income, such as land, natural resources, factories, durable goods, and machines
Environmental values	The goods or services considered as important for the community or society wellbeing such as food, water, fuels, pollination, shoreline protection, water and air purification
Existence value	The value assigned to the knowledge that species and ecosystems exist, even if the individual does not use them
Gladstone Ports Corporation	A company Government Owned Corporation (GOC), responsible for the import of raw material and the export of finished product associated with major industries in the Central Queensland region.
Gladstone Region/ the Region	Local government area in Queensland, Australia.
Hazard	Event with the potential for harm to the environment, people or a community, or a combination of these
Held values	The principles, or moral standards, of a person about what is important in life
Inductive mapping	Societal values' mapping method where the values are identified by the respondents
Intrinsic value	The value that something has in itself, regardless the human point of view

Likelihood	The probability of an event occurring
Likert scale	A rating scale used to represent people's attitudes to a topic.
Market value	The value of goods and services that are traded in markets
Non-market value	The value of goods and services that are not traded in markets
Non-use value	The value attached to a good even if humans never have and/or never will use it
Norms	Statements about how one or someone else ought to behave
Option value	The value of keeping the option to use a good
Participants	Stakeholder group representatives that were interviewed
Place attachment	The emotional bond that ties people with places
Port of Gladstone (also known as Port Curtis)	Is a 30 km long, deep water harbour bounded by Curtis in the north and Facing Island in the south
Quasi-option value	The value of information that would improve the use of a good in the future
Respondents	Individuals involved in the survey elicitation process
Risk assessment	A method used to determine the likelihood that an event may occur and its consequences
Social values	The attributes or goods that enable the generation of values like trust, respect or responsibility in individuals through the membership of one or more social groups
Societal values	The attributes, goods and services that are perceived to contribute to the community or society wellbeing. They can be classified as cultural, economic, environmental and social values
Solastalgia	Nostalgia for what the environment once was
Themes	Resultant categories from qualitative information
Use value	The value given to a good used by humans
Utilitarian value	The value that something has as means to another’s ends
Value	The worth of a thing or place (often based on monetary exchange)

ABS	Australian Bureau of Statistics
CATI	Computer-Assisted Telephone Interview
CBD	Central Business District
EPBC Act	Environment Protection and Biodiversity Conservation Act (Australian legislation)
FIFO	Fly-In, Fly-Out. A method of employing people in remote areas by flying them temporarily to the work site instead of relocating employees and their families permanently to the work site
GADPL	Gladstone Area Promotion and Development Limited
GBR	Great Barrier Reef. The world's largest coral reef ecosystem
GBRMP	Great Barrier Reef Marine Park. Declared in 1975 by the Federal Government of Australia. Does not include 3,600 km^2 of islands, ports and some State/internal waters that fall under the Queensland State Government jurisdiction, but are part of the GBRWHA (see below)
GBRMPA	Great Barrier Reef Marine Park Authority - Federal authority that manages the GBRMP
GBRWHA	Great Barrier Reef World Heritage Area. The United Nations Educational, Scientific and Cultural Organization (UNESCO) established the GBRWHA in 1981 because of its outstanding universal value
GIS	Geographic Information Systems
GRP	Gross Regional Product
HGA	Hydrogeomorphic Approach
LNG	Liquid Natural Gas
MEA	Millennium Ecosystem Assessment
NCGIA	National Center for Geographic Information and Analysis
NGO's	Non-Government Organisations
NIMBY	"Not In My Backyard" effect
nMDS	Non-parametric Multidimensional Scaling
OUV	Outstanding Universal Value
PES	Payment for Ecosystem Services. Economic incentives to land owners to encourage conservation
PPGIS	Participatory Geographic Information Systems. The process when GIS technology is used to enhance public participation and incorporate local knowledge
QAL	Queensland Alumina Limited. Alumina refineries and export facilities

SDA	State Development Area: area designated by the Queensland State Government for industrial development and materials transportation infrastructure
TEK	Traditional Ecological Knowledge
TEV	Total Economic Valuation
WET	Wetland Evaluation Technique
WTA	Willingness to accept
WTP	Willingness to pay

CHAPTER 1

Values and valuation within an environmental conservation context

1.1 Values' assessment

Given the situation of environmental degradation, scientists and regulators have been attempting to 'value nature'. This is done to keep up with political and economic arguments for the conservation of biodiversity and the maintenance of ecosystem services. Valuing natural systems however has proven to be a complicated task because: 1) nature is dynamic (spatially and temporally) and therefore difficult to understand, let alone value (e.g., Walters et al. 1997; Choi 2004; Dawson et al. 2010); 2) there are many competing stakeholders (all with differing belief systems and value judgements) (e.g. Beierle and Konisky 2001; Gregory and Wellman 2001; Reed 2008); and 3) there are various conceptual methodologies that can be used to undertake valuation (e.g. EFTEC 2006; Bagstad et al. 2013a). This is further compounded by not only the philosophical and ethical questions about what is the meaning of 'value' and its implications on human welfare, but also because of the relatively recent need to establish comprehensive methods to assess ecosystems values (not only as economic assets but also as socio-cultural goods) and to consider cumulative impacts.

1.1.1 What are values?

The term 'value' is used in everyday language, relying on the context of its usage to define its subtly different meanings. For example, when we compare the price of a pineapple in different markets we are asking ourselves its relative cost, then we decide which one to buy according to our opinion of its worth (i.e., is it a reasonable price?) and our need (i.e., is our need greater than the cost?). Our final decision can also be influenced by moral and ethical principles (values), like the kind of market we are buying it from (i.e., is the vendor ethical?), how was this pineapple grown (e.g., organic merchandise) and where was it grown (e.g., consideration of carbon miles in relation to where it was sold and ethical treatment of workers). Therefore, we can distinguish three different definitions of value (Stevenson 2010), which can be used together or independently:

a. the principles, or moral standards, of a person about what is important in life (held values) (Lockwood 1999);
b. the societal or personal importance of a thing, place or benefit from the environment (often based on opinion) (Brown 1984; Díaz et al. 2015a, b); and
c. the worth of a thing or place (often based on monetary exchange) and also known as assigned values (Dietz et al. 2005; Stevenson 2010).

Since the term 'value' is broadly used in our daily language, encompassing all of these three definitions, its use in the environment conservation scope is also frequently mixed or confused (Reser and Bentrupperbäumer 2005). Depending on the discipline approach (created by our philosophical paradigms), the term 'value' is used in different ways and recognises, or not, the intrinsic and utilitarian value of a thing. In the field of natural resources management, the term 'values' is commonly used to refer to the societal importance given to a place, the benefits that humanity (i.e. individuals, communities, societies, nations) obtains from the environment (Díaz et al. 2015a,b) or the specific modes of conduct or guiding principles of behaviour (Brown 1984; Seymour et al. 2010). In this context 'value' refers to the monetary worth of something, generally from an economic perspective (Seymour et al. 2010). To reduce the confusion associated with the term 'value' within this thesis, I will use the terms 'values' and 'value' as defined in Table 1.1.

Table 1.1 Discipline based usage and classification of the term 'value'

Use	Discipline	Classification	
Principles or moral standards	Ethics Philosophy Psychology	NA	
Societal or personal importance of a thing, place or benefit from the environment	Ethics Philosophy Psychology Environmental Science		
		intrinsic	utilitarian
The worth or importance of a thing or place	Ethics	✓	✓
	Philosophy	✓	✓
	Psychology	✓	✓
	Economics	×	✓
	Environmental Science	✓	✓
	Conservation Biology	✓	✓

It is thought that the use of the concept of value (i.e. as the worth of a thing) was first used in economic jargon in the 18th century and its use in ethics began in the 19th century with the German philosophers Lotze, Ritschl, Windelband and Rickert (Becker and Becker 2001). Economics estimates the value (price) of things as the result of the exchange process between people within a market (Spangenberg and Settele 2010). In this approach, according to an objects' value, people make choices to maximize their utility (their satisfaction). This focusses on people's preferences rather than on their values (as moral standards or societal importance) when making a decision (Stern et al. 1993). Alternatively, according to ethics and psychology, when the choice is not as clear cut, values help to make the final decision, appealing to strongly held beliefs when in need of more deep reflections rather than quick judgements (Dietz et al. 2005; Dolan and Kahneman 2008; Spangenberg and Settele 2010).

1.1.1.1 Held values

Human values (as principles of behaviour) (Stern et al. 1993) have been studied and described from different disciplines such as psychology, philosophy, economics, social science and ecology (Dietz et al. 2005). Figure 1.2 conceptualises the components of held values (Lockwood 1999). As mentioned previously, these values are guiding principles that individuals hold as very important, which are abstract or conceptual, and from an environmental ethics discipline viewpoint these values are expressed in relation to nature in general. From the psychological approach, these values are thought to be constructed from demographic and social characteristics, life experiences and institutional constraints and can be classified into the following three orientations: 'individual'; 'social'; and 'biocentric or ecocentric' orientations (Stern et al. 1993).

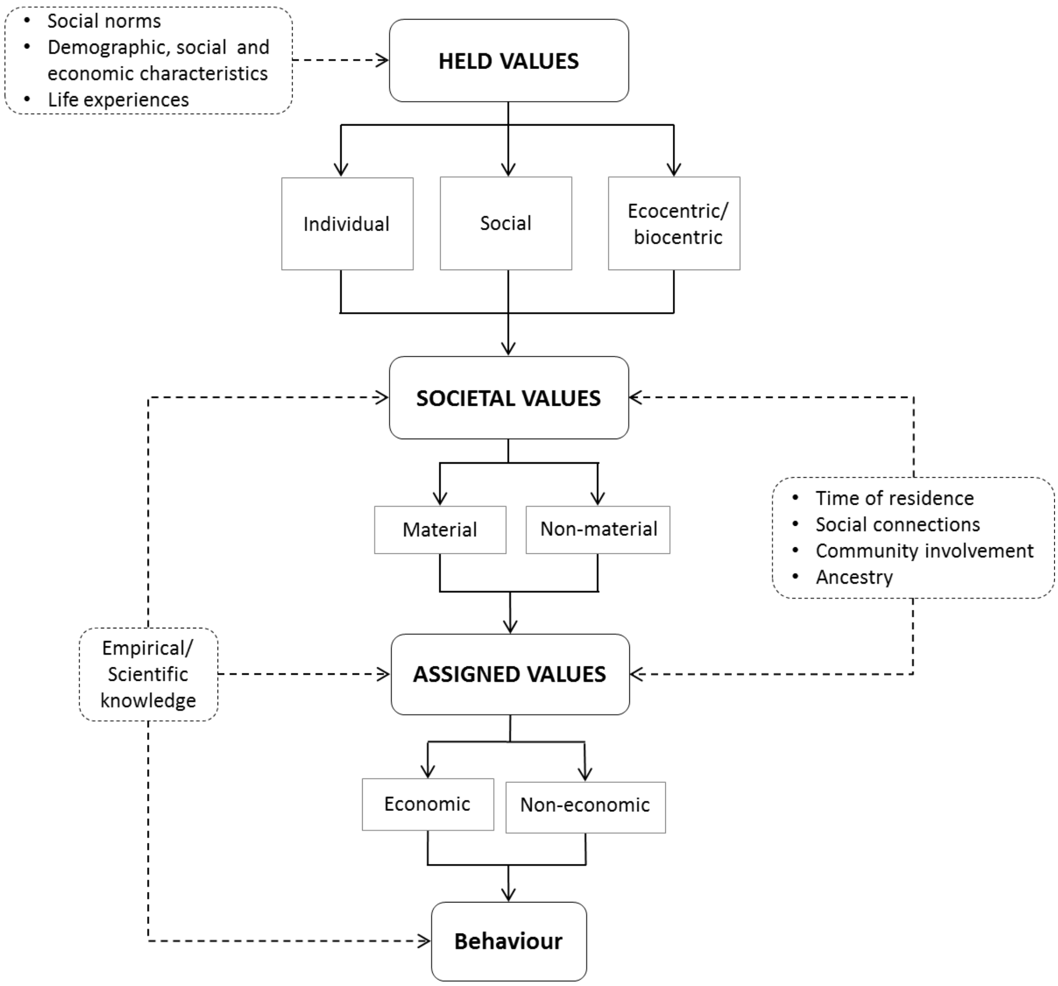


Figure 1.1 Relationship between social characteristics and held, societal and assigned values as behaviour drivers (adapted from Lockwood 1999).

The 'individual orientation' is where people care about the environment because it influences us personally and the values that we hold as important or care about; in this instance people make decisions based upon self-interest which benefits outweigh the possible costs (Stern et al 1993; Dietz et al. 2005). The 'social orientation' (as well as individual orientation) is anthropocentric, but it holds a wider scope of concern encompassing the community and possibly the whole of humanity instead of one's self and family (Stern et al. 1993). The third orientation, 'biocentricism', is based on the concern toward other species and ecosystems, giving them intrinsic value, which is different from the first two that are anthropocentric in orientation (Dietz et al. 2005). It is important to understand that this is a general classification and that there may be more 'varieties' of these value orientations. For example, people with a biocentric orientation may give intrinsic value to some animals, but not to plants and consider human survival as a priority. Alternatively, a person may give intrinsic value to both animals and plants and therefore not consider human survival as a priority (they have an 'ecocentric orientation').

In order to assess individuals' values orientation different research methods have been developed such as questionnaires that use the Schwartz Value Survey (Schwartz and Bilsky 1987). The Schwartz Value Survey asks respondents to rate different statements indicating how important the statements are in their life (e.g., Braithwaite and Law 1985). Survey tools have been created that focus on contrasting materialist (e.g., when a person prioritises economic and physical security) and post-materialist (e.g., focused on "needs of belonging, esteem and self-realisation") values (Inglehart 1977; Dunlap and Mertig 1997). Similarly, surveys have been developed to investigate the 'New Environmental Paradigm' (NEP; Dunlap and van Liere 1978), which is a scale designed to measure different environmental beliefs (Dunlap et al. 2000; Dunlap 2002; Lockwood 1999). Other measurements methods include the regression model developed by Stern et al. (1993) to assess the influence of values on the decision to take action and the measurement by experiments that are based on the discrepancy between the answers given in a survey and the actual behaviour, which has not been applied in environmental studies (Dietz et al. 2005).

It is also important to identify other psychological constructs that differ from the held values concept that also influence individuals' behaviour towards the environment. For example, attitudes are positive or negative evaluations of something that differ from values because they are more specific. Norms are 'ought to' statements that result from values. Preferences are rankings made about possible outcomes of a particular situation; beliefs and worldviews are understandings of the state of the world that can be constructed from empirical or scientific knowledge and concerns, which are the beliefs that something is important and it is at risk (Dietz et al. 2005; Stern 2000).

Because of the influence of held values on individuals' decision-making, it has been stated that it is important to consider them when eliciting societal and assigned values (Lockwood 1999). The Values-Belief-Norm theory (Stern et al. 1999) of environmental behaviour suggests that our (held) values influence our worldview about the environment, which can influence our beliefs about environmental change and therefore our perceptions about our ability to reduce risks on things we value (i.e. societal values). This in turn influences the relative importance of those values (i.e. assigned values) and eventually our norms about our behaviour that can result on political activism, voting preferences, or consumer choices (Dietz et al. 2005) (Figure 1.1).

1.1.1.2 Societal values

Ecosystems (or their components) create goods and services that can be useful and valuable to humans (MEA 2005). Ecosystem goods are generally tangible, material products that result from ecosystem processes like food (meat, fish, vegetables etc.), water, fuels, and timber and can be grouped in two broad categories: renewable and non-renewable (Daily 1997). In contrast, ecosystem services are the specific results of ecosystem processes like water and air purification, natural recycling of waste, soil formation, pollination, and the regulatory mechanisms that nature uses to control climatic conditions and populations of animals, insects and other organisms (Daily 1997). Together, goods and services provide intangible aesthetic and cultural benefits (Daily 1997).

It is thought by some researchers, that Costanza et al. (1997), who reclassified goods and services into the one class of ecosystem services, have obscured the conceptual distinctions between goods and services. The reclassification has the advantage of being a more succinct description, but it tends to "*blur the distinction between the functional nature of ecosystem services and the concrete nature of ecosystem goods*" (Brown et al. 2007). However, Costanza's and colleagues (1997) definitions are the most commonly used in the literature, have been promulgated through usage in the United Nations' Millennium Ecosystem Assessment, and the definitions appear to be more pragmatic when establishing management and conservation actions (MEA 2005; Barbier 2007; Braat and de Groot 2012; WBCSD 2012; IUCN 2014).

Management actions are addressed by identifying and valuing important ecosystem goods and services (MEA 2005). In the case of coastal zone habitats such as sand dunes, mud flats, coral reefs, mangrove forests, seagrass beds and rocky shores, a wide variety of physical and biological processes occur. For example, the constant interchange of nutrients, sediments and water that supports many different organisms. Because of interactions among ecosystem components, benefits that people obtain from ecosystems (ecosystem services) such as protection from storms, waves and flooding can be identified. These might include production of fish and shellfish, enhancement of water quality, recreation, and aesthetic, spiritual, and cultural values (MEA 2005).

Estuarine and coastal ecosystems are subject to intense use by humans and consequently they have been increasingly threatened (Halpern et al. 2008; Hinrichsen 1998). This is known to influence important ecosystem services such as fisheries (33% decline), nursery habitats provided by different wetlands (69% decline), and filtering services delivered by wetlands' vegetation (63% decline) (Barbier et al. 2011). Such alterations focus attention on the need for appropriate management measures (e.g. Agardy et al. 2005; FAO 2007, 2010; Valiela et al. 2001; Worm et al. 2006), and suggest that valuing ecosystem services could be used as a common language to quantify trade-offs, and to help reach consensus among stakeholders with competing interests (Granek et al. 2010).

There has been considerable debate about whether it is possible (or even ethical) (Soulé 1985) to confer monetary value to something that might be priceless (McCauley 2006). Examples of difficult to value components include clean air and water, the beauty of a sunset or the peace that someone could feel just by watching a forest landscape. Despite this potential difficulty, some ecosystem services are priced (e.g., Costanza et al. 1997). Nowadays almost everything has a monetary value, but valuation has struggled to exclude from the market certain things, especially those pertaining to humans. For example, "*we have attempted to take human beings off the market by outlawing slavery or take sex off the market by outlawing prostitution*" (Groom et al. 2006). Therefore, why shouldn't we take natural systems off the market by outlawing environmentally destructive human activities?

It is in this context that societal values include places, attributes, goods and services from nature that people regard as important. These values provide 'material' or 'non-material' benefits that people obtain from the environment (Figure 1.1). Tangible values are defined by their commercial, recreational, tourist, aquaculture and agricultural uses. Intangible values can include nutrient cycling or shoreline protection, aesthetic and intrinsic values, scholarly values embodied in scientific and historical studies, inspirational values that enhance arts development and traditional values that encompass historical, symbolic and spiritual values (e.g., Anthony et al. 2009).

Being that local people are the ones that have to deal with decisions made to protect or manage their environment It is logical to include local people in decision-making as their knowledge and concerns about natural resources in order to achieve long-term conservation goals through local community commitment (Harrison and Burgess 2000). Knowledge about environmental values is not restricted to scientist or economic communities. Considering that also scientific knowledge is considered subjective and dependent on personal background and ideologies (Bojórquez-Tapia et al. 2003; Robbins 2003), there is a real need for a more comprehensive view that can be achieved with economic and societal values (Larson et al. 2013b). This can be epitomised through the inclusion of Traditional Ecological Knowledge (TEK).

For example, indigenous peoples (mainly the sedentary fishing, horticultural and dependant on hunting and gathering ones) have learnt to use and manage their resources in a sustainable way (Gadgil et al. 1993), a fact that was ignored in the first years of conservation efforts and even nowadays the social component of TEK picture is not completely integrated (Brown, G.G. et al. 2004). Despite that traditional knowledge has been recognised as having monitoring potential, including an understanding of vegetation changes due to human intervention, as well as for disaster reduction (Mercer et al. 2007; Stevenson 1996; Verlinden and Dayot 2005), most of the times indigenous knowledge can be difficult to include and reconcile with scientific methods because of its closeness with moral and religious beliefs and values (Gadgil et al. 1993), and its basis on perceptual 'measurements' (Verlinden and Dayot 2005). Furthermore as well as indigenous peoples, other communities have knowledge and values related to their environment and are engaged in forest, fisheries or agricultural exploitation and recreation activities (McIntyre et al. 2008).

While some of these values fit the ecosystem services classifications created by the United Nations' Millennium Ecosystem Assessment (Bryan et al. 2011; Raymond et al. 2009), the MEA has been criticized for combining into one group some of the non-material values that are difficult to value economically (Chan et al. 2012). For example, the MEA (2005) named cultural values and described them as "*the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values*", which include non-use and non-material values. A more recent ecosystems goods and services conceptual framework was developed by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The IPBES model describes these values from a relational point of view that focus on the "*links between people and nature*" (Díaz et al. 2015b) to be inclusive of different stakeholders and their knowledge systems (i.e. *"western science, indigenous, local and practitioners' knowledge*").

1.1.1.3 Assigned values

According to (environmental) ethics and other disciplines there are a number of definitions of value as the worth of a thing (also known as assigned values), but in general they fall into two broad categories: utilitarian (also known as instrumental) and intrinsic. Utilitarian value is based upon an anthropogenic concept, where an item, task, or concept is valued because of its usefulness to people (Carson 2005). Examples of utilitarian values include goods (fuel, food), services (recycling, pollination), information (genetic, pure science) and psycho-spiritual resources (aesthetic, cultural) (Norton 1991; Brown et al. 2007; Chan et al. 2012; Russi et al. 2013). Intrinsic value exists by just being and is not associated with use or usefulness to anyone or anything (Soulé 1985; Rolston 1988). Intrinsic value transcends the need to be useful to people and anthropogenic value systems, which makes it difficult to assess and unlike utilitarian value it does not have different facets (see Table 1.1 and Figure 1.2). Intrinsic value has been attributed to species, ecosystems and biodiversity by various authors (Soulé 1985; Callicott 1986; Rolston 1988; O'Neill 1992; Dietz et al. 2005).

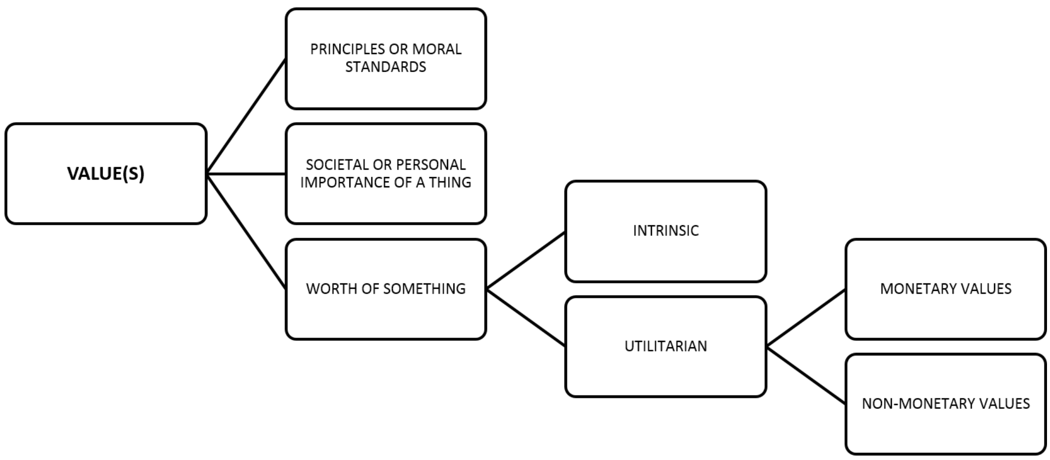


Figure 1.2 Classification of values.

Assigned values differ from held and societal values as they focus on determining a measure of worth relative to other components (Seymour et al. 2010), and can be expressed in economic and non-economic terms (Figures 1.1 and 1.2). Different valuation methods are described in section 1.1.2.

The assigned value granted to places, goods or services, are related to individuals' feelings that interrelates nature and self, enhancing an individual's identity construction (Schultz et al. 2004) (Figure 1.1). Identity is also related to cultural features such as social activities, which when mixed with the natural environment create the ‘sense of place’, ‘place attachment’ and connectedness (Kellert 1993; Lewicka 2011; Larson et al. 2013a). It is believed that the factors that develop strong place connections include time of residence, social connections, community involvement, and ancestry, and may influence an individual’s sense of place as well (Larson et al. 2013a; McIntyre et al. 2008). Exploring the links between values, identity and emotions may help with the understanding of conservation management conflicts (Dietz et al. 2005).

1.1.1.3.1 Intrinsic value?

The utilitarian concept of value is easy to understand because we all use it in our daily lives, but the concept of intrinsic value is infrequently used and has been consistently criticised because it grants incommensurable value (i.e., lacks a common standard) in an anthropocentrically utilitarian context (Justus et al. 2009; Maguire and Justus 2008). Also, some may declare that since all arguments are human constructs (and therefore) constrained by subjectivity, each person’s perspective places a different value on the same item (Daniel 1988). Hence, this argument is used to justify the idea that intrinsic values ”do not” exist without the presence of a rational organism (Daniel 1988). However, as noted by Rolston (2001), nature has self-maintaining non-conscious systems which have both beneficial and/or detrimental facets affecting them (independent of human consciousness). These non-conscious systems are able to “decide or value” between those on the basis of what is better for them, therefore leading to a “valuing organism” even if it is not sentient (Rolston 2001). In this case, the intrinsic value is independent of human perception. Therefore, intrinsic value does not have to be granted by any rational organism (i.e., humans), but recognized maybe as any other characteristic such as colour, size, or weight.

If we, as a society, acknowledge nature’s intrinsic value then it is unlikely that we would agree to trade or substitute it, which creates a more stable argument that justifies conservation goals (Sandler 2012). The advantage of this is that the burden of proof associated with the environmental risk of change or loss (of a species or ecosystem), is placed on the developers rather than the conservationists. In other words, the developers have to prove that their actions are not jeopardising the environment and assume the costs related to this activity or event (Fox 1993; Groom et al. 2006).

The arguments around intrinsic value seem strong, yet intense criticism exists. Proponents of this idea (scientists and environmental ethicists) use it in the hope of providing their viewpoint with an edge that prioritises it over competing claims, which will guarantee conservation (Callicott 1986; Rolston 2001; Spangenberg and Settele 2010). However this rarely occurs. Even human life has been instrumentally valued, such as when setting permissible levels of pesticides in food or life insurance amounts (Maguire and Justus 2008). Furthermore, because intrinsic values are deemed to exist independent of human perspective, it may have limited, or no connection, with conservation stakeholders. Justus et al. (2009) have argued that therefore "*it* [intrinsic value] *cannot have a role in conservation decision making*". Although intrinsic and utilitarian values are not mutually exclusive (Callicott 1986), it is necessary to find a way to reconcile these values in order to achieve conservation goals (Justus et al. 2009). I would argue that currently, both of these concepts are the best available.

This long-running discussion between environmental ethicists has led some to propose that the concept of intrinsic value should be abandoned (Weston 1985) and utilitarian value should be embraced (Sandler 2012). The reasoning behind this is that the ultimate recognition of both intrinsic and instrumental approaches is environment conservation (Norton 1991). As stated by Norton's (1991) 'convergence hypothesis', anthropocentric and non-anthropocentric views would recommend the same environmental policies and behaviours and therefore, environmentalist should adopt a 'weak anthropocentric' position (Steverson 2008). Furthermore, the use of utilitarian value is pushed by views such as the need to provide decision makers with effective tools to prioritise conservation. For example, Maguire and Justus (2008) state that effective comparisons of value can only occur if utilitarian value is used. Sandler (2012) points out that recognizing the intrinsic value of nature does not imply that it cannot be priced or valued in a utilitarian way. Often the utilitarian value of a species is too low and hence it is necessary to appeal to its intrinsic value for conservation purposes (Sandler 2012).

1.1.1.3.2 Utilitarian values

Thus, nature can be valued intrinsically and/or instrumentally depending on the approach we choose, and that those values are given according to our values (moral standards and/or societal importance of things). Recently, many studies have focused on assigning (utilitarian) value to nature using an ecosystem services framework (Ansink et al. 2008; Camacho-Valdez et al. 2013; Costanza et al. 1997; Liu et al. 2010; Costanza et al. 2014). This framework is used to appeal to public policy and enhance nature conservation (MEA 2005; Spangenberg and Settele 2010).

In general, utilitarian values are divided into use and non-use values, which are often defined under a Total Economic Valuation (TEV) conceptual framework. The former are the values given to goods and services used by humans such as food, water, fuel, recreation, flood control, shoreline stabilization, groundwater recharge (e.g., Kumar and Kumar 2008). Non-use values are attached to goods, even if humans never have and/or never will use that good. Therefore, goods can maintain an option value, which means that they may be used in the future (Beltratti et al. 1992). A quasi-option value can also be obtained. A quasi-option is the value of information that would improve decision-making about the use of a good in the future (Beltratti et al. 1992; Weikard 2005) (Figure 1.3).

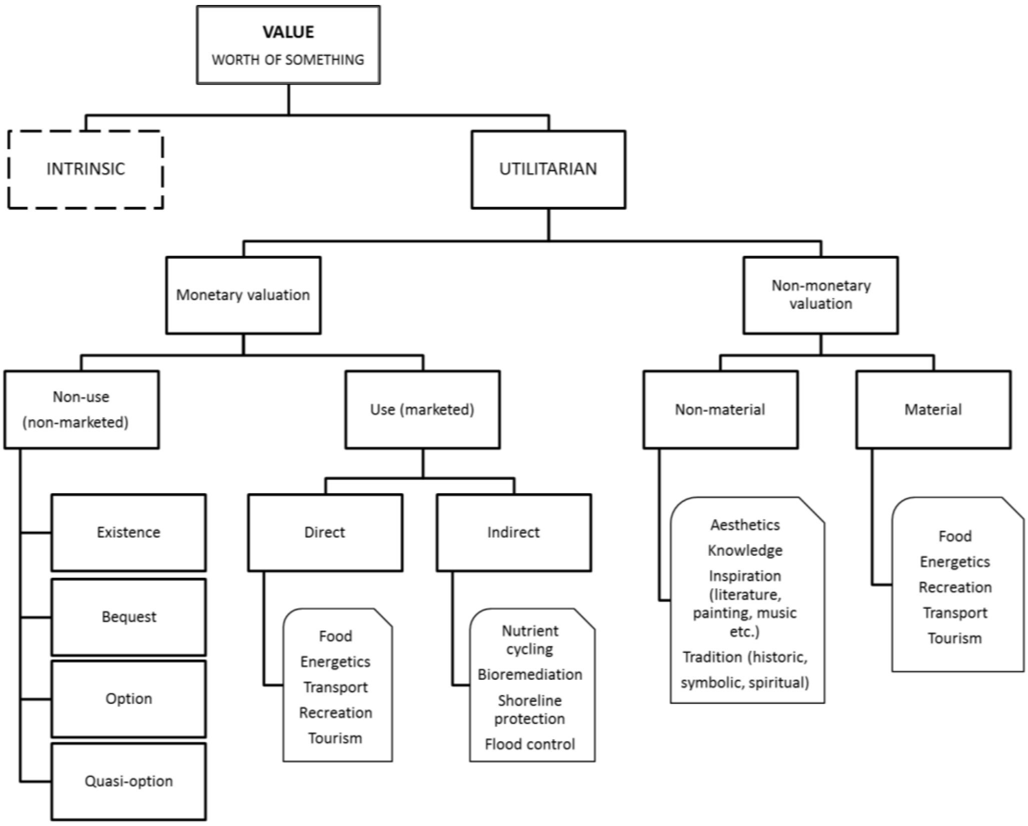


Figure 1.3 Classification and examples of utilitarian values, following a TEV conceptual framework.

1.1.2 Valuation approaches

Due to the broad variety of societal values related to the environment that the development of methods aiming to approach their valuation from different viewpoints has been encouraged. But although economic and non-economic methods exist, due to the adoption of the ecosystem services concept as an integrative approach of ecosystem values into decision making, an overwhelming effort has been focused on economic valuations (Dietz et al. 2005; Martín-López et al. 2014).

Even though the ecosystem services concept has successfully contributed to policy development (e.g. research funding for ecosystem services testing in the United States and research agenda around ecosystem services in the European Union) (Waage et al. 2011), "*it may have simultaneously closed the door to other social perspectives more representative to human behaviour and the less tangible social and ethical concerns*" (Chan et al. 2012). This is of special concern considering that throughout nature conservation history the view of environmental management has changed from the model based on the idea of 'wilderness as a place without people' (where not only human development has been stopped but also native peoples have been pushed off their land) to a more socially inclusive model where there is an urgent need for participatory management (Jepson and Canney 2001; Verschuuren 2006).

1.1.2.1 Economic valuation

Some environmental ethicists insist that economic measurements are *"unacceptably anthropocentric based on the utilitarian theory"* (Norton 2012) because it implies that all nature values can be framed in human welfare terms. However, recognising nature systems' intrinsic value does not necessarily mean they cannot be priced. The strength of valuing services and goods is that when they are given a price, they can be easily compared and those who support the instrumental approach manifest that economic valuation is a way of organizing information to help guide decisions by quantifying trade-offs and reach consensus among stakeholders (Granek et al. 2010; Chan et al. 2011; Farley 2012).

As touched upon in the above sub-sections, the economic concept of value has its roots on utilitarianism where the economic value expresses the degree of satisfaction of individual preferences, in this case regarding goods and services. Preferences are built upon personal welfare vision, to which use and non-use values contribute. The sum of these is expressed as the TEV (Table 2 and Figure 1.3) that can only be assessed by the stated preference methods, because those have the capacity to assess both use and non-use values, while revealed preference methods can only evaluate use values (Christie et al. 2008).

In the economic model, the standard value of a good is reflected by its price, which is established as a result of exchange between people within a market (Spangenberg and Settele 2010). Also, to be considered a marketed good, its direct use by consuming it or physically interacting with it is necessary to be valued. In this case ecosystem goods and services are easily quantified though the market price proxies and production function methods (Carson 2005; EFTEC 2006). These methods are based on direct observed prices related to the provision of a good or service and from them it is possible to assess hypothetical expenditures such as replacement costs (e.g. costs of replacing an environment service that provide the same functions) or costs of prevention behaviour (i.e. associated to mitigation actions), thus resulting in ecosystem pricing (Christie et al. 2008). For example, schemes like Payment for Ecosystem Services (PES; economic incentives to land owners to encourage conservation) were developed to include some services in the market (Spangenberg and Settele 2010).

The former goods and services are classified as use values, but as discussed already some services are intangible. Therefore these are called indirect use values, which are the utilities obtained from a good without physically using it. As explained above, to be a market good it is necessary to be able to interact physically with it and since these do not have this characteristic, they are considered as non-market goods (Carson 2005). Non-market goods do not have a *"real or hypothetical market price"* (Spangenberg and Settele 2010); in these cases economists calculate their price from revealed or stated preferences. The first one is estimated toward some marketed good connected to a non-marketed good. For example the value of all ecosystem services that contribute to recreation in a specific area can be estimated by the travel cost or the random utility methods, which consider all the expenses carried by tourists to specific areas (e.g., Adamowicz et al. 1997; Kelly et al. 2007). In these cases it is important to know that use and non-use values are embedded in it because visitors can hold non-use values (Figure 1.3) (EFTEC 2006).

On the other hand, stated preferences methods are only applied when non-marketed goods are to be valued. In these cases, contingent valuation and choice modelling methods are chosen. These approaches use surveys where respondents are asked to state their preferences about specific goods or services as their willingness to pay (WTP) or their willingness to accept (WTA) costs and compensations. The first one is asked when the consumer does not use or have a good and wants to acquire it and the second one is asked when the consumer is asked to give up a good (see Table 1.2; Carson 2005; Subade 2005).

Table 1.2 Valuation methods used for ecosystem services and goods adapted from EFTEC (2006).

Goods and services valued in:	Valuation method	Affected population captured	Value basis	Measure	Ecosystem services (ES)	Hypothetical costs
market	Market Price Proxies	users	use values	direct observed prices	• Marketed products from: agriculture, forestry, fisheries, genetic information. • Estimated avoided damage from: flooding, coastal erosion. • Marketed substitutes (water treatment). • Tangible impacts (illness)	opportunity costs alternative provision mitigation costs costs of prevention behaviour shadow costs
	Production function	users	use values			
non-market (hypothetical market)	**Revealed preference**					
	Hedonic pricing	users	use values	direct observed prices	• Landscape, air quality, peace and quiet: ES that provide these	
	Travel cost	users	use values (non-use)		• Recreation: all ES that contribute to recreation opportunities	
	Random utility	users	use values (non-use)		• Recreation: all ES that contribute to recreation opportunities	
	Stated preference					
	Contingent valuation	users/non-users	use/non-use	WTP/WTA	• All ES	
	Choice modelling	users/non-users	use/non-use	WTP/WTA	• All ES	

As many ecosystem services are not marketed, the contingent valuation method has been used most frequently because of its ability to estimate the Total Economic Value. This method is based on the assignment of costs to goods and services by survey respondents. It is generally used by agencies and researchers to estimate the value of non-marketed goods and services such as good quality air and water, outdoor recreation or protection of natural areas (Brouwer et al. 1999; Carson 2005; Kotchen and Reiling 2000).

From an economic viewpoint, ecosystem goods and services can often be monetised by funding agents as governments and stakeholders can best understand the concept of value if it is placed in monetary terms. Although these valuations are an improvement in terms of conservation goals, they are not perfect because individuals are seen merely as consumers 'neglecting their role as citizens' of environmental stewards, it neglects the multidimensional attributes of ecosystems (their emergent properties) and reduces their services to tradable assets (Sandler 2012; Spangenberg and Settele 2010).

1.1.2.2 Non-economic valuation

Although economic methods are widely used, ecosystem services can be also valued within a non-monetary framework. In this case, valuation methods are quantitative and qualitative. Qualitative methods concentrate on eliciting preferences and values from people about the environment (societal importance or moral standards) through different kind of surveys and interviews (Christie et al. 2008). The quantitative methods focus on ranking expected environmental benefits and sometimes on weighting different scenarios, which have the advantage of providing a broader view of trade-offs to help prioritize investment sectors (OECD 2011).

1.1.2.2.1 Qualitative non-economic valuation

The purpose of non-economic valuation is to scope a broader set of indicators that with economic valuation can be disregarded. For example, although contingent valuation considers use and non-use values and people's choices, it does not identify the reasons (or values –moral standards-) why respondents formulate their valuation. Also, people seem to find it easier to express their preferences (in terms of value as the worth of something) when they have a set of attributes to be ranked (Clark et al. 2000; OECD 2011).

In order to incorporate both kinds of values, social scientists have developed several methodologies to elicit this data, aiming to incorporate it into management actions (Anthony et al. 2009). These techniques range from consultative methods (e.g. questionnaires and in-depth interviews) to participatory and deliberative methods (e.g. focus groups and Delphi surveys) (Christie et al. 2008).

Questionnaires or surveys are one of the most common methods used to obtain people's feelings, attitudes, knowledge or opinions (e.g., de la Torre 2002; Satterfield 2001). By using open ended or closed ended questions it is possible to elicit quantitative and qualitative information. Unlike questionnaires, in-depth interviews are classified as a qualitative method because they place emphasis on the interviewee's perspective rather than the researcher's concerns (Bryman 2012; Christie et al. 2008).

It is known that interviews in groups elicit values exposure better than face-to-face surveys, which may only obtain preferences because they ask for fast rather than exhaustive answers (Bryman 2012; Satterfield 2002). Also, in groups there is space to confront and develop ideas in depth (Spangenberg and Settele 2010). Different participatory methods may achieve this goal, like the focus group where the aim is to find out the position of the participants regarding a specific issue. In those cases they also may be asked to choose or rank different scenarios (Biénabe and Hearne 2006; Christie et al. 2008).

In a different way, the citizen's jury method (Blamey et al. 2000) obtains the opinion of a 'jury' of 12-24 people to whom information about a single issue is presented by experts and stakeholders. In this case the aim is to acquire societal rather than individual values and address 'citizen value versus consumer value' statements (Blamey et al. 2000; Kenyon et al. 2001). In some cases this method has been used to make recommendations on different environmental projects (Aldred and Jacobs 2000; Kenyon et al. 2001).

A different method gathers groups of experts to condense their information and knowledge of a particular subject in a procedure called the Delphi approach. This method is characterized for being an iterative process that seeks consensus and is used to predict outcomes of situations where information is limited. Because of its repetitious nature it is thought to capture experts' values (Christie et al. 2008; Gokhale 2001; MacMillan and Marshall 2006). Modified Delphi approaches may use forego group consensus in a group interview style process (e.g. Campbell and Hewitt 2013). A further method that has been used within a specific scope is the health based valuation (Freeman 2006). Although it is mainly employed in the medical sciences to relate quality and length of human life, it is thought that it can also be used to determine how people value health benefits derived from the environment (Christie et al. 2008).

Finally, the Q-methodology (McKeown and Thomas 1988) seeks to understand how people think and feel about environmental problems and solutions by classifying their preferences and beliefs. It consists of four main steps where primary statements are obtained from personal interviews, a set of these are later chosen and ranked in other interviews and the obtained data is analysed using factor analysis (Christie et al. 2008). This methodology has proved to identify key values and concerns, which could be useful for solution of conflicts and policy development by assessing stakeholder views about the environment (Ellis et al. 2007; Visser et al. 2007; Cairns et al. 2014).

1.1.2.2.2 Quantitative non-economic valuation

Understanding that ecosystems are multi-attribute has led to a different kind of valuation, where a 'relative' (non-monetary) value is given instead of the traditional 'absolute' (monetary) value (OECD 2011). These values intend to integrate the different services by developing indicators that can be used to compare conservation alternatives or environmental impacts. Some of these approaches are based on physical and biological characteristics rated by 'professional judgment' (Novitzki et al. 1999) and some others rely on public surveys to build indices or weight different scenarios (Ahlroth et al. 2011).

For instance, the Wetland Evaluation Technique (WET) (Novitzki et al. 1999) and the Hydrogeomorphic Approach (HGA) (Brinson 1993) were developed to consider ecosystem function values such as ground-water recharge, sediment stabilization, aquatic diversity, recreation and bequest among others. In these cases, values are determined by the assessment of the function performance through a functional capacity index. Both techniques evaluate ecosystem function(s) in terms of effectiveness, social significance and habitat suitability assigning a probability rating of ‘high’, ‘moderate’ and ‘low’, which is an estimate of the likelihood that a wetland will perform a function on the basis of its characteristics. The HGA is based on the WET but it compares characteristics of specific wetlands with a group of regional wetlands (Brinson 1993; Novitzki et al. 1999; Smith et al. 1995). Another example is the Accounting for Nature model (Cosier and McDonald 2010) which uses a common unit of account for environmental assets and indicators of ecosystem health. In order to get the final value, several indicators must be integrated as well as reference condition benchmarks. Although results of this technique have not been published, the methodology has been developed and some of its components already used to assess factors influencing the current and projected future of environmental, economic and social values (Cosier and McDonald 2010; Great Barrier Reef Marine Park 2009).

Alternatively, some other indicators have been developed to elicit stakeholders’ opinions and knowledge to promote the combination of social and biophysical information for environment management. The data obtained is ‘quantified’ in different indexes and used to build spatial maps (Reed and Brown 2003; Sherrouse et al. 2011), to establish people’s opinions about specific ecosystem services (Cole 2010; Hajkowicz 2006; Larson 2009; Larson et al. 2013b) or to build a multi-criteria valuation from weighting different development scenarios (Turner 2013). Although the last ones are the most commonly used in practical situations there is a need of several and consistent ‘weighting/valuation sets’ in order to reflect the values that people and stakeholders have (Ahlroth et al. 2011).

1.1.3 Value mapping

A wide spectrum of Geographical Information Systems (GIS) methodologies have been developed for valuing and assessing ecosystem goods and services to better understand and address environmental management (Bagstad et al. 2013b). These methods are based on utilitarian approaches ranging from monetary to qualitative and quantitative non-monetary assessments. Due to the increasing ease of GIS and public availability of spatial data, a set of GIS frameworks are now commonly used to identify, characterise, quantify and value ecosystem goods and services (Troy and Wilson 2006).

In general, GIS tools have been applied to:

a. identify ecosystem services from local to regional scales (e.g, Egoh et al. 2008; Jiang et al. 2013);
b. create spatially explicit ecosystem services' economic value maps (e.g., Schägner et al. 2013; Troy and Wilson 2006);
c. include individuals' perceptions and valuation of specific geographic areas (e.g., Brown 2005; Klain and Chan 2012; Kobryn et al. 2017); and
d. evaluate potential conflicts by assessing individual's perceptions and existent spatial planning (e.g. Brown 2006; Moore et al. 2017).

1.1.3.1 Ecosystem services' mapping

There are two predominant methods of identifying and mapping ecosystems services in a spatial context:

- Use of historical (e.g. Borden et al. 1974; Tomlinson et al. 2011) and recent (e.g. Tomlinson et al. 2011) land cover, land use, and biodiversity distribution and hotspots' identification. This is done to determine areas that supply specific ecosystem services that could include carbon storage, flood control, agricultural production, and recreation (e.g., Chan et al. 2006; Egoh et al. 2008; Jiang et al. 2013; Pan et al. 2013; Roces-Díaz et al. 2014; Timilsina et al. 2013); or
- Identifying unrepresented species that may need to be included in new or existing management, or protected areas (Scott et al. 1993; Scott and Jennings 1998).

The scarcity of data is a major limiting factor to obtaining accurate spatial maps. This has led to the use of land cover and hotspot maps as primary data inputs, but it has been argued that these provide a poor fit for the analyses of ecosystem services (Eigenbrod et al. 2010; Naidoo et al. 2008).

The economic value of ecosystem services and goods is determined by considering supply and demand. Supply is "*largely determined by ecological processes and characteristics (e.g., functioning, fragmentation, productivity, resilience or climate) that may be influenced by human activities*" (Schägner et al. 2013). Demand is shaped by humans' needs and preferences, which is modelled by economists. Supply and demand have spatial characteristics and hence GIS models have been developed to represent changes in ecosystem services over spatial scales. These models are used to calculate economic value and change both spatially and temporally (Table 1.3) (e.g., Bagstad et al. 2013b).

Table 1.3 Characteristics and limitations of Geographical Information Systems used to identify, assess, model and value ecosystem services (ES) and societal values (SV). * Examples from Bagstad et al. (2013b).

Approach	**Methods used**	**Type of valuation**	**Advantages**	**Limitations**		**Examples* of developed tools**	
				Data	**Scale**	**Economic valuation: ES**	**Non-economic valuation: ES and SV**
Ecosystem services identification	Create layers to describe ecosystem services from existing or just created detailed spatial biogeophysical information. Information is obtained through field work or satellite image processing -Employment of multidisciplinary teams -Does not need stakeholder participation	1. Monetary valuation through the value transfer method: -Data must have similar regional characteristics, population and scarcity background 2. Non-monetary valuation: -Describes trade-offs between services -Calculates credits	Maximise biodiversity conservation by identifying critical areas that deliver important ecosystem services	1. Lack of detailed bio-geophysical spatial information 2. Lack of data related to specific ecosystem services: -Rate of service production -Flow of service -Presence of beneficiaries -Economic value -Probability of land use conversion -Temporal dynamics to account for changes in biodiversity and its impacts on ecosystem functions	Large scale assessments may: -Fail to consider small scale services (e.g. crop pollination) -Obscure local management, ecological, and human contexts -Increase heterogeneity within cover classes	InVEST, ARIES, MIMES, EcoServ, Co$ting Nature, Envision, EPM, InFOREST, EcoAIM, ESvalue, NAIS, Ecosystem Valuation Toolkit, Benefit Transfer & Use Estimation Model Toolkit	LUCI (illustrates tradeoffs between services), EcoMetrix (designed as a credit calculator)

Table 1.3 Continuation

Approach	Methods used	Type of valuation	Advantages	Limitations		Examples* of developed tools	
				Data	Scale	Economic valuation: ES	Non-economic valuation: ES and SV
Community values identification	Develop layers to describe social values from data obtained through interviews and surveys -Employment of multidisciplinary teams -Needs stakeholders participation	Non-monetary valuation: -Ranking of different social values or ecosystem services	More effective and efficient conservation actions by identifying important areas representing social values and community involvement on management actions	1. Lack of detailed bio-geophysical spatial information 2. High cost of time for data collection	Large scale assessments may: -Fail to consider small scale social values -Obscure local management, ecological, and human contexts -Increase heterogeneity within cover classes		-EcoAIM, ESValue, SolVES -Public Participation Geographic Information Systems

These approaches use land use and land cover as a proxy to assess supply of ecosystem services and their scale of assessment range from global (Costanza et al. 1997; Sutton and Costanza 2002) to regional, basin (Guo et al. 2000; Troy and Wilson 2006), or administrative regions (Chen and Wang 2009; Estoque and Murayama 2013; Grêt-Regamey et al. 2008). Schägner et al. (2013) evaluated 69 publications that use different GIS tools that map ecosystem services valuations against one to 17 ecosystem services and demonstrated that there are five commonly analysed services: recreation, carbon sequestration, water regulation, agriculture and biodiversity.

Schägner et al. (2013) also found that a large proportion (84%) of the evaluated studies used value transfer methodology (where pre-existing data of the value for a specific ecosystem service is used) for at least one ecosystem service to undertake monetary valuation (Schägner et al. 2013). In contrast, 42% of the evaluated studies used primary valuation (Schägner et al. 2013). Thus, there is a potential extrapolation of inappropriate data (secondary valuations) to current studies. These approaches have achieved a lot however, it is important to keep developing more accurate, precise and comprehensive ecosystem service measurements, and reporting practices for ecological socio-cultural and economic values "*to ensure comparability and transferability*" (de Groot et al. 2010). It is also important to incorporate policy scenario analysis to ensure the inclusion of ecosystem services and societal values in policy development recommendations (de Groot et al. 2010; Schägner et al. 2013).

To date, operationalising the ecosystem services approach into real management actions has eluded scientists and managers. This mechanism is still a "new" strategy and as such faces challenges like closing the gap between the governance needs and the ecosystem service paradigm, or the lack of local data (Primmer and Furman 2012).

1.1.3.2 Societal values' mapping

Societal values' mapping focusses on representing personal or community values spatially (e.g. Novaczek et al. 2011; Reed and Brown 2003; Ramírez-Gómez et al. 2015). The purpose of this approach is to understand the relationship between people and their environment, expressed in economic and non-economic values

(Brown and Reed 2012; Klain and Chan 2012). The final GIS maps provide visual identification of type, number and importance (or ranking) of the different identified values that participants have assigned to places within a defined geographical area (Table 1.4).

One of the most commonly used methods is Public Participation Geographic Information Systems (PPGIS). In this method individuals or groups are asked to: 1) mark on a map societal values (i.e. important places), and 2) assign to that value or place a non-monetary value (e.g. Alessa et al. 2008; Brown 2005, 2006; Reed and Brown 2003). Later, this data is used as input into the GIS to produce value maps (e.g. Brown and Reed 2012; Klain and Chan 2012).

PPGIS studies tend to focus on environmental conservation issues, applying the valuation outcomes across diverse matters such as climate change impacts, tourism development on national forests, marine and terrestrial protected areas management, and fisheries (e.g., Reed and Brown 2003; Tyrvainen et al 2007; Zhu et al. 2010; Ruiz-Frau et al. 2011; van Riper et al. 2012;). In these cases, the spatial maps are created to compare the identified societal values against ecological values or ecosystem services to identify "*socio-ecological hotspots*", or aid in identifying management preferences or enhancing spatial conservation priorities (e.g., Brown, G. G. et al. 2004; Raymond and Brown 2006; Alessa et al. 2008; Bryan et al. 2011; Brown et al 2016; Strickland-Munro et al 2016).

To better understand the tools being used within community values' mapping, I undertook a systematic literature review of 52 articles published from 2000 to 2015 (Scopus) using non-economic valuation (Figure 1.4, Appendix A). From this review, it is evident that the application of this methodology is still under development. An ample variety of research objectives and methodologies exist that can be used to obtain maps representing the views of communities and their environment (Figure 1.4, Appendix A). The methodology for the literature review and the table with specific results are in Appendix A.

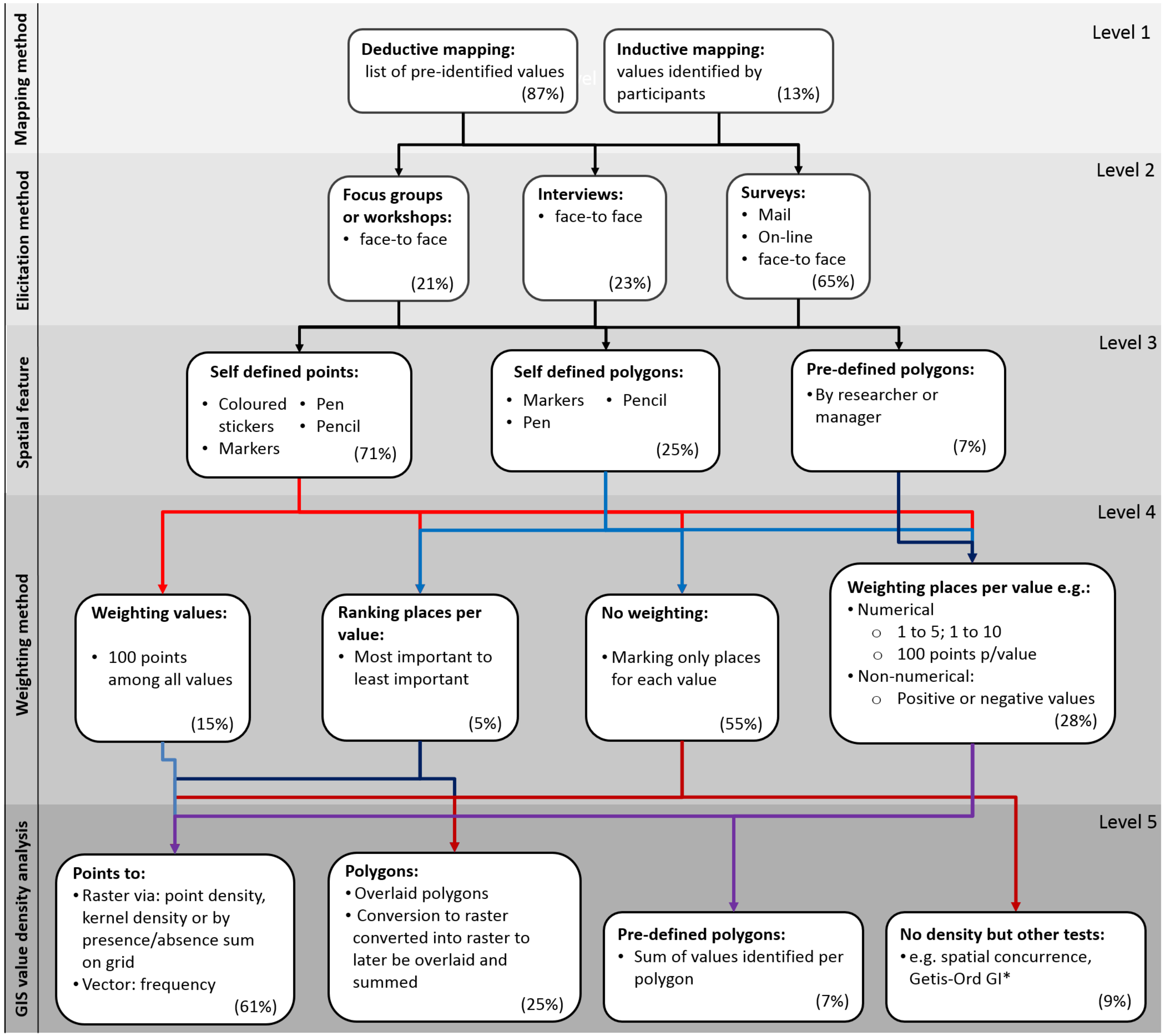


Figure 1.4 Overview of methods used to capture and represent societal values in a spatially explicit manner. Each level provides options of different methods that can be selected. Within the top three levels any pathway could be followed (black connectors). After level 3, not any pathway could be followed, therefore coloured connectors were used to make clear which pathways were followed. The proportion of studies using each option is in parentheses. Data is derived from Appendix A.

Figure 1.4 summarises the outcomes of the systematic review by illustrating the series of considerations and options that each study can select in order to elicit and map societal values. A given study could follow any path between levels 1-3, with levels 4 and 5 requiring the selection of a specific path (highlighted by a coloured connector). In level 1 and 3 the studies chose only one of the options, whereas in levels 2, 4 and 5 the studies chose one or two different options to develop their methodology to achieve its research objectives.

The review demonstrates that:

- most (87%) of these studies have chosen to use a list of pre-determined values to be mapped. The identification of values by the participants is a less commonly used method and it implemented via interviews or workshops (level 1).
- Based upon frequency of published papers, it would appear that the most common elicitation method is via mail surveys (65%), because researchers note that this method has good response rates and it relies on random sampling of a population, if implemented correctly (e.g., Karimi et al. 2015). Interviews, focus groups and workshops have also been used to elicit values that are then mapped (e.g., Strickland-Munro et al. 2016), to obtain in-depth information about the area and its benefits to local people (e.g. Klain and Chan 2012), or to elicit indigenous peoples' values in an inclusive manner (e.g., Ramírez-Gómez et al. 2015). Of note, was that although GIS tools have become more accessible via the internet, the systematic review highlights that online surveys are not used as often as other elicitation methods. This could be due to the online surveys introducing potential bias associated with targeting people with personal computer, or mobile device(s) access, and technology skills. Online surveys also inadvertently targets people with reliable internet access, which can be restricted in numerous countries or rural regions in terms of speed and coverage (Pocewicz et al. 2010; Norris and Inglehart 2013; Pearce and Rice 2013) (level 2).
- Some of the reviewed studies did not identify the elicited societal values and their importance spatially (e.g. Brown and Reed 2000), however most

(71%) of the studies selected points as the spatial feature used to identify values on a map (typically using coloured stickers or markers) (e.g. Ruiz-Frau et al. 2011; Whitehead et al. 2014). The least common method to identify spatial features was the use of polygons and pre-defined polygons. Use of polygons appears less favoured because points offer a visual advantage that provide more conservative results (Brown and Pullar 2012) (level 3).

- The next step in the PPGIS style approach is to ask respondents to assign a value to the societal values that they have mapped. At this point it in the approach, 55% of the studies analysed did not undertake this step (Figure 1.4; Appendix A). From the studies that did take this step, 28% ask respondents to weight each place marked on the map (which corresponds to one value) by assigning a numerical (e.g., by distributing 100 points among all places) or non-numerical weight (i.e., positive or negative). Alternatively, respondents weight or rank societal values without consideration of the geographical places for each value (level 4).
- The elicited spatial data is then used to create a density map of the values. This spatial analysis would depend mostly on the spatial feature chosen and also on the research aims (Figure 1.4; Appendix A). some studies did not produced density maps, but performed other type of spatial analysis (level 5).

Studies typically occur at a regional scale (Brown, G. G. et al. 2004; Brown 2006; Casalegno et al. 2013; Sherrouse et al. 2011), although there are some focussed at a smaller scale such as a basin (Bryan et al. 2011; Raymond et al. 2009) or at management unit scales (McIntyre et al. 2008; Tyrväinen et al. 2007). Almost half of the studies (48%) focus on terrestrial ecosystems while the remainder focus on a combination of terrestrial, coastal and marine ecosystems. These studies usually (73%) cover a mix of protected and non-protected spaces (Appendix A). For most of these tools, scale is of special importance because respondents are asked to pinpoint areas of personal interest that can be over or underestimated because of the size, scale and resolution of the map they are provided (Novaczek et al. 2011).

The review demonstrates discrepancies that exist among and across the terminology used when discussing and defining societal values’. More than half of the studies (60%) use the ‘landscape values’ typology first described by Brown and Reed (2000). Other projects refer to ‘ecosystem values’ (e.g. Lechner et al. 2015), ‘landscape services’ (Fagerholm et al. 2012), ‘ecosystem services’ (e.g. Ruiz-Frau et al. 2011), or simply ‘special places’ (McIntyre et al. 2008). Furthermore, in addition to the societal values some studies elicited possible threats, disservices (e.g., unpleasantness or noisiness), or negative values (Klain and Chan 2012; Tyrväinen et al. 2007; Raymond et al 2009; Plieninget et al. 2013) (Appendix A).

Despite that the PPGIS method has been widely assessed and improved upon through time, it has not been extensively used by the public sector because there appears to be a lack of encouragement to adopt innovation, lack of funds or reluctance to assess their own performance (Brown 2012b; Brown and Kyttä 2014). All these methods have positive characteristics such as the involvement of social and natural disciplines, but other aspects could be included. For example, it is important to assess spatial changes on ecosystem services and therefore the changes in their economic and perceived social values. This could be achieved by the assessment of different spatial and policies scenarios (e.g., Ambrose-Oji and Pagella 2012; Brown 2012b; de Groot et al. 2010) (Table 1.3).

While impacts in the coastal zone are the result of different inputs involving natural, social and political circumstances, conservation and management actions are one of the few ways ecosystem functioning can be maintained for future generations. In order to achieve this goal, it is important to consider local social values because these can lead to the community engagement on conservation actions (e.g., Black and Liljebald 2006; Ramirez- Gomez et al. 2015). Along with this, the use of spatial tools may help improve the visualization of these values, which could help to prioritize sites for conservation, or special management, by local governments or communities. With this in mind, this PhD will develop a method of mapping values that do not rely on hotspot mapping, but instead provides individual layers for different values (e.g., social) and their associated subcomponents (e.g., swimming).

1.2 Research aims and objectives

Maximising biodiversity conservation through management strategies is a clear need in all countries. Through the spatial assessment of societal values, this research project will address some of the critical gaps that have been identified by previous researchers (Brown and Raymond 2007; Chan and Ruckelshaus 2010; Kumar and Kumar 2008), specifically the identification and non-economic valuation of non-material values. The value mapping approach that is developed is taken one-step further by incorporating a risk mapping capability. The risk-mapping component of this approach will define spatial areas of potential concern explained and be explored through the use of a hazard scenario.

Previous approaches to value mapping have focussed on monetary valuation and creating biodiversity hotspots, but as Kareiva and Marvier (2007) have stated, 'cold spots' can be just as important as hotspots. Thus, the approach I present in this thesis will go beyond economic valuation when mapping values to include different categories of values (environmental, economic, social and cultural) to create a holistic GIS value mapping tool. Qualitative and quantitative data is used to develop different hazard scenarios to test how values mapped can be used to assess risk. The resulting outcomes provide a management approach to quantify and characterize diverse marine ecosystem values. This provides a more holistic picture of the extent to which the marine environment benefits people and will also rapidly define areas that are potentially at risk when faced with specific hazards, such as an oil spill or incursion of an introduced pest. No such tool exists that maps values and assesses hazards to create risk maps. Hence, this project is innovative and add new knowledge to the field on environmental management and conservation.

This thesis aims to create and apply a framework that consistently identifies, maps and can be used to assess the perceived environmental, economic, social and cultural values of a place. The utility of such a tool is then furthered by using a hazard scenario to create risk maps. As a proof of concept for this framework, the coastal and marine area of the Gladstone Region (central Queensland, Australia) was chosen as the case study region. The Gladstone Region is characterized by its intensive industrial and resource exploitation activities that occur within the Great Barrier Reef World Heritage Area (GBRMPA 2014b). Two main research aims are examined in the thesis:

1. To identify and map perceived environmental, economic, social and cultural values for the Gladstone Region in a spatially explicit fashion; and
2. To demonstrate the utility of the identified perceived values by using hazard scenarios to identify and create risk maps.

Accordingly, five research objectives are investigated and summarised on a chapter basis as follows:

1. Use a triangulation method (based upon literature searches, interviews, and surveys; Figure 1.5, Step 1) to identify qualitative information. This information is analysed to identify stakeholder groups perceived environmental, economic, social and cultural values in the coastal and marine zone of the Gladstone Region (Chapter 2);
2. Analyse the relationships between variables that may influence perceptions identified in Chapter 2. Specifically, the influence of respondents' age, gender, education level, residence time, place of residence and place of birth are examined against a values perceived level of importance (Chapter 3);
3. Determine a preferred approach to collecting perceived values by undertaking statistical comparisons of the data (Chapter 4). The foundation of this chapter is the data collected in Chapter 3;
4. Using GIS, generate robust "spatial value maps" from quantitative data collected via surveys (Chapter 5); and
5. Generate a spatially weighted risk model that enables the rapid assessment of risks posed to values when exposed to different natural and anthropogenic hazards (Chapter 6).

Figure 1.5 summarises the framework that was developed and tested in this thesis. The thesis uses a mixed-methods approach, collecting both qualitative and quantitative data and analysing the data in a statistically robust manner. As defined in Figure 1.5, step 1 identifies the societal values for the chosen area via the design, implementation and analysis of a series of in-depth interviews with representatives of relevant stakeholder groups in the target Region (Steps 1a to 1c; Chapter 2).

Once values are identified, four different surveys were constructed and implemented. Each survey focused on spatially identifying either cultural, economic, environmental, or social values and their perceived importance (i.e. non-economic value) in the target Region. Additionally, the respondent's opinion about different types of development, their perception about the Region's environmental health and their socio-demographic data is elicited. The data from the surveys is analysed in two stages: i) the relationship between respondents' demographics and the importance assigned to the values is explored (Steps 2d and 2e; Chapter 3 and 4); ii) the societal values' spatial distribution and correlation is explored (Step 2f; Chapter 5). The final step of the approach develops a spatially weighted risk model by using a hazard scenario to test a risk assessment of the identified and mapped values. The outcome of the scenario testing is the creation of spatially explicit weighted risks for the identified value's based on a respondent's perceived importance of a value (Step 3; Chapter 6). This process ensures that multiple values are assessed in a consistent and transparent manner.

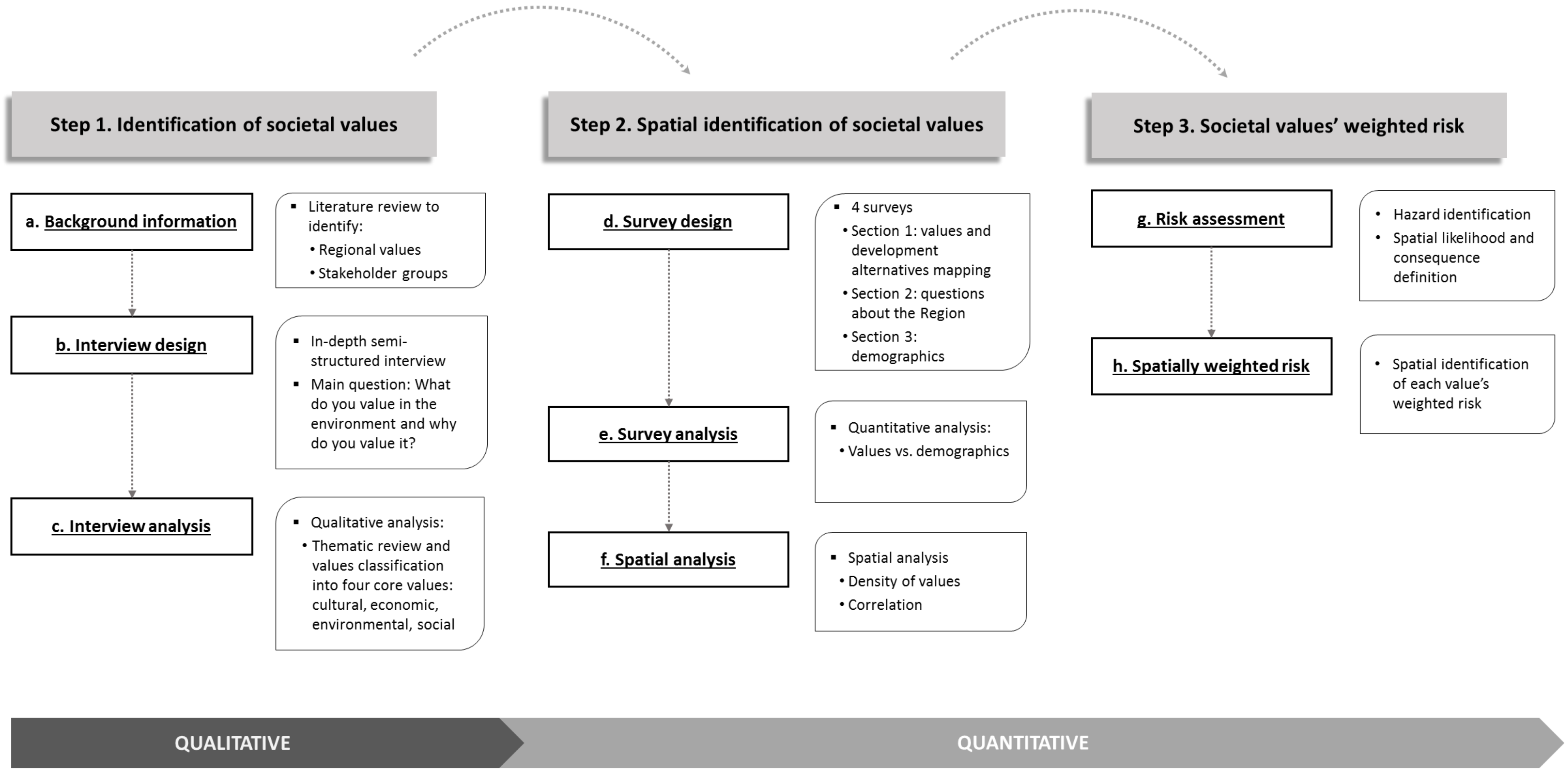


Figure 1.5 Framework followed to identify and assess societal values.

1.3 Case study site: Gladstone Region, central Queensland

The framework and approach that was developed was assessed in a case site – the Gladstone Region. To avoid duplication of information across the research chapters that follow a synopsis of the Gladstone Region is provided here.

Gladstone is a port industrial city located in the Gladstone Region, in central Queensland, Australia (Figure 1.6). It is approximately 550 km north of the Brisbane Central Business District (CBD) and lies next to the southern end of the Great Barrier Reef World Heritage Area (GBRWHA). The estimated population in the Gladstone Region is 60,000 people, with an average annual growth of 3.2%, compared with 2.6% for the State of Queensland. Of these people, approximately 32,000 live in the Gladstone metropolitan area, next to the port of Gladstone (GRC 2012).

The proportion of the population identified as Aboriginal and Torres Strait Islander was 3.5% in 2012 (GRC 2012). In comparison, the proportion of Aboriginal and Torres Strait Islander in Queensland was 3.6% and in the country was 2.5% (ABS 2012). A further 12.3% of the population are immigrants, with 4.2% of the population from countries where English is not the first language and 8.1% from English speaking countries (GRC 2012). Another important characteristic of the Region is that this is a work oriented community where unemployment is only 4.5% (GRC 2012). Among the working sector, the fly-in, fly-out (FIFO) workers are an important group, but by 2011 only represented ~7% of the population (Campbell et al. 2014), and by 2016 their population dropped to 2.2% (QGSO 2016a). This was due to the completion of capital works in the port region are completed (Hughes 2014). The main employment sectors are manufacturing (17%), construction (13.8%), and retail trade (9.5%), with individual income levels higher than that of other areas in Australia (GRC 2012).

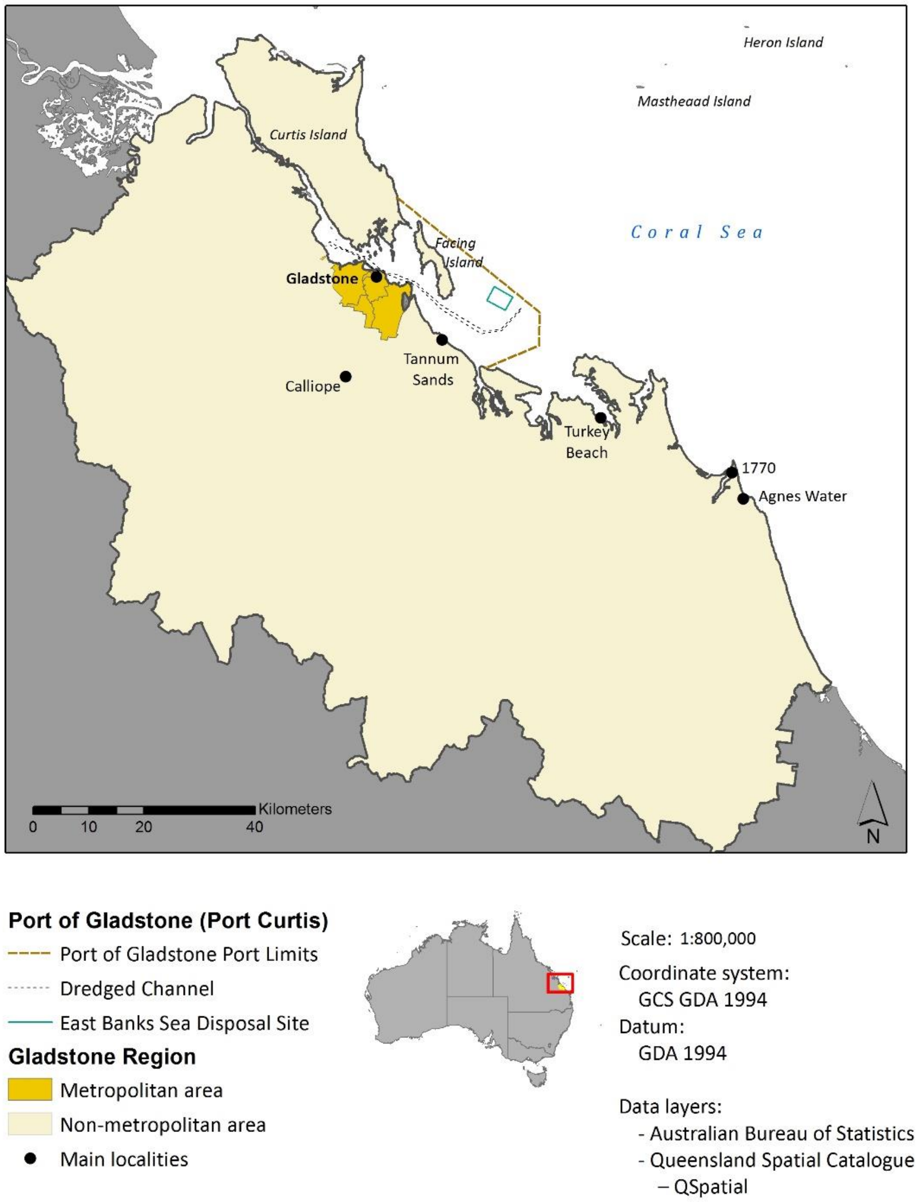


Figure 1.6 Gladstone Region indicating the main urban centres next to the port and the non-metropolitan beyond the port.

The Port of Gladstone (also known as Port Curtis) is a 30 km long, deep water harbour bounded by Curtis Island (the biggest island in the GBRWHA) in the north and Facing Island in the south (GPC 2012). It is one of the top three coal exporters for Australia and is a major industrial centre for minerals processing, transport, and power generation (Davey 2012). The limits of the Port of Gladstone lie within the GBRWHA and partially within the Great Barrier Reef Marine Park (GBRMP) (GBRMPA 2014a) (Figure 1.7).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) established the GBRWHA in 1981 because of its outstanding universal value. It includes the world's largest coral reef ecosystem and a variety of other habitats such as seagrass, mangroves, sand, algal and sponge gardens. The GBRWHA satisfies four natural criteria:

1. Outstanding example representing the major stages of the earth's evolutionary history;
2. Outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment;
3. Contains unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man; and
4. Provides habitats where populations of rare or endangered species of plants and animals still survive (GBRMPA 2014a).

The GBRMP, which was declared in 1975 by the Federal Government in Australia, does not include 3,600 km^2 of islands, ports and some State/internal waters that fall under the Queensland State Government jurisdiction, but are part of the GBRWHA. Thus, Gladstone is within the GRBWHA but not within the GBRMP.

The Gladstone Region contains over 20,000 ha of intertidal wetlands comprised of mangrove communities (14 species), saltmarsh habitat, and seagrass beds (7 species). Seagrass are of particular importance in this area as it supports green turtles (*Chelonia mydas*) and dugongs (*Dugong dugong*). Similarly, mangroves in the region have been identified as important habitats for fruit bats and migratory marine birds protected under international treaties. The dugong is classified as a species 'vulnerable to extinction' (IUCN 2013) and therefore a protection area has been established between the Narrows and Rodds Bay, which includes the Port of Gladstone (GPC 2012). Other marine mammals that may be present in the area include five species of whales, and six species of dolphins (GPC 2012). According to Currie and Small (2005), 409 taxa of invertebrates have been identified during species surveys from Gladstone harbour, where the most abundant group were molluscs, followed by polychaetes, with the less commonly detected species being echinoderms and cnidarians.

Located in a sub-tropical climate region, the Gladstone Region annual air temperatures averages a minimum of 18.6°C and a maximum of 27.7°C. The water temperatures ranges between 17-34°C (GPC 2012). The region receives most of its rainfall during the summer months (known as the wet season), averaging 850 mm per annum. Cyclones occur during the wet season, which can produce floods events that cause larger freshwater inputs, reduce salinity and increase turbidity in the coastal area. Within the Gladstone harbour the tidal range is 4-5 m, which ensures well mixed waters but the harbour has a low flushing rate with oceanic water and long retention times (Herzfeld et al. 2004).

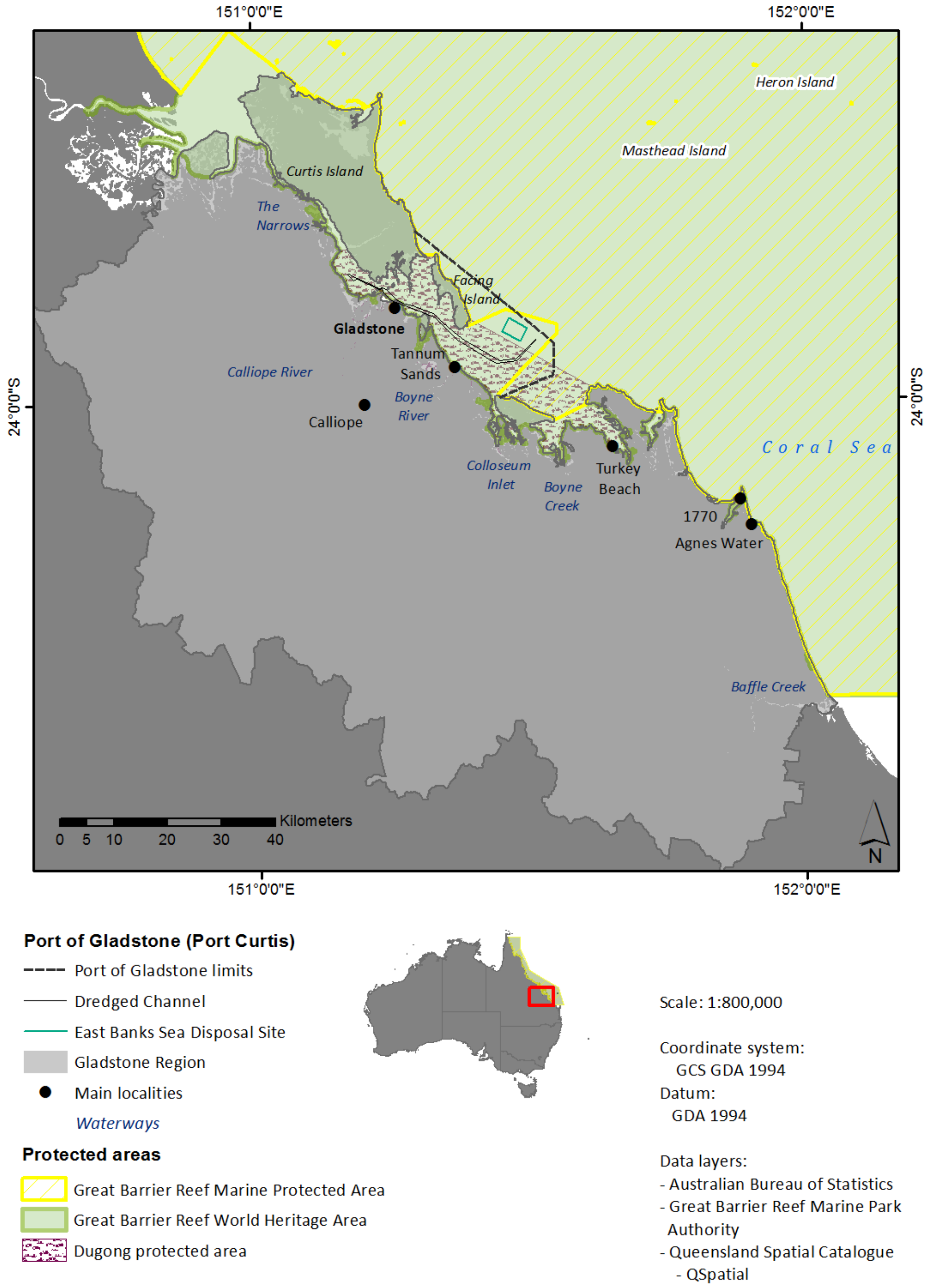


Figure 1.7. Study area of the Gladstone Region, Queensland, indicating port limits, protected areas, and the World Heritage Area.

The Bailai (or Byellee) and Gooreng Gooreng Aboriginal tribes inhabited the Gladstone Region prior to European settlement (GPC 2012; Tinney et al. 2013). The Bailai incorporates lands from the Fitzroy river mouth (to the north in Rockhampton), south to Gladstone and Boyne Rivers. The Gooreng Gooreng incorporates lands south of Gladstone city, from Baffle Creek to Agnes Water

(GPC 2012; Tinney et al. 2013). This area is important for the Traditional Owners with cultural heritage sites found in the Region and the continuation of traditional practices occurring. Within this area, 19,280 km^2 are under Native Title Claim by the Port Curtis Coral Coast Native Title Claim Group, which includes the Bailai, Gooreng Gooreng, Gurang and Taribelang Bunda Peoples (NNTT 2002).

Gladstone city was established in 1896 around a meatworks, and it evolved into a heavy industry town with the construction of an aluminium smelter in 1964. Since then, the city has become one of Australia's major ports and is a major industrial centre for minerals processing, transport and power generation (Davey 2012). Between 1983 and 2010, the Queensland Government established the Gladstone State Development Area, which is land parcel approximately 29,000 ha in size on the mainland north of Gladstone CBD and on Curtis Island identified for intense industrial development and future expansion (Tinney et al. 2013). For example, Curtis Island recently developed a number of port facilities for the production and export of liquid natural gas (LNG) (APLNG 2013). In 2012 the port was expanding to cater to new coal facilities (e.g., the Wiggins Island Coal Export Terminal) which involves dredging new shipping channels and berths to facilitate access to new port developments by larger vessels and creating a second channel into the port (GPC 2012). Industry in Gladstone includes:

- Gladstone Pacific Nickel - which is building a nickel and cobalt refinery and storage (GPNL 2013);
- Rio Tinto Alcan and Queensland Alumina Limited - alumina refineries and export facilities (QAL 2013; RT 2014);
- Gladstone Power Station (NRG 2008);
- Boyne Smelter Limited – aluminium smelter (PA 2013);
- Cement Australia - run Yarwun Australia's largest cement production plant (CA 2013); and
- Orica Yarwun - chemical complex facility (Greer et al. 2010; OL 2014; Tinney et al. 2013).

All these commodities are significant to the Australian economy. For the 2011-12 period, the value of coal exported through the port was around AU$7.5 billion.

Similarly, approximate monetary value of alumina was AU$1.5 billion, bauxite was AU$700 million and cement was AU$80 million. The estimated monetary value of liquid natural gas is AU$13.6 billion by 2020 (Tinney et al. 2013). Together, these industries have also generated more than 40,000 direct and indirect jobs (Tinney et al. 2013).

Commercial and non-commercial fishing is another important sector in the Region. The commercial fleet includes line, net/crab, trawl, and seasonal prawn fishers. Key species for this activity are prawns (*Penaeus esculentus*, *Penaeus plebejus*, *Penaeus semisulcatus*, *Metapenaeus endeavouri*, *Panaeus latisulcatus* and *Penaeus indicus*), mud crabs (*Scylla serrata*), sand crabs (*Portunus pelagicus*), barramundi (*Lates calcarifer*) and summer whiting (*Sillago* sp.). Recreational fishing activities predominantly include line fishing, crabbing and prawning and primarily occur in the Boyne River, Calliope River, South Trees Inlet, Narrows and to a lesser extent Gladstone harbour (GPC 2012).

Due to its geographical location, the Gladstone Region represents the main gateway to the Southern Great Barrier Reef (SGBR) islands such as Heron, Lady Musgrave, Wilson, and Lady Elliot that are important tourist destinations (GPC 2012). Local tourist operators offer a variety of activities such as sport fishing, day cruises, dive trips and access to reef resorts (GAPDL 2014). According to the Gladstone Area Promotion and Development Limited (GADPL), in 2007-2008 the contribution of tourism to the Central Queensland Regional economy accounted for 3.3% (GAPDL 2012a). Similarly, in the financial year ending in September 2011, the Gladstone Region had 499,000 domestic overnight visitors and 52,000 international visitors (GAPDL 2012b). By 2015-2016 the Region’s visitors incremented to 1,837,000 domestic overnight visitors and 136,000 international visitors as a result to promote the SGBR (Annette 2016) and by the establishment of the Port of Gladstone as one of the destination of the P&O Cruises (GAPDL 2016).

Gladstone is a complex place where a heavily industrialised city, with particular social dynamics, is juxtaposed against the imperatives of protected areas (Commonwealth, State and international) that are managed to conserve the GBRWHA. This juxtaposition and social dynamic presents a potential conflict of interest. To reduce conflict within an environmental scope, it is important to understand what the Gladstone stakeholders think are important about the economic, social, environmental or cultural aspects of the Region. To listen to these identified values and to manage these considerations with other political, governance, economic and environmental needs. I believe that a balance can be achieved that incorporates the needs of the many in a transparent approach. The first step in this is to elicit and map stakeholder's core values. By spatially identifying these values, we allow to integrate and recognise a wide variety of perspectives and views about shared places. In addition, this method supports the identification of priorities for management and conservation goals, while easily addressing conflicts and trade-offs.

CHAPTER 2

Perceived values and concerns about the marine and coastal environment in an industrial city

2.1 Introduction

2.1.1 Values

As discussed in Chapter 1, the term 'value' has different meanings depending on the context of its usage. In this chapter, community or societal values are explored in an attempt to capture how different stakeholder representatives perceive the environment of the Gladstone Region. This knowledge will aid in the creation of an environmental management tool that can be inclusive of community opinions and needs.

Individuals construct their values based upon the social structure that they interact with. This social interaction also influences our values (Stern et al. 1995). In the early stages of life, rather than solely receiving knowledge of standards from adults, children eventually reconstruct what they were told and what they experienced "*into their own self organised realities*" (Kagan et al. 1987). Social structure provides experiences, opportunities, and constraints that help to clarify an individual's values and beliefs through trial and error, which is crucial in the formulation of an individual's values (Lockwood 1999; Russell and Russell 2010).

Later in life, interpretation of social phenomena through communication and negotiation with other individuals in the social structure dynamically shapes a person's values and beliefs (McIntyre et al. 2008). It is during this stage that the identity and the most important values of an individual are developed through the interaction with people considered as respectable (Dietz et al. 2005). In this manner, shared beliefs, behavioural standards, and rules unfold become the common and characteristic values of a particular social structure (McIntyre et al. 2008).

Values form in early life stages, and remain more or less stable though life and are therefore hard to change in adulthood (Stern et al. 1995). Our values act as filters of new ideas or information, and the ones that are more alike to the values or worldviews we already hold are more likely to influence our beliefs and following attitudes (Stern et al. 1995). Although a change of values in adult life is unlikely to occur, a shift in the dominant way of thinking of society can happen as a generational process, but their effects on behaviour is experienced in the long term (Gardner and Stern 1996). Hence, it is thought that a change from materialist (e.g., when a person prioritises economic and physical security) to post-materialist values (e.g. focused on needs of belonging, esteem and self-realisation) that was observed during the Western prosperity period after World War II, occurred because people's basic material needs were satisfied (Dunlap and Mertig 1997). If this interpretation is accurate, post-materialist values could prevail for a long time (Gardner and Stern 1996).

2.1.1.1 Demographics and values

Although the general assumption that values are acquired and shaped through socialisation (Stern et al. 1995), it is also known that individual factors like age, gender and education can influence values, environmental attitudes, behaviours and concerns (Larson et al. 2010). Some studies demonstrate that pro-environmental attitudes and environmental concern is characteristic in women, young, higher educated, politically moderate, or liberal people living in rural dwellings (Klineberg et al. 1998; Vorkinn and Riese 2001; Hamilton et al. 2010; Sodhi et al. 2010; Mobley 2015). However, some studies suggest that demographic influences are not conclusive (Dietz et al. 1998; Twenge et al 2012). For example, studies have also demonstrated that although the younger generations are more concerned about the environment, they were less willing to participate in collective change and engage in pro-environmental behaviour (Pinto et al. 2011; Twenge et al 2012).

Generational differences in behaviour could be the result of something relevant happening to the older generations or situations that have a bigger impact in one generation than another (Gifford and Nilsson 2014). For example, while the Baby Boomer generation is known for being politically and socially liberal (Egri and Ralston 2004; Yu and Miller 2005), and with high moral priorities regarding environmental issues, Generation X is considered to be more conservative in their political and family values, but still supportive of social liberalism and environmentalism (Craig and Bennett 1997).

In relation to gender, females are thought to be more likely to have more pro-environmental positions than men, to show more concern, and also to get involved or support environment conservation activities (Stern et al. 1993; Dietz et al. 1998; Vorkinn and Riese 2001; Hamilton et al. 2010; Hamilton and Safford 2015).

2.1.1.2 Concerns, beliefs and norms

There are other psychological constructs that differ from the values concept that may influence individuals' values and behaviour. Concerns reflect the sense that something is important and that it might be at risk (Stern 2000). For example, people may feel that landscape aesthetics may be at risk because of the construction of a building. Our beliefs and worldviews are understandings of the state of the world that are constructed from empirical or scientific knowledge (e.g., poor human health is caused by air and water pollution). Norms are 'ought to' statements about someone's behaviour that result from each individual's moral standards (i.e., held values) (e.g., high levels of air pollution should not be allowed) (Stern 2000; Dietz et al. 2005). The Values-Belief-Norm theory (Stern et al. 1999) of environmental behaviour suggests that our values (moral standards) influence our worldview about the environment, which can influence our beliefs about environmental change and therefore our perceptions about our ability to reduce risks on things we value. This, in turn, influences our norms about our behaviour, which can result in political activism, voting preferences, or consumer choices (Dietz et al. 2005) (See Chapter 1, Figure 1.3).

2.1.1.3 Cultural, economic, environmental and social values

The societal perceived importance of tangible or intangible things are called values (Throsby 1999; Klamer 2002), and they are born from a wide variety of people's worldviews (Dietz et al. 2005). For instance, the different economic activities important for the community in a region is referred to as economic values. Therefore, societal values can be classified into four categories: cultural, economic, environmental and social, and these contribute to the importance given to a geographic place, either in a broad sense (e.g., the ocean) or a specific sense (e.g., the Great Barrier Reef). The values classification used throughout this thesis used for pragmatic reasons, with an anthropocentric view as the identified values classified as benefits that people obtain from nature.

In this context, cultural values are the attributes that contribute to any kind of spiritual experiences that would award meanings to symbolic goods (Klamer

2002), which could lead to the conception of particular cosmogonies (e.g. religions), creation of traditions, and heritage. These attributes are related to the capacity to be inspired by specific places and their aesthetics (Klamer 2002) in an artistic way, or to do something. Therefore, within this research spiritual values encompass not only the belief in forces or entities larger than oneself, as it may be understood by formal religions such as Christianity, but a broader view of the natural world with which an emotional connection is created.

Economic values are the attributes or goods that contribute to society's capacity to generate economic income, such as land, natural resources, factories, durable goods, and machines (Klamer 2002). Environmental values are the goods or services considered as important for the community or society wellbeing such as food, water, fuels, pollination, shoreline protection, water and air purification (Daily 1997). Finally, social values are the attributes or goods that enable the generation of values like trust, respect or responsibility in individuals through the membership of one or more social groups (Coleman 1988; Klamer 2002), like families or social clubs. In this case the attributes that contribute to the physical and psychological wellbeing of people are considered values. Social values could be use or non-use benefits from the ecosystem, such as recreational activities or aesthetics (Chiesura and de Groot 2003; Bryan et al. 2011).

2.1.2 Management and societal values

Since the early 1990's there has been emphasis on the need for an improved coastal management approach by the United Nations Conference on Environment and Development (UNCED) (Robinson et al. 1992). In that same time period, an extensive review on coastal management practices in Australia concluded that there was a need for national policies aimed to preserve the Australian coastline and that the current coastal management strategies were inadequate or inefficient, and therefore a reform was needed (HORSCERA 1991; RAC 1993). Additionally, Harvey and Caton (2003) concluded that the existing mechanisms did not provide for adequate coastal management and policies were not inclusive of social, economic and environmental goals.

But achieving sustainable environmental management and policy implementation is a difficult task to achieve (Gregory and Wellman 2001). A balance or trade-off is needed to bring together expert technical input and stakeholder values, that is then successfully implemented, with the ideal outcome being a scenario that benefits both conservation and society (Beierle and Konisky 2001; Cairns et al. 2014). In order to achieve this outcome, consensus have to exist among all parties, but unfortunately this is rarely the case given the diversity of interests in play and the lack of public involvement in many stages of the environmental management process (Cairns et al. 2014). To address this, a switch from idealised outcomes towards an acknowledgement and incorporation of trade-offs when discussing conservation and development plans is required (Weinstein et al. 2007; Cairns et al. 2014; Loomis and Paterson 2014).

Stakeholder participation has become and remained a fundamental component in the implementation of successful conservation and management programs (Beierle and Konisky 2001; Gregory and Wellman 2001). Yet, there is evidence that the decisions made through stakeholder participation do not necessarily improve environmental quality (Beierle and Konisky 2001). The quality of those decisions depend on the processes followed to make them (Reed 2008). Stakeholder involvement has positive societal outcomes in terms of public knowledge and values' incorporation, conflict resolution, institutional trust building and building capacity to better understand and address environmental issues (Beierle and Konisky 2001; Cairns et al. 2014). However, in order to make choices where different interests are at play, trade-offs need to be considered. To understand what elements are at stake an institutional effort has to be made to identify and take into account different perspectives (Cairns et al. 2014).

In this chapter, the values of a group of stakeholders from the Gladstone Region that represent diverse interests are identified and explored. This is undertaken to provide a broad understanding of the relationship between the community and the surrounding environment. The industrial character of Gladstone city and its geographical context provide a strong case study to explore the relationships between community values, conservation and industrial growth.

2.1.3 Societal values in Gladstone

The juxtaposition of the industrial Port of Gladstone within the GBRWHA has led to international interest in how the environment in this Region is protected and managed at State, National and international levels. Consequently, a series of studies have been commissioned to examine the perception of the community regarding environmental and development aspects of the Region (Lockie and Jennings 2003; Lockie and Rockloff 2005; Greer et al. 2010; Davey 2012; GPC 2012; Llewellyn et al. 2013; Tinney et al. 2013; FBA 2014). These studies identified values and concerns of different stakeholder groups of the Gladstone Region (see Figure 1.7 in Chapter 1). The outcomes from these studies are summarised in Table 2.1. Each study had different aims and data collection methods, however, they all identified that the main societal values in this Region relate to the ecological significance of the marine area, water quality, sustainability, scenery, and recreation activities (Table 2.1). Identified concerns from past studies included water and air quality, habitat and resource degradation, information access, discontent with planning, coordination and stakeholder involvement by the government, investment on infrastructure, and services improvement by industry (Table 2.1). These values form the basis of the identified values for this research.

Table 2.1 Previous studies in the Gladstone Region to identify or assess important values for the community.

Region	Date	Methods	Focus of the study and aims	Main findings	Gaps in the study	Reference
Lower Fitzroy River and Port Curtis catchments	2002	818 Computer assisted telephone interviewing surveys	*SOCIAL-ENVIRONMENTAL* - Identification of key waterway values and management priorities - Perceptions of water quality and change in water quality	- Ecological significance of waterways, town water supplies, scenery, landscape and symbolic values were the most important values. - Port Curtis residents place more value on scenery and recreation activities than river catchment residents. - Water quality in PC was believed to be higher than in creeks and rivers - There were high levels of uncertainty regarding specific waterway issues and proposals.	Different uses of water were prioritised Recreational fisheries, cultural and industrial values were not included	Lockie and Jennings (2003)
Port Curtis and Fitzroy catchments	2001-2003	80 In-depth interviews with stakeholders	*SOCIAL-ENVIRONMENTAL* - Investigate the values, interests, attitudes and aspirations of those involved in, or affected by, decision making in the Port Curtis and Fitzroy catchments.	- Main values: water quality, preservation of natural systems, fisheries, sustainability, mangroves and seagrasses - Main concerns: water and air quality, industrial and port development and expansion, education and information - Indigenous Peoples' concerns: loss of indigenous culture		Lockie and Rockloff (2005)
Gladstone Harbour	2010	520 surveys 12 in-depth interviews	*SOCIAL-ECONOMIC* - Perceptions about Gladstone industry performance by the residents of the Gladstone Region	Perception is that: - Gladstone industry is performing satisfactorily in the task of maintaining a 'social licence to operate' in the Region. - Gladstone industry should considerate priority areas of health infrastructure and urban based facilities as well as balancing environmental protection.	Perceived values are only the ones related to industry but no other values that could be related to it like cultural or social values.	Greer et al. (2010)

Table 2.1 Continuation

Region	Date	Methods	Focus of the study and aims	Main findings	Gaps in the study	Reference
Gladstone Harbour	2012	34 semi-structured interviews	*SOCIAL-ENVIRONMENTAL* - Document and assess how high-use stakeholders (fisheries and conservationists) view current usage and management of the harbour in relation to the GBRWHA	- The WHL of Gladstone Harbour remains significant for local user groups - The stakeholders have misconceptions about the governance and regulation of the WHA space. - The high users of the area expressed discontent with the current practices of both the state and federal government.	Results are biased in relation to the vision of only two stakeholder groups related to the GBRWHA.	Davey (2012)
Curtis Coast	2012	Literature review	*SOCIAL-ENVIRONMENTAL* - Provide an overview of the current historical, social, cultural, economic and natural resources and pressures on the resources of the region current state of the marine ecosystem.	- Inventory of the historical, cultural and natural resources of international, national, state and local significance, i.e. protected areas, localities, items, communities and species.	It does not assess how important are the natural resources for the community	GPC (2012)

Table 2.1 Continuation

Region	Date	Methods	Focus of the study and aims	- Main findings	Gaps in the study	Reference
Capricorn-Curtis Coast basins	2011 - 2013	Workshop with 65 catchment representatives Spatial mapping	*SOCIAL-ENVIRONMENTAL* - Identification of Environmental Values (EVs) for waters of the Capricorn and Curtis coast basins, and coastal waters.	- Local community spatial identification of EVs for waters in each catchment in the Capricorn and Curtis coast basins, and coastal waters.	Values and uses are considered the same. Participants were not asked their main values, those were given to them. No assessment of importance of values. More importance is given to economic values. Cultural and spiritual values are considered as one.	FBA (2014)
Gladstone Harbour	2013	Literature review	*SOCIAL-ENVIRONMENTAL-ECONOMIC* - Synthesis of available information relating to environmental, social and economic aspects of Gladstone Harbour.	- Large amount of data describing water quality and sediment sampling, megafauna and macroscopic flora - Sparse temporal and spatial coverage of socioeconomic datasets relating to Gladstone Harbour (especially those with direct causal links to the environmental condition of the harbour). - Human health links to water quality or wildlife health are particularly poorly understood and understudied.	It does not include an assessment or summary of the condition of Gladstone Harbour. It does not assess how important are the natural resources for the community	Llewellyn et al. (2013)

Table 2.1 Continuation

Region	Date	Methods	*Focus of the study and aims*	Main findings	Gaps in the study	Reference
Gladstone Harbour	2013	Public submissions Interviews Expert advice	*ENVIRONMENTAL* - Examine and report on the management arrangements for the Port of Gladstone, to respond to the World Heritage Committee's Decision 36 Com 7B.8. - The Review has focused its work and findings on environmental management and governance matters relevant to the protection of world heritage values.	- The OUV of the GBRWHA is expressed in the Port of Gladstone. - There has been variable consideration of world heritage and environment matters in the state and port strategic planning processes for the Port of Gladstone. - Aboriginal involvement in policy, planning and management of the Port of Gladstone has been limited to date. - The environmental management and governance within the Port of Gladstone is generally comprehensive. However, the multiple layers and mechanisms in place can contribute to stakeholder confusion and mistrust.	It does not consider social and cultural values	Tinney et al. (2013)

As mentioned in Chapter 1, the general objective of the thesis is to deliver a framework that comprehensively identifies people's values on a spatial scale that can enrich management and/or conservation decision-making. With this in mind, this chapter implements Step 1 (Figure 1.5). Societal values will be identified using a bottom-up approach, through to implementation of a series of stakeholder interviews.

2.2 Aims and hypotheses

Coastal management plans need to be in constant review and, where necessary, adapt to better achieve conservation and sustainable development. Given that management plans are often driven by governmental socio-political imperatives, it is important to develop strategies that assess all facets of the issue, including the communities' perceived values. Understanding and acknowledging these values creates opportunities that effectively engage the community while meeting the needs of the all stakeholders. This approach aims to balance the environmental management requirements with stakeholders needs.

Thus, this chapter explores the perceived cultural, economic, environmental and social values associated with the Gladstone Region. The specific focus is the coastal area. In addition, the concerns, beliefs and norms of different Gladstone stakeholder groups are identified and the influence of demographics and group belonging is investigated. The main objective of this chapter is to:

- Identify and analyse the perceived environmental, economic, social and cultural values about the coastal and marine zone of the Gladstone Region that are held by different stakeholder groups in this Region.

The associated hypotheses explored in this chapter are:

H_I Participant's demographics (gender, generation, education level, income, place and time of residence, birthplace, and the stakeholder group they belong to) influences their values, concerns, beliefs and norms.

H_{II} The number of values and concerns identified will differ depending on a participants' time of residence in the Gladstone Region, their gender and their generation.

H_{III} Participants belonging to the same stakeholder group will share similar values, concerns, beliefs and norms.

2.3 Methods

A mixed methods research approach was used. Information was collected in a qualitative manner, with quantitative statistical analyses being applied. An exploratory designs was used, which is often utilised when a new phenomenon is explored (Creswell and Clark 2007). Human ethics approval was received from the Human Research Ethics Committee Central Queensland University in Australia (project number H14/01-005) before any research was conducted.

2.3.1 Previously identified values in Gladstone

Former research in the Gladstone Region has identified more than 14 values and up to 12 stakeholder groups (summarised in Table 2.1; Lockie and Jennings 2003; Lockie and Rockloff 2005; Greer et al. 2010; Davey 2012; GPC 2012; Landos 2012; FBA 2014; Llewellyn et al. 2013; Tinney et al. 2013). These previously identified values are used as a starting point in this study to build a standardised method to consistently identify values for a given community. Similarly, the identified stakeholder groups and associated community members from the previous research were used as initial points of contact for organising interviews in this study.

2.3.2 Participant selection

A preliminary list of key potential participants was derived from different stakeholder groups obtained from the Gladstone Healthy Harbour Partnership (GHHP)[1]. A total of 43 potential participants were identified for the interview list. I was formally introduced to the potential participants via my university and social networks, with follow-up invitations sent to participate in the research sent to participants via email. If a person was unavailable to participate in the interview but they had a skillset or interest they were then asked to propose

[1] The Gladstone Healthy Harbour Partnership (GHHP) was formed in 2012 and it brings together 23 partners from community, government, industry, research and statutory bodies with the objectives of "monitoring and contributing to the development of specific environmental values of Gladstone Harbour, facilitating cooperation among stakeholder groups and improving community engagement" (McIntosh et al. 2014).

another person from their organisation that could be suitable for inclusion in the study. This snowballing approach attempted to ensure that similar types of participants to the initial interview list were maintained for the interviews (see Bryman 2012). Once people had agreed to participate, a follow-up phone call was made to arrange a meeting at their offices or at the university campus (whichever was more convenient to the participant).

Finally, 30 of the 43 stakeholders (~70%) contacted agreed to participate. Participants were categorised into nine groups (depending on their current job or affiliation) that represented the local government, state government, conservation groups (Non-Government Organisations – NGO's), industry, primary school principals, recreational fishers, tourism, community, and Aboriginal Peoples (Table 2.2). Each stakeholder group was formed by at least three persons and one person from each of the organisations in the group was selected in order to get a broader view of the Region. For the industry, state and local governments, representatives of the environmental departments were particularly chosen because of their close knowledge of the marine and coastal environment.

Table 2.2 Stakeholder groups consulted and the reasons for their inclusion in this research.

Reason for inclusion	**Stakeholder Group**								
	Local government	State government	Conservation groups (NGO's)	Industry	School principals	Recreational fishers	Tourism	Community	Aboriginal Peoples
Knowledge/familiarity of marine and coastal environment	✓		✓	✓	✓	✓	✓	✓	✓
Understanding of local environmental health	✓	✓	✓			✓			✓
Understanding of local fishing activities					✓	✓		✓	✓
Understanding of local conservation activities			✓		✓			✓	✓
Engagement with community groups			✓	✓	✓				✓
Understand and enact Region's development plans	✓	✓							✓
Manage or involved in environmental regulations		✓							✓
Jurisdictional governance		✓							
Economic investment in the local region				✓			✓	✓	✓
Engagement with future generations					✓				✓
Cultural ties to the Region									✓

Although this study did not target Australian Aboriginal Peoples solely, particular attention was given to acknowledge and to correctly collect their values regarding the coastal and marine environment. In this regard, a preliminary meeting was conducted in January 2014 with the Port Curtis Coral Coast (PCCC) Traditional Owners to introduce them to the research, the research aims, and to emphasise the importance of their participation (the inclusiveness of the interviews). When the interview was ready to be conducted, the protocol was sent to two representatives of the PCCC, to enable them to provide advice about appropriate language and questions. Their feedback and inclusion and consequential amendments to the interview questions ensured that the interview met their cultural requirements.

A second meeting then occurred to explain in more depth the study objectives, and for the PCCC to select appropriate representatives of the Traditional Owners of the Region to participate in the study. Unfortunately, the target of three representatives of the Aboriginal people was not met. Although this objective was not met, the information gathered from the one interviewee is included for descriptive purposes, but is excluded from statistical analyses because the sample is too small to be representative of the Aboriginal population targeted in this research.

2.3.3 The interview protocol

To identify the societal values of different stakeholder groups, an in-depth semi-structured interview method was used to collect qualitative data. The method followed was similar to methods used by Klain and Chan (2012) and is summarised as follows. The interview approach included narrative methods that allowed participants to articulate their values about the Region by exploring subjective and experiential subjects. Narrative-based methods from Klain and Chan (2012) were modified (adapted to the Gladstone Region circumstances) and included in the interview process. This method enabled participants to articulate their values about the Region by exploring subjective and experiential subjects, which helped the participants to reflect their values (Klain and Chan 2012).

A pilot study was run (with six participants) to ensure that the questions asked in the interview were well articulated, logical in question sequence, if the questions revealed relevant values information, and to gauge the average length of time each interview would take (aiming for a 45 to 60 minute interview). After this process, amendments to the interview questions were made where needed.

To avoid linguistic biases, at the beginning of each interview a short description of the project was provided to each participant. This description included information relevant to the Human Ethics in Research Australian National Guidelines. All interviews started by asking the participants:

- their place of birth;
- how long they have resided in the Region;
- their reasons to move in (if they were not born in the area) or to stay; and
- what they like about the Gladstone Region.

The following prompts were set to investigate the cultural, economic, environmental and social values being explored in this thesis and included:

- General demographic questions: age, highest level of education, income, time and place of residency, place of birth and occupation;
- What do you value in the environment and why do you value it?
- Personal experiences, feelings and views about the marine environment in the Region in the past, present and future;
- Personal spiritual connection to the Region and if this inspired them in any way;
- Participant's perception of the state of the Region's environmental health (in general and the harbour in particular), if according to them it was improving, deteriorating or staying the same) and their perception about the impact of industrial and urban development on the Gladstone Region; their thoughts about environmental management and the role and participation in management decisions of the different stakeholder groups involved; and

- Participant's perception about the industrial development impacts on the Great Barrier Reef World Heritage Area and thoughts about the GBRWHA management.

Each interview was digitally recorded to aid with interpretation and analysis. The full interview protocol is provided in Appendix B.

2.3.4 Qualitative analysis

An iterative and reflexive method of collecting interview data was used, following a modified version of the Halcomb and Davidson (2006) method. This method emphasised the use of field notes and common themes (that were coded) and hence reduced the reliance on transcriptions post-interview. This greatly reduced the time that each interview and its subsequent interpretaion took, while maintaining reliable qualitative data (Poland 1995; MacLean et al. 2004). It also overcame the potential difficulties of (mis)interpreting concepts due to linguistic difficulties that may occur post sampling (*sensu* Oliver et al. 2005).

A modified grounded theory method was used, where an inductive approach is taken when analysing the data but using *a priori* categories (codes) as a start point (i.e. cultural, economic, enviornmental and social themes) (Maxwell 2005; Gould et al. 2014). Within the qualitative analysis, coding is one of the most important processes: it entails labeling ideas or themes (referred to as codes) that are particularly salient within the framework established (Bryman 2012). These themes are treated as potential indicators of concepts which are in constant revision. Thus, initial coding tends to be very detailed. Later, focused coding would emphasise the most common code themes, those that were represented by participants as most important and those that are revealing about the research objectives (Bryman 2012).

Accordingly, the method implemented involved a six step data reduction process:

- Step 1: field notes (raw data) were compiled immediately after each interview and contained reflections and initial impressions of the interaction such as behaviour of the participants or reflections, and major ideas or questions raised from the interview;

- Step 2: the interview recording was listened to. During which time the recording was compared against the field notes, noting obvious flaws and making amendments where needed;
- Step 3: using NVivo software (QSR International Pty Ltd. Version 11, 2015), a thematic analysis was done to elicit common themes represented by the codes that are obvious and could be classified to the four core values of interest (cultural, economic, environmental or social values). The values elicited were used later to construct a survey (see Chapter 3);
- Step 4: an extensive thematic review was undertaken, where codes were edited if two or more where used to describe the same theme; also connections between codes were established;
- Step 5: Themes and subthemes were re-classified as values, concerns, beliefs or norms; and
- Step 6: Evocative examples were identified to exhibit participants' ideas.

2.3.4.1 Data saturation

The data saturation test determines the point when no new information is observed in the data. In other words, the saturation point is the number of interviews needed to gather all the information about a specific theme (Fusch and Ness 2015). This test was used to determine if the total number of interviewees was large enough to capture the whole spectrum of values, and therefore the sample representativeness of the community.

In order to do this test, a matrix containing the themes mentioned by each interviewee was constructed using NVivo. Each cell was allocated a binary value: if the person mentioned a theme in his or her interview, a "1" was assigned; and if the person did not mention it then a "0" was allocated. This matrix was exported to Microsoft Excel. Following the methods of Francis et al. (2010) a line chart was generated in Excel using the number of new places marked by each consecutive participant. While data saturation is a well-known test, there is no consensus in the literature on when the saturation point is reached (Francis et al.

2010). In a qualitative study Francis et al. (2010) showed that the saturation point was most likely to be reached if three consecutive participants did not mention new themes. Therefore, in the context of this research, and following the methods from Francis et al. (2010) the saturation point was considered to be reached when three consecutive respondents did not mention new themes (Francis et al. 2010). As a content validity procedure, this test will address the uncertainty of the qualitative data elicited.

2.3.5 Statistical analyses

In order to analyse qualitative data in a quantitative manner, the binary matrix already constructed for the data saturation test was used and joined with the interviewees' demographic information: gender, generation (Baby Boomers: 1946-1964 or Generation X: 1965-1981), education level (higher or other education), income, time of residence (transient, short term, long term, permanent), birth place and stakeholder group. The following analyses then occurred.

2.3.5.1 Test of independence

To determine if any of the themes mentioned by the participants had a significant relationship with any of their demographic factors (H_I), Fisher's Exact tests of independence were conducted using SPSS 20.0 (Statistical Package for the Social Sciences) and the Exact r×c Contingency Table website (Kirkman 1996) for tables bigger than 2x2. This statistical test is an alternative to the chi-squared test (χ^2) and was used because the sample sizes were small.

Due to the limitations in the number of factors that can be used in the Exact r×c Contingency Table website (Kirkman 1996), for the analysis on the relationship of the themes with the stakeholder groups a bootstrap analysis was performed along with the Fisher's Exact test on SPSS 20.0. Bootstrapping was used as it can derive robust estimates from sampling with replacement (Higgins 2005).

2.3.5.2 Values and concerns

McNemar and Cochran Q tests were used in the software SPSS 20.0 to determine if there was a significant difference in the number of values and concerns depending on participants' time of residence, gender and generation (H_{II}). To do this, a binary data table was constructed where “1” meant that at least one person in a group (i.e. depending on their time of residence, gender and generation) mentioned the theme, and a “0” denoted that no one in that group mentioned it. The McNemar and Cochran Q tests are non-parametric procedures to test whether the proportions of two (McNemar), or three or more (Cochran Q) binary variables are equal in a population. In this case the McNemar test was used to determine if there was a significant difference on the amount of values and concerns about the Region depending on the gender and generation. The Cochran Q test was used for the different groups depending on their time of residence.

2.3.5.3 Participants’ similarity regarding stakeholder groups

Participants were selected by their membership in the different stakeholder groups (Table 2.2) in order to gather a wide variety of the perceived values about the coastal and marine environment. To have a better understanding of the overall similarity of themes mentioned between the stakeholder groups (H_{III}), a Non-parametric Multidimensional Scaling (nMDS) process was performed, using the ALSCAL algorithm in SPSS. In the nMDS test, the elements are represented as points in a Euclidean space, where the points that are more similar are expected to be close to each other and the dissimilar points would be apart (Cox 2005). Hence, this analysis allowed the determination of whether the entire suite of values expressed in each interview by the participants were clustered as per the pre-defined (*a priori*) stakeholder groupings.

To achieve this, the themes were divided in four categories depending on what they were related to: values, concerns, norms or beliefs. Also, the themes related to values were divided into the four core values (cultural, economic, environmental and social). A dissimilarity matrix was used to calculate the presence or absence of each of the 131 themes that were identified across all of the 30 interviews. It was important to capture both similarity and dissimilarity between the participant’s values or when a theme was not mentioned at all. Hence, the dissimilarity matrix was calculated using the Simple Matching Coefficient (Cox 2005), which gives equal weights to the absence and presence, as well as the matches and mismatches on the data.

2.4 Results

2.4.1 Participants

A total of 43 invitations were sent via email to potential stakeholders to participate and of these, 30 people agreed to participate, representing a 70% response rate. Interviews were conducted over a short time-frame (between April 14th and June 3rd 2014) to restrict temporal influences on perceptions. Only one interviewer was used to maintain a consistent interview approach. The characteristics of the sampled participant population are summarised in Table 2.3. On average, interviews lasted between 35 minutes to 2 hours, with all of the targeted stakeholder groups being represented by at least three participants, with the exception of the Australian Aboriginal Peoples.

Table 2.3. Characteristics of the Gladstone interviewees (n=30).

Descriptor	Category	Number of participants
Gender	Women	12
	Men	18
Age		
33 to 71 years	Baby Boomers generation	18
(mean 51.9 years)	Generation X	24
Education[1]	Other education	8
	Higher education	22
Time of residency	0 to 5 years	7
	6 to 10 years	3
	11 to 40 years	15
	40 or more	4
	Not in Gladstone	1
Place of birth	Gladstone	3
	Other in Australia	23
	International	4
Residency area[2]	Metropolitan area	13
	Non metropolitan area	13
	Islands	3
	Other	1
Stakeholder group	Local government	3
	State government	4
	Conservation groups	4
	Industry	5
	Tourism	3
	School principals	3
	Recreational fishers	3
	Community	4
	Aboriginal Peoples	1
Income[3]	\$20,001 to \$60,000	8
	\$60,001 to \$100,000	4
	\$100,001 to \$200,000	15
	More than \$200,001	2
	No Answer	1

[1]*Other education*: highest level of education completed is primary or high school; *Higher education*: highest level of education completed is Certificate I – IV, diploma, bachelor or postgraduate degree.

[2] *Metropolitan area*: Gladstone City, West Gladstone, South Gladstone, Barney Point, Kin Kora, Sun Valley, New Auckland, Kirkwood, Clinton, Byellee, Callemondah, Telina, South Trees, Glen Eden, Toolooa, O'Connell. *Non*

metropolitan area: Boyne Island, Tannum Sands, Benaraby, Wurdong Heights, Calliope, Beecher, Burua, Curtis Island, Facing Island, Quoin Island, Miriam Vale, Seventeen Seventy, Agnes Water.

[3]*Income*: annual individual income

2.4.2 Data saturation

Data saturation as determined using the method of Francis et al. (2010) was not reached in the sample size of 30 interviews (Figure 2.1). At 30 interviews the slope of the accumulation of new themes had still not fully plateaued. Thus, unfortunately data saturation for the interviews was not reached. However, the data obtained still provides some useful insights.

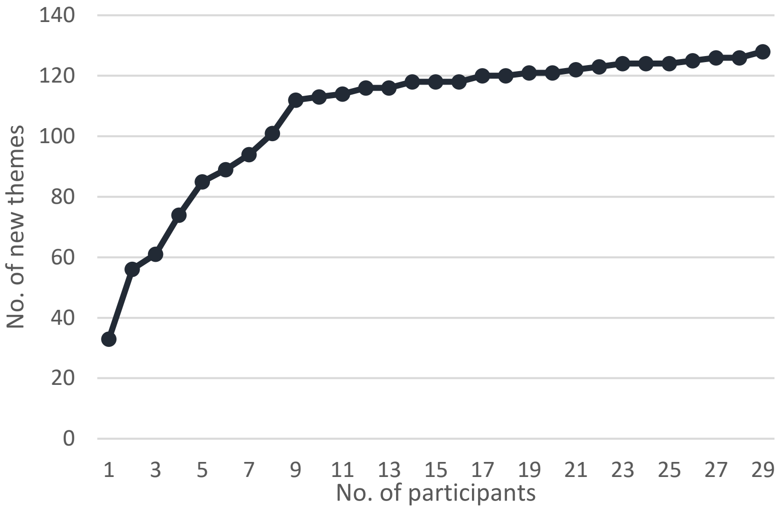


Figure 2.1 Number of new themes by participant (ordered chronologically based upon interview time sequence).

2.4.3 Identified themes

A total of 131 themes were identified and 31 of these (21.6%) had a statistically significant relationship with the participants' demographic characteristics ($p < 0.05$). Of the 131 themes and subthemes, 39 were classified as values, 30 as concerns, 40 as beliefs and 22 as norms (Tables 2.5, 2.6, 2.7 and 2.8). The cultural theme was composed of 14 subthemes in total (summarised in Appendix C, Table C.1); the economic theme was composed of 16 subthemes (Appendix C, Table C.2); the environmental theme was composed of 46 subthemes (Appendix C, Table C.3) and the social theme of 55 subthemes in total (Appendix C, Table C.4). Within each cultural, economic, environmental and social theme there were subthemes associated or complementary to others, but also that were connected within the mayor themes. This sharing across themes is summarised in a Venn diagram (Figure 2.2) for the four major themes.

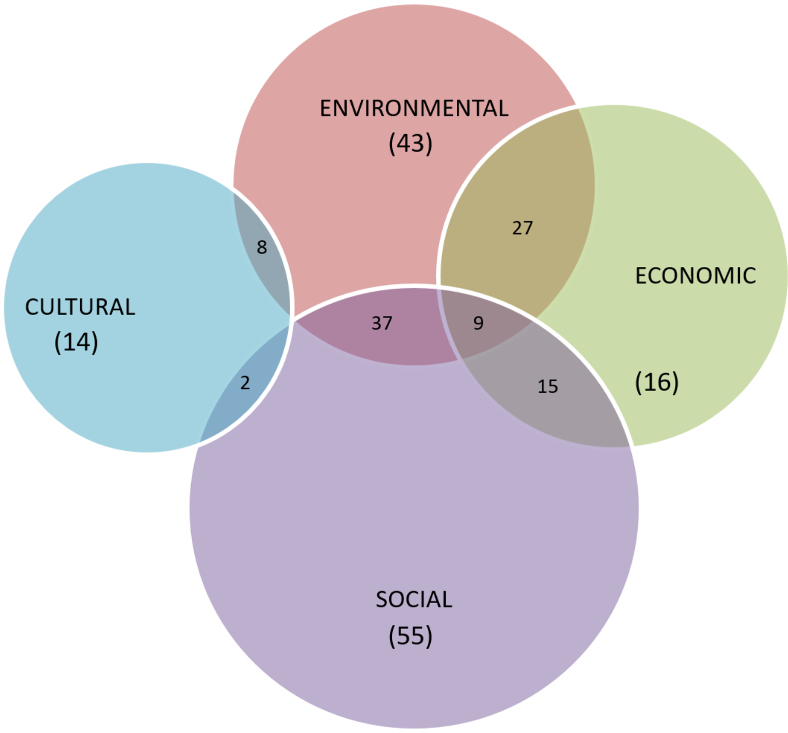


Figure 2.2 Number of themes and subthemes shared between topics. Size of theme set (circle) represents the number of total subthemes, which are also provided in parentheses.

Thus, a theme could be explained as follows. The subtheme of industry was recognised as a job and wealth creator for the Region (coded as an economic theme). But for some participant, industry meant different types of environmental impact. This could include perceptions such as that itinerant and/or incoming industry workers resulted in increased pollution rates due to the population increase, and the removal of vegetation due to the housing needed for these workers (coded as environmental themes). According to the participants, this negative impact is caused by the lack of appropriate planning strategies by the government and industry because "*they only care about development and not about the community or environment's wellbeing*" (coded as social theme) (interview participant). Another example of the coding, is that some participants mentioned that because of the "*low air quality in Gladstone*" (coded as an environmental theme), they decided to live outside the urban area (coded as a social theme). A detailed description of the themes is provided in Tables 2.5 to 2.8.

2.4.3.1 Values

At each interview, participants discussed values in no specific order, with the values mentioned being a reflection of their individual feelings and also their perceptions about the environment of the Region and the socio-economic aspects related to it (Table 2.4). Cultural values were mostly associated with specific places. Feelings such as ‘awe’ and the relaxation provided by some places, were related to the participants’ sense of connection with the environment and the inspiration they get from the environment, and sentiments that build on the appreciation of the environment. Other cultural values mentioned in the interviews focussed on historical places and places that are important for the Indigenous community such as ceremonial places. From the 39 themes related to values, 14 were classified as cultural values, seven as economic values, eight as environmental values and 10 as social values.

Table 2.4 Values expressed by the interviewees categorised into the four core values (cultural, economic, environmental and social)

CULTURAL	ECONOMIC	ENVIROMENTAL	SOCIAL
• Connection with the environment (spiritual)	• Industry: - Jobs creation	• Biodiversity	• Recreation
• Historical places	- Community's wealth	• Ecosystem importance	• Aesthetics
• Inspiration	• Tourism (and industry tourism)	• Water quality	• Family and friends
• Important for Traditional Owners	• Farming		• Psychological health (state of environment and importance of the port)
	• Other business		• Lifestyle
	• Aquaculture		

Identified economic values were mainly influenced by the perception of importance of industry to the Region as a job and wealth source. Economic activities such as tourism or farming were mentioned in interviews, but participants noted these as being secondarily important. Environmental values were mostly associated with the marine and terrestrial fauna and flora regional biodiversity. Importance of the ecosystem was mentioned in broad terms including maintenance qualities such as clean water and biodiversity that are particularly appreciated by participants when going outdoors for recreational purposes. Finally, the most important social value mentioned was recreation, along with its wide variety of associated activities and its close relationship with family and friends. The aesthetics of the Region was of particular importance for creating or adding to the quality of these experiences.

2.4.3.2 Cultural themes

This section further describes the relationship between participants' cultural values, concerns, and beliefs (Table 2.5). Representative quotes from some of the interviewees are provided. Within this section, participants are identified by gender, age, and place of birth (e.g. male, 55, Gladstone).

Five (relaxation, appreciation, awe, historical place, and taking care of the environment) of the 14 identified cultural themes had a statistically significant relationship with either one, or two, of the demographic factors: gender, generation, place of birth, and income. The demographic influences partially, support the H_I (influence of participants' demographics on values, concerns, beliefs and norms) (Table 2.5). The five themes that had statistical patterns are discussed further below.

Table 2.5 Cultural themes and subthemes (i.e. a values, b concerns and c beliefs) stated on the interviews ordered by number of participants that mentioned them. The last column shows the demographic factors with statistically significant relationships with the theme. NS = not significant (Fisher's Exact test). The ↑/↓/= symbols specify if the proportion of respondents is statistically larger, smaller or not different from the expected percentage.

Theme	Subtheme [a, b, c]	Description	No. of mentions	Demographic factors	Proportion of respondents per demographic factor
FEELINGS	Connection with the environment [a]	Feelings of forces or energies bigger than oneself related or not to a specific religion	17	NS	
	Relaxation	Feeling of relaxation provided by particular places in the Region	9	Gender: $p = 0.001$	Females: 66.7% ↑ Males: 5.9% ↓
	Appreciation [a]	Acknowledgement of the surrounding environment	7	Place of birth: $p = 0.019$	Queensland: 16.7% ↓ Other than Queensland: 14.3% ↓ Outside Australia: 100% ↑
	Just being	Feeling of existence provided by some places in the Region	6	NS	
	Awe	Emotion of reverence and surprise provided by some places in the Region	3	Generation: $p = 0.045$	Boomers: 0% ↓ Generation X: 27.3% ↑
				Income: $p = 0.046$	\$20,000 – \$60,000: 37.5% ↑ \$60,001 - \$100,000: 0% ↓ \$100,001 - \$200,000: 0% ↓ More than \$200,001: 0% ↓
	Solastalgia [b]	Nostalgia for what the environment was once	3	NS	

Table 2.5 Continuation

Theme	Subtheme [a, b, c]	Description	No. of mentions	Demographic factors	Proportion of respondents per demographic factor
CULTURAL	Historical places [a]	Answer to prompt about places important for the community because of their history	10	Income: p = 0.002	$20,000 – $60,000: 37.5% ↑ $60,001 - $100,000: 80% ↑ $100,001 - $200,000: 7.1% ↓ More than $200,001: 100% ↑
	Important for Traditional Owners [a, c]	Answer to prompt about places important for the community	5	NS	
	Ceremonial [a]	Answer to prompt about places important for the community	1	NS	
INSPIRATION	To take care of the environment [a]	Answer to prompt about places that could provide inspiration or ideas to create or do something	11	Gender: p = 0.018	Females: 66.7% ↑ Males: 17.6% ↓
				Place of birth: p = 0.030	Queensland: 16.7% ↓ Other than Queensland: 42.9% ↑ Outside Australia: 100% ↑
	To show the area to others [a]	Answer to prompt about places that could provide inspiration or ideas to create or do something	8	NS	
	To look for more [a]	Answer to prompt about places that could provide inspiration or ideas to create or do something. Inspiration to explore more the Region	6	NS	

Table 2.5 Continuation

Theme	Subtheme [a, b, c]	Description	No. of mentions	Demographic factors	Proportion of respondents per demographic factor
	To work for the community [a]	Answer to prompt about places that could provide inspiration or ideas to create or do something	5	NS	
	To create [a]	Answer to prompt about places that could provide inspiration or ideas to create or do something	3	NS	

Within the cultural themes, the most commonly expressed value was related to spiritually special places, which are not only related to religion or particular beliefs, but to feelings of connection with the environment.

> "*I'm a practicing Catholic, I have a connection with the larger entity and the place and responsibility and all of that. I live on an island* [redacted to maintain anonymity] *and that island is a beautiful place. We live it with the environment, and our children, and the animals, and our spirituality. We live it very actively every day. Our connectedness, our philosophy, our spirituality, our family and the place: they're the four of Indigenous 'canini'* [sic] [i.e., canon or codes] *and they are what Saint Francis lives. So, coming here has heightened my spirituality because I got to know the Goorang Goorang and Franciscan spirituality, which is the connection with the environment and responsibility and an understanding of creation and our place*". (Male, 60, other in Australia).

> *"My feelings and connections with earth certainly happen through Gladstone. If that connection wasn't there I'd probably wouldn't be here. It's my connection to the outside world."* (Male, 40, Gladstone).

> *"It's one of the reasons why I like going to Mount Larcom*[2]*: because up there when you look out at everything you just know that you're part of something much bigger. I love to be out there particularly when there's not too many people, so you have that space for yourself and just feel connected, it's awesome."* (Female, 37, other in Australia).

> *"In traditional European culture you need to have a building for it to be culturally significant, but for Traditional Owners a place can be significant with nothing there because it was a ceremonial or an initiation place."* (Male, 49, other in Australia).

More than half of the interviewees mentioned connection with the environment (Table 2.5). Two participants were adamant (certain) that they did not connect

[2] Mountain of 631 metres visible from most points in Gladstone. It is a popular hiking place and landmark. From the peak, it is possible to have a good view of Gladstone and the harbour (GAPDL 2015).

with the environment when in the urban area of the Region (i.e. the city of Gladstone): *“I've had those feelings of connection to the environment only in 1770 and Agnes* [two districts south of Gladstone], *not in Gladstone.”*

Also, when talking about their feeling of connectivity, some people mentioned their solastalgia, which is the nostalgia for what the environment was once. In some cases, participants stated that solastalgia moved them to engage with community or environmental work. Examples of solastalgia statements from long-term residents include:

> *“Part of my devastation comes from seeing all the dead things that were washed up on the beach [in Tannum Sands]. While the dredging was going on it was really bad: birds, sea snakes, turtles, fish, fish with rashes.” (Female, 49, other in Australia).*

> *“One of the biggest things that I've seen here was that large scale dredging program in the last couple of years, and as [a person] that's been here for 40 years, I’ve watched the [marine] animals change. For example, watching our natural harbour get turned to silt over these couple years just ripped your heart. That was a major one... You can't do anything about it, you can't stop it, it's not natural, not meant to be. It might not have long-term effects, but let’s just call it mid-term effects. We all know that animals struggle in those circumstances and you struggle emotionally. Like someone bulldozing your home, you can rebuild but someone's bulldozing your home, so at that point in time you feel that emotion, 'cause you have a strong connection. People that have no connection with earth or the local area don’t feel it. I felt frustrated, but I think it goes further and certainly goes deeper: irreversible scarred, it has cut deep; you can cover it with dust and pretend it’s not there but it’s there.” (Male, 40, Gladstone).*

Some places in the Gladstone Region triggered different feelings to the participants that were related to environmental connection, such as relaxation, awe and ‘just being’. For the feelings just mentioned (coded as themes) there was a statistically significant relationship with some demographic characteristics. For example, women were more likely to talk about how different places in the Region made them feel relaxed ($p = 0.001$). Also, people from Generation X ($p = 0.045$) and a lower income bracket ($p = 0.046$) mentioned that they have been surprised and experienced awe in some places of the Region (Table 2.5).

> *"I feel calm and relaxed when running in Tannum* [Sands] *and Boyne* [Island]. *Good energy feeling, clean thinking. Only there I get that feeling, not in the city* [Gladstone].*"* (Female, 44, other in Australia).

> *"I used to have a yacht and lived in the marina and one of the most beautiful things that I saw in Gladstone was really magical. During the winter when it's cold I saw little seahorses very close to the surface of the water. I don't think many people have actually seen these beautiful little creatures. And it's actually the emblem that they used to use for Calliope[3]"* (Female, 49, other in Australia).

> *"Any of the islands, like North West or Heron hold that magic. Anytime you're snorkelling in that area you can't help but to feel that Wow! Swimming with stingrays and sharks and turtles, they're just there with you!"* (Male, 52, other in Australia).

The appreciation for the surrounding environment subtheme had a statistically significant relationship between place of birth and the appreciation theme ($p = 0.019$). All of the people born overseas mentioned appreciation. Whereas, only 17% of people born in Queensland and 14% of people born in other states of Australia mentioned appreciation (Table 2.5).

> *"Because of what I've seen and grew up with, I want to pass those values onto my kids. So I want to make sure that the environment is still suitable for them to appreciate it…* [and] *they do have those values because my daughter just recently went camping in the middle of the night with her boyfriend because it was a nice night and it was just there, so this is appreciating what's there."*(Male, 52, other in Australia).

[3] The Calliope Shire became part of the Gladstone Region in 2008. Its logo was a seahorse but in that same year the logo was adopted by the Millenium Esplanade in Tannum Sands (GRC, 2008).

"That's special, that you have places where you can sit on the beach and you can see the turtle tracks and you know that you're part of a system that is quite special. When you're camping on Colosseum Inlet [south of Gladstone] *on the beach and this monster comes out* [in the water] *and scare the hell out of you and it's a dugong that comes up* [close to where you are], *that's special."* (Male, 58, international).

"My kids appreciate the environment. I don't know if they like it, but they appreciate the opportunity to be out there." (Female, 52, international).

The historical importance of the Region was mentioned by a third of the participants, particularly the township of 1770 as the place where Capitan Cook landed for the second time in Australia (Table 2.5). Similarly, places like Facing Island and Police Creek were mentioned as important Aboriginal ceremonial places or settlements. There was a statistically significant negative relationship between the historical places theme and annual individual income (p = 0.002). This theme was mentioned mostly by people in the '$60,000 to $100,000' and 'More than $200,000' income categories (Table 2.5).

"[The Bustard Head] *Lighthouse is the only operating lighthouse operating* [sic] *in the state* [of Queensland]*… That's a fairly huge, historical monumental thing to have in our little tiny community, it's actually the second oldest building in the Region. The town of 1770 is the second town where James Cook landed in Australia. These are small things that make this place unique."* (Female, 37, other in Australia).

"Barney Point [Gladstone] *is extremely important because that's where Colonel Barney landed and set* [up] *a colony there. It was going to be the capital of the* [Queensland] *state..."* (Female, 62, Gladstone).

"QAL [Queensland Alumina Limited] *has a historical significance because it was the first industrial part of the town. Indigenous peoples have sites further up in The Narrows… Police Creek and by the airport."* (Male, 50, other in Australia).

"Gladstone is one of the most culturally significant places I've ever heard of. Police Creek was the only freshwater source for 100 years. It kept the beef and cheese factory alive. Pretty much any culture that ever lived in Gladstone relied on Police Creek… There's places that got rock quarries, camping sites and all of that, that are 6,000 or 7,000 years old that were used before [the] *Ice Age. Facing Island is significant, it's got scarred trees, earth ovens, all that sort of things. It's everywhere seriously, you could stop almost anywhere and see something culturally significant."* (Male, 49, other in Australia).

"Canoe Point, Boyne Island, Tannum Beach and all that bush land is pretty special and important for the Goorang Goorang… I'd expect for future generations to have still available our indigenous traditions, this land has special significance. In Facing and Curtis [Islands] *there are places where Aboriginals had their camp fires and the flint stones they used for spears or starting fires. People are not aware of the significance of this land, that's something that needs to be nurtured."* (Male, 60, other in Australia).

Finally, one of the interview questions specifically asked if any place in the Region had provided participants with inspiration to do or create something. Although this is not a value *per se*, it is related to the appreciation and to spiritually special places. In this regard, the interviewees mentioned being inspired to take care of the environment, to show the people to others, to explore the Region, to look for more places to discover in the area, and to work for the community as some kind of representative or community voice. Only two participants mentioned that they were inspired in an artistic way like taking photos or painting.

There was a statistically significant relationship between the theme 'inspiration to take care of the environment'. Gender (it was mostly mentioned by women ($p = 0.018$)) and place of birth, (mostly Australians born in states other than Queensland and people born overseas mentioned it; $p = 0.030$) were influential demographics. Also, participants that have lived in Gladstone for less than 5 years were more likely to be inspired to look for more places to explore in the Region (p = 0.028) (Table 2.5).

> *"*[I have had feelings of connection with the environment:] *that's why I do what I do, because I'm driven by a love for the environment, and it comes from a value that I have …. And I feel like a protector of that.*
>
> [I'm inspired] *to educate others and my children to understand nature and the part that they play and their responsibility around it. I've been involved with a lot of [different sorts of environmental] groups to make a lot of noise. I try to go out and do as much as I can for the environment."* (Female, 52, other in Australia).
>
> *"I've taken work colleagues to the island* [Facing Island] *before, and you sort of feel like you're a bit of a tour guide, you sort of feel like you're justifying yourself to them. We love it for so many different reasons that you feel like you're trying to convince them to love it as much as you do…"* (Female, 40, other in Australia)
>
> *"*[My connection with the environment is] *the reason I'm working every day for the community and I like to think that I'm improving the community as well. To me that's a sort of spiritual connection with the people of this town."* (Male, 67, other in Australia).
>
> *"How could you not be* [inspired by nature to take pictures]? *It's gorgeous! You see something green, fresh with morning's dew on it, you can't help but be inspired by it."* (Female, 60, other in Australia).

2.4.3.3 *Economic themes*

As with the previous sections, the relationship between values, concerns and beliefs classified as being within an economic theme (or subtheme) are summarised in Table 2.6. Further clarity around these concepts are explored by provided representative quotes from some of the participants. Sixteen economic themes were identified. Of these 16, two (i.e. increased living cost and need for tourism services improvement) had a statistically significant relationship with two demographic factors: place of residence and place of birth (Table 2.6). These results partially support the H_I (influence of participants' demographics on values, concerns, beliefs and norms).

Table 2.6 Economic themes and subthemes (i.e. [a] values, [b] concerns and [c] beliefs) stated on the interviews ordered by number of participants that mentioned them. The last column shows the demographic factors with statistically significant relationships with the theme. NS = not significant (Fisher's Exact test). The ↑/↓/= symbols specify if the proportion of respondents is statistically larger, smaller or not different from the expected percentage.

Theme	Subtheme [a, b, c]	Description	No. of mentions	Demographic factors	Proportion of respondents per demographic factor
INDUSTRY	Jobs creation [a]	Answer to prompt about the aspects of the Region's development that are vital for its prosperity	19	NS	
	Cost of living [b]	Increased cost of living (house rentals, food and services) since the industrial boom	13	Place of birth: p = 0.024	Queensland: 58.3% ↑ Other than Queensland: 21.4% ↓ Outside Australia: 100% ↑
	Important for wealth [a]	Answer to prompt about the aspects of the Region's development that are vital for its prosperity	8	NS	
	Commercial fisheries [a]	Perceived negative impact on commercial fisheries from the dredging and the industrial activities related to it	6	NS	
	Region can have more [c]	Certainty that the Region could host more industries	3	NS	
TOURISM	Recreation cost [b]	High cost of recreation activities in the Region like going to the GBR islands or owning a boat	10	NS	
	Compatible with industry [c]	Tourism activities are compatible with heavy industry activity in Gladstone	6	NS	

Table 2.6 Continuation

Theme	Subtheme [a, b, c]	Description	No. of mentions	Demographic factors	Proportion of respondents per demographic factor
TOURISM	Industry tourism [a]	It is a good tourism option since tourism is not the main economic activity in the Region	6	NS	
	Need services improvement [c]	It needs to improve its services to be a real alternative economic activity in the Region	6	Place of residence: $p = 0.020$	Outside Gladstone: 37.5% ↓ Gladstone City: 0% ↓
	Need more information [c]	It needs to increase and improve the information and promotion about the Region to be a real touristic attraction	5	NS	
	More tourism [c]	There is room for expansion of this activity because the Region offers a wide diversity of places to go	5	NS	
	Incompatible with industry [c]	The activity is incompatible with the heavy industry in the Region.	2	NS	
OTHER ECONOMIC ACTIVITIES	Diversification [c]	Need to diversify the economic activities of the Region to stop depending on industry	6	NS	
	Farming [a]	Farming has been a consistent activity in the Region but not practiced in bigger scale	7	NS	
	Business [a]	Other business like restaurants, shops and services related to industry could prosper in the Region	4	NS	
	Aquaculture [a]	It could be an alternative economic activity	2	NS	

Industry was the most common theme mentioned by participants (Table 2.6). Industry was linked to perceived positive and negative implications, such as jobs and general wealth generation, but on the downside it has caused a high cost of living in the Region. For example, 12 of the 30 participants (40%) moved to Gladstone because they, or someone in their family, got a job at one of the industries in town. The remaining interviewees moved to Gladstone for family reasons, because they got a job not directly related to industry (36.7%), or they grew up there (23.3%).

> *"The prosperity of the Region is driven by industry, and by industry I mean the manufacturing, the processing. There's* [also] *fishing, beef and agriculture and tourism industries. They are major employers, major investors in the area in terms of wages and benefits that they put into the community. At the end of the day, it's the reason we are here. The growth of Gladstone has been associated with all those industries coming; so in terms of prosperity, industry is a part of that. It's important for the workers and the services… It's a symbiotic relationship between the* [community and industry].*"* (Male, 50, other in Australia).

> *"There's lots of work here. That's good for people and that means that the community has money."* (Female, 49, other in Australia).

> *"People's ability to enjoy the environment is generally relevant to cash: they've got to be able to afford it. So, if there's no industry, you've got none of that. You don't need schools [or] social infrastructure.*
>
> *Without coal mines we wouldn't be here, there'd be no homes, or hospitals, or schools. That puts a lot of pressure on the politicians."* (Male, 57, other in Australia).

Although tourism is not a particularly strong economic activity in this Region (REMPLAN 2012), a few participants identified it as an alternative economic activity that could help to diversify the regional economy. These participants identified that the Region can provide a wide variety of landscapes and experiences from bush walking to fishing, kayaking and snorkelling.

"[Tourism and industry are compatible]: *I believe so, given that industry doesn't encroach and expand too far into those unique environments…* [I've seen that] *in my business: the first impression of people is about all that industry, but ten minutes later* [they can see dugongs and then they're in a completely different world]*."* (Male, 40, Gladstone).

"We've got two main rivers, the harbour, we're close to the islands, the reef, so yeah, definitely there's room for tourism." (Male, 41, other in Australia).

"There's always been talk about a resort on Curtis Island, there was a talk of an ecotourism resort on Hummock [Hill] *Island and never happened*[4]*. Between here and Agnes Water people really thought about it, there are little islands and beautiful coastline; from an ecotourism point of view, a lot could be done."* (Male, 60, other in Australia).

Even though five participants (16.6%) mentioned that the Region could have more tourism, they also recognised that there is a need to improve services related to tourism first. These services included the availability of information about the different activities and places that could be visited that would supplement current information, which focuses solely on Gladstone being the gateway to the Southern Great Barrier Reef area. People living outside of the metropolitan area of Gladstone were more likely to mention a concern about tourism services and information, with the statistical relationship between these variables being significant (p = 0.024) (Table 2.6). Industry tourism was also mentioned as a good option to diversify the economic activities of the Region. They noted that day trips to visit and see the "inner workings" of different industrial facilities are becoming popular, especially among older tourists.

"Gladstone is in need of some good attractance [sic] *on the water. It has this beautiful harbour but not enough that encourages people to access it on a regular basis, so whether that's shop fronts, coffees or something*

[4] The Hummock Hill Island development plan was approved by the Federal Government on November 2015. It includes 460 rooms for a five star resort, a four-star beachfront hotel and a motel, along with a camping and caravan campground, a golf course and shopping precincts (QGDSD 2016a).

like that… I think if there was more information about where to go and what to do in Gladstone for its natural attractions that would be a worthwhile. [Also an] *information centre other than the one in the marina because I think that's out of sight. If you've never been here before you don't even know where to go to find* [the marina information centre]. *It took me a long time to find it, until someone mentioned it to me. If you need to go there you don't know it's there. There's no clear signage that says: 'Marina, that way'. There's no welcome information, visual information as you enter Gladstone from any of the highways that tells you to go down there and have a look at that."* (Female, 44, other in Australia).

"There's so much to do here, but it's not accessible if you don't have a car… It's a challenge to go to Tannum Sands or Mount Larcom by public transport…The industry is also fascinating in itself as a tourism attraction. I know the industry tour is generally more popular within older tourists; our 'grey nomads' love to go on the free industry tours and they would stay sometimes the whole week. It's not an attraction to the younger people [because they] *don't stay as long and they want something right here, right now"* (Female, 37, other in Australia).

Activities such as small-scale farming, aquaculture and businesses related to industry were mentioned as having good potential to thrive if not all economic incentives within the Region were directed to industry. Some of the participants have shown concern about the period after the current economic boom[5], when jobs are scarce and the economy in the area struggles.

"Certainly we need industry, but what we also need is diversity, rather than relying on the resources, whether it is aluminium, or coal, or whatever." (Male, 67, other in Australia)

[5] According to Rolfe et al. (2012), Gladstone has gone through at least two other economic boom periods. The first one at the end of the 1970's with the construction of Queensland Alumina Limited and the Power Station. The other one in late 2004 due to the development of the Yarwun alumina plant by Rio Tinto.

"The problem at the moment is that [industry] *is going backwards… Now* [Gladstone] *needs something like a steel works to start another employment source."* (Male, 71, other in Australia).

"We have to [diversify] *but we don't, because we are putting all our eggs in the fossil fuel basket. Gladstone [has] gas, coal exports, the ambition to become the largest exporter of liquefied natural gas… and billions have been invested on that* [but those resources are limited]. *So what we can do [is to harvest] renewable energy: we can harvest the sun, the wind, the ocean."* (Male, 58, international).

Although the economic benefits are recognised, aspects like the increased cost of living, high recreation costs, the perceived direct or indirect impact to commercial fishing from dredging, and the perceived negative input on the community by the Fly-In Fly-Out (FIFO) workers regarding increased violence, insecurity and pollution were also mentioned (see Section 2.4.3.5) for further discussion on FIFO themes).

"I take the opportunity to play golf twice a week…The area has lots of things that you can do, [but I don't think this is the situation for the general community]: *accessibility comes with a price tag* [and that] *immediately includes or excludes different groups of people. There are a whole range of activities that people don't involve themselves* [with] *like some sports because of the cost of registrations, or music because of the cost of the music instrument… and I think in Gladstone that's a problem with some groups in the community."* (Male, 57, other in Australia).

"About five years ago, during the construction period [of the Liquid Nitrogen Gas facilities on Curtis Island]*, we had three murders. Two were domestic violence related, but one was a particular murder of a young girl related to a shift worker in one of the plants and the community was incredibly sensitised at that time on this growth of workers coming in. So those sorts of pressures also come with growth."* (Female, 60, other in Australia)

"There's a lot of transient people here now. It's not their home, it's a place they come to work, short or long periods, they rent a home, they

can't be bothered taking their rubbish to the dump so they put it on the bush trails. You wouldn't believe, there's fridges, mattresses, domestic rubbish, and plastic bottles. People are apathetic, this place doesn't mean anything to them. It's a place to come and work, make money, as much as they can and go, what the impacts are they don't care." (Male, 60, other in Australia).

The increased cost of living was identified as one of the largest economic impacts, especially to families that did not have a job in industry, because the house rental prices increased approximately 65% from December 2012 (when the median rent in Gladstone was below the Queensland median) to December 2014 (QGSO 2016b). Consequently, a proportion of people had to move out of the Gladstone Region to more affordable locations such as Bundaberg or Bagara (a coastal suburb of Bundaberg). There was a statistically significant relationship between the theme 'cost of living' and birth place ($p = 0.024$), where people born in Queensland and overseas were mostly likely to mention this theme (Table 2.6).

"It's a hard one to balance, I think there's going to be a fine line in the balancing of how you are going to develop this, (because we all need it because it's where you're going to make your money from), without damaging everything else. I think the social-economic issues that Gladstone has had it's been quite immense on the locals that were here before, because I know people in our street who left. They make money, they sold their house for a decent price, whereas a lot of retired people in their 70's left to Bundaberg or Brisbane, because they couldn't afford to live here, but also part of it was that they could make money out of their houses. A lot of it was they couldn't handle the busyness of the town; sounds silly but there was a lot of influx of traffic." (Female, 52, international).

Another negative perception of industry that some participants voiced was the reduction of commercial fishing in the harbour due to increased shipping and as a consequence of the dredging and the fish disease event in 2011 (see section 2.4.3.4). Specific comments made around these issues included:

"Some stakeholder groups have been significantly impacted: we used to have a strong commercial fishing industry, we've hardly got any now. We had a seafood business with packaging and processing shed and now it's closed. It was a family business and now they only got a shop front. So there's a lot of jobs lost. They used to process scallops in the harbour, they don't do that now because after the dredging and flooding events the turbidity in the water meant that the water quality wasn't sufficient. There were fishers that brought live[coral] *trout, but they had to stop doing that because they had to have a continuous flush of water through the tanks, and they found that the fish health deteriorated because the turbidity of the harbour."* (Female, 60, other in Australia)

"Maybe the commercial fisheries should be compensated because they can't fish anymore here." (Female, 52, international).

"There's nowhere near the number of professional fishermen around anymore, they probably moved. We used to see prawn boats trawling up and down in the harbour, don't see them anymore." (Male, 71, other in Australia).

2.4.3.4 Environmental themes

The relationships between values, concerns, beliefs and norms within an environmental context are summarised in Table 2.7. Again, representative quotes are used to help illustrate the themes mentioned. Seven of the 46 (15%) environmental themes had a statistically significant relationship with either one, two or three of the next demographic factors: time of residence, education, generation, place of residence, stakeholder group and income, results that partially support the H_I (influence of participants' demographics on values, concerns, beliefs and norms) (Table 2.7).

Biodiversity was the most commonly expressed theme within the environmental subject. During the interviews, the participants alluded to sea turtles, dugongs, birds, dolphins, fish (mostly mentioned when talking about recreational fishing), mangroves and seagrasses. Time of residence in the Region was statistically related to the biodiversity allusion. Almost all the participants that had lived in the Region from 6 to 40 years mentioned biodiversity (p = 0.013) (Table 2.7).

Other animals mentioned less frequently were whales, mud crabs, kangaroos and echidnas. A relevant sample of the comments made are:

> *"I inherited this beautiful place with kangaroos jumping all over, bush turkeys and goannas, snakes, echidnas and black cockatoos."* (Male, 60 years old, Australian).
>
> *"Everybody likes to go and enjoy the harbour: go swimming, for picnic, fishing.* [But] *if there's no seagrass beds, no corals or nothing interesting out there why would I go?"* (Female, 33, international).
>
> *"I like the location of Gladstone… we get northern and southern species* [and] *because of that we have incredible diversity of animals and plants.*
>
> *Curtis Island is the place I like to visit more… Its diversity in landscapes, wetlands on the north eastern side. The wide diversity* [of landscapes] *is what hits you: rain forest, open grasslands, tea trees, swamps, mega sand dunes, blackboy grass trees, mangroves, oceanic blue water, coral reef."* (Male, 40, Gladstone).

Table 2.7 Environmental themes and subthemes (i.e. [a] values, [b] concerns and [c] beliefs) stated on the interviews ordered by number of participants that mentioned them. The last column shows the demographic factors with statistically significant relationships with the theme. NS = not significant (Fisher's Exact test). The ↑/↓/= symbols specify if the proportion of respondents is statistically larger, smaller or not different from the expected percentage.

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor
ECOLOGY	Biodiversity [a]	Mentions about different animals that can be seen on the Region	23	Time of residence: $p = 0.013$	0 to 5 years: 57.1% ↓ 6 to 10 years: 100% ↑ 11 to 40 years: 93.3% ↑ Over 40 years: 25% ↓
	Changes are natural [c]	Answer to prompt about future environment scenarios	8	NS	
	Ecosystem importance [a]	Recognition of the importance of the environment in general and of mangroves and seagrasses in the harbour for dugongs and turtles	5	NS	
	Rivers' input on harbour [a]	Importance of the freshwater input from rivers in the harbour	3	NS	
GLADSTONE'S ENVIRONMENTAL HEALTH	The same/good health [c]	Answer to prompt about the environmental health of the Gladstone Region	12	NS	
	Health deteriorating [c]	Answer to prompt about the environmental health of the Gladstone Region	11	Time of residence: $p = 0.026$	0 to 5 years: 14.3% ↓ 6 to 10 years: 100% ↑ 11 to 40 years: 46.7% ↑ Over 40 years: 0% ↓
	Health improving [c]	Answer to prompt about the environmental health of the Gladstone Region	7	NS	

Table 2.7 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor
PERCEIVED ENVIRONMENTAL IMPACTS FROM DEVELOPMENT	Impact will occur [b]	Answer to prompt about the increasing development in the Region	18	NS	
	Dredging impacted [c]	One of the reasons for the decreased environmental health of the harbour or the reef	15	NS	
	Dredging did not impact [c]	This activity did not impact on the health of the harbour or the reef	4	NS	
	Harbour is turbid [c]	The harbour's turbidity is not caused by the dredging, it is usually like that	4	Income: p = 0.010	\$20,000 – \$60,000: 0% ↓ \$60,001 - \$100,000: 20% ↑ \$100,001 - \$200,000: 7.1% ↓ More than \$200,001: 100% ↑
				Stakeholder group: p = 0.013	Recreational fishers: 0% ↓ NGO: 0% ↓ State Government: 25% ↑ Local Government: 0% ↓ Tourism: 0% ↓ Community: 0% ↓ Industry: 60% ↑ School principals: 0% ↓
	Fish disease	Event happening after major flooding and during the dredging	8	Place of residence: p = 0.044	Outside Gladstone: 43.8% ↑ Gladstone City: 7.7% ↓

Table 2.7 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor	
PERCEIVED ENVIRONMENTAL IMPACTS FROM DEVELOPMENT	Fish disease not caused by dredging [c]	This event was not caused by the dredging	4	NS		
	Housing impact [b]	One of the reasons for the decreased environmental health in the Region	11	NS		
	Pollution [b]	One of the reasons for the decreased environmental health in the Region	9	Time of residence: $p = 0.050$	0 to 5 years: 28.6% 6 to 10 years: 100% 11 to 40 years: 26.7% Over 40 years: 0%	↓ ↑ ↓ ↓
				Education: $p = 0.033$	Higher education: 42.9% Other education: 0%	↑ ↓
				Generation: $p = 0.048$	Boomers: 16.7% Generation X: 54.5%	↓ ↑
	Population increase [b]	One of the reasons for the decreased environmental health in the Region	8	NS		
	Resilience [c]	The environment in the region has been able to recover from different impacts	7	NS		
	Biodiversity loss [b]	One of the consequences of the decreased environmental health in the Region	6	NS		

Table 2.7 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor
	Water quality [b]	Awareness of the harbour's water quality for health reasons	5	Place of residence: *p* = 0.048	Outside Gladstone: 31.3% ↑ Gladstone City: 0% ↓
	Ecosystem fragmentation [b]	One of the consequences of the decreased environmental health in the Region	4	NS	
	Localised impact [c]	It is preferable to have concentrated areas of development, that having it spread all over the coast	4	NS	
	Introduced species [b]	One of the reasons for the decreased environmental health in the Region	1	NS	
IMPACT MANAGEMENT	Effective management [d]	The need for effective management of environmental impacts	8	Place of residence: *p* = 0.010	Outside Gladstone: 6.3% ↓ Gladstone City: 53.8% ↑
	Alternative power sources [d]	The need for alternative power sources to reduce dependence on coal and environmental impact	4	NS	
	Lack of broader view [d]	Management of impacts should be done from a watershed perspective	3	NS	
	Not enough monitoring [c]	Harbour's water quality monitoring before and after dredging has not been sufficient	2	NS	
	Enough monitoring [c]	Harbour's water quality monitoring before and after dredging has been sufficient	1	NS	
	Balance not possible [c]	Balance between development and environment conservation is not possible	1	NS	

Table 2.7 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor
GREAT BARRIER REEF WORLD HERITAGE AREA (GBRWHA)	No impact on development [c]	Answer to prompt about the impact of the WHA establishment on the development of the Region	18	NS	
	Negative perception [c]	Gladstone Region is perceived negatively by people living outside the Region or internationally	18	NS	
	Positive impact [c]	The establishment of the WHA has had a positive impact because it constrains industry development and regulations were enforced	10	NS	
	Port is not the GBR [c]	There is no coral reef in the harbour, therefore there is no reason to belong to the GBRWHA	10	NS	
	Port is the GBR [c]	There is coral reef in the harbour	1	NS	
	No reason to be part of the WHA [c]	The harbour and the Region have no heritage value, therefore there is no reason to belong to the GBRWHA	8	NS	
	Awareness [c]	The GBRWHA has brought consciousness to what is happening in the Region regarding industrial development	7	NS	
	Ecological significance [a]	The GBRWHA is important from an environmental point of view	4	NS	
	Industry shouldn't be here [c]	Because of the closeness to the GBRWHA, industry should not be in Gladstone	4	NS	

Table 2.7 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents per demographic factor
(GBRWHA)	Negative impact on industry [c]	The GBRWHA has had a negative impact on industry	4	NS	
	Intrinsic value [a]	The GBRWHA has value on itself	3	NS	
	Good management [c]	The GBRWHA has been well managed by the authorities	3	NS	
	Protection [d]	The government has now the obligation of ensure that impact does not happen from the activities in the region	3	NS	
	Reef declining [c]	The reef is declining due to natural and anthropogenic reasons like dredging and shipping increase	3	NS	

Mangroves and seagrasses were mentioned by participants as important ecosystems, but also as ecosystems being affected by coastal development and by dredging activities in the port. Concern about biodiversity loss was also expressed due to the increased development of the Region.

> *"So much industry going on in the past, that there's a lot of damage already done, a lot of trees have been take out, a lot of mangroves have been taken out, there's been a lot of disconnection in the ecosystem."* (Male, 49, other in Australia).

> *"Where we are sitting now* [in the marina], *it used to be a creek and it lost a lot of mangroves during the last 30 – 40 years. So we just want something left alone* [by industry] *so we can go and have peace and quiet."* (Male, 63, other in Australia).

> *"Turtles were starving when the flooding happened because the seagrass beds were covered by a lot of the silt coming out from the rivers."* (Male, 57, other in Australia).

> *"I don't think we have the abundance of species, but the diversity is still there. I've certainly seen a decrease in abundance."* (Male, 40, Gladstone).

> *"I haven't seen dolphins since the dredging started. My children won't have that opportunity to have that wildlife right out of their door. That's a terrible thing."* (Female, 52, other in Australia).

> *"The impacts* [due to development] *have been significant. Tell me how many dugongs and dolphins you've seen? Tell me how many fish they're catching now as opposed to 10 years ago, when I first arrived. Are we that silly? It's in your face!"* (Male, 60, other in Australia).

The importance of the regional ecosystem was mentioned by 16.6% of the participants, and the importance of the input or connection of the rivers and the sea, especially the Calliope and Boyne Rivers was mentioned by 10% of the participants. In these cases, the input of freshwater to the port and the freshwater provision for the area were particularly emphasised.

> *"It is required to release water from the* [Awoonga] *Dam* [to ensure the maintenance of the ecosystem]*… that puts fresh water back into the rivers and activates cycles like the breeding cycles of fish: trying to simulate what naturally happens."* (Male, 52, other in Australia).

> *"The harbour needs freshwater, or things in the harbour need fresh water to rejuvenate itself, to clean it up. We're lucky that we have the Calliope and Boyne Rivers. As long as we have the rivers, the harbour will be healthy."* (Male, 63, other in Australia).

> *"Port Alma and the Fitzroy River is another massive and unique ecosystem… the whole delta attached there is significant, with all that mangroves and estuary system there* [and] *it becomes a part of* [the Gladstone harbour] *if that makes sense."* (Male, 40, Gladstone).

Participants were asked directly if they thought the environmental health of the Region was improving, deteriorating or staying the same. Some of the participants were hesitant (or uncertain) to answer this question, and were not clear about providing a specific answer either because they said they did not have strong data to justify their answer, or because they had not lived long enough in the Region to know. But after clarifying that I was seeking information about their personal perception not about the precision or accuracy of their comments, then nine (30%) of the participants then felt comfortable to provide input. These participants stated that the environmental health of the Region was the same or in good health, 11 (38%) said it was deteriorating, eight (28%) said it was improving and one (3%) preferred not to answer. There was a statistically significant relationship between the answer provided for 'deteriorating environmental health of the Region' and time of residence (p = 0.026). In general the longer a person lived in Gladstone, the more they felt that the environment was deteriorating (Figure 2.3; Table 2.7).

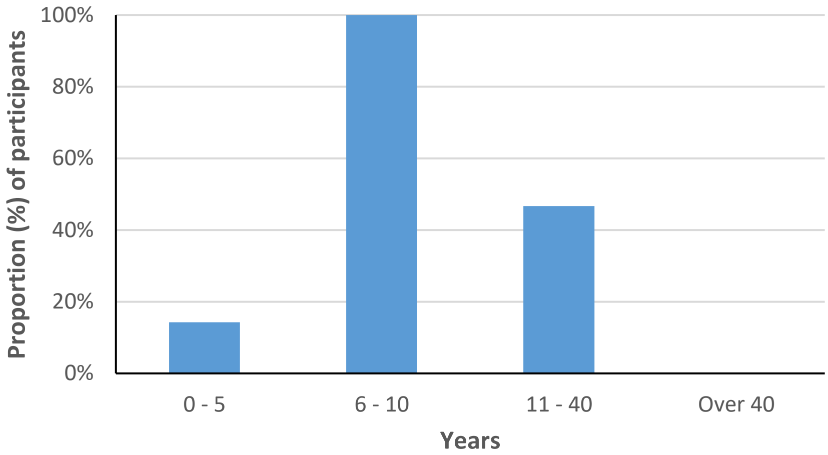


Figure 2.3 Proportion of participants (based upon their time of residence in the Gladstone Region) that consider that the environmental health of the Region is deteriorating.

> *"You can see a slow but steady damage on the quality of our environment,* [but] *it can be improved by all of us taking care of the environment, and understanding the effects of simple actions."* (Male, 40, Gladstone).

> *"At the moment I'd say that the environmental health is deteriorating because of all the construction activities on land* [because it produces] *litter and increases dust,* [but] *that's a temporary thing. It's hard because every new person in town* [adds pressure] *in the environment…"* (Male, 44, international).

> *"*[The environmental health of the region] *is staying the same… There has been an expansion of coal loading facilities with some footprint because they had to dredge or build stuff, a bit of noise but there are no bigger issues associated. I think that because the industry hasn't been expanded greatly in the last years and regulations have made sure that it doesn't get any worse, which has led no variation of the quality."* (Male, 48, other in Australia).

Although, consequences that could be associated with or perceived related to the harbour dredging activities from 2010-2013 were not actively elicited, they were mentioned by 17 (56.6%) of the participants. Eleven (36.6%) of the participants voiced the sentiment that harbour dredging activities are one of the main contributing factors to environmental degradation. In addition, while most of these participants thought the impact was temporary and by the time of the interview (2014) the environment was rebounding to normal, other participants considered that the impacts would last long term and would even affect the GBRMP reef (which is outside of the harbour boundaries) . Participants may not understand the difference between the GBRWHA and the GBRMP.

> *"Environmental health of the Port is improving because the dredging is finished. I believe that flooding, dredging and activity contributed to diminishing harbour health on last years. I can't only blame the flooding."* (Female, 60, other in Australia).

> *"What is happening here* [industrial development and dredging] *it's going to affect the marine park. Nobody knows yet if the effects will be short or long term. Even if the impact occurs at once… there will be long term effects."* (Female, 44, other in Australia).

> *"The top part of the layer of the sediment it's got animals, but as you go deeper becomes anoxic and per definition, there's a zone that sequesters metals. It takes ions and locks it up in the anoxic layer. That's why that [layer] is dangerous, because you bring it into the oxic zone. What happens when you expose it to the dissolved oxygen in the water? You convert it to a metal hydroxide and it's very mobile: we're liberating all these metals and making them available to the biology around (sic)."* (Male, 58, international).

> *"All what they said on the news about the toxic plums, where's the toxicity coming from? The only issue is about metals* [which] *are not toxic if they're in a dissolved state above* [sic] *a certain level and in no time during* [the dredging] *did that occur, there was never a mechanism to get into the dissolved state,* [and] *only dissolved can bioaccumulate."* (Male, 53, Gladstone).

Two further impacts related (directly or indirectly) to the dredging that were mentioned by the participants were the cases of fish disease and the decreased water quality in the harbour. According to the participants, the fish disease was the result of the decreased water quality that was caused by the dredging, the flood in 2011, or a combination of both. Five (17%) of the participants firmly stated that the dredging did not cause the fish kills, while three others (10%) asserted that it did, and three more (10%) were not sure because of the contradictory information they received about the fish kill event(s). In this case, there was a significant relationship between the 'Fish disease' theme and a participant's place of residence (*p* = 0.044) (Table 2.7), with participants living outside the metropolitan area of Gladstone more likely to mention it, than participants living in the metropolitan area (see Table 2.3 for 'Place of residence' categories description).

> *"*[Fish kills] *were caused by the maximum stress from all the filthy water from the floods, rather than dredging, because dredging didn't even started* [sic] *at that time. The fish disease event was four to six month later after the flood and dredging didn't kicked off until June… and there is no toxins associated with it, you keep it wet so it doesn't acidify and it stays as it is: solid."* (Male, 53, Gladstone).

> *"They dredged 20 km of soil around 1982 and nothing happened to our fish on the harbour. So how can you explain 30 years later, the same scenario, moving the same amount of soil and yet all this fish disease* [happened]*."* (Male, 63, other in Australia).

> *"The government officials are saying 'everything is fine' and they're blaming the floods: 'the reason we have dying dugongs, sick turtles, algal blooms, crabs with holes in their shells, fish with rashes, it's because we had a flood'. Floods are normal, although they have been more frequent and they're not completely harmless.* [But] *to categorically state that the dredging had no impact on these numbers is false. It's lying to the public."* (Male, 58, international).

> *"There's been a lot of research about* [the fish kills]. *I don't know whether the research might have been as rigorous as it could've been. There was a lot of political pressure. It was very interesting that ministers were able to make announcements before the results were out, and the results coincided with what the minister said. So, there's*

a high degree of scepticism about the announcements by the port corporation (for example).” (Male, 63, other in Australia).

Five participants (17%) mentioned being more aware of the harbour’s water quality since the dredging started, because they heard of some cases of skin rashes and about the fish disease. This information was prevalent in the media at local, state, national and international scales. The harbour’s water quality theme had a statistically significant relationship with the participant’s place of residence (p = 0.048), where 31% of the people living outside the metropolitan area of Gladstone mentioned it (Table 2.7). No participants living in the metropolitan area mentioned this concern. Thus, of the dredging and the fish disease, four participants (14%) clearly stated that they no longer consume fish from Gladstone.

> *“I used to like eating the seafood, but now I’m a little bit scared to do that because of: what are they eating? What’s in the water? When the dredging was happening there were birds, sea snakes, turtles, fish, fish with rashes. Some fishermen had skin infections. So that made me scared about going into the water.”* (Female, 49, other in Australia).

Another perceived consequence of the dredging was the increased turbidity of the harbour. Four (13%) of the interviewees noted that the harbour is usually turbid or that changes in its turbidity are natural depending on the time of the year, tides and winds. This theme had a statistical significant relationship with participant’s individual annual income (p = 0.010): no one from the \$20,000-\$60,000 category mentioned this concern, but 20% of the \$60,001-\$100,000; 7% of the \$100,001-\$200,000; and all of the ‘More than \$200,001 categories’ mentioned this. The relationship between this theme and participant’s stakeholder groups was significant (p = 0.013). In this case, 25% of the State Government group and 60% of the Industry group mentioned it, while no one in the other groups mentioned it (Table 2.7).

> “*During the dredging campaign people wouldn’t go swimming because it looked dirty… but on the spring tides Gladstone harbour is always dirty and on the neap tides it’s always pretty clean and that was the case for the dredging as well. The dredging only added a*

certain amount to the background and it's been shown not to have any effect." (Male, 53, Gladstone).

"The aesthetic view of the harbour is totally relevant to the direction of the wind and the height of the tide, so if you have 1m neap tides is not going to pick up a lot of sediment, if you've got a 4m run, it picks up speed with a southeastly wind, the harbour is going to look like shit. Get a northerly wind at any stages, on a neap tide and the water is crystal clear." (Male, 57, other in Australia).

Although there are several concerns about the harbour's water quality, only two participants mentioned that the environmental monitoring has not been enough or has done poorly, and only one person stated that the monitoring was adequate (more details are discussed in section 2.4.3.5).

Just over half (57%; n = 17) of participants stated that the increasing development in the Region will affect the environment. One of the commonly mentioned consequences (37%; n = 11) is the increased housing due to the growth in the population followed by the establishment of the LNG plants on Curtis Island. According to these participants, the increased development (housing and industry establishment) led and/or will lead to problems such as unregulated runoff, clearance of vegetated areas (without restoration), ecosystem fragmentation, biodiversity loss, littering, or air and water pollution.

"Impact on the environment will depend on the type of development: if it's developed in a sustainable way, impacts can be considered and reduced because they can occur. It depends on level and scale…If you're saying mining and gas [industries]: *yes, the impacts will be significant, and I can already see that when I drive through Tannum Sands to Gladstone: the amount of lands cleared for housing is ridiculous and I don't know if that's been done in a sustainable manner, but I doubt it. Land developers are just clearing and not looking at species distribution. Queensland's laws are extremely lax about planning."* (Female, 44, other in Australia).

"In the short term the increasing development will impact the environment: mainly during construction. They're essentially clearing

vegetation and destroying habitats, and it is going to happen in Gladstone because [it] *is one of the designated ports, so it will continue to extend and habitat will become increasingly scarce. Thankfully Gladstone as a town is a good place to have a city because it's got pretty crappy resources. But in the long term it is difficult to say, it depends on what happens to environmental objectives as far as air quality goals: at the moment there's a PM10* [particulate matter 10 micrometres or less in diameter] *limit of 50µ/m³. None is ideal and 50 is high, and 5 exceedances a year are allowed, but it doesn't consider sensitive individuals (e.g. asthmatic individuals). But from this point* [in time] *there's no way* [air] *quality will get worse."* (Male, 53, Gladstone).

Although the environmental impact is an important concern, seven (23%) of the participants considered that the environment has been and is resilient. I note that no statistical trends regarding demographics and this theme existed. These participants appear to feel therefore that the impacts to the environment are not permanent as the environment will rebound.

"The environmental health of the harbour is improving [and] *I think* [it is because] *nature has its own way of managing* [the impact]*."* (Male, 52, other in Australia).

Pollution in general was mentioned by 30% of participants (n = 9) as one of the main concerns related to the increased development of the Region. Air pollution has been a concern for a long time in this Region due to the constant industrial activity in Gladstone, and because of this, air pollution has been assessed the Department of Environment and Resource Management (DERM) with Queensland Health and local industry partners (Kennedy et al. 2009). Because of their concern and perception that the air pollution was higher in the metropolitan area, seven (24%) of the participants stated their decision to live outside the metropolitan area (i.e. Calliope, Boyne Island, Tannum Sands and Agnes Water).

"We also chose to live in Tannum Sands, due to the prevailing winds in Gladstone, because of the heavy industry. Also the [because of the]

high incidence of ill health in children and cancer." (Female, 44, other in Australia).

Pollution was more likely to be mentioned by participants that belong to Generation X (1965 - 1981) (p = 0.048), participants that have a higher level of education (p = 0.033), and participants that have lived in the Region between '6 to 10 years' (p = 0.050) (Table 2.7). Some of these participants identified littering as a consequence of the increase in the short-term work population in the Region.

"Now in Gladstone I go to Police Creek, a beautiful walking and bird life, and it's filthy with rubbish, people dump their rubbish daily or weekly there, it's incredible the impacts! I'd say the biggest change in these 10 years is the amount of rubbish dumped there. That's the most destructive. We have to take really strong initiatives to stop all this rubbish going to the sea." (Male, 60 years old, Australian).

"At the moment construction is unregulated, so all that runoff increases the turbidity [in the harbour]. *In here the council do nothing to improve regulations and the appropriate infrastructure to stop litter and runoff from getting into the marine environment." (*Male, 44, international)

In relation to the perceived environmental impacts, four (13%) participants noted that they prefer the development and their impacts to be concentrated in a few places rather than being spread across more regions in Queensland. This comment can be placed into context as the Queensland government have listed Gladstone as an area where heavy industrialisation will occur and that a further six major ports located next to the Great Barrier Reef may occur (QGDSD 2016b; Wilkinson and Hichens 2011). In this regard, these participants felt that rather than having the entire Queensland coastline developed (by industry and tourism) they would rather "sacrifice" a particular area to development and protect other areas.

"There should be sections of the coast line completely undeveloped to maintain their natural state. I'm in favour of centralisation of port facilities, rather than multiple smaller ports. Since Gladstone is

already established it is a good area to have more industry." (Male, 48, other in Australia).

"So you could say that Gladstone has been sacrificed, industry [in the city] *sacrifice that area, hopefully learn from that to improve elsewhere... Putting emotion aside (because I live in Gladstone), I'd rather see one area fully utilised as opposed to scattered."* (Male, 40, Gladstone).

"It's probably better to develop this area and, ok you have to have some detrimental effects in the WHA, but let's not do it in 10 places along the coast, let's try to reduce it. I think Gladstone it's probably identified for that, that it probably can withstand development and still [have] *some environmental value for the Region".* (Male, 67, other in Australia).

Since the Port of Gladstone is a heavily industrialised city located within the boundary of the GBRWHA, it was important to know whether a participant was aware of this and if so what their thoughts on this status were. Ten (33%) of the participants thought that the GBRWHA designation was useless because "*the port is not the Great Barrier Reef*" (i.e. according to the participants there is no coral reef in this area), and that there is nothing in this area of particular importance to be considered as World Heritage. However, one person from the tourism group that was also born in Gladstone, mentioned that there is coral in this area but that it is not that accessible and therefore not commonly known

"There's an assumption that we have 'Nemo'[6] in the harbour, and he doesn't live here. He's on a TV screen somewhere, but there are a few 50 miles away in a thing called the Great Barrier Reef not in muddy Auckland Creek. Yes, there's coral in Facing Island but it has mud all around. The reef it's actually 100 miles away, it's stupid. Move the boundary away from the affected areas. Why have the GBR and the

[6] 'Nemo' is the main character from the computer animated movie 'Finding Nemo' from 2003. Nemo and his father are clown fish (*Amphiprion ocellaris*) living in a coral reef in the Great Barrier Reef.

authority governing an area of a busy port? It's totally dumb." (Male, 57*,* other in Australia*).*

"I think [the boundary of the GBRWHA] *it's a ridiculous line drawn on a map that tells us nothing about the Region and it adds no value whatsoever. About three years ago that line was different, so in the legislation it says that the line follows the high tide mark and includes all coastal islands (so Boyne Island is in the WHA, including the smelter), but the official maps had Gladstone Harbour excluded… and about a year and a half ago I search for the map and the map popped out showing* [the Gladstone Harbour] *in it. So we've taken it to federal level to get clarification on that map change and they stand by the fact that the act hasn't changed, and that now the map is a reflection of the Act, so I think it's ridiculous. I think it devalues the value of having World Heritage listing when you have a fully operational harbour in a WHA."* (Female, 40, Gladstone).

"I think the WHA was a mistake. Its boundary shouldn't follow the coast. What's the heritage value of the Gladstone Harbour? In 200 years you can say." (Male, 44, international).

Although the GBRWHA was established in 1981, 18 (60%) participants thought that it has not had an impact on the scale or rate of development in the Region, with only four (13.3%) of the participants stating that industry should not be in the Region in order to protect the GBRWHA.

"You would expect (because it is a WHA) the respect from humans for that particular place would be there. But it clearly doesn't exist, otherwise we wouldn't have the debates that happen all the time like the ones in Bowen, Mackay, Abbot Point and other places in the GBR: they're all about, 'what's industry doing and is it ok?' So I don't think the protection has been provided to the degree it should." (Female, 37, other in Australia).

"The regulation that the [WHA] classification brings with it adds any value to the management of the harbour either. There are other regulations that are more hands on that are restricting impacts on the

> *Harbour than that piece of classification, I think."* (Female, 40, other in Australia).

> *"I don't think it has impacted on the development of the region because the attitude of past and current governments is to promote development, regardless of what's out there. But it has impacted on management practices of business, because it sounds worse if you say I would impact on the WHA than I would impact on the harbour."* (Female, 33, international).

As a consequence of the presence of heavy industry and its proximity to the GBRWHA, 18 (60%) participants felt that the area has a negative reputation among people living outside the Gladstone Region (or from overseas), mostly because of the "bad press" it has received. In contrast, seven (23%) participants felt that this "bad press" was a positive thing, since it has also brought awareness about the Region and the conservation challenges it is facing both in coastal land and in the marine park.

> *"But people from outside think Gladstone is polluted, and that perception is been created by their actions on the last decade. In here the ecological and sustainable issues are at the bottom of the list."* (Female, 37, other in Australia).

> *"I think internationally they think: What a disgrace! That all this development is going on in a WHA! When we're actually trying to protect the GBR and it is well protected. It comes down to how much information does someone have, if they're well informed then they're not concerned".* (Male, 53, other in Australia).

Another positive impact identified by ten of the participants (33%) was that the GBRWHA establishment induced regulations enforcement and industry constraint and although it has had good management by the authorities, the government needs to make sure that no impacts will happen in the future.

> *"I think if the WHA wasn't there, a lot more stuff would be going on. The borders aren't disconnected so if you draw the boundaries here or there, the impact is going to be the same. Just having something*

called WHA, technically it shouldn't make any difference on how you manage the environment, because the GBR is still right outside your doorstep. At the moment I think it's one of the only drivers trying to get some sort of environmental responsibility." (Female, 33, international).

"It has a benefit because the values of the WHA need to be in consideration when port development is proposed. Appropriate controls have been put into place to minimise the impacts… It might help the Ports [Authority] *because they can say that they're successfully operating it in a WHA."* (Male, 48, other in Australia).

The purpose of the main question in the interview about the WHA was to elicit the different perceptions about the fact that the Gladstone Port lies within the WHA boundaries and how does that impact (or not) on the development and conservation goals that occur simultaneously. Therefore a variety of concerns and perceptions were mentioned but only four (13%) of the participants recognised its ecological significance globally, with 10% of participants recognising its intrinsic value.

"I'm a bit outraged of how [the government has] *allowed* [industry] *to go forward because of the potential effects. The GBR isn't owned by industry, or by Gladstone, or Queensland or Australia: is World Heritage, which means it is a treasure of the whole world."* (Female, 49, other in Australia).

"We don't know completely how the mangroves have a relationship with the coral reef out there, but they're an intricate part of that. I mean, I don't like sand flies or mosquitoes but they're all there and they must be there for a reason." (Male, 52, other in Australia).

Considering the increasing development in the Region and its closeness to the GBRWHA eight participants (27%) stated that they felt that the government needs to make sure that the foreseen environmental impacts are managed effectively. This theme had a significant relationship with the variable 'place of residence' (p = 0.010) and was most commonly mentioned by the participants living in the Gladstone metropolitan area (Table 2.7). Three (10%) participants also stated that an effective management of the impacts would only be achieved if a broader geographical view of the impacts was taken into account by the government. In order to minimise the impacts, four (13.3%) participants stated the need for alternative power sources instead of coal.

> *"All our eggs are in the fossil fuel basket. You have a look at Gladstone we do gas, we're going to double coal exports, we have the ambition of becoming the second largest exporter of liquefied gas… So we're investing everything in that. What we can do, Australia is the best place for renewable energy. We can harvest the sun, wind or the ocean."* (Male, 58, international).

2.4.3.5 Social themes

An overview of the relationship between values, concerns, beliefs and norms is presented in Table 2.8. In order to clarify the results, representative quotes of some of the participants are provided below. Sixteen of the 55 (29%) social themes had a statistically significant relationship with either one or three of the demographic factors of: time of residence, gender, place of residence, place of birth, stakeholder group and income. These results partially support H_I (influence of participants' demographics on values, concerns, beliefs and norms) (Table 2.8).

Table 2.8 Social themes and subthemes (i.e. [a] values, [b] concerns and [c] beliefs) stated on the interviews ordered by number of participants that mentioned them. The last column shows the demographic factors with statistically significant relationships with the theme. NS = not significant (Fisher's Exact test). The ↑/↓/= symbols specify if the proportion of respondents is statistically larger, smaller or not different from the expected percentage.

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
RECREATION	Recreation activities [a]	Mention of different activities practiced in the Region	30	NS	
	Psychological health [a]	Importance of the environmental health of the Region to enjoy it through recreation activities	19	Gender: p = 0.019	Females: 91.7% ↑ Males: 47.1% ↓
	Easy access	The easy access to different recreational sites is important	18	NS	
	Boating restriction [b]	Boating activity has been restricted because of dredging and shipping increase	2	NS	
AESTHETICS	Aesthetics – positive [c]	Positive aesthetic perception of the Region	23	NS	
	Aesthetics – negative [c]	Negative aesthetic perception of the Region	8	Income: p = 0.019	\$20,000 – \$60,000: 62.5% ↑ \$60,001 - \$100,000: 40% ↑ \$100,001 - \$200,000: 7.1% ↓ More than \$200,001: 0% ↓
	Aesthetic value of the port [a]	Positive aesthetic perception of the port	6	NS	
COMMUNITY	Family and friends [a]	Importance of family and friends when enjoying the Region	22	Time of residence: p = 0.043	0 to 5 years: 42.9% ↓ 6 to 10 years: 66.7% ↓ 11 to 40 years: 93.3% ↑ Over 40 years: 75% =
	Community feel [a]	Answer to prompt about what they like of the area	11	NS	
	Public events	Mention of different public events in the Region important for the community	10	NS	

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
COMMUNITY	Not the rush from the cities [a]	Answer to prompt about what they like of the area	9	NS	
	Port is important for the community [a]	Answer to prompt about what areas are important for the community	7	Time of residence: $p = 0.043$	0 to 5 years: 57.1% ↑ 6 to 10 years: 33.3% ↑ 11 to 40 years: 6.7% ↓ Over 40 years: 25% =
	Lifestyle [a]	Relaxed lifestyle. Answer to prompt about what they like of the area	5	Income: $p = 0.018$	$20,000 – $60,000: 0% ↓ $60,001 - $100,000: 40% ↑ $100,001 - $200,000: 7.1% ↓ More than $200,001: 100% ↑
				Stakeholder group: $p = 0.033$	Recreational fishers: 100% ↑ NGO: 0% ↓ State Government: 0% ↓ Local Government: 0% ↓ Tourism: 25% ↑ Community: 0% ↓ Industry: 40% ↑ School principals: 0% ↓
	Loss of attachment [b]	People living in the area for short periods have no attachment to the Region	5	NS	
	Ownership [d]	The need for enhancing belonging and ownership feelings to protect the environment of the Region	5	NS	
	Lack teenager entertainment [c]	There are no places or recreational activities available for teenagers	3	NS	

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
	There is no community [c]	Gladstone's community is not a healthy one	2	NS	
	It's home [a]	Living in Gladstone means feeling at home	1	NS	
SOCIAL CONCERNS	Concern about the state of environment [b]	Answer to prompt about feelings on a scenario where the environment of the Region is impacted	22	Place of birth: *p* = 0.011	Queensland: 41.7% ↓ Other than Queensland: 92.9% ↑ Outside Australia: 100% ↑
	Cancer and asthma [b]	Mention of Gladstone as being a place known for having many cases of asthma and cancer due to the high industrial activity	7	NS	
	Prefer to live outside Gladstone [b]	Choose to live outside Gladstone due to air quality concerns	7	NS	
	Lack of concern [c]	One of the causes of the environmental deterioration of the Region	6	NS	
	Selfishness [b]	One of the causes of the environmental deterioration of the Region	6	NS	
	Don't consume fish from Gladstone [c]	Due to the fish disease event and water quality in the port	4	NS	
	FIFO [b, c]	Negative impact of Fly-In, Fly-Out workers in the community	4	NS	
	Long work hours [c]	Impact on physical and psychological health on workers with long work shifts	3	NS	
	Choose to ignore the reality [c]	Some people in government or industry choose to ignore the deterioration of the environment in the Region	2	NS	

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
GOVERNMENT	Lack of confidence on government [b]	State and local governments have not been honest with the community and have not been looking for the long term sustainability of the area	15	NS	
	Need for services improvement [d]	Health care, childcare, age care services, public transport and shopping services need to improve	14	Time of residence: $p = 0.018$	0 to 5 years: 71.4% ↑ 6 to 10 years: 100% ↑ 11 to 40 years: 33.3% ↓ Over 40 years: 0% ↓
	Main interest is development [c]	Government's main interest is development, not the wellbeing of the community or the environment	11	Gender: $p = 0.018$	Females: 66.7% ↑ Males: 17.6% ↓
	Need for management improvement [d]	Government needs to improve the environmental management to avoid further damage	11	NS	
	Tax investment [d]	Taxes are high and those should be used for improvement of services, infrastructure and face potential environmental impacts	10	NS	
	Need for environmental monitoring [d]	Government has not been doing enough air and water monitoring	10	Place of birth: $p = 0.008$	Queensland: 8.3% ↓ Other than Queensland: 42.9% ↑ Outside Australia: 100% ↑
	Need for better regulations [d]	Government needs to improve regulations regarding environmental impact	9	Time of residence: $p = 0.022$	0 to 5 years: 42.9% ↑ 6 to 10 years: 100% ↑ 11 to 40 years: 20% ↓ Over 40 years: 0% ↓
	Regulations have improved [c]	Government regulations regarding environmental impact have improved	9	NS	

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
	Need of environmental education [d]	For all the population	9	NS	
	Community involvement [d]	Government needs to enhance community participation on development plans	8	NS	
	Improve communication [d]	Government needs to improve its communication with the community about their development plans and environment monitoring results	7	NS	
	Not to overdevelop [d]	The Region should not be overdeveloped (regarding industry, housing and tourism)	7	Place of residence: $p = 0.026$	Outside Gladstone: 6.3% ↓ Gladstone City: 46.2% ↑
	Lack of reimbursement [b, c]	Funds from industry go to the government, but this is not reflected on the Region's infrastructure or services	6	Place of residence: $p = 0.020$	Outside Gladstone: 37.5% ↑ Gladstone City: 0% ↓
	FIFO [c]	Lack of government and industry planning regarding the amount of FIFO coming into Gladstone	6	Place of residence: $p = 0.020$	Outside Gladstone: 37.5% ↑ Gladstone City: 0% ↓
	Need for infrastructure improvement [d]	Government needs to invest on infrastructure improvement	6	NS	
	Information availability [d]	Information about government's development plans and environment monitoring results should be available	2	NS	
	Lack of interest [c]	Government is not interested on the environmental health of the Region	5	NS	
	Need of philosophical change [d]	Government needs to change its short term vision about development and plan ahead for future generations	4	NS	
	Responsible on emergencies [d]	Answer to prompt about responsibility when problems in the environment occur	3	NS	

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
	Improve fishing regulations [d]	Government needs to improve commercial fishing regulations	1	NS	
INDUSTRY	Responsibility [c]	Answer to prompt about who is responsible when problems in the environment occur	17	NS	
	It is an industrial town [c]	Acceptance of Gladstone as an industrial town and its consequences	7	NS	
	Proactive behaviour [c]	Industry has an open behaviour towards the community and it is interested on the environmental health of the Region	5	NS	
	Investment on community [c]	Industry has invested on services for the community	5	NS	
	Communication [d]	Industry needs to improve its communication with the community regarding future plans and environmental monitoring results	4	NS	
	Need for improvement [d]	Industry needs to improve its environmental management approach	4	Stakeholder group: *p* = 0.046	Recreational fishers: 0% ↓ NGO: 75% ↑ State Government: 0% ↓ Local Government: 0% ↓ Tourism: 0% ↓ Community: 0% ↓ Industry: 20% ↑ School principals: 0% ↑

Table 2.8 Continuation

Theme	Subtheme [a, b, c, d]	Description	No. times mentioned	Demographic factors	Proportion of respondents by demographics
	No safety plans [c]	Industry has no safety plans needed in case of an accident like an oil spill	3	Income: p = 0.019	\$20,000 – \$60,000: 37.5% ↑ \$60,001 - \$100,000: 0% ↓ \$100,001 - \$200,000: 0% ↓ More than \$200,001: 0% ↓
	It is a guest [c]	Gladstone was an established town when industry came to the Region, therefore industry should act as a guest	1	NS	

The social values recognised by the participants focussed on recreational activities, regional aesthetics and different aspects of the 'community feel'. All the participants mentioned at least one recreation activity when they were asked why they liked the places they usually visit in the Region. Participants would usually share their recreational moments with family and friends. Recreational fishing was the most commonly stated (63.3%) activity and it was identified as being equally important for past and present generations. There was mention that Gladstone has one of the largest boat ownership ratios per capita in Queensland. Other activities mentioned included swimming, going to the beach, camping, snorkelling or diving, boating or sailing, kayaking, and surfing or paddle boarding (Figure 2.4). Three participants (10%) noted their concern about the recent restriction on boating and sailing since traffic increased in the harbour.

> *"You could go wherever you wanted in the harbour. We've got our own boat so we used to go to Facing Island or the Narrows and Graham's Creek. Now unfortunately those areas are inhabited by the company areas."* (Female, 33, international).

> *"We used to* [sail] *from Tannum to Auckland Creek, but now* [it] *is very dangerous with so many ships coming through. The channel between mainland and Facing was quite wide it was a perfect playground for small boats, whereas now there's so much shipping traffic that it's no longer available. The area close to LNG is very busy as well."* (Female, 52, other in Australia).

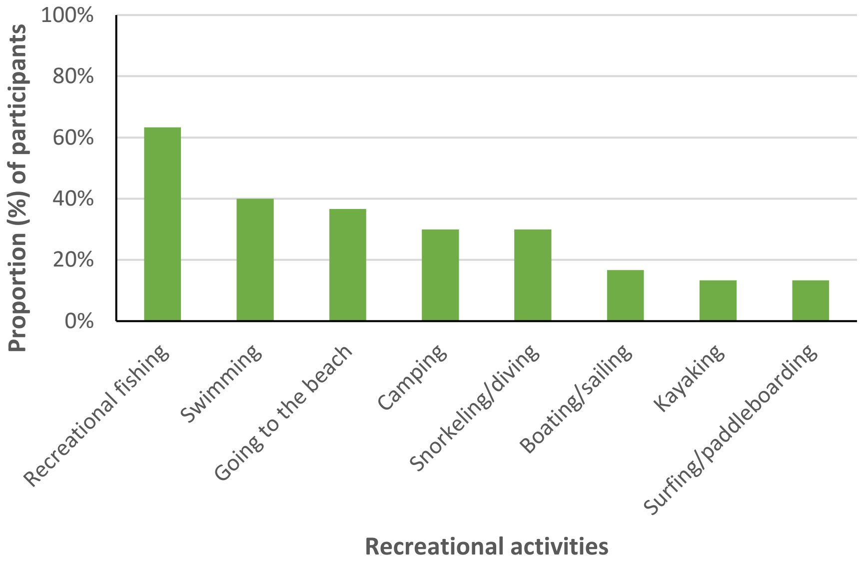


Figure 2.4 Proportion of participants that practice each identified recreational activity*.*

Living in Gladstone meant different things for all the participants. A number of economic, environmental, cultural and social reasons were self-identified by participants as being important (at a personal level) about the Region. However, only two people (7%) interviewed referred clearly to Gladstone as home.

> *"This place, this environment, this climate, community and people are important. For me, the place is part of who I am now."* (Male, 40, Gladstone).

While recognising the enjoyable aspects of the Region, all the participants also acknowledged that the environment was connected to their own wellbeing, which was reflected in their psychological health. They also mentioned that a perceived good quality of the environment was important for the quality of their outdoor experiences. This theme was influenced by a participants gender (p = 0.019; Table 2.8), with women being significantly more likely to mention it (Table 2.8). Ease of access to many of the places was mentioned as an important element with regards to recreation activities by the participants.

> *"Around 2006 air quality was a concern because of the number of industries in town and people believing it was impacting on their health. There's an extensive study done that demonstrated quality was ok, but*

there was a perception that it wasn't. Poor air quality would have potential psychological impacts [because] *of what people perceive as a bad environment impacting on their lifestyle."* (Male, 48, other in Australia).

"We can go for a half hour drive and pitch a tent somewhere and have a nice weekend away and you don't have to drive for four hours to find a nice place." (Female, 40, other in Australia).

Many participants (73.3%) referred to family and friends either because some of them moved to the Region because of their family, or because their recreation time is spent with them. This theme had a statistically significant relationship with the time of residency (p = 0.043; Table 2.8). Participants that have lived in the Region for more than six years mostly mentioned it. Some (6.6%) of these participants recognised that having the social connections and support, even when having no family in the area or the country, was extremely essential to make you feel secure and part of the community.

"I think people need to get involved with sport and stuff [to increase their sense of community]*; that seems to be a really good place to socialise with all sorts of people, especially if it's a team sport and you don't have family in town. We've met lots of friends through that activity."* (Female, 52, international).

A common theme mentioned by participants was that they like the Region's "community feel". Interviewees felt that this was (in part) due to the small size of the population and because Gladstone still has the feeling of a rural town, with friendly people. Another factor that influenced the community feel was the different public events held in the Region, such as the Harbour Festival (http://gladstonefestival.com/harbourfestival), Boyne Tannum Hook Up (https://boynetannumhookup.com.au/), Ecofest (http://gladstonefestival.com/events/ecofest), and the Tannum Sands Beach and Arts, Music Market (http://www.gladstonelife.com/bam-markets-beach-art-music/). Although the community feel theme was mentioned by 11 (37%) participants, two other participants clearly stated that for them "*there is no community*" or a "*healthy community*" in Gladstone. These participants have lived in the Region for more than 15 years and based their comment on the fact that people in the community were transient and therefore there was a loss of attachment to the Region due to the increased development.

> *"There is nothing that says 'This is Gladstone', there is no community. People come here because there's a job and it is promoted as a place to go for work. But nobody sees Gladstone as a place to settle, because this is not where their heart is or where they belong to. I belong to Tannum Sands, I genuinely thought I would retire there, but then it changed, it lost what it meant to me to be part of a community. Instead of building homes, they built investments: houses with no green areas. And I think most of Gladstone is that way."* (Male, 58, international).

> *"There's a bunch of social indicators,* [such as] *high rates of divorce and youth suicides that suggest that there's not a really healthy community… It's also a community of the young: age and wisdom are not valued, where earning money and materialism* [are the ruling] *values".* (Male, 63, other in Australia).

An additional factor that nine (30%) of the participants mentioned that they enjoyed about the Region was that it does not have "the rush from the cities", in relation to less traffic and the small size of the population, which contributes to a relaxed lifestyle. This perceived good lifestyle theme was statistically influenced by a participants income (p = 0.006; Table 2.8) and the stakeholder group they belong to (p = 0.033; Table 2.8). Participants that had an individual income of more than $200,000 per annum, are recreational fishers or are from an industry group most commonly mentioned the good lifestyle theme.

> *"It's a nice place where you can do business, it's not the rush and bustle of the cities it's certainly a quieter pace. People here is* [sic] *very friendly, I wouldn't continue to live here without friends."* (Male, 67, other in Australia).

Aesthetically, the Region was perceived as really beautiful and with nice weather by most of the participants (77%; n = 23). According to these same participants, the area was highly unappreciated by the Region's inhabitants due to the attention given to the industrial development. This sentiment was reaffirmed by eight (26.6%) of the participants who thought that visually, the city of Gladstone is not particularly attractive due to the intense industry presence. Particularly, these participants pointed out that the water in the harbour looked dirtier than usual after the dredging campaign for a long period. This was mainly mentioned by people with an annual income of $20,000 to $60,000, with a significant negative relationship between these variables (p = 0.024; Table 2.8).

> *"I love the natural environment that we've got* [in the Region]*… Deepwater National Park is one of my favourite places on the planet; it is absolutely spectacular* [with] *beautiful camping spots. It's so clean and natural that it's just beautiful!"* (Female, 40, other in Australia).

> *"*[In] *Gladstone industries are very visible; whereas in Brisbane or Melbourne, major industries* [are] *in suburbs, so people don't see them and they don't know where the cement or aluminium or other products come from. Here you see it and it's quite confrontational."* (Male, 50, other in Australia).

> *"This beautiful place used to be amazing, but now industry happened."* (Female, 52, other in Australia).

> *"On a national level everybody thinks that Gladstone is dirty."* (Female, 33, other in Australia).

One of the main landmarks of the area is the port. Six participants (20%) thought that the port is not only important aesthetically, but it is also important for the whole community's state of mind and connection with the perceived health of the harbour. Some participants considered that this relationship was more evident during the dredging event, because a 'low mood' was felt amongst the community because some areas were not accessible anymore for fishing or boating, the fish disease, or the unpleasant aesthetics of the water. This concept was typically mentioned by participants that have lived in the area up to five years, with the relationships between these variables being significant (p = 0.043; Table 2.8). A common sentiment that was captured was:

> *"You cannot not have a spiritual connection with the water. That's why a lot of people were devastated when we see dead dolphins. This used*

> *to be a beautiful place, but now industry happened."* (Female, 49, other in Australia).

> *"When the harbour was closed (during the oil spill and the flood events) people were not happy. Even if they didn't go there every weekend for fishing, the opportunity was there. When the harbour was closed the opportunity wasn't there. It was an emotional response to that inability, because people* [feel] *intrinsically linked to the port and the waterfront. Here people is* [sic] *quite connected with the port because it's in the centre of town, unlike the Brisbane port, where people is* [sic] *not connected to it."* (Female, 60, other in Australia).

> *"The harbour is the heart and soul of Gladstone. People's perception of the harbour relates a bit to the perception of the community. When the Harbour looks good then the people feel good about themselves, but when it's dirty and gets bad media coverage it too reflects on the community. We are a coastal village and the way that the harbour is perceived by the people it relates directly on the way we perceive ourselves, so it's important in terms of that relationship."* (Male, 50, other in Australia).

While talking about these values and their personal importance, a general concern around the condition of the environment and the potential perceived threats was evident; mentioned by 22 (73%) participants. This response was elicited when participants where asked if they would be concerned about future events that could impact the environment, such as floods, or oil spills. In this case, participants born in states other than Queensland, or born overseas, were statistically more likely to express their concern about the state of the environment (p = 0.011; Table 2.8).

One of the main concerns mentioned by seven participants (23%) was air pollution and its relation with many cases of asthma and cancer among the Gladstone population. This was the main reason given by seven of the participants as to why they decided to live outside the Gladstone metropolitan area: they could avoid the pollution from the local industries. This sentiment had environmental implications, as noted in section 2.4.3.4 above.

Some of the participants felt that the degradation of the area is due to the loss of attachment and care people have for their surroundings. Participants noted that this loss of connection (or attachment) is fomented by people's self-centred attitude: people in the Gladstone Region are only thinking about their own satisfaction and benefit. These comments were made in a general, societal context and related also to feelings about the government people in charge of decision making regarding the Region's development.

> *"We have a society where materialism is very high, high levels of self-centredness. We don't think on the* [environmental health] *until we cross a certain level and as Aussies we don't tend to react. We'll just cruise along, lay back and then suddenly when everything goes wrong then we'll act."* (Male, 63, other in Australia).

> *"Negative impacts* [on the environment] *come down to selfishness. If it affects me and my enjoyment: it's a negative impact… But if it happens somewhere that I don't see and it doesn't impact me or my family, somewhere in the desert, I don't care. So, it all comes down to the observer and that's very selfish and short sighted here long term consequences are not considered. It's also our Western culture: it's all about me and now, but that's what we all do."* (Male, 50, other in Australia).

When considering the lack of attachment further, five participants (17%) indicated that a feeling of belonging and ownership needed to be enhanced within the community to improve environmental protection in the Region. These opinions were expressed when participants were asked what could be done to improve the management or conservation actions of the area. Some of the participants had a pessimistic opinion about people's attitudes in general.

A different aspect of the loss of attachment and environmental health detriment identified by the participants was the presence of a growing FIFO community in the Region. In this case, almost half of the participants (43.3%) commented that the government did not guarantee the appropriate infrastructure (e.g. enough housing or childcare services) to receive an influx of people in the community. This situation led to an increase in prices for housing and not enough places in childcare facilities (for example). Participants also stated that the FIFO people had only come to the Region for the income and go back to their hometown. Participants felt that this was the reason why the FIFO community had no feelings of attachment with the Gladstone Region, which added to the short time spent to get to know the Region and make friends would have led to a lack of care for the local environment and society. In this case, the FIFO community was not identified as a "culprit" of the situation but as a consequence.

Almost half (43.3%) of the participants expressed these feelings about FIFO workers. However, 13.3% of the participants expressed that the FIFO community was in fact responsible for a negative input on the community. These participants stated that since the arrival of the FIFO worker community (four to five years ago), pollution had increased as well as cases of domestic violence and sexually transmitted diseases. Those participants considered that FIFO workers had only come to the Region for the monetary benefits of the industry but that they did not care about the local community or the environment.

> *"The growing population and their lack of regard is one of the main problems.* [This is because] *people are apathetic, there's a lot of transient people here: it's not their home, it's a place they come to work, they can't be bothered to take their rubbish to the dump so they find a bit of bushland and they dump it there... what the impacts are on the place they don't care."* (Male, 60, other in Australia).

> *"People only come here for one reason and that's to take what they can to go somewhere beautiful, and they don't really care about what they're doing here. They've got no conscience whatsoever, they don't love this place, never loved it, they don't want to love it."* (Female, 49, other in Australia).

In relation to the FIFO theme, six of the participants (20%) mentioned that the government and industry should have had a better (regional) "plan" for all the people that came to work for the LNG industry on Curtis Island. Concepts commonly mentioned were proper housing, environmental education and social programs that would enhance the community feeling and therefore caring about the Region. The better plan theme was mentioned statistically more frequently

(p = 0.020; Table 2.8) by people living outside the metropolitan area. Closely related to this, eight (27%) of the participants mentioned the need for better urban planning, with improved construction activities' regulations and where the community's opinion would be taken into account.

Other concerns expressed by the participants that were associated with the management or conservation actions in the Region focussed on the performance of the local and state government. Half of the interviewees expressed a lack of confidence in that (mostly) the state government has been doing a "good job" in terms of environmental protection and infrastructure enhancement. This lack of confidence appears to stem from their perception that the core interests of the government are economic benefits from industrial development only, regardless of the environmental health and the local community well-being. There was a statistically significant relationship between this theme and the gender of a participant (p = 0.018; Table 2.8). Females were more likely to mention that economic benefits seemed to outweigh environmental and community health. This perception had a basis in the observation that the money obtained by the government from industry in this Region is not reinvested into the Region, but was invested in Brisbane, or Rockhampton, where there are more voters. Comments around the conflict of interest that government has regarding environmental stewardship and permitting industrial growth that leads to state tax growth was also mentioned.

> *"You just make assumptions that the government is on top of it, you think the government wouldn't approve something unless it's safe, but they don't really do that, they just get the money."* (Female, 49, other in Australia).

> *"Coal mines are not rehabilitated, but they don't because it's not economically viable, because the government is all about revenue, so that they can buy more votes to get re-elected. That's the system that we live under. There's tens of millions spent on the harbour at the moment on environmental testing but is it being used in the right areas? No, it's done by local people? No, is there someone that know the actual issues? No. There's a big leak of money at the moment that could*

> *potentially solve some of those issues but it's not been spent in those areas, and who knows where that is being spent, because no one from here would be making that decision… Tests should have been done before the dredging, but it didn't happen and the decision came from Canberra, at the Federal level, guess why? Because they want the money from the gas, so they can buy more votes, to build more houses."* (Male, 57, other in Australia).

According to 13 of the participants (43.3%) this unmanaged state government conflict of interest between environmental stewardship and "sustainable growth" was the main reason why services such as schools, health care, childcare, aged care, public transport, and shopping opportunities have not been improved in the Gladstone Region. This theme was mentioned significantly more by participants that have lived in the area up to 10 years ($p = 0.018$; Table 2.8). Similarly, ten of the participants (33.3%) mentioned that they pay high rates and taxes, and that they do not consider that this is reflected in the services or infrastructure improvement.

> *"The social infrastructure is tied up with liveability and if you got pure industrial development then, do you really need education? Because you just have FIFO's and DIDO's so you can have your industry and just fly in people. You don't need to have a local population, you don't need social infrastructure, which is not necessarily bad. From the industry's point of view that's probably better, because who's going to provide that infrastructure? That's government, then the industry it's being subsidized, someone's got to pay, and if industry is not going to pay then it's going to be me as a tax payer, so in other words, I'm giving a subsidy to the industry for doing that."* (Male, 63, other in Australia).

The need to improve the government communication with the general community was mentioned by seven (23.3%) participants. Similarly, two (6.6%) participants mentioned that the information from environmental monitoring should be more accessible to the public. This last theme had a statistically significant relationship with the place of birth variable ($p = 0.007$; Table 2.8), being only mentioned by participants born overseas.

"As a community member I'd like to see more open and honest communication from the government. I think there is a lot information held by them that should be available. I go to a lot of meetings with stakeholders and there's always the idea that [the government] can't trust the community with information because they think that the community is stupid, and if they interpret it wrongly they'll have to defend themselves." (Female, 33, international).

Participants also suggested that the industry accountability for improving environmental protection. For example, eleven of the participants (37%) stated that the industry needs to be better managed, that regulations regarding environmental impact should be strengthened, and monitoring of air and water needs to be improved. Again, these opinions were typically mentioned by participants that have lived in the area for up to 10 years (p = 0.022; Table 2.8). Similarly, the theme of improvement of monitoring had a statistically significant relation with the place of birth of the participants (p = 0.008; Table 2.8), where it was most likely mentioned by people born in states other than Queensland and by people born overseas.

"If you walk on Facing or Curtis islands' coasts and pick up the cigarette lighters, and the plastic bottles and the rubbish thrown out from those ships, if you look at the potential consequences to the reef, or the bulk of shipping that is going to increase with gas trade; dredging it's going to continue (it can't stop). They're not shipping the coal, and gas yet, that's all coming so it has to be thought about. They're building infrastructure but they haven't thought about the other impacts so it has to be patrolled and heavy fines [should be enforced], *and legislation in relation to how that is managed."* (Male, 60, other in Australia).

"From an environmental perspective I would suggest that the two key things are air quality and water quality… The Queensland government is about development at all costs. For example, there's a proposal for a steel plant in the Region that doesn't use the latest technology so the air emissions are going to be atrocious, whereas if they apply [the] *newest technology available they would actually not have pollutants of concern.*

I would expect from the government that the latest technology available is used, clean technology… Especially in an area where you already have a lot of sources [of pollution]*. It's a Queensland problem that environmental standards are lacking and it's starting to deteriorate because there's budget constraints, we have a bit of debt so we have to do whatever we can at all cost."* (Female, 33, international).

Four participants (13%) thought that the industry needs to improve its communication with the community (much like how the government is thought to need improved communication) about future developments and its environmental management approach. This last theme had a significant relation with the stakeholder group that people belong to ($p = 0.046$; Table 2.8) and it was mostly mentioned by people from NGO's and industry.

"Major industry need to focus more on [what will happen after] *they finish doing their job (for example construction). They need to consider how they can maintain the environment around them because once they're finished they don't attend* [sic] *the environment. There's no follow on."* (Female, 40, other in Australia).

"Industry and government need to think more about the decisions they make about the industrial development and its impacts, not just rush and do things." (Female, 33, international).

And even though industry was perceived as having had more a negative than a positive input in the Region, five of the participants (17%) stated that industry has had a proactive behaviour towards the community. For example, industry has financed public services such as the hospital and environmental studies or monitoring. However, because of industries' environmental impact, 17 of the participants (57%) said that industry should be responsible of its actions in case a major event should occur, such an oil spill. In relation to this, three participants (10%) considered that some, or all, industries do not have the appropriate safety plans required for emergencies. This theme had a statistically significant relationship with participants' income ($p = 0.046$), being more commonly mentioned by participants in the lowest annual income group ($20,000-$60,000) (Table 2.8).

After explaining what they, the participants, thought were problems caused by the government's poor management on a local scale (such as the environmental impact caused by the increased industrial development), four of the participants (13%) suggested that at a country and global scales, there should be a change in philosophy about how resources are used and traded.

> *"We have to take the sustainable view point. What we need is a revolution of minds: you can't keep doing what you're doing in terms of lifestyle in order to be able to sustain that lifestyle.* [Change] *will come because it's not sustainable: when our health and lifestyle and economy is badly impacted it will change and it may be too late. The tipping point is coming. We're smart enough* [to avoid it] *but we're too selfish. We have the innovation and creativity and finance to do something about it but we're too selfish."* (Male, 58, other in Australia).

> *"Capitalism is purely relying on the exponential growth of the human population.* [But] *we have to have an economic system that would survive without population growth. That would require a reduction on the standard of living. But that would imply a reduction of jobs creation and you are going to not get elected. That's why we need leaders, no politicians."* (Male, 57, other in Australia).

Most of the concerns expressed by participants about the economy, community and environmental health were related to industry. However, seven of the participants (23%) mentioned that Gladstone is an industrial town, and as such you have to accept the industrial landscape when moving into the Region.

> *"Gladstone is an industrial Region. That's an acknowledgement that you have to make. But also we have to say that in recognising that is a heavy industrial area there's an expectation by the community that it will also be a healthy place to live,* [but] *there's been challenges to that. There's a recognition that there's going to be development, and people say: yes we want that, we want the jobs but not at the risk of our health and our family."* (Female, 60, other in Australia).

> *"I don't have concerns about the environmental health of the city. I've always known that Gladstone is an industrial city. You have the visual*

impacts of the power station, but I don't think there's a significant environmental impact. Any coastal city has urban development next to the creeks. As far as it goes Gladstone is no different to any other coastal city where there's development." (Male, 48, other in Australia).

"I've always been of the belief that this is an industrial town, and it's not going to go anywhere, and we have to work with industry to keep them honest and creating an ethic for the environment to preserve what we have." (Female, 52, other in Australia).

Even though this sentiment was expressed as a general understanding, one person from the industry stakeholder group stated that industry established after the town already existed, and therefore industry is only a guest.

"Industry is the reason why we are here and industry needs the community… it's a symbiotic relation between those two. [But] *industry needs to be accepted by the community as a responsible member so they respect the people and their environment, the other business and the cultural aspects of it as well… Gladstone was an independent community and then QAL came here in 1967… So* [industry] *has to be mindful that it's a guest in this town and it could damage the place, but it can be quickly shut out down the door. It has happened before."* (Male, 50, other in Australia).

Although participants expressed their general acceptance of the increased industry establishment in the area, seven of the participants (23%) mentioned that they do not want the area to be overdeveloped. For these participants, overdevelopment was defined as the area having more industry than already present. This would lead to more houses and people, as well as large scale tourism, which would imply more visitors coming to the Region. These growth factors would directly affect the things that those participants like about the Region: a small community feeling; particular special places because of good memories with family and friends; and the feeling of relaxation that these things provide precisely because there are few people around.

"[What I like about] *the islands close to Gladstone is that there's not a lot of people going there. It's just get away from society, you don't have*

a TV or a mobile [phone]. *It's just nice and quiet. That's why we want to keep the area like that".* (Male, 63, other in Australia).

"Our destination needs to keep the pristine factor… We think more visitors would be good, but I don't think we'd be a good destination for thousands of visitors. A person that wants to come here is someone looking for a pristine place." (Female, 37, other in Australia)

The idea of maintaining these same 'connection' features also came through with the added sentiment that these things should be enjoyed by future generations.

"When I go out and do things, like lying on the beach or just look at the sea, it's something I do experience: that oneness with the earth and being a part of it, and that in a sense feels like you want to make sure you do protect that so that future generations (my children and grandchildren) can experience the same sort of oneness with earth." (Male, 67, other in Australia).

2.4.4 Values and concerns

A participants time of residency in the Region influenced both the proportion of values ($\chi^2_{[3]}$ = 23.867, p = 0.000; Figure 2.5a) and concerns ($\chi^2_{[3]}$ = 17.143, p = 0.001; Figure 2.5b) they identified. Participants that had lived in the Region from 11-40 years provided the highest number of values, with participants living in the Region from 6 – 10 years mentioning the fewest number of values (Figure 2.5a). Statistically significant differences were present among all categories except within the 6 – 10 years and > 41 years residency categories (Figure 2.4a). Participants that had lived in the Region from 11-40 years also mentioned the highest number of concerns (Figure 2.5b). Yet, participants that had lived in the Region for more than 41 years mentioned the fewest concerns (Figure 2.5b). Statistically significant differences are evident for all residency categories, with the exception of the 0–5 years and 6–10 years (Figure 2.5b).

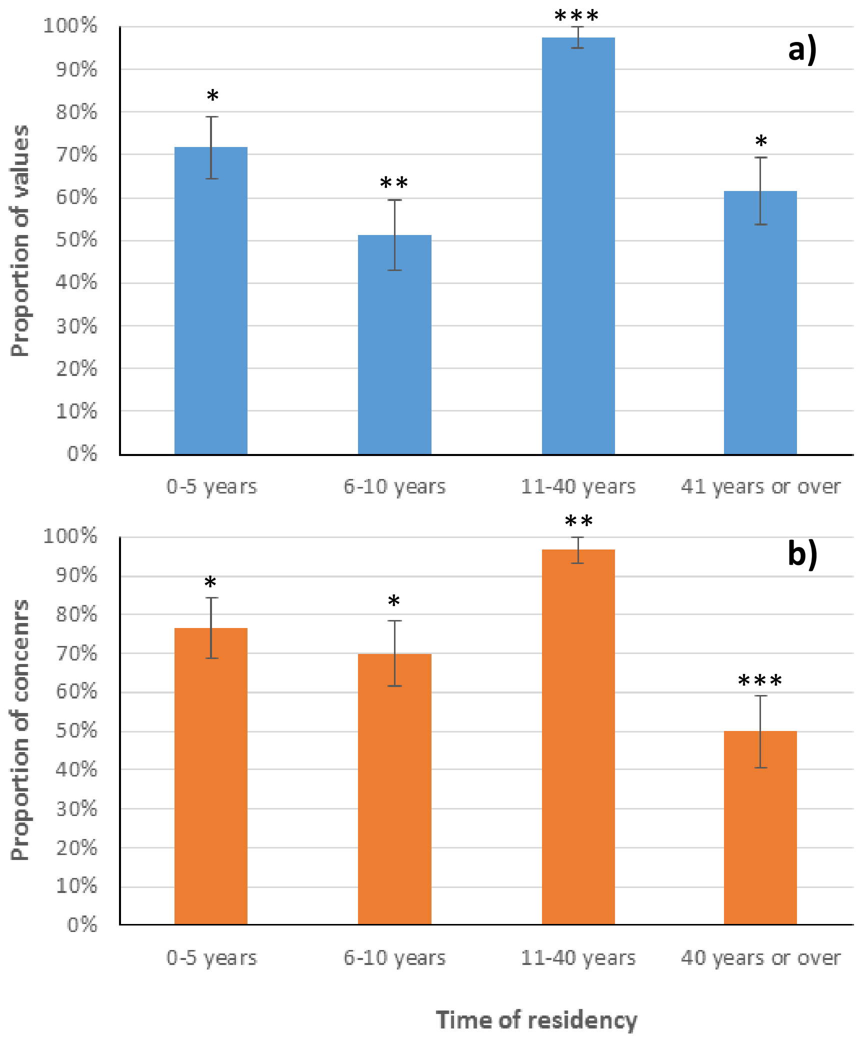


Figure 2.5. Proportion (%) of participants' **a)** values (± SE) and **b)** concerns (± SE) by time of residence in the Region. Cochran Q test comparison result differences at $p<0.05$ expressed as groups *, **, and ***.

Therefore, the results partially support H_{II} (number of values and concerns differ by participant's demographics), however the results for gender and generation were not statistically significant. A participant's gender and their generation had no influence on the number of values or concerns that a participant provided (Table 2.9).

Table 2.9 Mean number (±SE) of values and concerns mentioned by the participants belonging to each gender and generation category, with the associated McNemar test result.

	Gender		
	Female	*Male*	*p (2 sided)*
Values	0.87 ± 0.34	0.97 ± 0.16	0.219
Concerns	0.93 ± 0.25	0.97 ± 0.18	1.00
	Generation		
	Boomers	*Generation X*	*p (2 sided)*
Values	0.92 ± 0.27	0.97 ± 0.16	0.625
Concerns	0.93 ± 0.25	0.97 ± 0.18	1.00

2.4.5 Individual's similarity regarding their stakeholder group

A high degree of overlap was evident between the individuals regarding the values, concerns, norms and beliefs that they mentioned (Figure 2.6 and 2.7). This suggests that the stakeholder group categorisation (which was *a priori* did not influence these variables (Figure 2.6). This result reject H_{III} (participants from the same stakeholder group share similar values, concerns, beliefs and norms).

Some clustering occurred for the industry (G) (Figure 2.6a, b, c), community (F) (Figure 2.6a, b, c), local government (D) (Figure 2.6a, c) and school principals (H) (Figure 2.6b, d) stakeholder groups. However, not all members of these stakeholder groups clustered with their particular group. The stress (i.e. goodness of fit) values for the cultural, economic and social analyses demonstrate that the data are a good representation, with the environmental values being very well represented (Figure 2.6). The environmental values' clustering is strong (stress 0.069), suggesting groupings of industry and local government together and community in other different group (Figure 2.6c).

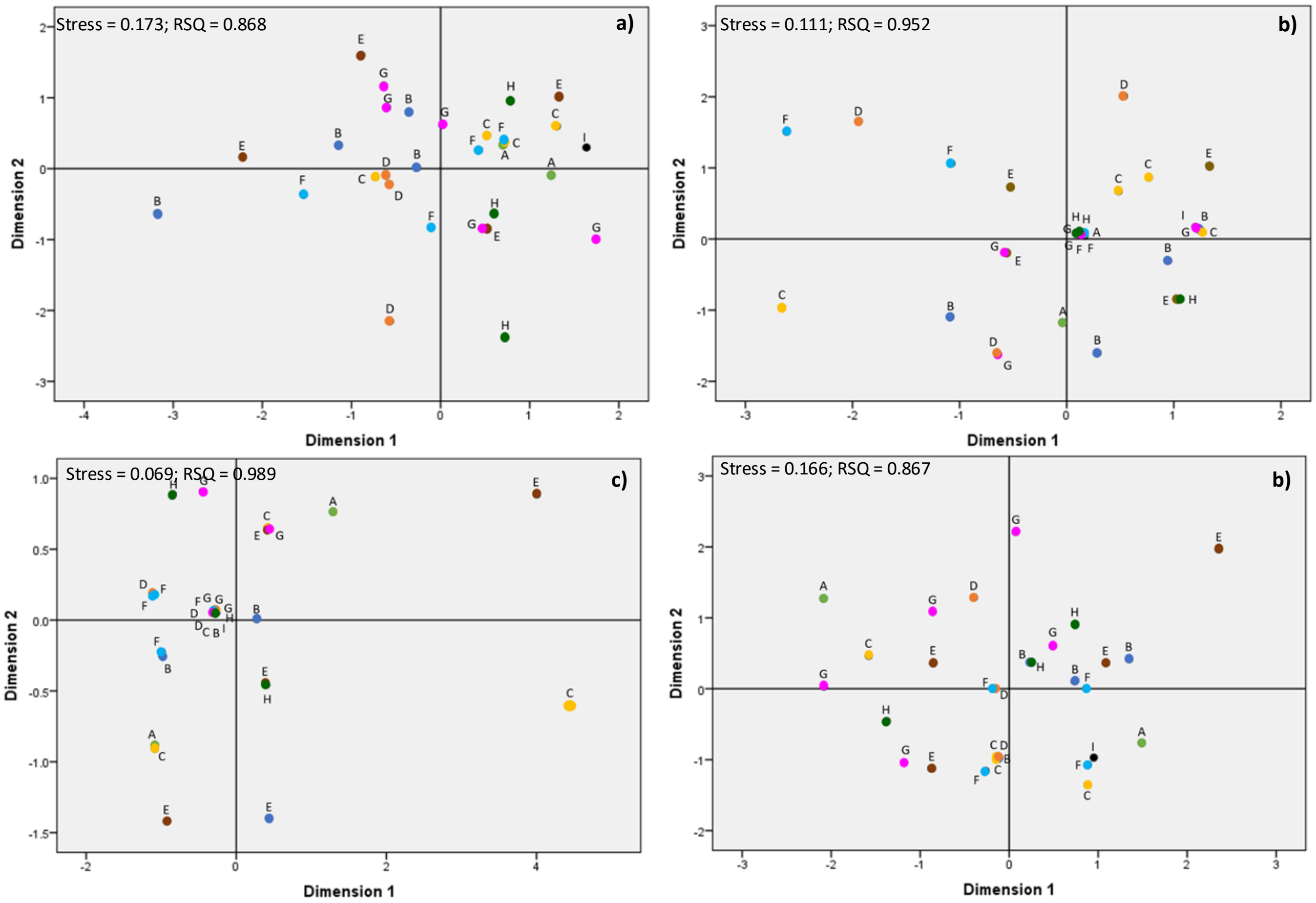


Figure 2.6. The similarity of the participants from the different stakeholder groups according to the mention of different values: a) cultural, b) economic, c) environmental and d) social. Stakeholder groups are represented with different colours and letters: **A:** Recreational fishers (light green); **B**: Non-Government Organizations (dark blue); **C:** State Government (yellow); **D:** Local Government (orange); **E:** Tourism (brown); **F:** General Community (light blue); **G:** Industry (pink); **H:** School Principals (green); **I:** Australian Aboriginal Peoples (black).

When pooling values, concerns, beliefs and norms the nMDS analyses indicate some clustering relating to a participants stakeholder group affiliation. However, the clustering is relatively poor for the values, concerns and beliefs and only a fair fit for the norms (Figure 2.7a-d). In essence, the data representation (based upon stress) is relatively weak and therefore the clusters formed do not represent valid groups.

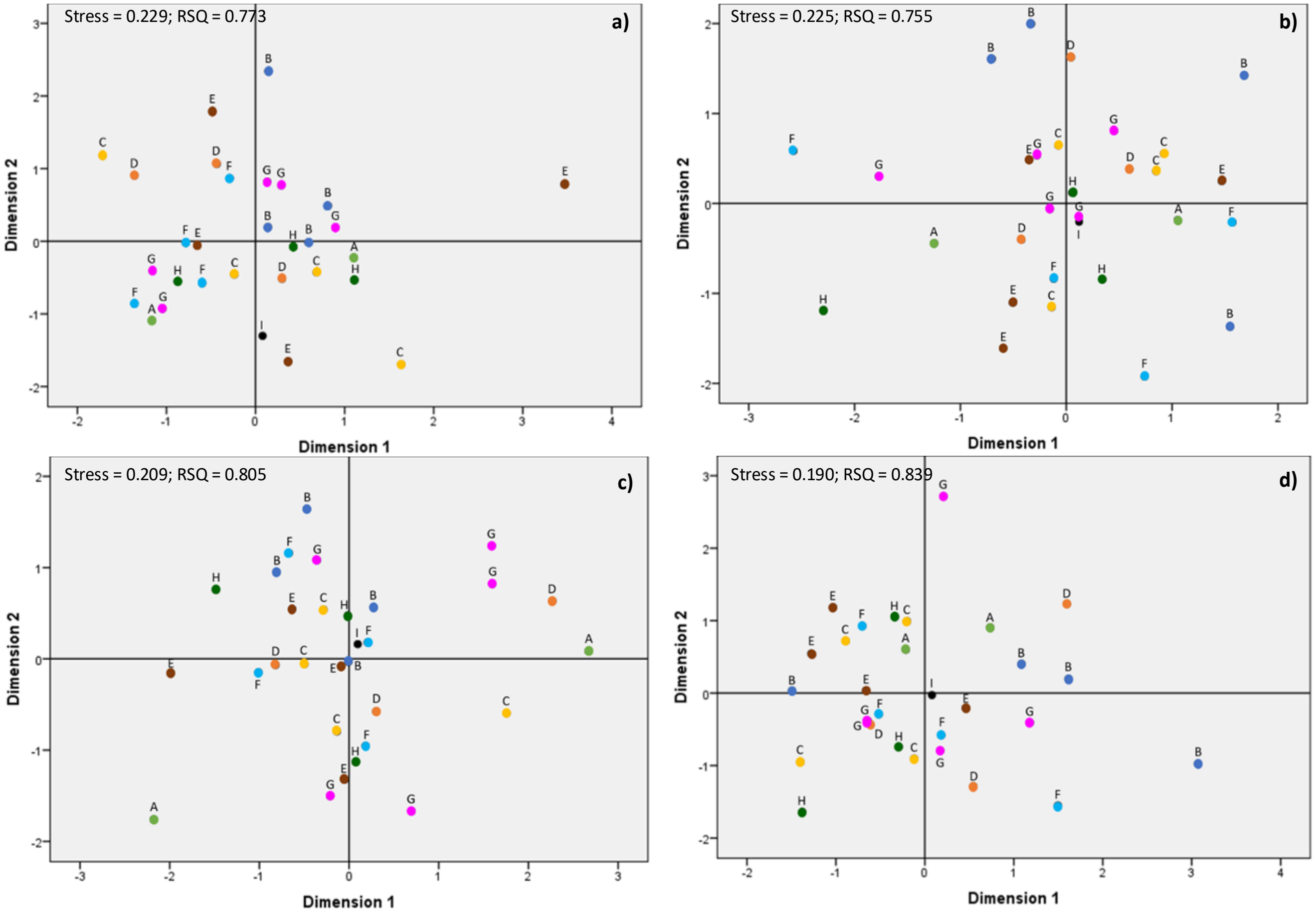


Figure 2.7. The similarity of the participants from the different stakeholder groups according to the mention of: a) all values, b) concerns, c) beliefs and d) norms. Stakeholder groups are represented with different colours and letters: **A:** Recreational fishers (light green); **B**: Non-Government Organizations (dark blue); **C:** State Government (yellow); **D:** Local Government (orange); **E:** Tourism (brown); **F:** General Community (light blue); **G:** Industry (pink); **H:** School Principals (green); **I:** Australian Aboriginal Peoples (black).

2.5 Discussion

From an environmental management perspective, it has been acknowledged within the literature that efforts to address sustainable management goals lack the understanding and inclusion of people's values and attitudes (Weinstein et al. 2007; Larson et al. 2013a, b; Loomis and Paterson 2014). Hence, the main objective of this chapter was to focus on the identification and exploration of cultural, economic, environmental and social values associated with the Gladstone Region and particularly its coastal area (H_{II}) (section 2.5.1). I have also investigated the influence of a participants' individual demographics upon their self-stated values and concerns (H_{I}). Finally, I have also explored whether participants that belong to the same stakeholder group share the same values, concerns, beliefs and norms (H_{III}) (section 2.5.2 and 2.5.3).

The group of values identified by the participants demonstrate that even though some values vary within a given variable (e.g. gender, income or time of residence, findings that are discussed in section 2.5.2), other values did not. This suggests a somewhat unified vision of the Region based upon held value sets. The most commonly identified values were:

- the different elements of biodiversity;
- recreation;
- aesthetics;
- connection with the environment;
- good memories with family and friends; and
- the jobs from industry (Tables 2.4 – 2.8).

Most of these values identified in this study have been identified previously by other studies in the Region (Table 2.1). In general, the values identified echo the findings of other studies across different areas in Australia such as the wet tropics (Bohnet and Smith 2007), riparian ecosystems (Jackson et al. 2008; Larson et al. 2013b) and the Great Barrier Reef (Bohnet and Kinjun 2009; Marshall et al. 2013; Stoeckl et al. 2013). In these studies, some of the most important values where related to biodiversity, aesthetics, recreation, and in some cases the economic benefits. However, new values were also identified in this study and are further discussed below.

2.5.1 Identifying Gladstone stakeholder's values

2.5.1.1 New findings

To the best of my knowledge, this is the first study that reports "other non-material" (i.e. connection with the environment, inspiration, the good memories associated with family and friends, the psychological health provided by environments in good condition, the lifestyle of the Region) and "material" perceived values (i.e. opportunities for business associated to the main industry) for the Gladstone Region.

The cultural values of natural ecosystems are understood as the tangible and intangible things of importance associated with ethno cultural groups or religions, and its heritage aspects as well as a broad range of artistic expressions within the society (Norton and Hannon 1997; Klamer 2002; Lewis and Sheppard 2005; Jackson 2006; Verschuuren 2006). Within environmental management domains, the spiritual element is included as a cultural value, but it is mostly associated to indigenous peoples, since the feelings of connection and oneness with nature are more conspicuous within indigenous and non-industrialised communities who are more likely to perceive themselves "*as interdependent components of nature*" (Pretty et al. 2009). It has been argued that indigenous and non-indigenous values and uses of aquatic systems "*can be quite different*" (Finn and Jackson 2011) and that the recognition of indigenous cultural values among management authorities may "*create the space for comparable non-indigenous values*" in decision-making (Jackson 2005). However, in general there has been a lack of acknowledgement of non-indigenous cultural and spiritual values within this context (Gould et al. 2014). Therefore, the identification of these values in a sample lacking Aboriginal representation may point to the need of more inclusive definitions of non-indigenous cultural values (Cocks 2006; Brown 2008). This is especially important given the general understatement of the values of inhabitants of the urban areas within industrial ports, which tend to be less aware of nature given the dominance of the urban life (Tam 2013).

The identified cultural values encompassed the broader view of the natural world with which an emotional connection is created and from which different sorts of inspiration are obtained. This was opposite to a religious belief on forces or entities larger than oneself, adopted mainly by formal religions such as Christianity (Winter 2007). Also, 40% of the participants in this study expressed feelings of stewardship of nature (i.e. inspiration to take care of the environment), which could also be typified as a spiritual value linked to the Judeo-Christian belief system. But when participants were asked directly about spiritual values, most participants were reluctant to recognise these values in themselves. This could be caused by the disassociation of Western culture from religion and its traditional definition of spirituality (Hughes and Morrison-Saunders 2003).

New values identified in this study include elements that contribute to the psychological wellbeing of people, such as relationships with family and friends, accessible outdoors experiences, and the relaxed 'rural' lifestyle available in the Region. Even though these are not elements of the landscape *per se*, they are factors widely recognised to build upon social capital and place attachment (Mesch and Manor 1998; Kyle et al. 2004; Abraham et al. 2010; Lewicka 2011; Polyakov et al. 2013), which may in turn enhance environmental conservation outcomes. Therefore, these values should be considered in the design and implementation of environmental management (Mesch and Manor 1998).

Participants also identified 'other business opportunities' as an economic value that has not been mentioned in previous studies (Table 2.1). Even though 'other business' it is not the main economic activity the Gladstone Region, business related to industry services represent the 9% of the gross regional product (GRP) (GAPDL 2012a). Previous studies may not have identified these 'new' values as their focus was on economic and environmental values rather than the four core values explored in this study. The consideration of four core values provides an opportunity to create a more accurate panorama of a community's values. As such, it is important to be as comprehensive as possible to be able to make suggestions about a given area, or region's environmental management goals, and potential outcomes.

2.5.1.2 Other cultural, economic, environmental and economic values

This study builds on the understanding of the complex human relationship with the environment in an industrial area where economic development is a priority.

Even though not all stakeholder groups were interviewed and more participants were needed to have an exhaustive coverage of themes (Figure 2.1), the results demonstrate that in general, the participants have a great appreciation for the Region and its environment. Factors such as a good quality of life and the social ties built over the years led the participants to consider the different industrial activities as positive economic opportunities, but not without concerns about industries environmental and social impacts. This situation is no different to other cities, or regions, in Australia and globally where other activities are the main source of economic welfare such as tourism (González et al. 2008; Cairns et al. 2014), or renewable energy industries (Devine-Wright 2009; Tilt et al. 2009).

From 2006 to 2011, the industry growth in the Gladstone Region increased jobs creation by 14.4% (REMPLAN 2012). Commensurate with a growing workforce, by 2010 the estimated GRP of the Gladstone Region was around AU$2.5 billion, with approximately 43% of this represented by manufacturing, construction, mining, and electricity, gas, and water supply (all the sectors considered as 'industry' by the participants) (GAPDL 2012a). Therefore, the emphasis that participants give to the industry in the Region is unsurprising as it is commonly linked to participants' personal wealth. For example, 63% of participants moved into the Region because either a member of their family or they had got a job in Gladstone (Table 2.6). Participants did differentiate between personal and outer regional wealth (Table 2.6 and 2.8), since they perceived that most of the profit from the industrial development was being used somewhere else. This concern has also been identified by Benham (2017) for the Gladstone Region. However, similar sentiments occur elsewhere in the world.

Other social concerns related to industry development identified by participants were the reduced access to recreational sites, increased living cost, and changes in the community due to the increase of a transient workforce (e.g., FIFO and DIDO workers). This was no different to perceptions in other places in Australia where the FIFO community is increasing (Lockie and Rockloff 2005; Benham 2016). Although this workforce maybe increasing some studies indicate that the community perceptions about transient workforces do not always agree with the empirical data (e.g., Campbell et al. 2014).

Consistent with Benham's (2017) Gladstone study, limited access to the harbour was perceived because of the increased industrial activity that disrupted specific recreational activities (i.e. the most commonly identified social value; Table 2.8). In the present study, 10% of the participants mentioned that one of the things they enjoyed was the easy access to areas where they could be alone with nature (Table 2.8). These kind of opportunities, along with other values such as social ties and cultural values, have been found in other studies *"to achieve the spiritual dimension of interaction with nature"* (Hughes and Morrison-Saunders 2003; Miller 2005) and to build on people's sense of place (Poe et al. 2016).

Recreational activities provide the ground to connect with the environment and strengthen social ties, and it was this value the only one mentioned by all of the participants. This result supports the idea that Australia is a recreational society, where sports and recreational activities provide the society cohesion that religion embodies for other cultures in the world (Mosler 2002). In particular, recreational fishing in Gladstone is one of the most important activities since there are around 7,000 boat registrations and it supports a range of other outdoor activities including caravanning, camping and boating (NPRSR 2014), which are factors that contribute to place attachment and pro-environmental behaviour (Kaltenborn 1997, Dietz et al. 2005).

Participants identified perceived environmental impacts and risks (related to industrial activity), within the harbour area (Table 2.7). The harbour represents an area in the Gladstone Region where biodiversity loss, dredging (and its effect on fish health and commercial fisheries), and the air and water pollution are seen as the main factors causing a decline in the harbour health (according to 33% of the respondents; Table 2.7). The remaining Gladstone Region was seen as having stable or improving health (Table 2.7). The Region's biodiversity was one of the commonly identified values across participants. Its commonality may be due to the large extent of wetlands/salt marshes in the Region where a wide variety of species can be easily observed (e.g. turtles, dugongs, birds, bats, sharks, fish, dolphins and whales) (GPC 2012). Similarly, the area is in close proximity to the GBRMPA, which is thought of as a factor of pride within the communities living next to it (Larson et al. 2013a; Stoeckl et al. 2013). These notions have been previously identified by other studies in the Region (Lockie and Rockloff 2005; Benham 2017).

According to the participants, the economic benefits from industry in the Region are scarce or non-existent. This lack of economic benefits, when coupled with the social and environmental concerns that participants identified can be seen one of the leading factors to the participants voicing a generalised lack of trust in both the different levels of government (local and state) and the industry. This lack of trust relates to a common perception that a re-investment of industrial profits in the Region is lacking.

Also of concern, is a perception of the accountability of both sectors is lacking with regards to honesty about environmental impacts, the enforcement of regulations, and industrial growth control. Again, similar findings are supported by other studies in the Region (Greer et al. 2010; Davey 2012; Tinney et al. 2013; Benham 2017). Contrary to my results, Greer et al. (2010) noted that the Gladstone community considered that industry was "*performing satisfactorily in the task of maintaining a 'social licence to operate' in the Region*."

In general, the participants in this study were somewhat satisfied with the economic benefits. Yet, this does not mean that the participants did not recognise the need for improvements in terms of public involvement and communication channels, which are recognised as some of the basic elements to build trust in organisations and with communities (Gregory and Keeney 1994; Gregory and Wellman 2001; Moffat et al. 2016; Benham 2017).

Participants identified a lack of trust in multiple areas of enquiry in this research. For example, participants expressed this when considering their perceptions and beliefs about the location of the harbour within the GBRWHA. Previous assessments by the Great Barrier Reef Marine Park Authority (GBRMPA) (Lucas et al. 1997; Tinney et al. 2013; GBRMPA 2014b) determined that Outstanding Universal Value (OUV) of the GBRWHA is still present within the Region: aesthetic values, ongoing geological processes, ecological and biological processes and biodiversity conservation. Participants did identify most of the OUV related values as present in the Region, yet they did not appear to associate these values with the World Heritage Area (WHA). For example, eight participants expressed that there was no reason to be part of the WHA. This belief seemed to be partly related to the perception that the WH listing has not been an impediment to industry growth or to the establishment of stricter environmental regulations.

2.5.2 H_I: Do socio-demographic factors have an influence on identified values, concerns, beliefs and norms?

The initial hypothesis tested in this chapter examined the influence of demographics on participants' self-stated values. All demographic factors had some statistically significant results. The most influential demographics were:

- time of residence;
- place of residence;
- place of birth; and
- income

These outcomes support H_I. These outcomes are discussed further below under core value themes.

2.5.2.1 Cultural themes

Within the literature, it is noted that feelings of awe, relaxation, appreciation, and connectedness with nature are related to spiritual values (Pretty et al. 2009; Powell et al. 2012). In this research, all these themes had a significant relationship with gender, generation and place of birth (Table 2.5), which is consistent with previous studies where these feelings and pro-environmental behaviours (i.e. inspiration to work for the environment) are commonly attributed to females and younger generations (Stern et al 1993; Dietz et al 1998; Twenge et al. 2012). Alternatively, appreciation for the Region was more likely to be identified by participants that were born overseas. Awaritefe (2004) found that foreign visitors appear to assign higher significance on nature appreciation activities than local tourists. This pattern of higher awareness, or appreciation by internationals may be explained by these participants having been exposed to a broader variety of environments and landscapes. Broader exposure to these elements may provide individuals with a different perspective and therefore a conscious appreciation for the places where they currently live.

There are at least 26 historical places in the Gladstone Region (DEHP 2013), yet only a few of these locations (e.g., Barney Point, Bustard Head Lighthouse and Seventeen Seventy) were identified by the participants as important in the Region. The historical places theme had a statistically significant relationship with two different groups: people with an annual income of $60,000-100,000 and more than $200,000 (Table 2.5). Previous research has indicated that people visiting places of historical interest had a higher education level (Remoaldo et al. 2014; You and O'Leary 1999), and also that 'historian' tourists had a higher family income compared with tourists that did not have an interest in historical places (Solomon and George 1977). Additionally, those respondents that identified the historical places also worked in the government, tourism and industry sectors, where knowledge of the Region is important.

2.5.2.2 Economic themes

Tourism is not one of the major economic activities in the Region, yet some participants (rural based participants; Table 2.6) noted that it is a potential economic activity. To give tourism a more central role within the Region, participants felt that services (such as information availability) needed to be improved. The tourist attractions that occur in the Region are in rural areas, which was reflected by these participants considering the economic potential of this activity.

Participants noted that although the industry activity has brought high employment and wages to the Region, this activity has also delivered negative personal economic consequences, such as a (short-term) increased cost of living. At the time this study was done, the cost of living in Gladstone was 8% higher than Brisbane, which is the capital city of Queensland (QGSO 2014a, b). The Gladstone regional council has recognized the high cost of living, along with other associated difficulties of living in industrial regions. For example, other difficulties that have been recognised include housing affordability, a lack of child care, and family stress (GRC 2013). Specifically, in comparison to Brisbane in 2013 housing in Gladstone was 33.4% higher (QGSO 2014b). Similarly, the cost of furnishings, household equipment and services was 14% higher and recreation and culture were 9.2% higher than the same or similar services available in

Brisbane (QGSO 2014b). Concern about cost of living was statistically influenced by a participant's place of birth, with participants born overseas and in Queensland more likely to note this concern (Table 2.6). Why place of birth would influence perceptions of the cost of living remains elusive, but it could be related to these people having a general increased awareness about the living costs in other regions of Australia and the world, as they have experienced other places.

2.5.2.3 Environmental themes

The environment where we (as individuals) live, and the presence of charismatic and conspicuous species in those environments are thought to influence how a person constructs their sense of place and place attachment to local communities and visitors (Lewicka 2005; Nevin et al. 2012, Haussman et al. 2015). In this study, all participants mentioned charismatic megafauna (such as sea turtles, dugongs, and birds) as one of the things that they enjoyed more about the Region. This suggests, that for these participants in the Gladstone Region these species could signify wilderness of the landscape (Nevin et al. 2012). Therefore, the loss of biodiversity (or loss of these species) may lead to a decrease in community engagement, social capital, and place attachment (Lewicka 2005; Haussman et al. 2015). This in turn, is a potential problem in the Region. Most of the participants that have lived in the Region for up to 10 years mentioned their concerns about losing biodiversity, due to increasing development, dredging activities, and/or the increased housing (Table 2.7).

Concerns raised by participants (such as having clean water, the presence of pollution, and poor air quality) were directly related to consequences of the different industrial activities. Participants affiliated with Generation X, that were more highly educated people, and that have lived in the Region for more than 6 years, all identified pollution as a value (Table 2.7). The Baby Boomer Generation is reported to have high moral, environmental priorities (Smith and Clurman 2007), and a strong presence and participation in the environmental movement (Moody 2009). Yet, this current research suggests that Baby boomers showed statistically less concern and interest about pollution than Generation X participants did. Generational differences in behaviour could be the result of the aging itself, or could be an ‘era effect’. Gifford and Nilsson (2014) defined the ‘era effect’ as when people age they become less concerned about the environment due to a growing socio-political conservative view.

Typically, environmental concern and people with high education levels are positively correlated, because these people are more informed or more inclined to seek out information (Klineberg et al. 1998; Vorkinn and Riese 2001; Dietz et al. 1998; Hamilton and Safford 2015). Additionally, time of residence has been found to foster place attachment feelings (Lewicka 2011). Place attachment can result in environmental concern and pro-environmental behaviours (e.g., Vorkinn and Riese 2001; Scannell and Gifford 2010). The observation that participants that have lived for more than 6 years in the Region are statistically more inclined to identify concerns about environmental health, due to the industrial activity, may be a consequence of these individuals having established a place attachment (Table 2.7). Furthermore, this perception and connection to place appears to be consistent with the industry and population growth that has occurred in the Region since 2011, when construction of the LNG plant, Wiggins Island Coals Export Terminal, and the Western Basin Dredging and Disposal Project commenced (Rolfe et al. 2012).

I note, however, that not all socio-demographic factors are related to environmental concern. For example, place of residence (i.e., urban vs. rural) is one of the factors that has inconsistent results within the literature (Klineberg et al. 1998). In some cases, people from rural areas are more concerned about the environment than city residents (Berenguer et al. 2005). But in other instances, evidence of a rural versus urban divide has been inconclusive (Klineberg et al. 1998; Huddart-Kennedy et al. 2005). In this current research, participants living outside the metropolitan area (i.e., rural residents), were statistically more likely to show concerns about water quality and fish health (Table 2.7), which supports Berenguer’s et al. (2005) findings.

Lastly, a perception that water turbidity in the harbour was not caused by the recent dredging activity was related to participants’ income and the stakeholder group they are affiliated with (Table 2.7). Participants with a higher income and those associated with the industry stakeholder group were more likely to state that the water quality was not dredge activity related (Table 2.7). This perception by these groups was foreseeable, and it reinforces the official research commissioned by the state and local governments, and the industry to examine the water quality issue in the harbour (GPC 2012; Vision Environment QLD 2011).

2.5.2.4 Social themes

As discussed in Chapter 1, social values are closely related to social ties and its ramifications. Family and friends are some of the most common factors noted as influencing a person’s sense of place and belonging (Lewicka 2011). This is also closely related to recreational activities (Vorkinn and Riese 2001, Larson et al. 2013a). In this study, participants that have lived for more than 6 years in the Region were more likely to mention family and friends as an important element in their relationship with the area (Table 2.8). Other researchers have had similar findings. For example, developing a social network influences people’s place attachment (Lewicka 2011; Larson et al. 2013a) and their preferences for a particular landscape or place. These preferences are a reflection of pervious social interactions with family and friends (Kaltenborn and Bjerke 2002) that create favourable memories.

A positive regional feature identified by participants was the relaxed and rural lifestyle, particularly by participants with an individual annual income of more than $200,000 (Table 2.8). Rural lifestyles has long been identified as trending, popular, or appealing lifestyles for urban residents because this lifestyle concepts portrays an idyllic notion of living close to nature and having a less hurried lifestyle (Cloke 1996; Heins 2004). Similarly, people with middle and higher income, and those with children would select or favour living in houses in rural settings where there is more peace and quiet (Heins 2004).

Female participants typically identified the influence recreational activities in a healthy environment have on psychological health (Table 2.8). Some of the benefits of outdoor recreation noted in the literature include an increase in feelings of affection, reduced stress (Ulrich 1979), attention to restoring individual’s physical health, and decreased levels of depression (Sandifer et al. 2015). Thus, the significant trend of females identifying recreational activities and psychological health can be explained by women’s tendency to be more aware of things that affect children and their family's health. Therefore, females are more accepting of the fact that the connection between the environment and human health (de Vries et al. 2003; Sugiyama et al. 2008; Sandifer et al. 2015).

The emotional connections with a place are also integral to personal and social well-being (Sandifer et al. 2015). In this study, seven participants identified that the community have an emotional connection with the harbour and the marina, which is one of the main landmarks in the city. Landmarks are icons that help residents identify their neighbourhood. Consequently, landmarks can influence a person's construction of their sense of place but also represent important places, especially for immigrants (Keogan 2002). The relationship for immigrants might be reflected in this study by the statistically significant relationship between the short-term residents (participants living in the area for less than 5 years; Table 2.8) and the importance given to a place.

In general, the participants' perception of the Region's aesthetics was positive, yet eight participants had a negative view of the aesthetics (Table 2.8). The negative perceptions were directly associated with the heavy industrial activity and were more commonly made by participants that have a lower income (Table 2.8). These participants belonged to NGOs, tourism, and recreational fisher stakeholder groups; these groups can be in touch more regularly with non-residents and therefore this could explain more why they mentioned this theme instead of their income.

Participants identified concerns about industry and government accountability regarding environmental regulations, and the need for improved social welfare (Table 2.8). Six demographics (time of residence, place of residence, place of birth, gender, stakeholder group, and income) statistically influenced these specific concerns (Table 2.8). An increasing lack of trust in the government and other institutions is a phenomenon occurring worldwide (Kong et al. 2013) with Australia being no exception (Ward et al. 2016). The recent development boom period in Gladstone (2010-2015), the apparent lack of planning for the large growth in the industry workforce (formal estimates suggested 13,000 workers were employed in that time) (Benham 2017), and the subsequent impact on services (such as health care or transport and infrastructure) were all noted by the participants. It would seem that these revelations made by participants have resulted in a lack of trust in the local and state government's actions regarding the wellbeing of the community (Table 2.8). Meyer et al. (2013) demonstrated that residents of inner regional areas in Australia are less likely to trust local and state institutions. Meyer et al.'s (2013) finding was reinforced by the results of this study. It has been speculated that local councils have less resources than state institutions and are therefore less likely to provide for the community needs (Storey 2010; Meyer et al. 2013).

Community lack of trust in Australia is more visible when a government's goals appear to be directed towards profit revenue rather than community impact management (Storey 2010). For example, female participants were more likely to be concerned about the impact on communities than males. Benham (2017) has suggested that the gender differences are a reflection of female concerns for their own personal safety related to the perceived increased "*transient male-dominated workforce*" present in the Gladstone Region (Benham 2017). This perception is accurate given that in 2011 there were 111 males per 100 females in Gladstone, while in Queensland the ratio was 98 males per 100 females (Benham 2016).

Participants perception that the government need to improve environmental regulation(s), monitoring and the communication of these studies in the Region was significantly related to whether a participant was born in another state (other than Queensland) or outside of Australia (Table 2.8). This difference between 'locals' and non-'locals' has been documented in terms of conservation discourse in the Galapagos Islands: people born overseas were more concerned about the impacts of increased development on the endemic flora and fauna than those that live on the Galapagos Islands (Cairns et al. 2013). This influence of place of birth could be due to the participants' that come from outside of Queensland may have been exposed to higher levels of environmental regulations (England 2013). Each Australian state has their own policies and associated regulations, and Queensland is known for having lax environmental policies (e.g., Papadakis and Grant 2003) that have yet to be reconciled with sustainability (e.g., Norton 2013).

2.5.2.5 H_{II}: Values and concerns

Values and concerns are thought to be influenced by gender, generation, and time of residence (Klineberg et al. 1998; Vorkinn and Riese 2001, Larson et al 2013b; Hamilton and Safford 2015). Hence, H_{II} (number of values and concerns differ depending on participant's demographics) was formulated in this thesis to test if this influence was evident in a variety of participants in the Gladstone Region. The results presented here support the concept of time of residence as a factor that influences a participant's values and concerns, in the surveyed Region. However, this study found that gender and generation only influenced some of the participants' values and concerns.

The results of this research do support other studies, where values and concerns for the environment and other aspects of a place or region people live in, were related to the time people have lived in an area (Vorkinn and Riese 2001; Scannell and Gifford 2010). Time of residence fosters place attachment and 'sense of place' feelings (Lewicka 2011; Larson et al. 2013a). In this study, long-term residents (i.e., 11 to 40 years) identified more values and concerns than any other residential time category. Thus, the longer to have lived in the Region the more values and concerns you had for the Region. The identified number concerns and values did not increase linearly through time (Figure 2.5), which could imply that due to the time spent in the area, long term residents had more appreciation and attachment to the Region. This was then reflected in the conscious decision of these residents to stay and live in the area (Lewicka 2011; Larson et al. 2013a).

However, there is a flaw in this logic. If time spent in a region increased values and concerns for the region, then one would expect that the people living in the area for more than 40 years had the most number of concerns and values. This was not evident in this study. However, one also has to consider that people in this category were older than the other participants, and therefore the differences in values and concerns could be the result of aging itself, or an era effect (Gifford and Nilsson 2014; Hamilton and Safford 2015). On the other hand, the sample size in this category is rather small, which could have influenced these results.

2.5.3 H_{III}: Influence of stakeholder groups on values and concerns

Stakeholder are described as groups with similar values and interests, and their participation in decision making has been proved to be beneficial in aspects like the incorporation of their values and knowledge in decisions and resolving conflicts (Beierle and Koniski 2001). Given that this chapter is exploring the different values in the Gladstone Region, H_{III} was formulated to test if stakeholder affiliation influenced participants identified values, concerns, beliefs and norms. To a certain extent this was a contrived analysis as stakeholders were placed into stakeholder groups *a priori* based upon where they worked.

The results in this study refused H_{III}: there was no clear clustering of individuals based upon their stakeholder affiliation (Figures 2.6 and 2.7). However, some stakeholder groupings were observed for industry (Figure 2.6a, b, c), community (Figure 2.6a, b, c), local government (Figure 2.6a, c) and school principals (Figure 2.6b, d). While the goodness of fit was good or strong in the analyses regarding values (signalling to groupings of people sharing values) (Figure 2.6), those were not necessarily based upon their stakeholder relationship. In the groupings observed not all members of the groups were present with their particular group and sometimes were located in opposite sides of the graphic (e.g. industry, Figure 2.6a), thus no conclusive statements regarding these results can be made. These results do not support other studies that have found clear differences about conservation discourses among stakeholders (e.g. Bohnet and Kinjun 2009; Cairns et al. 2013). Alternatively, they point to a somewhat generalised consensus among the different groups assessed in this study regarding values and concerns, which has already been described for the Region (Lockie and Rockloff 2005).

As mentioned above, the stakeholder grouping in the area is contrived. This grouping does not reflect if participants identify with more than one group (e.g., Beierle and Koniski 2001), and/or if the participants' perceptions reflect their occupational values rather than their personal values. Both aspects are sometimes closely interrelated given the symbolic value that occupations can have on an individual (Persson et al. 2001). Identifying the existence of common values and concerns creates an opportunity for community empowerment and enhanced stakeholder participation (e.g., Fraser et al. 2006; Reed 2008)

2.5.4 Study limitations

Identifying the existence of common values and concerns creates an opportunity for community empowerment and enhanced stakeholder participation (e.g., Fraser et al. 2006; Reed 2008). It is important to acknowledge that this study focused on the coastal and marine environment in an industrialised, rural, coastal city. As such, only participants associated with these areas were included in the study. The sampling frame was thus restricted. Unfortunately, due to logistical constraints, the Aboriginal people’s values are inadequately represented in this study. Therefore, in order to have a comprehensive understanding of the values within the Region, future studies need to address all stakeholder groups and account for the particular long time that it may take to have each stakeholder adequately participate.

Additionally, the small sample size in mixed method studies like this may result in apparent patterns or trends regarding participants’ characteristics, which must be treated with caution and cannot be generalised to the views of the whole community. Qualitative studies are often seen as offering “rich, deep data” in contrast to “hard, reliable data” that quantitative studies can offer (e.g., Bryman 2012; Brown et al. 2017). The reliability of quantitative data requires precision and hence sampling of a representative portion of the population. Qualitative sampling relies on under-representative sampling that may only reflect a few peoples or groups beliefs. In this study, a mixed-method approach that used qualitative sampling to gather information and then a statistical approach to examine trends was used. However, the sample size does not represent the Gladstone Region. I note that other studies in the Region (e.g., Lockie and Jennings 2003; Lockie and Rockloff 2005; Davey 2012) have also failed to statistically, represent the population.

2.6 Conclusions

There is an increasing need and expectation to include societal values and acknowledge community concerns in coastal development, environmental management and conservation plans. Thus, a large effort has been placed on eliciting this information in many regions of the world. However, the inclusion of societal values in decision-making is complex since these values are influenced by numerous variables such as personal and regional social, economic, and cultural factors. Some of the values identified in this research have not been previously described for the Gladstone Region: spiritual and inspiration values held by non-indigenous people.

In general, participants had a positive perception of the Gladstone Region in terms of aesthetics and quality of life. There were several expressions of concern regarding impacts to both the environment and the community due to the increasing industrial activity and the government's apparent lack of planning and regulations. Participants voiced that Gladstone harbour and the islands in the Harbour that are within the GBRWHA did not add more value to the Region. In fact, participants noted that the WHA listing was counter-productive in terms of having a good image outside of the Region due to the intense industrial activity.

Some of identified values and concerns were related to socio-demographic factors that support the idea that time of residence, place of residence, place of birth, and income influence a person's perceptions, appreciation and concerns about the place in which they live. It was evident that in general, the community accepts that Gladstone is an industrial town and if the government works towards a balance between profit generation and environmental and social impact management, it is possible to achieve sustainable development. Alternative views also existed that suggest that the community would be (or were) willing to accept some environmental impact for the economic or social welfare of the Region.

In conclusion, the results of this chapter highlight the variety and complexity of values (and concerns) in a small industrial city next to an iconic World Heritage Area. This study under-represented the population but still managed to identify 39 values, 30 concerns, 40 beliefs and 22 norms. Of these, 6 cultural and economic values have not been identified previously for the Region. Although this study has its limitations, in the wider context of this PhD this chapter has identified a number of values and concerns that are used to further explore methods to map values (Chapters 3, 4 and 5) and to assess and map risks (Chapter 6). The endpoint of this PhD is to create an environmental management tool that can identify societal values and concerns in a valid manner, map these values and then use the information to test risk scenarios. These steps are explored further in the following chapters.

CHAPTER 3

Societal values of the Gladstone community

3.1 Introduction

Environmental protection has primarily focused on "*protecting nature for human's sake"* (instrumental value) (Chan et al. 2016), although nature's protection for its own sake (intrinsic value) has also been considered to be reason enough to protect nature or the environment (Tallis et al. 2014). These two perspectives have led to the debate of whether one or the other should be the target to achieve sustainability (Dietz et al. 2005). Recently, it has been proposed that a third type of value exists and could be used besides the instrumental and intrinsic categories. This value is referred to as 'relational values' and is more inclusive, bringing together personal and collective well-being as a desirable outcome of interactions between humans and nature (Díaz et al. 2015a; Chan et al. 2016). It is in the context of relational values that the understanding of what people value and how relative importance is assigned to those values, has acquired relevance within the conservation and sustainable development fields. The following introduction discussion provides an overview of how societal values have been identified in previous research and it illustrates knowledge gaps and trends (or lack thereof).

3.1.1 Assessment of societal values

As explored in Chapters 1 and 2, societal values can be understood as the importance that people assign to things, places, attributes, goods and services in nature (Seymour et al. 2010), and its assessment can be done in economic and non-economic terms.

Economic valuation is widely used and has even been incorporated into legislation in some countries under the guise of conservation strategies, such as Payment for Environmental Services or offsets (Gómez-Baggethun et al. 2010; Madsen et al. 2011). This method has been criticised for being *"unacceptably based on the utilitarian theory"* (Norton 2012), yet it is viewed as a practical way of presenting information and it provides a consistent mechanism to ease decisions about trade-offs and reach consensus among stakeholders (Granek et al. 2010). Alternatively, it has also been suggested that valuation can occur within a non-economic framework enabling the different dimensions and types of values to be acknowledged (Chan et al. 2012; Kenter 2014). Consequently, this non-economic framework should provide a more comprehensive understanding of the relationship between humans and the environment (Raymond et al. 2014; Chan et al. 2016).

Qualitative or quantitative methods can be used to undertake non-economic valuation. According to Raymond et al. (2014) qualitative assessment adheres to a deliberative paradigm focused on reaching agreement(s) via the exchange of arguments. This is achieved via a structured process of communication and participation, with an ultimate goal to gather participants' assigned and held values (Kenter 2014). Quantitative assessments tend to focus on objectively measuring and rating values by professionals (or experts), or identifying individuals' values and their importance through interviews or surveys (Novitzki et al. 1999; Reed and Brown 2003). I note that a further description of the qualitative and quantitative methods used to elicit values, such as Q methodology, the Delphi approach and the expert valuation, are described in Chapter 1.

Non-economic quantitative valuation methods are relatively recent tools developed to explore the potential of assigning non-economic values in a similar 'objective' way as the one used to appoint or determine economic values (Klain and Chan 2012). Non-economic values can be elicited through workshops, or interviews, and then assessed by the community (e.g. McIntyre et al. 2008). More commonly though, the values are 'pre-identified' by the researchers and then assessed by the community (e.g. Sherrouse et al. 2011). Within the published literature, the non-economic value (i.e. importance) of societal values have been assessed in a few different ways, with the two commonest methods being to:

i. ask respondents (via interviews or surveys) to allocate a relative importance weight between 0-100, 1-100, or 1-10 to each place marked per value (e.g. Sherrouse et al. 2011; Klain and Chan 2012; Martín-López et al. 2012; Gould et al. 2014; Larson et al. 2013b); or
ii. ask respondents to allocate 100 points among all the values elicited by the researcher (e.g. Brown and Reed 2000; van Riper et al. 2012).

Assessment of values' importance can also be achieved, or visualised, by assigning positive or negative value to places on a map (Raymond et al. 2009), or simply denoting if an identified value is important to the participant (Sodhi et al. 2010). For further information, Figure 1.4 (Chapter 1) and Appendix A, Table A1 summarise the variety of methods that have been used to identify and assess values.

The development of different techniques to assess values in a non-economic fashion is relatively recent. Subsequently, a standard method focussed on how the identified values are explored and assessed does not yet exist in the literature. As summarised in Appendix A, Table A1, there are a variety of methods that exist in the literature that attempt to develop an approach to address this methodological gap. Furthermore, as discussed in Chapter 2, factors such as place attachment and people's socio-demographics add a level of complexity to the assessment of these values. Yet, the influence of socio-demographics needs to be explored and understood given that these factors are known to influence the type of values and their perceived importance (Dietz et al. 2005; Chapter 2 [in some cases]). As touched upon and discussed in Chapter 2, some of the socio-demographic factors did not appear to influence the values that were identified in Chapter 2. However, evidence of place attachment was present in the results of Chapter 2.

3.1.1.1 Place attachment

The relationship between people and places has been studied for about 40 years and was driven by human geographers focussing on the difference between 'space' as the physical environment and 'place' as the experiential and meaningful setting (Relph 1976; Tuan 1977). The emotional bond that ties people with places is called 'place attachment' (or place identity, rootedness, place satisfaction, sense of place) (Lewicka 2011). What this term actually encompasses is still an academic area of discussion. Although touched upon in Chapter 2, the following discourse builds upon what was presented and places it into a further exploration of this concept within this chapter.

The majority of studies have focussed on factors that predict place attachment based on an individual's characteristics, such as socio-demographic factors. Of these, residence time has been consistently found to be a positive predictor where the longer a person has lived or spent in a place, the stronger the place attachment is (Hay 1998; Gustafson 2008). Chapter 2 of this thesis also found a positive relationship between residence time and environmental and social values such as biodiversity and family and friends. Home ownership is also a consistent positive predictor of place attachment (Mesch and Manor 1998), but education and age have shown both positive and negative relationships within different studies (Lewicka 2005; Lewicka 2011), suggesting that the relation between place attachment and age and education level may be mediated by other factors (Lewicka 2011). Similarly, factors such as social relationships (i.e., strength of community ties, or involvement in social activities) and sense of security can predict place attachment (Brown et al. 2004). Less frequently reported predictors of place attachment include the physical factors of a place such as its population size (rural/urban), environmental features, or landscape (e.g. Vorkinn and Riese 2001).

Both positive and negative relationships have been reported between place attachment, or connectedness to nature with pro-environmental behaviour and support for protected areas (e.g. Uzzell et al. 2002; Lewicka 2005; Scannell and Gifford 2010; García-Llorente et al. 2012; Lokhorst et al. 2014). The negative associations between place attachment and connection to nature reported by Uzzell et al. (2002) and Lewicka (2005) suggest that other factors may contribute to positive environment actions. These factors could include:

- geographical proximity to a perceived threat to the status quo (also known as the Not In My Backyard [NIMBY] effect) (Dear 1992; Devine-Wright and Howes 2009);
- perceived economic benefits (Vorkinn and Riese 2001; Devine-Wright and Howes 2010; Visschers and Siegrist 2014) or detriments (Bonaiuto et al. 2002);
- socio-economic and racial diversity of the neighbourhood (i.e. the higher the diversity the lower the attachment) (Stolle et al. 2008; Chapin III and Knapp 2015); or
- personal characteristics such as values orientation (Dietz et al. 2005).

Given the amount and variety of personal, social and physical factors that could influence place attachment and the different theoretical perspectives from which this theme can be studied (qualitative phenomenological or quantitative approaches) (Lewicka 2011), it is of little surprise that there has been limited advance in the design of a theory of place. However, Lewicka (2011) has suggested that cartographic methods could contribute to the qualitative understanding of place meanings (i.e., what is important – this concept has not been thoroughly explored) and the quantitative significance of places (i.e., the amount or level of important).

3.1.1.2 Demographics

As discussed in Chapter 2, the relationship between socio-demographic factors, behaviour and concern towards the environment has been studied by several researchers (e.g. Stern et al 1993; Guagnano and Markee 1995; Vorkinn and Riese 2001; Hamilton et al. 2010; Twenge et al. 2012). Sometimes the results of these studies have been contradictory, but in general, it could be said that age (or generation), gender, level of education, and place of residence (rural/urban) are some of the most important influencing factors. The results from Chapter 2 demonstrated that concern about water quality was influenced by place of residence. According to those studies in general, the following socio-demographic factors are associated with a higher concern for the environment:

- Gender – specifically females (Stern et al. 1993; Dietz et al. 1998; Vorkinn and Riese 2001; Trenouth et al. 2012; Mobley 2015);
- Level of education attained - specifically people with higher levels of education (Guagnano and Markee 1995; Trenouth et al. 2012; Hamilton and Safford 2015),
- Age/generation - specifically younger adults (Hamilton et al. 2010; Twenge et al. 2012), and
- Political views - especially in the US, people with political liberal opinions (Dunlap et al. 2000; Hamilton et al. 2010).

The influence of place of residence is less consistent in the literature. There is evidence that people living in urban settings are more concerned about the environment than people living in rural settings (Tremblay and Dunlap 1978; Jones and Dunlap 1992). Additionally, some researchers have demonstrated that the levels of pro-environmental behaviour are higher within rural populations (Berenguer et al. 2005; Huddart-Kennedy et al. 2009). Yet other researchers have failed to detect a difference in levels of concern and pro-environmental attitudes between rural and urban people (e.g., Huddart-Kennedy et al. 2009; Mobley 2015).

Demographic factors are usually examined against concerns and attitudes, but not against societal values and their relative importance. Furthermore, only a few studies have explored the importance given to different ecosystem services (Brown and Reed 2009; Sodhi et al. 2010; Martín-López et al. 2012; Larson et al. 2013b; Plieninger et al. 2013; Zoderer et al. 2016). In these studies, some of the factors that demonstrated a statistical pattern were age, gender, level of education attained, place of residency (urban vs rural), time of residence, and place of birth. For example, Martín-López et al. (2012) and Zoderer et al. (2016) demonstrated that females assigned higher values to some ecosystem services than males. Similarly, higher levels of education attained influenced the services acknowledged and the values assigned to them (Sodhi et al. 2010; Martín-López et al. 2012; Zoderer et al. 2016).

As stated in Chapter 1, the general objective of the thesis is to deliver a framework to comprehensively assess people's values that can enrich management and/or conservation decision-making. With this in mind, this chapter aims to continue the proof of concept of the framework (see Figure 1.5) designed and presented in Chapter 1. Specifically, this chapter implements Step 2 of the framework (Figure 1.5) by undertaking an analysis of societal values. This is done by investigating how, or if, such values and perceptions are shaped by the socio-demographic factors of the community. This should provide further information on the influence of age, gender, education, time of residence and place of residence and birth on the relative importance that people assign to cultural, economic, environmental and social values that were identified by stakeholders in Chapter 2.

3.1.2 Aims and hypotheses

When implementing conservation actions, development plans, or during policy making processes, the multidimensional characteristics of societal values and opinions of the public, and their influencing factors have tended to be ignored (Díaz et al 2015b; Kenter et al. 2015). Therefore, I anticipate that exploring potential regional societal values and their perceived worth to the community will create an improved approach to better understand and include societal values in environmental conservation and management programs. Hence, this chapter explores the relationship or influence that socio-demographics have on the perceived importance (weight) of specific cultural, economic, environmental and social values, opinions and knowledge of the Region. To test this, six socio-demographic factors previously identified in the literature for their influence on concerns and perceived societal values were chosen to examine three hypotheses. A series of values were identified by a group of stakeholders in Chapter 2, which are used in this chapter to investigate the influence of the six socio-demographic factors. The four hypotheses examined in this chapter are:

- **H_{IV}**: The median weight (perceived importance) assigned to the 22 values will be statistically different from each other;
- **H_{V}**: Age, gender, education, residence time, place of residence and place of birth statistically influence the 22 identified values;
- **H_{VI}**: Societal opinions about future residential, tourism, industrial development and no-development areas are significantly influenced by the six demographic factors analysed in H_{V}; and
- **H_{VII}**: Knowledge and opinion about the environmental health of the port of Gladstone and the GBRWHA are significantly influenced by the demographic factors analysed in H_{V}.

3.2 Methods

This chapter builds upon the qualitative data collected in Chapter 2 and brings in further quantitative analyses to test the concepts of what socio-demographic factors influence respondents' perceptions of values. Data was collected via a series of face-to-face, paper-based surveys. Surveys were developed to identify the level of importance ascribed to cultural, economic, environmental and social values by a sample population of Gladstone residents. Thus, the collected data provides an understanding of the values held by the Region's population. The information explored in this chapter uses the societal values that were identified in Chapter 2 (qualitative interviews that identified values), thus providing a mixed method approach.

3.2.1 Study case: Gladstone's population

The city of Gladstone is often described as an industrial city, due to the presence of a large number of industries such as alumina, nickel and cobalt refineries and smelters, a cement production plant, a power station, three gas liquefaction plants and one of the largest exportation ports in Australia (Tinney et al. 2013; Chapter 1). Yet, this city is also located next to the Great Barrier Reef World Heritage Area (GBRWHA) (GBRMPA 2014a). A comprehensive description of the Region and its environment is provided in Chapter 1.

The total number of people usually resident in the greater Gladstone Region in 2011 was 59,461. This population are people that lived or intended to live for six months or more from the reference date in the Region. This population represents an increase of 23% from the 2001 total population of 45,479 people in the Gladstone Region. In 2011, 6% of the population stated that their usual address is elsewhere in Australia (i.e. they are itinerant workers) and 94% of the population said that Gladstone was their home. More than half of the population (54%) live in the metropolitan area of Gladstone (REMPLAN 2015).

In the period from 2006 to 2011, there was an increase of 14% in the total number of jobs in the Gladstone Region due to the mining led boom (REMPLAN 2015). This population growth was most commonly associated with jobs in the 'mining' and 'professional, scientific and technical' sectors (population increases of 146.41% and 76.11% respectively; REMPLAN 2015). In 2011, Gladstone's Socio Economic Indexes for Areas (SEIFA) score was 1,016 (represents a high score) (REMPLAN 2015). This index ranks areas according to relative socio-economic disadvantage and in this case, the high score indicates a relative lack of disadvantage, which could mean that in the area there are "*few households with* *low income, few people with no qualifications and few people in low skilled occupations*" (REMPLAN 2015).

It has been suggested that the increment of industry facilities in Gladstone, since it was founded in 1896, has led to a 'development boom' that has impacted negatively on both the social fabric of the community and the environment. This in turn, has raised concerns about the extent of the negative impacts of the port's recent expansion activities and increased industrial development (Tinney et al. 2013; Benham 2016).

3.2.2 Survey development

Questionnaires and surveys are some of the most common methods used to obtain data about people's feelings, attitudes, knowledge or opinions. The use of open ended or closed ended questions enables the elicitation of qualitative and quantitative information (e.g., de la Torre 2002; Satterfield 2001). In this chapter, face-to-face surveys were used as they have the advantage of typically having higher response rates than self-completed surveys, with assured completion, and the ability of the surveyor to clarifying information to the respondent (Christie et al. 2008; Bryman 2012). Based on the cultural, economic, environmental and social values obtained on the in-depth interviews (see Chapter 2); four different face-to-face survey tools were developed and implemented, separately addressing cultural, social, economic and environmental values.

Each of the four surveys (cultural, economic, environmental and social) consisted on four sections:

a) values mapping and weighting;
b) identification of future development areas;
c) knowledge of the Region; and
d) demographic data.

Section a) (values mapping and weighting) consisted in two activities: i) participants were asked to look at each value and to mark on a map of the Region the places they felt that a value corresponded to (i.e., map the identified values); and ii) to assign a 'weight of relative importance' between 1 and 10 to each mark, where 1 is less important and 10 is most important (Table 3.1). With each of the four surveys addressing either the cultural, economic, environmental, or social values, section a) differed between surveys, but the subsequent sections (b, c, and d) were the same in all four surveys. For the purposes of this chapter, only the weighting of values of section a) is used, together with data from sections c) and d). The mapping results from section a) are described and explored further in Chapter 4. The surveys are provided in Appendix C.

Table 3.1 Summary of survey questions by methodological section and their characteristics. NA = not applicable.

Section	Type of questions n = number of questions	Likert scale used	Geographical identification
a	Spatial location of values and their perceived importance (n = 3 cultural, 6 economic, 5 environmental, 8 social)	1 to 10 (least important to most important)	Yes
b	Spatial location of future development and opinions (n = 4)	NA	Yes
c	Environmental health of the harbour (n = 1)	-2 to +2 (totally disagree to totally agree)	No
	GBRWHA (n = 3)	Yes/No/Unsure questions	
d	Sociodemographic (n = 10)	NA	No

As described above, the values included in the four different surveys were elicited in the stakeholder interviews that are described in Chapter 2. Table 2.4 provides the list of values that were identified in the Chapter 2 interviews, with Table 3.2 illustrating which of these values were included in the four surveys in this Chapter. In order to construct a 15 to 20 minutes long survey, not all values identified were included in the final four surveys. To decide which values would be used in the surveys two aspects were taken into account: the number of mentions a value received by the interview participants and if multiple values were similar to each other (i.e., similarity of concept or cognate words). In the first case, values that were mentioned by less than 10% of the interview (Chapter

2) participants were discarded from inclusion in the surveys in this Chapter. Second, values that were considered to be similar to each other (i.e., had the same or similar meanings, or had a similar etymological origin) were re-grouped into one value classification and in cases where the value was considered to be too general, it was dissected into two or more values. Finally, given the literature review done for the Region and the knowledge of it by my supervisors, some values were included even when the participants in Chapter 2 did not mentioned them, as these values were considered to be relevant for the Region. At the end of this process, a total of 22 values were identified for use (3 cultural, 6 economic, 5 environmental and 8 Social; Table 3.2).

Table 3.2 Values elicited from the interviews (see Chapter 2) and final list of values included in surveys. Values in italics are provided with further description based on how or why they were included in the surveys.

	Values from interviews	**Values on surveys**
CULTURAL	Importance for Traditional Owners	Natural and human history
	Connection with the environment	Sacred or spiritually special
	Appreciation	Appreciation or respect for nature
	Inspiration	*Values related to appreciation were joined into one question*
ECONOMIC	Jobs creation by industry	Industry development
		Port facilities
		Included due to its importance on the economic activity of the Region
		Commercial shipping
		Included due to its importance on the economic activity of the Region
	Commercial fisheries	Commercial fisheries
	Tourism and industrial tourism	Tourism opportunities
	Business that prosper due to the industry presence	Recreational business opportunities
	Farming and aquaculture	*Not included due its low mention rate on interviews*

Table 3.2. Continuation

	Values from interviews	Values on surveys
ENVIRONMENTAL	Biodiversity and ecosystem importance	Habitat for fish
	These values were split into more specific values	Habitat turtles and dugongs
		Habitat for birds
		Habitat for other wildlife
	Rivers' input on harbour	Maintenance of the harbour health
	Environmental health of the harbour	*Values related to the environmental health of the harbour were joined into one question*
	Water quality	
SOCIAL	Recreation activities and psychological health	Recreational Fishing
	These values were split into more specific values	Camping
		Other recreation activities
	Aesthetics	Scenery
	Community feel	Important for community
	Lifestyle	*Values related to the community values were joined into one question*
	Family and friend's importance	Future generational use
	These values were split into more specific values	Good memories
	Intrinsic value of the GBRWHA	Existence

The first section of the surveys (section a) consisted of a series of sentences used to elicit the respondent's values by addressing the cultural, social, economic and environmental values for the area. For example, 'I value these places because they provide port facilities'. First, each respondent was provided with an A4 sized black and white map of the Gladstone Region at a scale of 1:800,000 (Appendix C) and represents the Regional Council boundaries used for management purposes. The respondents were asked to identify and mark on the map, with a point, as many places as they considered were important for the value that was listed. To demarcate different values sets, a different coloured marker was used to identify the different values. In order to detect the perceived importance (i.e., worth) of the each place, the participants were requested to assign a weight (along a scale of 1 to 10) to each one of the points marked on the map in a non-ranking fashion. The weighting used was where 1 equated to least important and 10 equated to most important, regarding each individuals personal perception of each value. This enabled mapping of identified values (the process, analysis and results of the spatial data is discussed further in Chapter 4).

Gladstone's regional development has been gradually increasing since the establishment of Queensland Alumina (in 1966) (Greer et al. 2010). This industrial development is seen as an important component of Gladstone's history. Therefore, it was considered necessary to elicit respondent's views about this situation, and hence provide data that could be used to map values in a spatial context against development pressures (this is discussed further in Chapter 4).

Section b) of the surveys collected opinions on where respondents felt that development should, or should not occur. Following similar methods to Brown (2006), respondents were asked to use their knowledge to identify and circle areas/places (i.e., mark polygons on the maps) where they believe that:

1. future development should be prohibited, and
2. areas where they believe that:
    a. residential;
    b. tourism; and
    c. industrial development should occur.

Again, different colours were used to identify and differentiate the polygons. This second mapping sequence occurred on the same map that was used to identify their valued places. In addition, for the 'No Development' question, respondents were asked to explain the reasoning behind the areas they indicated as should not be developed. Questions following on from this, did not actively elicit information, but information was inferred from respondent's comments that were wrote down during survey elicitation process.

The third section of the survey (section c) consisted on three questions that focussed on the GBRWHA. During the in-depth interviews (Chapter 2) the GBRWHA theme was explored because the port of Gladstone lies within its boundaries. It became evident in Chapter 2 that some respondents were not aware of the GBRWHA boundaries and that the port and the GBR were perceived as two separate and unconnected entities. Because of this lack of societal knowledge, it was decided to include questions focussed upon the determining respondent's familiarity with the World Heritage Area term, assessing whether they knew if the port lies within its boundaries, and if they considered that the activities occurring in the port could affect the Great Barrier Reef. Additionally, given the recent controversy on the environmental impact of the dredging in the port (Brodie 2014; UNESCO 2014) a question about the perceived health of the harbour was included (Appendix C).

The final section of the survey (section d) collected respondents' demographic and place information, specifically: age; gender; occupation; level of education attained; individual annual income; and 'Indigenous Status' (i.e., people who identify themselves as being of Aboriginal and/or Torres Strait Islander origin) (Appendix C). The interviews undertaken in Chapter 2 highlighted that the perception of regional environmental health and human health differed depending upon the area of residency (i.e., metropolitan or non-metropolitan area; Fisher's exact test: p = 0.048) and therefore it was decided to ask for respondents' place of residence to further explore this pattern. Furthermore, place attachment is known to be an important factor that influences the construction of individuals values and attitudes (Brown and Raymond 2007; Larson et al. 2013a), and hence, like in Chapter 2, the survey respondents were asked if they were born in the area, and/or their period of residency in the Gladstone Region.

3.2.3 Survey implementation

Sampling was implemented over a period of 37 days between August and October 2014. A restricted temporal period was used to limit potential externalities that could influence respondents' perceptions during sampling. Data was collected from eight sites (geographic anchor points) that were sampled on different times and days to overcome the sampling of a representative group of people within the community. Sample sites were at the Gladstone marina (n = 2), the Gladstone airport (n = 15), the Gladstone City public library (n = 13), the Stockland shopping mall (n = 2) and the Curtis ferry (n = 3) (that makes daily trips from Gladstone to local the destinations of Curtis, Facing and Quoin Islands) and Southend in Curtis Island (n = 1). Surveying also occurred at three public events: Ecofest (http://gladstonefestival.com/events/ecofest), which occurs every June at the Gladstone Botanical Gardens; the Central Queensland University Open Day at Gladstone campus; and at the Tannum Sands' 'Beach, Arts and Music' market (http://www.gladstonelife.com/bam-markets-beach-art-music/). The majority of sampling effort was expended on surveying people within the metropolitan area of the Region.

A group of six volunteer surveyors were trained individually to ensure cohesion and consistency on the results. In every case, the lead researcher showed the volunteer surveyors how the survey had to be conducted: self-introduction, introduction of the study, request to participate and briefing of ethical considerations. All surveyors were briefed on how the questionnaire had to be applied (with probing examples). For the mapping section they tried doing it themselves to clarify the methodology.

In the field, the surveyor(s) asked every person available to participate in the research. At most sampling sites, surveyors were allowed to walk around to locate and ask people to participate in the survey. However, at the shopping mall, Ecofest, and the Open Day a strict geographic anchor point was applied, requiring surveyors to wait at a designated location until a person approached them before they could engage with the potential respondent.

As stated in Chapter 2, all data collection occurred under human research ethics approval (Project Number H14/01-005) and adhered to the Australian National Statement on Ethical Conduct in Research Involving Humans. When approaching the potential respondent, the surveyor introduced him or herself and mentioned quickly the research project to inform the person what the survey was about. The surveyor then asked the person if they would like to participate in the survey. When people agreed, they were verbally briefed on the research project (including ethical considerations), including ensuring that respondents understood that their completion and submittal of the survey implied that they had provided consent for their information to be used for this research. Respondents were also briefed about the privacy of their personal details and that the survey data was being collected in a non-identifiable manner. When people did not agree to participate in the survey, they were asked if they lived in Gladstone, if they were visitors, or Fly In Fly Out (FIFO) workers and this information recorded.

3.2.4 Data analysis

Upon completion of the surveys the data was manually entered into a Microsoft Excel spreadsheet and coded. Coding is a process to facilitate analysis by numerically categorising survey responses. This process also facilitates its use for statistical analysis (Bryman 2012). In the case of open-ended questions, a thematic coding was used to categorise all responses into certain themes (following the methods described in Chapter 2, section 2.3.4). Four questions in section b of the surveys were open-ended, focussing on different development options for the Region (Appendix C) and hence were thematically coded. Respondents were asked to explain why they chose the areas where 'No Development' should occur. For the questions about Residential, Tourism and Industrial development, a respondent's reasons for selection of areas were not actively prompted but, if comments were provided they were recorded and subsequently analysed. In the case of an incomplete survey being collected, the data was still retained for the completed questions to enable statistical analysis.

3.2.4.1 Exploratory analysis: demographics and place setting

Descriptive analysis was used to explore the survey population. Frequency graphs and tables were used to examine the proportion of responses to all questions (except the questions related to value mapping). To determine if the sample size was representative of the Gladstone population, the variables of age, gender, education, income, occupation and 'Indigenous Status' (ABS 2016) were compared against the data from the Australian Bureau of Statistics' (ABS) Census from 2011 for the Gladstone Region using chi-square (χ^2) goodness of fit tests. Please note that 2016 Australian census data was released after analyses had been completed for this research. Thus, the 2011 census data was used as it was the best available data at the time of analysis.

The number of sub-categories of level of education attained, place of residence, and time of residence, were reduced (or collapsed to fewer choices) post-survey during the data entry process to ease statistical analysis (Blaikie 2003). These 'reduced' categories have been used in other studies exploring the relationship of values or preferences (Caro and Ewert 1995; Guagnano and Markee 1995; Teye et al. 2002). Education consisted of five categories that were then collapsed into two categories: 1) higher (i.e. university, postgraduate and vocational education and training qualifications); or other education (i.e. primary school or high school qualifications). Each respondent answered their suburb of residence, which was *a posteriori* classified as being either metropolitan or non-metropolitan. Thus, an analysis of metropolitan versus non-metropolitan values and opinions could be undertaken. Information about the period that a respondent had lived in Gladstone was grouped into four categories reflecting the transient (0-5 years), short (6-10 years), long (11-40 years) and permanent (more than 40 years) term of residence in the area (see Table 3.3 in Results).

3.2.4.2 Importance (weight) assigned to values

In order to test H_{IV}, one weight per value for each respondent was calculated using median values. Given that each respondent provided different weightings for each of the places marked per value, it was necessary to standardise the data. This was done to achieve only one weight per value for each respondent. The data collected was ordinal, hence in the cases where more than one weight was assigned to each value, the median was calculated for each value per respondent and used for the statistical analyses. In order to determine if there was a statistically significant difference within the overall (median) weights given to values of the same survey, a Friedman test was conducted. When the results were statistically significant a Wilcoxon signed-rank tests (with a Bonferroni correction) was conducted as a *post hoc* analysis to identify significant differences.

3.2.4.3 *Ordinal and Multinomial logistic regressions*

In order to assess the most appropriate approach to examine the statistical relationship between the perceived importance of values and the respondents' socio-demographics, Appendix D explored the use of two different methodological/statistical approaches. In this case, the data supported a multivariable approach as being appropriate and robust compared to a bivariate approach (which is more common in the published literature). The reasoning behind the use of a multivariable statistical approach is further explained and discussed in Appendix D.

To test H_{V}, H_{VI} and H_{VII}, all 22 identified values were examined using ordinal and multinomial regressions to determine associations with demographic and socioeconomic factors. The median weights assigned to each value and the Likert-scaled question in section c (see Table 3.1) were tested using multivariable ordinal regression where odds ratios (ORs) and 95% confidence intervals were estimated using SPSS 22.0 (Statistical Package for the Social Sciences). Six socio-demographic factors (i.e. age, gender, education, residence time, place of residence, and place of birth) were used for all tests. These six factors have been identified in the literature as capable of influencing assigned values (Caro and Ewert 1995; Guagnano and Markee 1995; Teye et al. 2002).

In order to assess if the regression model was accurately predicting the variation of the weights assigned by the respondents to the places mapped for each value, the model fit, pseudo R-square and test of parallel lines were taken into account. The model fitting results determine whether the model improves our ability to predict the outcome, and a statistically significant chi-square values ($p < 0.005$) indicates that the model improves the baseline model. The test of parallel lines evaluates the assumption of proportional odds, and if the p value is significant, the assumption of proportional odds is rejected. Finally, the pseudo R-square value explains the proportion of variance explained by the model (ReStore 2016).

A series of multinomial logistic regression were used to test the association of the categorical data results from questions that examined future development areas (questions 2-5), and questions focussed upon the knowledge and perception of GBRWHA (questions 7-9) against the socio-demographic factors.

Since these questions were the same within the four different surveys, the data was pooled and the analyses were across all respondents, with the 'type of survey' (i.e., cultural, economic, environmental or social) included as an extra factor. For logistic regressions, the SPSS software has the option to choose the reference category against which the likelihoods are calculated. For example, in the case of the question about areas with no further development, people mentioned 10 different reasons for choosing those areas, and one of those reasons ('optimistic agreement') was selected as the reference category. This cannot be done for the ordinal regression models and in those analyses, the default reference category was the highest median weight assigned to each value.

3.4 Results

3.4.1 General results

A total of 614 people were invited to participate in the surveys, with 217 people agreeing to participate providing a response rate of 35.3%. The 397 people that did not agree to participate were self-identified as locals (68%), visitors (17%) and workers from the FIFO community (15%).

Frequencies of all the demographic characteristics elicited on these surveys, with the exception of age, differed significantly from the proportions estimated by the 2011 census of the Gladstone Region (Table 3.3). Females, people with higher educational attainment, those with an annual individual income of $80,001 - $180,000 and more of $180,001, or less than $18,000, Australians and First Nations from other countries, and people living in the metropolitan area were over-represented in the sample frame. Data related to the place of birth and time living in Gladstone is not collected for the Australian census and hence could not be analysed for representativeness.

Table 3.3. Comparison of the surveys demographic information against the 2011 Australian census data (REMPLAN 2015) for the Gladstone Region.

Age	**Count**	**%**	**Census %**[1]	χ^2	*df*	*P* value
18-25	31	14.3	13.3	1.613	5	>0.05
26-35	38	17.5	18.5			
36-45	41	18.9	20.9			
46-55	48	22.1	20.5			
56-65	36	16.6	14.6			
66 or over	23	10.6	12.2			
Gender			[1]			
Male	93	42.9	52.0	7.267	1	<0.05
Female	124	57.1	48.0			
Education*			[2]			
Higher education	120	55.8	46.01	8.336	1	<0.05
Other education	95	44.2	53.99			
Income (per year)			[1]			
$1 - $18,200	34	15.7	32.01	77.286	5	<0.05
$18,201 - $37,000	26	12.0	9.51			
$37,001 - $80,000	61	28.2	27.67			
$80,001 - $180,000	56	25.9	10.03			
$180,001 +	16	7.4	10.99			
Chose not to answer	23	10.6	9.79			
Identification			[1]			
Australian	196	90.3	80.01	8.415	2	<0.05
First Nations from another country	15	6.9	12.38			
Australian Aboriginal	6	2.8	3.54			
Time living in Gladstone (years)*						
Not living in Gladstone	34	15.7				
0-5	76	35.0				
6-11	15	6.9				
11-40	75	34.6				
Over 40	17	7.8				

Table 3.3 Continuation

	Count	%	Census %[1]	χ^2	*df*	*P* value
Place of birth						
Gladstone	34	15.7				
Other than Gladstone	183	84.3				
Place of residence[3]*			[1]			
Metropolitan area	134	62.0	54.99	22.079	1	<0.05
Non-metropolitan area	48	22.2	45.01			
Do not live in Gladstone	34	15.7				

[1] Source: Community Profile website (REMPLAN 2015)
[2] Source: Australian Bureau of Statistics (ABS 2014)
[3] *Metropolitan area:* Gladstone City, West Gladstone, South Gladstone, Barney Point, Kin Kora, Sun Valley, New Auckland, Kirkwood, Clinton, Byellee, Callemondah, Telina, South Trees, Glen Eden, Toolooa, O'Connell. *Non-metropolitan area*: Boyne Island, Tannum Sands, Benaraby, Wordong Heights, Calliope, Beecher, Burua, Curtis Island, Facing Island, Quoin Island, Miriam Vale, Seventeen Seventy, Agnes Water.
*Reduced categories for better analysis

Although the survey targeted individuals residing in the Gladstone Region, some respondents (15%) from other regions participated. These respondents noted that they participated because they had lived in the Region previously and hence felt that they were confident in knowing the area well enough to respond to the survey questions. Since most of the spatial effort to survey people occurred within the metropolitan area of the Region, it is comprehensible that the biggest proportion of the sample resided in that area.

3.4.2 Importance assigned to values

For most (95%) of the surveys, respondents marked each value multiple times on the map, with each of those places assigned a different weighting. No statistically significant differences existed between the weights given to the values from the cultural, economic and environmental surveys (Table 3.4). However, the weights assigned to the social values survey did differ statistically (Table 3.4). *Post hoc* analysis with Wilcoxon signed-rank tests, with a Bonferroni correction applied for the social values' weights, resulted in a significance level set at $p < 0.006$. The results showed a statistically significant difference between the Recreational Fisheries value and all values (except for Camping and Other Recreation). The weights given to Recreational Fisheries were significantly lower than the rest of the social values (Table 3.5).

Table 3.4. Results of Friedman's test for differences within the weights assigned to cultural, economic, environmental and social values. Statistically significant results are indicated in bold and italicised font.

	Value	N	Percentiles			X^2	df	*p*-value
			25th	50th (Median)	75th			
CULTURAL	Appreciation for nature	34	7.88	8.00	10.00	4.500	2	0.105
	Natural and human history	34	6.75	8.00	10.00			
	Sacred or spiritual	34	8.00	9.00	10.00			
ECONOMIC	Commercial fisheries	30	6.00	8.00	10.00	5.645	5	0.342
	Commercial shipping	30	6.00	9.00	10.00			
	Industry development	30	5.00	8.00	9.25			
	Port facilities	30	7.00	9.50	10.00			
	Recreational business	30	8.00	8.00	10.00			
	Tourism opportunities	30	7.00	8.00	10.00			

Table 3.4. Continuation

	Value	N	Percentiles			X^2	df	*p*-value
			25th	50th (Median)	75th			
ENVIRONMENTAL	Birds habitat	38	8.00	10.00	10.00	5.006	4	0.287
	Fish habitat	38	8.00	10.00	10.00			
	Harbour health	38	8.00	9.75	10.00			
	Other wildlife	38	9.00	10.00	10.00			
	Turtle and dugong habitat	38	9.00	10.00	10.00			
SOCIAL	Camping	42	7.00	9.00	10.00	15.599	7	***0.029***
	Existence	42	8.00	9.00	10.00			
	Future generational use	42	8.00	9.00	10.00			
	Good memories	42	8.00	9.50	10.00			
	Important for community	42	7.75	8.00	10.00			
	Other recreation	42	7.00	9.00	10.00			
	Recreational fishing	42	5.75	8.00	10.00			
	Scenery	42	7.00	9.00	10.00			

Table 3.5. Wilcoxon signed rank test for differences within weights assigned to the Recreational Fishing value versus the rest of the social values. Statistically significant results are indicated in bold and italicised font.

Recreational fishing vs.	**Z**	**Asymp. Sig.** (2-tailed)
Camping	-2.291[a]	.022[1]
Existence	-3.433[a]	***.001***
Future Generational Use	-3.248[a]	***.001***
Good Memories	-3.283[a]	***.001***
Important for Community	-2.853[a]	***.004***
Other Recreation	-2.681[a]	.007[1]
Scenery	-2.905[b]	***.004***

[a] Based on negative ranks; [b] based on positive ranks
[1] After Bonferroni correction, these values are not statistically significant.

Further exploration of the importance that was assigned to values, showed that seven of the 22 values were given weights from 1 (least important) to 10 (most important): across the whole range of weights (Figure 3.1). In particular, economic values showed a wide range of weightings (Figure 3.1b), whereas cultural, environmental and social surveys had narrower ranges (Figure 3.1a, c, and d). The narrowest range of weightings occurred for Other Wildlife from the environmental survey (Figure 3.1c). The narrow the range of weightings suggests that participants were closer in opinion.

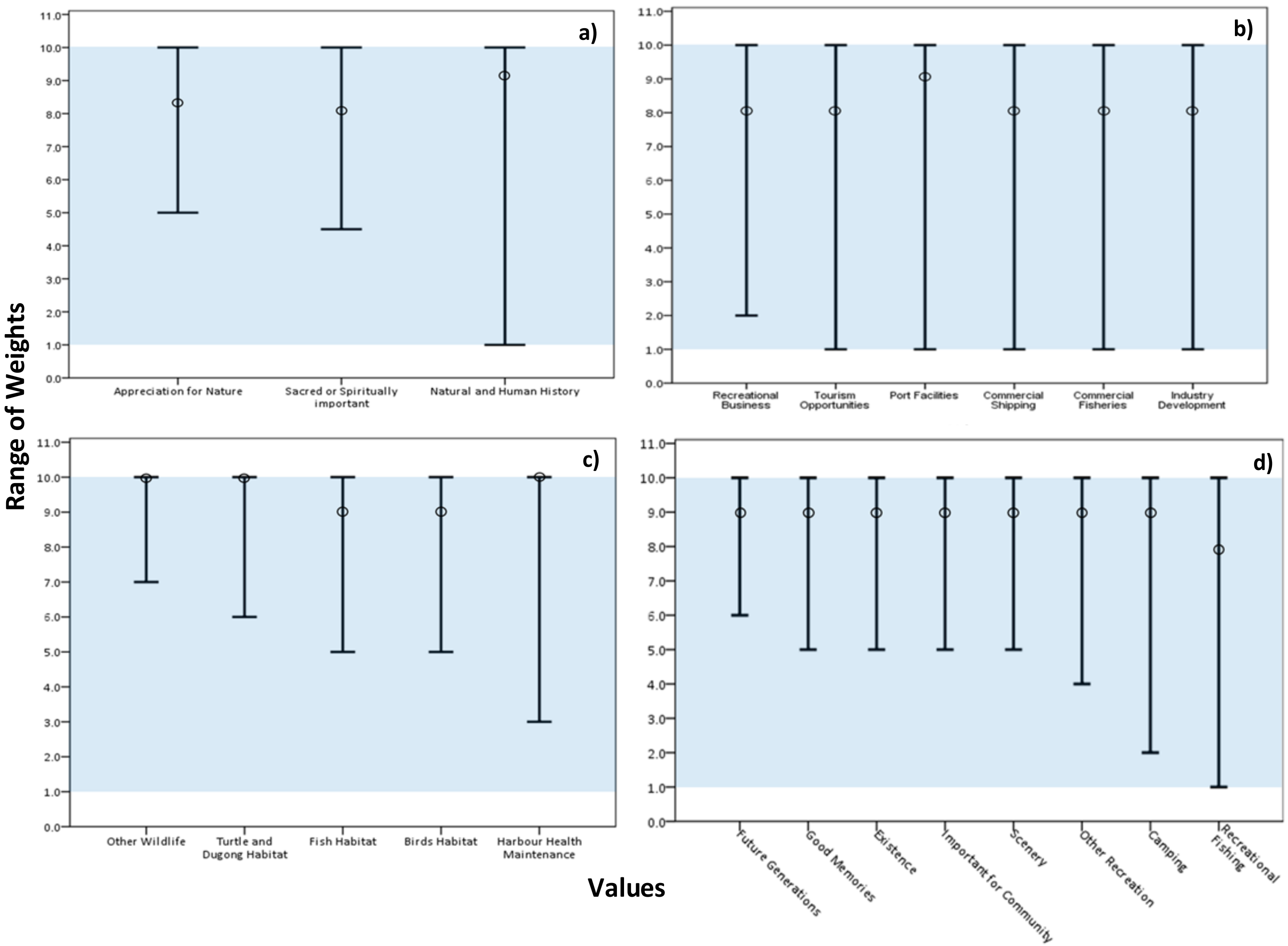


Figure 3.1. Ranges of weights assigned to each value for: a) cultural; b) economic; c) environmental; and d) social surveys. Lines denote the range of weights and the O symbol denotes the median values.

It is important to note that not every respondent identified a place on the map for all the values. The response rate for each value and the proportion of people assigning either low (1 to 3), medium (4 to 7), or high (8 to 10) weights to each value is summarised in Figure 3.2. Places Important for Tourism had the highest response rate (96%) of all values (Figure 3.2b). Appreciation for Nature had the highest response rate (91%) within the cultural survey (Figure 3.2a). Overall, Sacred or Spiritual Places had one of the lowest response rates (60%), with the lowest weighted value being Commercial Fisheries (53%) from the economic survey (Figure 3.2b). The highest response rate was for both the environmental and social surveys for the Other Wildlife (Figure 3.2c) and Other Recreation Values (94%) (Figure 3.2d). The lowest rates were places important for Harbour Health Maintenance (71%) and Camping (76%) (Figure 3.2d).

In general, respondents tended to highly weight (8 to 10) all values (Figure 3.2). However, it is noticeable that almost a third of the respondents (13% to 31%, respectively) within the cultural and social values assigned weights within the middle range (4 to 7) (Figure 3.2a, d). Alternatively, all values within the environmental survey were given high weighting by more than 68% of the respondents, which is higher than any of the other surveys. Finally, of all the surveys the economic survey respondents consistently gave low weights to all the values (Figure 3.2b).

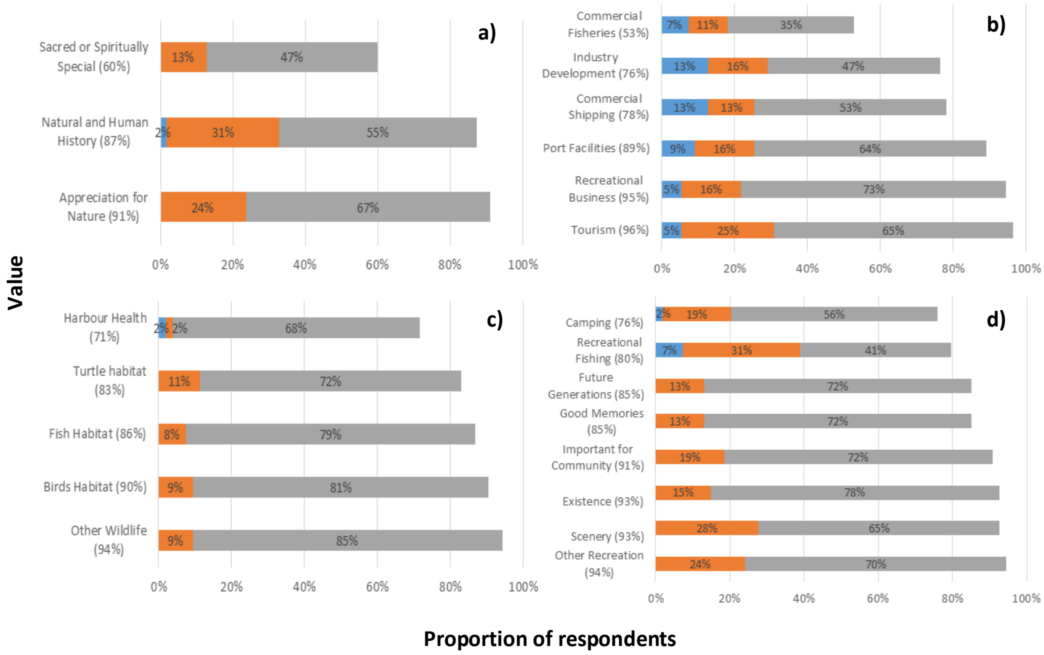


Figure 3.2. Proportion of respondents assigning either low (1 to 3: blue), medium (4 to 7: orange) or high (8 to 10: grey) weights to each value for the four different surveys: a) cultural; b) economic; c) environmental; and d) social. Response rate for each value is represented after the value name.

The ordinal regression models determined that the group of socio-demographic factors chosen predicted the weights given to the places mapped in 23% (5 of 22) of the values assessed: one cultural (Sacred or Spiritual), one economic (Commercial Fisheries) and three social values (Camping, Good Memories, and Scenery) (Table 3.6). The model fit, pseudo R-square and test of parallel lines for each model are summarised in Table 3.6 and complete models' of statistically significant results are provided in Appendix E.

Table 3.6. Ordinal regression model fitting, pseudo R-square and test of parallel lines for each value modelled. Successful models are identified by bold and italic font.

Survey	Value name	Model fitting *p*-value	Goodness-of-fit (Pearson's)	Parallel lines test	Nagalkerke R^2	Cells with zero frequencies
CULTURAL	Appreciation of nature	0.174	0.989	0.490	0.306	86.1%
	Natural and human history	0.182	0.000	0.677	0.311	86%
	Sacred or spiritual	***0.048***	***0.000***	***0.996***	***0.510***	***88.9%***
ECONOMIC	***Commercial fisheries***	***0.025***	***0.000***	***0.619***	***0.609***	***87%***
	Commercial shipping	0.072	0.206	0.992	0.415	86.6%
	Industry development	0.399	0.893	0.075	0.283	86.9%
	Port facilities	0.090	0.120	0.955	0.367	87.1%
	Recreational business	0.452	0.400	0.006	0.243	87.7%
	Tourism opportunities	0.349	0.001	1.000	0.259	89%
ENVIRONMENTAL	Birds habitat	0.391	0.695	0.000	0.264	83.9%
	Fish habitat	0.035	1.000	0.000	0.438	77.5%
	Harbour health	0.880	0.104	0.740	0.206	78.2%
	Other wildlife	0.215	0.727	0.000	0.313	70.6%
	Turtle and dugong habitat	0.258	0.978	0.731	0.328	76.8%

Table 3.6 Continuation

Survey	Value name	Model fitting *p*-value	Goodness-of-fit (Pearson's)	Parallel lines test	Nagalkerke R^2	Cells with zero frequencies
SOCIAL	***Camping***	***0.002***	***0.000***	***1.000***	***0.539***	***87.3%***
	Existence	0.015	1.000	0.000	0.414	82.5%
	Future generational use	0.000	0.968	0.005	0.588	83%
	Good memories	***0.000***	***1.000***	***1.000***	***0.960***	***83.8%***
	Important for community	0.061	1.000	0.997	0.389	85%
	Other recreation	0.002	1.000	0.027	0.494	88.3%
	Recreational fishing	0.010	0.005	0.002	0.486	88%
	Scenery	***0.024***	***0.986***	***0.241***	***0.410***	***83.6%***

For the five statistically significant models, only the time living in Gladstone and age factors statistically influenced the results. Respondents living in the Region for between 11-40 years were statistically more likely to give higher weights to places with Sacred or Spiritual values (OR = 90.833, p = 0.007). Respondents aged between 18-25 years were statistically less likely to give high weights to this value (OR = 0.017, p = 0.024). Respondents residing in the area 0-5 years (OR = 352.737, p = 0.018) and of ages 56-65 were more likely to give higher weights to the Commercial Fishing value (OR = 192.313, p = 0.022). Respondents living in the Region for a short period (i.e. 0-5 and 6-10 years) and those that do not live in the area (OR < 0.001, p < 0.001) were statistically more likely to assign lower weights to places related to the social values of Camping (OR < 0.001, p < 0.001), Good Memories (OR < 0.001, p < 0.001) and Scenery (OR < 0.001, p < 0.001). Also, respondents aged 18 – 55 were more likely to assign lower weights to places related to Camping (18 – 24: OR = 0.001, p = 0.001; 26 – 35: OR = 0.005, p = 0.016; 36 – 45: OR = 0.003, p = 0.004; 46 – 55: OR = 0.011, p = 0.015). Respondents aged 56-65 were statistically more likely to assign higher weights to places mapped for Scenery (OR = 18.668, p = 0.030).

3.4.3 Views on development areas

Open ended questions were used to explore respondents reasoning behind the spatial localisation of areas for future development, noting that sometimes the 'reasons' given were either in favour or against the specific type of development. For example, for the question: "Identify areas in the map where industrial development should occur", respondents who thought that "industry should expand into other areas within the Region" would mark areas bigger than the current distribution of the industry. Alternatively, respondents who thought that "there was enough Industrial Development in the Region", they would either refuse to mark any area on the map, or would mark only the areas where it already exists. The outcomes are summarised in Figures 3.3 and 3.4.

Please note, that not all respondents either answered these questions or marked areas on the map. For instance, the question that most people commented on was about No Development, followed by Industrial Development, Residential Development, and then Tourism Development (Figure 3.3). The question that most respondents agreed to mark areas on the map was to indicate where Tourism Development should occur, followed by No Development, Industrial Development and Residential Development (Figure 3.4).

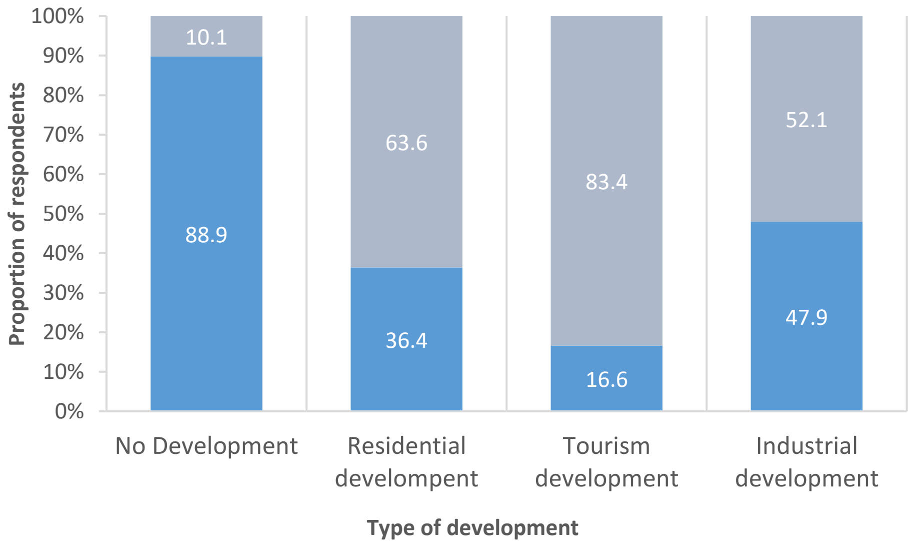


Figure 3.3. Proportion (%) of respondents that provided comments (blue), or not (grey), for questions focussed on types of development in the Gladstone Region (N = 217).

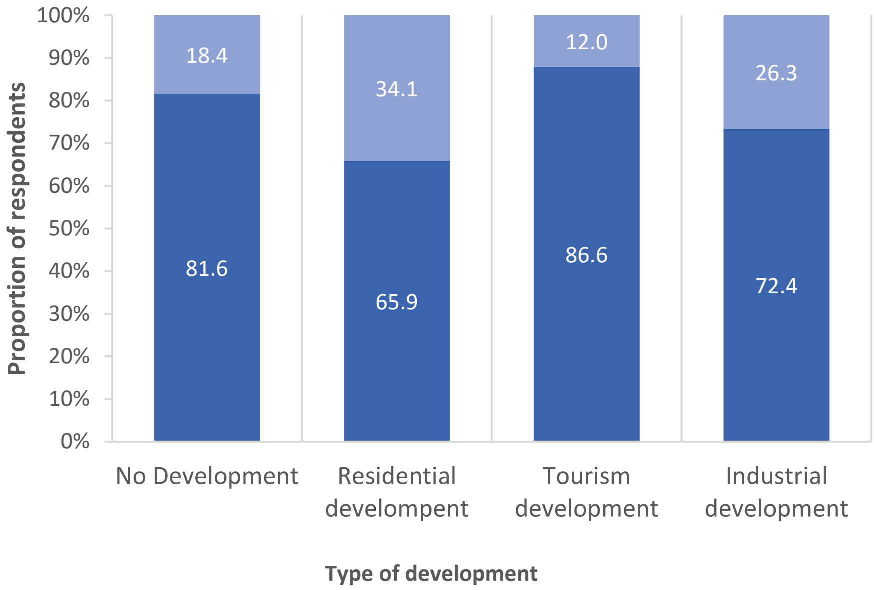


Figure 3.4. Proportion (%) of respondents that provided polygons on the map (dark blue), or not (light blue) of areas where they thought different types of development should occur in the Gladstone Region (N = 217).

3.4.3.1 No Development

The respondents' reasons for No Development were coded into 10 categories (Figure 3.5). The majority (89%) of the respondents were able to provide opinions about where they thought development should, or should not occur. Most (24.4%) of the respondents stated that the reason they selected an area that should have no further development was that the environment in those locations was important and needed to be maintained (Table 3.7, Figure 3.5).

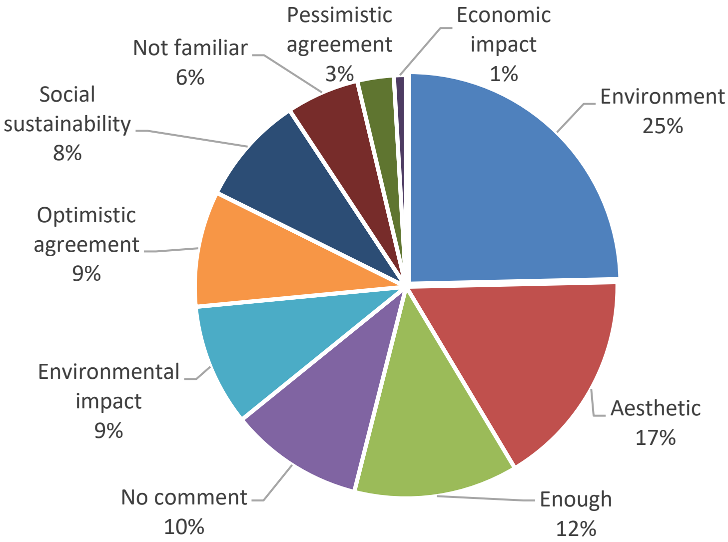


Figure 3.5. Percentage of respondents' comments as to why development should not occur. Example statements for each comment are in Table 3.7.

Table 3.7. Respondents' reasons for places mapped as No Development areas. NB: Respondents could state more than one reason.

Reason	Example statements	Frequency	%
Environmental importance	*"Mudflats are important ecologically,* [I chose those areas] *to keep them healthy"*	63	24.4
	"I believe they have environmental value, different ecosystems. LNG was a big mistake. It's a World Heritage Area. There are important wetlands."		
Aesthetic	*"Beautiful part of the country"*	45	17.4
	"They're nice places, leave them as they are"		
We have enough development	*"We don't need more development, enough is enough"*	34	13.2
	"We've got enough industry here. The whole area should be protected"		

Table 3.7. Continuation

Reason	Example statements	Frequency	%
Environmental impact	*"You gotta* [sic] *think about the reef and dredging"* *"I chose those areas because of the pollution, the impact. We shouldn't be messing the area, we're in front of the Great Barrier Reef"*	26	10.1
Social sustainability	*"Keep natural habitats for future generations"* *"Keep the islands. It's nice to have recreational and wild areas around."*	25	9.7
Optimistic agreement (i.e. agreement without further thought)	*"Development is fine, it can coexist with environment"* *"Development is happening so it's ok"*	20	7.8
Not familiar	*"I don't know enough to comment on it"*	12	4.7
Pessimistic agreement (i.e. fatalistic agreement)	*"Development has to happen. Unfortunately it's gonna* [sic] *happen"* *"Gladstone is already wiped off"*	6	2.3
Economic impact	*"Lots of farming there"* *"Small scale ecotourism could occur there"*	5	1.9
No comment		22	8.5

A number of socio-demographic factors influenced the reasons and comments respondents gave to questions related to different types of future development in the Region (Appendix F). When examining the respondents' reasons when selecting a specific site for No Development, the regression models statistically explained 67% of the proportion of variance (time living in Gladstone, p =0.022; birth place, p =0.007; place of residence p =0.005; gender, p =0.035; and education, p =0.008) and provided a good fit (p < 0.001) (Appendix F).

Two different trends were evident in the model. Respondents born in Gladstone (Place of Birth [PB]), living in the area 0 to 5 years (Residence Time [RT]), and males (Gender [G]) were more likely to give opinions that were positive about having more development areas in comparison to other factors. For example, these respondents were less likely to mention the following opinions:

- the environment is more important (PB: OR = 0.071, p = 0.014; RT: OR = 0.051, p = 0.036; G: OR = 0.231, p = 0.020);
- there is enough development already, and therefore no more development should occur (PB: OR = 0.025, p = 0.012);
- those areas should be kept for future generations (PB: OR = 0.032, p = 0.010; G: OR = 0.097, p = 0.006);
- the aesthetic of the area is more important (G: OR = 0.194, p = 0.022); or
- the potential environmental impact of more development (G: OR = 0.143, p = 0.015).

The second evident trend was that respondents with “other education” were more likely to have no opinion either in favour or contrary to places with No Development. Specifically, these respondents were less likely to give social (OR = 0.035, p = 0.001), environmental (OR = 0.082, p = 0.002), aesthetic (OR = 0.137, p = 0.020), environmental impact (OR = 0.057, p = 0.002), or ‘we have enough development’ reasons (OR = 0.071, p = 0.003) than having a clear opinion.

3.4.3.2 Residential Development

The respondents’ Residential Development comments were coded into six different categories. Just over a third of respondents (36%) provided a Residential Development comment (Table 3.8). Of these respondents, the majority (51%) stated that this type of development is no longer necessary in the Gladstone Region because they believe that there are already enough houses in the area (Figure 3.6, Table 3.8).

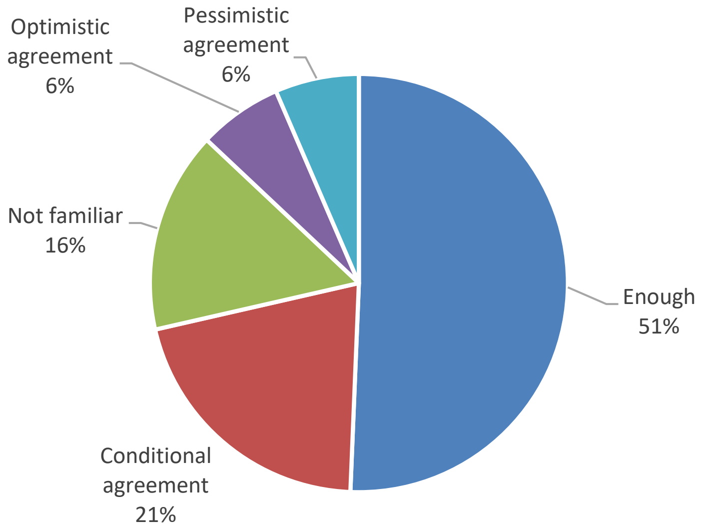


Figure 3.6. Percentage of respondents' that provided comments focussed on why Residential Development areas should occur.

Table 3.8. Respondents' self-identified reasons for places mapped (or not) as Residential Development areas. NB: Respondents could state more than one reason.

Reason	Example statements	Frequency	%
We have enough development	*"Residential development is unnecessary. Stop building houses."* *"Building big houses with no green areas is not sustainable, it doesn't help to social connection. Keep it where it is, not expand it. They need to think and build for people that is going to be here for short periods of time."*	39	18.14
Conditional agreement (i.e. agreement with restrictions)	*"I don't see a problem with residential development anywhere as long as they provide natural parks is ok"* *"Everywhere. Provided is not interfering the major habitats"*	16	7.44
Not familiar	*"I don't really know the area"*	12	5.58
Optimistic agreement (i.e. agreement without further thought)	*"It should occur where they want or need it."* *"The city is industrialised, it should expand."*	5	2.33

Table 3.8 Continuation

Reason	Example statements	Frequency	%
Pessimistic agreement (i.e. fatalistic agreement)	*"So much pollution that it doesn't matter where they develop or what more damage they can do."* *"People will always live in coastal areas."*	5	2.33
No comment		138	64.19

The results of the multinomial logistic regression showed a good model fit (p = 0.002), with these variables explaining 50% of the proportion of the variance. Of the seven factors in the model, place of residence was the only statistically significant factor (p = 0.006; Appendix F).

People living in the Gladstone metropolitan area were less likely to state that residential development was enough (OR = 2.268E-7, $p < 0.001$), or should occur inland. These respondents noted that if development was appropriately designed (OR = 2.656E-7, $p < 0.001$), they gave optimistic agreement (e.g. *"The city is industrialised, it should expand"*). Thus, Gladstone metropolitan dwellers were more likely to agree with the need for residential expansion than stating that there was enough residential development, or that there should be greater regulation on residential development.

3.4.3.3 Tourism Development

A small number of respondents (17%) provided comments regarding Tourism Development. Respondents' comments about this type of development were coded into five different categories (Figure 3.7, Table 3.9). Most of the respondents that provided a comment (39%) stated that Tourism Development should occur anywhere within the Gladstone Region (Figure 3.7).

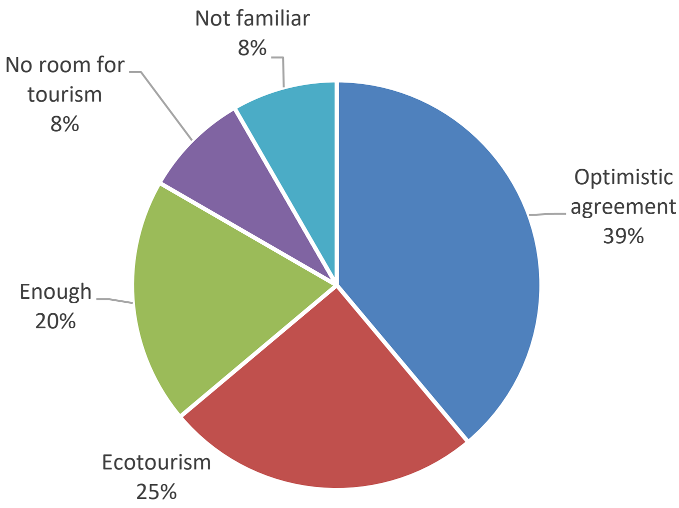


Figure 3.7. Percentage of respondents that provided comments focussed on why Tourism Development areas should occur.

Table 3.9. Respondents' self-identified reasons for places mapped (or not) as Tourism Development areas. NB: Respondents could state more than one reason.

Reason	Example statements	Frequency	%
Optimistic agreement (i.e. agreement without further thought)	*"Anywhere that hasn't been affected by industry"* *"Everywhere.* [It is] *more important than industry."*	14	6.45
Ecotourism	*"Turkey Beach was seen as an appropriate place for eco-tourism due to the abundance of wildlife."* *"Should be kept as natural as it is. Ecotourism."*	9	4.15
We have enough development	*"We don't need anymore. 1770 and Tannum are special because they're not like* [the] *Sunshine Coast."* *"Keep it how it is. More tourism, more people."*	7	3.23
No room for tourism	*"I don't think there's much room for tourism development"* *"It's unnecessary"*	3	1.38

Table 3.9 Continuation

Reason	Example statements	Frequency	%
Not familiar	*"I don't know the area."*	3	1.38
No comment		181	83.41

The model explained 57% of the proportion of the variance and had a good data fit (p = 0.009). The variables time living in Gladstone (p = 0.049), birth place (p = 0.002), place of residence (p = 0.015), gender (p = 0.030), and education (p = 0.020) were statistically significant (Appendix F). Due to the high variability in the data, post-hoc results were not significant for all these factors, except for gender. Males were less likely to state that Tourism Development should keep occurring if ecotourism-type developments were increased (OR = 0.027, p = 0.024) and that this type of development could occur anywhere (OR = 0.071, p = 0.038) as compared to stating that there is already enough Tourism Development in the Gladstone Region (Appendix F).

3.4.3.4 Industrial Development

Almost half of the respondents (48%) provided their opinion as to why and where Industrial Development should occur (Table 3.10). Of those that provided a comment, most (63%) of the respondents expressed that no more industrial development was needed in the area, and that Industrial Development should be contained in one area, or where it already exists. A small proportion (16%) of the respondents stated that Industrial Development could occur, but in locations far away from the coastline (Figure 3.8, Table 3.10).

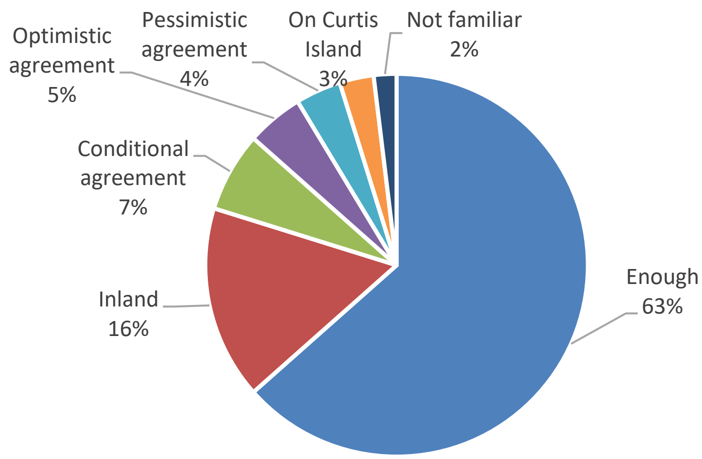


Figure 3.8. Percentage of respondents that provided comments focussed on why Industrial Development areas should occur.

Table 3.10. Respondents' self-identified reasons for places mapped as Industrial Development areas. NB: Respondents could state more than one reason.

Reason	Example statements	Frequency	%
We have enough development	*"We've got enough. It's so much it worries me."* *"Industry should be limited to an area. It affects all the Region."*	66	30.41
Inland	*"Industry should be sited inland unless it is really reliant on shipping"* *"Inland, but probably people around there won't like it."*	17	7.83
Conditional agreement (i.e. agreement with restrictions)	*"Industrial development can occur but depends on what kind it is. Need to diversify."* *"Industry should be more responsible. Industrial development is fine as long as they care of their waste and if they're not causing any problems."*	7	3.23
Optimistic agreement (i.e. agreement without further thought)	*"It's ok where it is already. If they need more is ok."* *"Industry and port mean jobs. Probably not good for the environment."*	5	2.30

Table 3.10 Continuation

Reason	Example statements	Frequency	%
Pessimistic agreement (i.e. fatalistic agreement)	*"It's already an industrial town. It doesn't matter."* *"It's already been affected by industry. It could be anywhere."*	4	1.84
In Curtis Island	*"Keep it in Curtis, sacrifice the island."* *"It's already too late for Curtis"*	3	1.38
Not familiar	*"I don't know the area"*	2	0.92
No comment		113	52.07

The model used explained 56% of the proportion of the variance and was a good fit for the data (p = 0.011). The variables place of residence (p = 0.001) and education (p = 0.010) were statistically significant (Appendix F), with place of residence showing a stronger *post-hoc* pattern. People living outside the Gladstone Region were more likely to state that Industrial Development should occur inland (OR $=1.035 \times 10^8$, $p < 0.001$) compared to stating that Industrial Development could keep occurring but with more regulations (e.g., "Industrial development is fine as long as they care of their waste and if they're not causing any problems"; Table 3.10) (Appendix F).

3.4.4 Perceived environmental health and knowledge about the Port of Gladstone

The perceived environmental health of the harbour was fairly equally divided between people agreeing with the statement: "The environmental health of the harbour is currently improving" (35.95%), not agreeing (32.26%) and not having an opinion (30.41%) on the improvement of the harbour's health (Figure 3.9). Respondents answers were not statistically influenced the socio-demographic factors that were used in the ordinal regression model, which did not fit the data well.

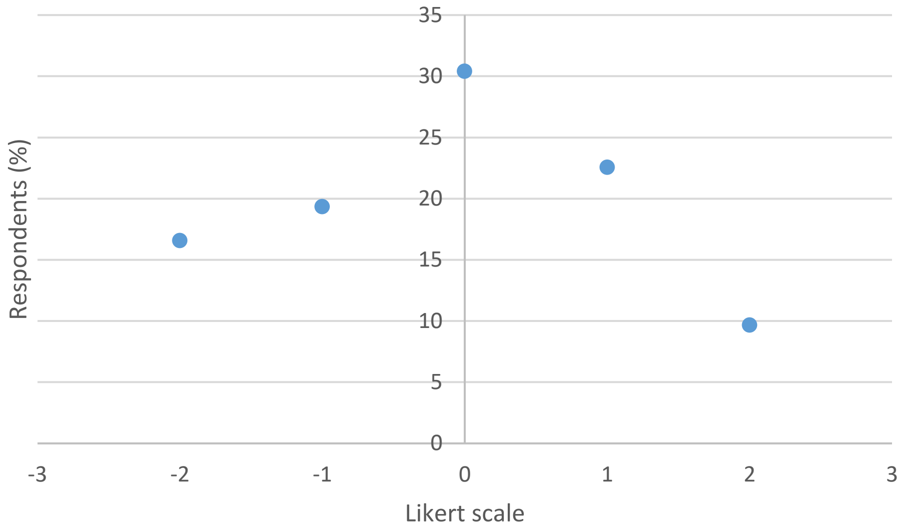


Figure 3.9. Proportion of respondents' agreement or disagreement on the improvement of the environmental health of the harbour. The Likert scale used is: totally disagree (-2), slightly disagree (-1), neutral (0), slightly agree (1) and totally agree (2). NB: 1.4% of respondents did not answer this question.

In general, the respondents felt that they were familiar with the terms and concepts being explored around the GBR, GBRWHA (81% familiarity; Figure 3.10a) and potential environmental health impacts. A third (36%) of respondents were aware that the port of Gladstone lies within the boundaries of the GBRWHA (Figure 3.10b). Furthermore, most of the respondents (77%) stated that they felt that the activities in the port of Gladstone affect the GBR (Figure 3.10c).

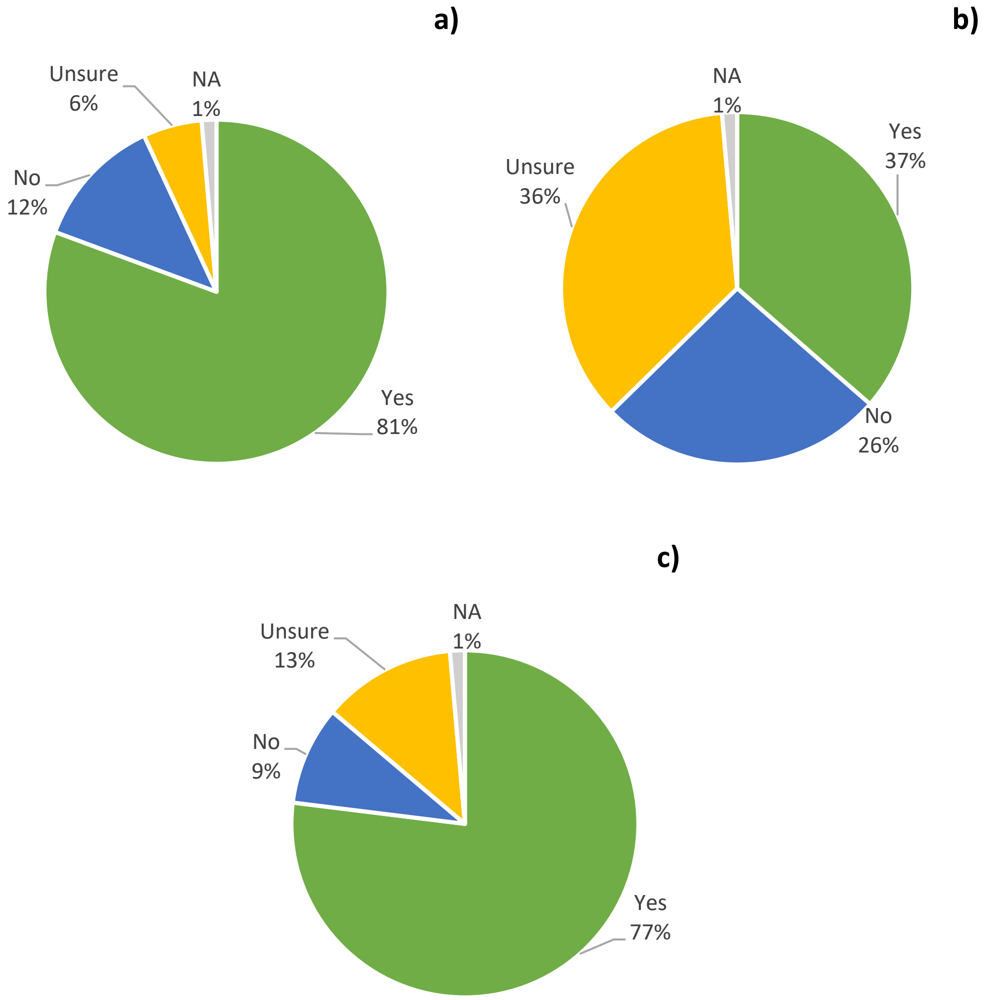


Figure 3.10. Respondents' perceptions of environmental health and knowledge of the Great Barrier Reef World Heritage Area (GBRWHA). Specifically: a) familiarity with the World Heritage Area term; b) knowledge of whether the Port of Gladstone lies within the GBRWHA; and c) perceptions about whether activities in the port would affect the Great Barrier Reef.

For the question about familiarity with the WHA term, the multinomial regression model fitted the data well ($p < 0.001$). This model explained 54% of the proportion of the variance. The variables time living in Gladstone ($p < 0.001$), age ($p = 0.001$), and education ($p < 0.001$) were statistically significant (Appendix F), with education showing a stronger *post-hoc* pattern. Respondents with 'other education' compared to respondents with 'higher education', were more likely to say that they were not familiar with (OR = 18.987, $p = 0.001$), or were unsure (OR = 20.683, $p = 0.004$) about the WHA term (Appendix F). The regression model for the question about the location of the port within the GBRWHA fitted the data well ($p < 0.05$), but only explained 23% of the variance. Gender was the only statistically significant factor ($p = 0.008$), where males were more likely to think that the port is not located within the GBRWHA boundaries (Appendix F).

Opposite to these results, the multinomial logistic regression model did not fit the data well for the question eliciting if respondents considered that the activities undertaken in the port would affect the GBR. Further outcomes are explored in Appendix D. Additionally, when the type of survey (i.e., cultural, economic, environmental or social) was included as a factor in the multinomial logistic regression models, it improved outcomes, with statistically significant patterns in three of the five successful models (Appendix F).

3.5 Discussion

Material and non-material values that humans associate with the environment could be expressed as a human-construction that are influenced by worldviews, life experiences, held values, individual's characteristics and the political and social context of a particular place (e.g., Lockwood 1999). Due to their multidimensionality, assessment of societal values' is complex, with numerous methods to undertake an assessment existing in the literature (e.g. Sherrouse et al. 2011; Klain and Chan 2012; Martín-López et al. 2012; Gould et al. 2014; Larson et al. 2013b). Taking this into account, this Chapter explored socio-demographic factors' (one of the many elements) influence on societal values and opinions, using the Gladstone Region, Queensland as a case study.

By examining differences between people of different age, gender, level of education attained, place of residence, place of birth and time of residence I have attempted to explore the importance assigned to specific values as well as their relationship with opinions about future development and environmental health of the Region.

3.5.1 Perceived importance of values

Based on results from the interviews described in Chapter 2 and other studies in the area (Lockie and Jennings 2003; Lockie and Rockloff 2005; Greer et al. 2010;

Davey 2012; Tinney et al. 2013) *a priori* expectations were that weightings for cultural, economic, environmental and social values would be polarised. However, this pattern is unsupported by the results in this Chapter. This chapter's results demonstrate no significant statistical differences were evident between the median weights assigned to the values assessed (Table 3.4 and 3.5), with the except for Recreational Fisheries. Hence, H_{IV} is rejected. These differences between previous research, the findings in Chapter 2 and the findings in this chapter could be due to the social, economic and environmental context of the Gladstone Region: extensive industrial development has occurred next to a natural marine area of international importance, which has shaped the regional panorama. On the other hand, while the proper methodological procedure was followed, it is possible that there were not enough respondents to detect differences or that the respondents do not adequately capture the diversity of the sampling population.

This outcome is particularly salient given the popularity of recreational fishing in the Region, which by 2013 had the highest rate of 'fishing households' that own a boat in Queensland (around 70%; DAF 2015). According to the 2013-14 Statewide Recreational Fishing Survey (DAF 2015), more than twice as many males than females were recreational fishers and were aged within the 30 – 44 age bracket. This study under-sampled (by 2/3s) males in the 25 – 35 and 36 – 45 age groups, which may explain why recreational fishing was assigned a significantly lower weight than that seen for the other social values that were identified.

Within all four surveys, the average weights assigned to all the values were high: between 8 and 10 (Figure 3.1), with no statistically significant patterns identified. These results are similar to those from Nielsen-Pincus (2011), where the respondents tended to assign higher weights to the places chosen, even though they had four different weight options. This pattern is thought to occur because it may be less cognitively challenging to assign higher than lower weights (Nielsen-Pincus 2011), or by over-emphasising the importance the respondents is attempting to ensure that their opinion is considered (Klain and Chan 2012).

Alternatively, there is the potential that a positive bias (Tourangeau et al. 2000) may have influenced peoples' responses. Tourangeau et al. (2000) have noted that respondents may show a pattern of responding positively to questions, especially when answering questions related to the evaluation of another person's performance, such as professors, teachers or politicians. This could also occur because respondents wish to appear knowledgeable or to provide socially desirable responses (Nederhof 1985; Furnham 1986). Although this may be a commonly reported respondent bias that can influence survey outcomes, it is important to keep in mind that respondents mark places that they value, not the places that they do not value. Therefore, it is reasonable to expect that the places respondents marked were the ones they considered more important to them and in consequence they gave these a higher weighting.

While median weights for the perceived level of importance for all values were clustered at the high end of the scale (i.e., more important) the results were variable (Figures 3.1 and 3.2). Clustered responses suggest that the respondents had similar opinions, but when levels of importance were spread across the scale (such as for economic values; Figure 3.1b and 3.2b) the variability suggests that these values may be controversial in the Gladstone Region or highlight that respondents have differing opinions. This idea is supported by other qualitative and quantitative studies that have noted that Gladstone residents have mixed views regarding economic, social, and environmental impacts and benefits brought by growing development (Greer et al. 2010; Lockie and Jennings 2003; Davey and Gillespie 2014; Benham 2016).

In comparison to the economic values, perceptions about the importance of environmental and social values clustered towards high importance (Figures 3.1c, d and 3.2c, d). As mentioned above, a tight clustering of responses infers that the respondents shared similar opinions about environmental values. If the debateable nature of economic values drives variability (because it is a true reflection of the diversity of respondents' opinions), and if environmental and social importance is diametrically opposed to economic importance, then there would be an expectation that the environmental values would have less variability, as seen here. This could be true particularly in places where the environment is not seen as essential for subsistence (Fagerholm et al. 2012), and is more likely considered a hedonistic commodity (Mosler 2002).

A different explanation for these results is that individuals can form two different dimensions of place attachment:

i. natural attachment, where newly arrived members of the community value the environmental features more than cultural assets (Hernandez et al. 2007; Lewicka 2011); and/or
ii. a civic attachment, driven by community ties and cultural assets (Lewicka 2011).

If these two dimensions of place attachment are possible, then this study's results indicate that the environmental values (followed by social values) are very important within the Gladstone community, independent of the time the respondents have resided in the area.

Lockie and Jennings (2003) and Pascoe et al. (2014) have reported some similarities regarding the perceived importance of societal values for the Gladstone area. The studies by Lockie and Jennings (2003) and Pascoe et al. (2014) used slightly different spatial extents, and survey methods however, the same "importance scale" (1 to 10) was utilised. In general, the perceived importance of Recreational Fishing, Other Recreation (i.e., kayaking, swimming) and Scenery were similar to my findings. Whereas the perceived importance of Habitat for Fish, Turtles and Dugongs, Other wildlife, Sacred or Spiritual, Camping, and Commercial Fishing values were lower in Lockie and Jennings (2003) and Pascoe et al. (2014) studies compared with this Chapter's results. The inconsistencies between the results of these studies could be due to the various methodological differences used, and to the different sample sizes used.

While the results of the mapping section of the survey is further analysed and discussed in Appendix D, it is important to consider some points here. The refusal to mark places in the map may be due to lack of confidence (Brown et al. 2017), lack of knowledge (Brown 2012a; Brown and Pullar 2012) or fear of the mistreat of the data (Klain and Chan 2012). Even though some values were not as frequently marked as others were, the final distribution maps were unaffected because each map was developed independently of the other values.

3.5.2 Are socio-demographic factors shaping Gladstone's community values and opinions?

3.5.2.1 Values' importance

The results of this study clearly indicate that a respondent's length of residency and their age are the only measured socio-demographic factors that were successful predictors of the perceived importance of five of the 22 values in the Gladstone community. This outcome partially supports H_V. Nevertheless, the results for the other 17 values did not explain the variance in the data. The low prediction power of the models could be explained by the small sample size (n = 217) (Larson et al. 2013B), but also may suggest that other factors are influencing respondent's perceived importance (Sodhi et al. 2010). Additionally, some values (such as existence or aesthetic values) may be likely to appeal to people with different characteristics and backgrounds (Raymond et al. 2009; Larson et al. 2013).

In general, a consistent relationship between socio-demographic factors and levels of concern, place attachment, and pro-environmental behaviour is documented within the literature (e.g. Stern et al 1993; Guagnano and Markee 1995; Vorkinn and Riese 2001; Hamilton et al. 2010; Twenge et al. 2012). However, there are few studies that analyse the same relationship with societal values' importance (Larson et al. 2013b; Zoderer et al. 2016) or awareness (Sodhi et al. 2010; Martín-López et al. 2012). Unlike this research's results, Larson et al. (2013b) and Zoderer et al. (2016) found that gender, education and Indigenous status influence the importance assigned to societal values or ecosystem services. Alternatively, Sodhi et al. (2009) found that time of residency influenced the identification of some ecosystem services in a forested area. Similarly, Martin-Lopez' et al. (2012) found age as the factor of influence on values' awareness, but given that in this research 'awareness' was not assessed a direct comparison cannot be done.

Spiritual values are typically examined within the context of an individual's ethnicity or religious bearings rather than against other socio-demographic factors. The reasoning behind this constrained analysis of influencing factors is based upon the theory that an individual's spirituality is a result of their collective experiences and heritage (Gould et al. 2014). Yet, spirituality and cultural values are also experienced individually (Verschuuren 2006) and in this study there is evidence (at least in this Region) that those values are more important for mid- to long-term residents and respondents older than 26 years.

It is possible that the importance of social and cultural values is developed in the same way as place attachment: through a series of experiences and social connections that can only be constructed with time (Lewicka 2011). Taking this into account, it would be reasonable to infer that activities such as camping and the good memories and other experiences were more important for people that do not live in Gladstone. Therefore, respondents that do not live in Gladstone (such as FIFO workers) may go to places closer to their home that they are more familiar with. Similarly, respondents that have lived in the Region for more than 10 years may also explore further from home. People that have lived in Gladstone for less than 10 years are potentially considered to be transient or semi-transient by the community, and as such may have not had the time to develop a local social network that would inform them of good camping areas in the Region. Alternatively, for people aged 18 to 45 years, camping may be less important than for older people. This pattern is noticeable given that the official Australian camping statistics report that half of the campers at a national level in Australia are aged 30 to 54 (Tourism Research Australia 2012). These results could be also related to the growing sector of 'grey nomads' (i.e., older Australian population that may travel for months at a time after retirement). Grey nomads are usually older than 65 years (TRA 2012), and in this case are long-term residents of the Region that travel further afield in search of new experiences and places to see.

Alternatively, scenery was more important for people aged 56 to 65 years old and those that had been living in the area for more than 40 years. These results contrast to examples in the literature, where other factors such as landscape characteristics (e.g., species richness or perceived naturalness) or the respondent's studied field major had a bigger influence in aesthetic preferences than general demographics (Junge et al. 2011; Zheng et al. 2011). Yet, if we consider that scenery appreciation is positively related to place attachment (Matarrita-Cascante et al. 2009), it is reasonable to expect that long-term residents and therefore older people may find this value more important than newcomers.

Gladstone is characterised by an influx of transient workers that live in the Region for short periods in response to economic booms that have been occurring (Benham 2016). The main reason for short-term workers and residents to move into this type of industrial, or mining boom, location is the high financial remuneration (Carter and Kaczmarek 2009; McKenzie et al 2014). These types of respondents owe a certain dependence to extractive activities that may influence their preference for economic development over environmental protection (Huddart-Kennedy et al. 2009). Thus, it would be reasonable to assume that people living in the area for a short period of time would be more likely assign to higher importance to economic values. This study demonstrated that the only economic value that transient respondents (i.e., those living in the area from 0 to 5 years) considered to be more important was Commercial Fisheries (Table 3.5; Appendix E).

Similarly, this trend was also evident in respondents aged 56 to 65 years old. Of interest, is that Commercial Fisheries (along with agriculture and farming) is one of the least contributing industries to the Gross Regional Product (REMPLAN 2016), particularly since the establishment of the alumina refinery in 1964. It is also likely that the Commercial Fisheries perceived importance mapped in this Chapter stems from a series of events that occurred in Gladstone just before and during the study period. A series of flood events influenced the fish health of Gladstone Harbour (Landos 2012; Tinney et al. 2013) and the port was undergoing expansion with extensive dredging activities, which the general population thought had influenced fish health (Landos 2012). Media coverage of these events occurred at multiple scales – local (e.g., Sparkes 2013), national (e.g., Fitzpatrick 2012), and international (e.g. GBRMPA 2014). Similarly, during these events there was a perception that access to the harbour was reduced due to the increased shipping and dredging (see Chapter 2) (Davey 2012; Benham

2016). Thus, these events may have biased respondents opinions and perceptions.

By identifying societal values (Chapter 2), their importance (this Chapter) and spatial location (Chapter 4), it is possible to create an approach that explores the 'meaning' of a particular region (Lewicka 2011). Although place attachment is a construction derived from a diverse group of affective, cognitive, and behavioural experiences, it has been suggested that mapping of individual's special places could provide some insight to the meaning of those places as an expression of place attachment (Lewicka 2011). In this context, the weights assigned to each value could be considered a measure of place attachment as a manifestation of both place-based experiences and "*place-based symbolic expressions that are not necessarily derived from experiences (e.g., the spiritual and intrinsic special place descriptions)*" (Brown and Raymond 2007).

Furthermore, it is important to acknowledge that values and their perceived importance by communities are neither absolute nor static, they "*change over time in response to local and global events and to changing individual or social circumstances, the external environment and new information*" (Díaz et al. 2015b). Therefore, assessments of values and their importance should occur before any management or conservation project start, especially where conservation and development activities are in constant battle. These perceptions of values and their importance should then be monitored through time.

3.5.2.2 Development areas

This Chapter's results indicate that a respondent's gender, education, place of residency, place of birth, and time of residence are the only socio-demographic factors that were successful predictors of respondents' opinions about future residential, tourism, industrial development and no-development areas in the Region. These outcomes partially support H_{VI} (respondent's opinions about different development types are influenced by their demographics).

Socio-demographic factors and place attachment are thought to be the primary driving elements that influence peoples selection of areas for development or conservation (e.g. Vorkinn and Riese 2001; Carrus et al. 2005). In this Chapter, the results show that among males, people born in Gladstone, and those living in the Region from 0 to 5 years there is a certain level of acceptance about the current location and the potential increase of industrial development within the Gladstone Region. Although this Chapter did not focus on a particular type of industry, the findings based upon respondents' comments about areas suitable for No Development and Industrial Development were somewhat consistent with previous research. With the exception of the age demographic, the results support other studies that have demonstrated that women and younger people can be less supportive of most types of energy developments (e.g., hydropower, natural gas, coal, nuclear, hydraulic fracturing; Vorkinn and Riese 2001; Boudet et al. 2014). In contrast, older people tend to show less support for emerging technologies (Boudet et al. 2014). Also, trends in the literature suggest that women and younger people have positive attitudes towards the establishment of natural parks (Bonaiuto et al. 2002).

The 'acceptance' of industrial development in the Region by the respondents born in Gladstone, short-term residents, and males, may respond to a trade-off between perceived risks and benefits that occurs in places where local economic and social benefits are seen as a better benefit proposition (Jenkins-Smith et al. 2011; Matarrita-Cascante et al. 2015). Supporting this phenomenon is the 'extractive commodity hypothesis' that suggests that people that depend economically on resource extraction activities are more likely to value more economic activities over environmental protection (Huddart-Kennedy et al. 2009). However, Jones et al. (2003) have argued that a pro-environmental change is occurring in people employed in resource extractive industries. The outcomes of this Chapter clearly support the 'extractive commodity hypothesis' within the Gladstone Region.

Respondents felt that areas needed to be set aside or that no further development should occur, given that they felt the Region had important environment and aesthetic values, coupled with the feeling that there was already enough development in the Region (Figure 3.5). Respondents also stated that industry should keep occurring (as the area was already impacted/degraded), but future industry should be focussed inland, or be implemented with more regulations than what is currently in place (Figure 3.8). These responses illustrate the differing community views and highlight that concerns exist.

These concerns may represent a generalised sentiment in the Region's community (Greer et al. 2010; Tinney et al. 2013; Benham 2016), that has not outweighed the importance of the industrial development (i.e., the extractive commodity hypothesis still has influence). The respondents' perceptions may have been influenced by the establishment of the liquefied natural gas (LNG) facilities on Curtis Island and the harbour dredging to facilitate shipping access to these facilities that occurred during the research period of this PhD. These events received extensive media coverage in the local, national, and international media outlets, highlighting the possible impacts on wildlife and human health (e.g., Lloyd 2013; Backhouse 2014; Robb 2014; Gladstone dredging project 2014; Problems for wetland 2014). As a researcher living in the Region during this time, it was evident that these events could influence the respondent's awareness and self-valuation of the environment (personal observations).

In response to the industrial development boom that occurred in the Gladstone Region, there was an increase of new residential areas to accommodate incoming workers. During the period of 2010 until 2014, the value of residential building approvals had an upward trend from $200 million to $450 million (REMPLAN 2016), particularly in non-metropolitan areas like Tannum Sands (QG 2016). This effect was evident in responses, where 18% of the respondents (particularly people living in the non-metropolitan areas such as the suburbs of Tannum Sands, Boyne, and Calliope) mentioned that there was already enough residential areas and that no more development was needed. The struggle to accept changes and adapt to post-industrial societies and the resistance to the establishment of new land uses is documented in the literature (e.g., Goehring and Stager 1991; Devine-Wright and Howes 2010). The typical pattern observed and reported in the literature is that conflict is positively correlated with geographical closeness to a persons' place of residence (i.e., the closer the development is to a residence, the more concerned people are) (e.g., Jenkins-Smith et al. 2011).

Although more respondents indicated areas for Tourism Development, fewer comments (both positive and negative) were provided (Figure 3.3 and 3.4). These outcomes could reflect the generalised acceptance of tourism activities, as suggested by the studies by Lockie and Jennings (2003) and TEQ (2013). While this could be true, most of the respondents' comments suggest the need for conditioned development (e.g., well regulated, at a sustainable level) and the promotion of ecotourism options (Figure 3.7, Table 3.8). While the manufacturing, construction and mining industries are the main economic activities in the Region (REMPLAN 2016), in 2013 tourism represented the 8th largest industry based on total income (REMPLAN 2016). Although most of the visitors arrive to Gladstone as a gateway to the Great Barrier Reef islands, there are other attractions in the Region, such as national parks and historical features (GPC 2012). In two different studies of Gladstone, more than 50% of the respondents agreed that the development of tourism facilities was vital for the long-term prosperity of the Region (Lockie and Jennings 2013), and more than 60% of respondents expressed that they were happy with continued growth of the tourism industry (TEQ 2013).

3.5.2.3 Perceived environmental health and WHA definitions

Respondent's perception of the environmental health of the harbour was divided, with no socio-demographic factors influencing perceptions. Level of education attained influenced the respondents' knowledge of WHA definitions and their perception of impacts in the GBR. These results partially rejects H_{VII}.

The outcomes of the surveys undertaken in this chapter, illustrate that the Gladstone community have various opinions about the environmental health of the harbour. Some individuals felt that the environmental health is improving; others felt that it is not improving, while others still, were unsure (Figure 3.9). The Gladstone Healthy Harbour Partnership survey has also documented a variability of opinion regarding environmental health for the Region (Pascoe et al. 2014). However, as McCombs and Shaw (1972) have noted, perceptions are influenced by the type and importance of a given issue as seen through the media. The environmental health of the harbour is controversial, especially after the 2011-2012 floods, dredging, and fish health events, where conflicting evidence and opinions were presented in the media. Hence, it is comprehensible that public opinion in the Region was divided. The results in this Chapter are consistent with the literature, enforcing the perception that the community opinion about environmental health is divided (e.g., de Groot 1967; Dogaru et al. 2009; Marin et al. 2009). The literature also shows some trends where people with higher education are more aware of degradation (Dogaru et al. 2009). In contrast, as discussed in Chapter 2, people that more attached to a place may perceive their region as less polluted than others (Bonaiuto et al. 1996).

Most (81%) of the respondents in this survey were familiar with the WHA term but relatively few (37%) were aware of the GBRWHA boundaries (Table 3.10). The familiarity with the WHA term supports previous studies that suggest that the terminology of the WHA is well known and understood within the Gladstone Region (e.g., Stoeckl et al. 2013; Becken et al. 2014; Davey and Gillespie 2014). For example, the World Heritage listing of the GBR has been identified as the third most important 'value' by residents of the GBR catchment, with 94% of respondents from that survey stating that they felt proud of the World Heritage Area (WHA) international status (Stoeckl et al. 2013). Furthermore, qualitative studies within the Region have also identified the importance that the WHA status has for the local community, as an environmental protection mechanism to conserve the area for future generations and to enhance tourism (Becken et al. 2014; Davey and Gillespie 2014).

The fact that respondents with 'higher education' in this survey were more likely to confirm their familiarity with the WHA term (Appendix F) could be attributed to the higher awareness, knowledge and ability to get information, that is characteristics of this socio-demographic group (Guagnano and Markee 1995; Sudarmadi et al. 2001; Dogaru et al. 2009).

The respondents' low awareness (37%) of the GBRWHA boundaries did not show a relationship with any of the socio-demographic factors tested, suggesting again, that other, unmeasured factors may have had an influence. For instance, spatial illiteracy (i.e., the ability to understand and recognise space and distance) has been identified as a problem when identifying places or boundaries on a map, particularly in young students (Patterson et al. 2003; RoperASW 2006) and females (Weiss et al. 2003). Also, a possible confusion among the community may exist between the GBRMPA and the GBRWHA concepts and therefore their boundaries. Additionally, the WHA boundaries have been subject of debate since the Queensland Government and the Gladstone Ports Corporation recommended that the port be removed from the WHA (Wordsworth 2012). This debate garnered some media attention. I note that such a bold move to annex the port from the GBRWHA is unlikely to occur since WHA is under Federal government management (EPBC act) (not State government) and the Federal Minister is the only authority that can approve changes that may have a significant impact on the values of a WHA (Tinney et al. 2013; GBRMPA 2014b).

Almost 80% of the respondents in this study considered that the activities that occur in the port, such as shipping and dredging, affect the GBR (Figure 3.10c). Catchment runoff, coastal development, ports, shipping and fishing are some of the threats to the environmental health of the GBR that have been identified by international and national institutions, the scientific community, the media and the general public (Baker et al. 2008; Arup 2013; Cagnazzi et al. 2013; Stoeckl et al. 2013; Tinney et al. 2013; Brodie 2014; Davey and Gillespie 2014; Kininmonth et al. 2014; McCalman 2014; Milman 2014; Siddle 2014; UNESCO 2014; Coles et al 2015; Brodie and Pearson 2016; GBRMPA 2016). These threats have also been linked to the port of Gladstone (and other areas along the Queensland coast). This linkage suggests a high level of awareness and concern that could influence the perceptions recorded in this study (Figure 3.10). Unfortunately, the driving influence of the perceptions of environmental health and knowledge of the WHA term and GBRWHA boundaries was not predicted by the socio-demographic factors examined in this study. Thus, other factors may be at play here, such as people's main source of information (McCombs & Shaw, 1972; Lankester et al. 2015).

While all these results may be suggesting some trends regarding people's socio-demographics, it is important to interpret them cautiously since the sample size is not representative of the Region's population. On the other hand, it could be argued that even though the census data is the best data available, it may not be representative of the subpopulation studied (i.e. people living in the coastal area). This could be another reason why the sample was not representative. Further discussion about this can be found in Chapter 4.

3.6 Study limitations and recommendations

A number of limitations are identified in this study and could be improved in future studies. First, due to limited survey time available, the sample size is representative of the Gladstone Region population age structure, but proved to be small. In order to be fully representative of the Gladstone Region, a sample size of 1,049 ± 3% people was needed. Even when the sample size is representative of the population, it could be that it is still not statistically robust. Therefore, researchers should aim to increase their sample sizes as much as possible. For example, most Computer-Assisted Telephone Interviewing (CATI) surveys aim for 1000 surveys (Yang and Eyeson-Annan 2006). Increasing the sample size would reduce the number of cells with zero frequencies on the regression analyses and therefore increase the reliability of the results. This could be achieved if one single survey is applied (instead of four different surveys), increasing the effort (e.g. more surveyors), increasing the amount of time spent surveying, or using a CATI style survey to reach high target numbers.

Additionally, the survey design could be altered to improve the statistical reliability by: a) reducing the number of categories within the factors assessed; b) reducing the number of factors used; and c) rewording and adding some other questions that may enrich the result's interpretation. For example, reducing the number of options in the Likert-scale used to assign importance to the values (e.g. low, medium, high; which is discussed further in Chapter 4) or asking close-ended questions in order to have only three or four possible answers. The present wording of the questions eliciting the values' importance may have affected the elicitation of the full spectrum of importance of values (i.e., not important all to most important). Therefore, a different wording or Likert scale might be needed in future studies. Discussions with a linguistics expert may aid this endeavour. Although such changes could improve the statistical results' reliability, the researcher must consider the possible trade-offs such as loss of detailed data and poorer model fit (Auld et al. 2009).

Second, the multinomial regressions’ results suggest that having four different surveys had some influence on the responses given to open-ended questions related to the types of development in the Region and familiarity with the World Heritage Area term. Therefore, in order to avoid this type of bias, it is suggested that future studies use only one type of survey (instead of four). By doing so, the statistical analyses and results would be more straightforward and opinions and perceptions of all four values is collected for each individual.

Third, from a tactical perspective, the inclusion of questions such as sources of information, social connections, previous access to environmental education, if respondents have children, and if they or a family member depends economically from industry, place attachment, pro-environmental behaviour, may provide an improve panorama on the factors influencing people’s values. I note however, that this extra data would create a large source of further information and complex analyses that would be beyond the scope of this PhD study. Acknowledging these limitations and moving forward, will add to the body of information around societal values and their importance within coastal management.

3.7 Conclusions

The purpose of this study was to investigate the influence of respondents’ socio-demographic characteristics on the perceived importance of specific cultural, economic, environmental and social values (that were identified in Chapter 2); opinions about development; and knowledge of the Region. The results demonstrate some trends that add to the corpus of knowledge that links non-economic societal values and socio-demographic factors.

In general, the weights assigned to all values were high (i.e., 8 to 10), and in some cases (particularly, economic values) the whole range of weights (1 to 10) were used. This may reflect the wide variety of interests and held values at play within the examined community. Respondents, also, assigned a lower level of importance to recreational fishing places. This is an unexpected result given the high level of recreational boat ownership in the Gladstone Region. In general, the results show that age and time of residence are the main socio-demographic factors that influenced the perception of a value’s importance in this study.

Specifically, the values of Sacred or spiritually special (cultural), Commercial Fisheries (economic), Camping, Good memories and Scenery (social) were influenced by these socio-demographic factors.

Respondents' opinions about development were statistically influenced by a respondents' time of residence in the Gladstone Region, their place of birth, their place of residence, gender, and level of education attained. An unexpected finding was the acceptance of industrial development and its consequences, appear to contradict the concerns raised throughout the respondents' comments. This contradiction may be an artefact of response bias, where respondents felt it necessary to provide responses that they felt were socially acceptable or met the desires of the surveyor but they were not able to consistently maintain their façade. In contrast, socio-demographic factors had little or no influence upon a respondent's perception of the harbour's environmental health, knowledge of the WHA term, or the GBRWHA boundaries. These results may be a reflection of the current situation and the multiple and opposite opinions about the activities held in the area and its local and regional impacts.

It is unfortunate that the survey was unable to obtain a representative sample and there are also statistical limitations to the outcomes. For example, there was unexplained variance in the data (up to 60% in the ordinal models and up to 48% in the multinomial models; Table 3.6 and Appendix F). However, I note that most surveys that have occurred in the Gladstone Region have also failed to be representative of the population, and have statistical limitations in the sample design and analyses. I also note that gathering values (and opinions) are neither absolute, nor static. With this in mind, future work should be focused both in achieving statistical confidence and temporal consistency.

Although limitations do exist in this chapter, I argue that the data collected via a mixed method does provide an insight for future considerations. Also, different statistical analyses have been used for this type of data, which provides a different perspective and results. This is further explored in Appendix D. Additionally, the data collected via mixed methods provides information that can be used to illustrate how values can be collected, mapped in a geospatially manner, and used to assess risk. These aspects are further explored in Chapter 4 (creating a value mapping tool) and Chapter 5 (creating a spatially weighted risk mapping approach), with the outcomes placed into the context of how such a tool can aid conservation and management efforts.

CHAPTER 4

Assessment of a value mapping approach: spatial identification of societal values in the Gladstone Region

4.1 Introduction

The relationship of humans to their environment is built through their daily interactions with the environment, and while feeling, thinking, observing and experiencing the environment, people construct their individual perception to create values and attribute a relative importance to those values, particularly within a landscape context (e.g., Brown 2005). The understanding and incorporation of these perceived values is suggested to play a key role in land or resource management by gathering information needed for analyses of trade-offs and by engaging with community and hopefully achieving the community approval. In this context, it is not only important to know what people value in a particular area, but to also know where these values are spatially distributed. To date, geographic information systems (GIS) have been the main assessment tool for undertaking such tasks.

Geographic data and analyses play an important role in marine spatial planning. In the last decade, these technologies have improved in terms of their ease of use and accessibility, enabling their use by non-specialists (Butler 2006). While the concept of participatory GIS has been used since the early 1990's and its positives and negatives have been discussed (e.g., representativeness, accessibility) (Elwood 2006), the term Public Participation Geographic Information Systems (PPGIS) was conceived in 1996 by the National Center for Geographic Information and Analysis (NCGIA), in the United States. PPGIS was developed to describe the process when GIS technology is used to enhance public participation and incorporate local knowledge (Brown 2012b). Merrifield et al. (2013) noted that PPGIS helps to empower a community, especially when used within a community planning or environmental management context (Dunn 2007).

The geographic information gathered through PPGIS offers opportunities to visualize different types of socio-spatial data useful for planning and management (McLain et al. 2013). One of these types of data focuses on identifying areas or different societal values of high or low perceived importance to the community by using non-economic valuation methods. A systematic literature review (Chapter 1, Section 1.1.3.3; Appendix A, Table A.1) showed that this information can be elicited in three general ways:

1) individual interviews (e.g., Klain and Chan 2012);
2) mail, online or face-to-face surveys (most frequently used) (e.g., Brown 2006; Brown et al. 2012a; Zhu et al. 2010; van Riper et al. 2012); and
3) focus groups or workshops (e.g., Lowery and Morse 2013).

In all cases, respondents are requested to answer a series of questions related to a specific geographic area printed or displayed in an image next to the questions. Then respondents are asked to mark the places that correspond to each question or value. The collected data is recorded in a spatial database.

The identified places can be marked either with points, polygons, or pre-defined polygons, with most of the published literature favouring the use of points when surveys are the elicitation technique (e.g., Alessa et al. 2008; Bryan et al. 2011; Brown et al. 2012a; van Riper et al. 2012; Sherrouse et al. 2011). However, when interviews are used to gather information, polygons tend to be the favoured method of marking places (e.g., Klain and Chan 2012; Morse et al. 2014, Strickland-Munro et al. 2016). Qualitative data collection methods usually use polygons to mark data, citing that this method enables the meaning to be deeply explored through a series of in-depth questions that allow the participants to assign more than one attribute to that polygon and discuss its boundaries (Klain and Chan 2012; Strickland-Munro et al. 2016).

In comparison, quantitative studies use points, or predefined polygons (e.g. as a grid) as the data collection method because geographically, they are less ambiguous and more conservative (Brown and Pullar 2012). Based on their results, Brown and Pullar (2012) estimated that to achieve spatial agreement and "make meaningful inferences" 350 respondents would be needed if points are used. If polygons are used, at least 25 respondents would be needed (since a few polygons may represent "collectively significant" areas) (Brown and Pullar 2011). It's also noted that the final number of respondents may differ depending on the objectives of the research, the study area size and the researchers' time frame and the available budget (e.g., Mahboubi et al. 2015).

In order to claim representativeness of a survey, aspects such as the study area size, population and their socio-demographic characteristics need to be considered (Bryman 2012). Also in the PPGIS context, a data saturation test can be used to verify that the values are not over- or under-represented in the map. This technique is commonly used in qualitative studies and was described in Chapter 2. The data saturation test determines the point where no new information is found and therefore it is a useful tool to find the appropriate sample size (Fusch and Ness 2015). To the best of my knowledge, only Morse et al. (2014) and Rohrbach et al. (2015) have explored the 'spatial' data saturation test within the participatory mapping literature. They have done so with focus groups and interviews (Morse et al. 2014; Rohrbach et al. 2015).

When data collection uses a hard copy medium, points have been drawn with markers, pencils, pens, or by using coloured tokens or stickers, and polygons are drawn with markers or pencils (e.g. Brown 2012b) (see Figure 1.4 in Chapter 1). A wide variety of methods have been explored to record the weighting of those points or polygons. For example, some studies request the respondents to state if the value was important or not (Tyrväinen et al. 2007; McIntyre et al. 2008). Other studies have recorded 'intensity' (i.e., number of dots) by asking respondents to use 'positive' and 'negative' dots to indicate important and threatened places (Raymond et al. 2009; Bryan et al. 2011).

Studies by Brown and colleagues (e.g. Brown 2006; Brown and Raymond 2007) ask respondents to allocate up to 100 points to each of the values listed by placing mnemonically coded stickers, additionally the stickers have different weights written on them, which enables respondents to rank the locations chosen for each value. Mahboubi et al. (2015) has used a variation of this weighted tokens technique. The importance of an area can also be indicated using hypothetical dollar values. Sherrouse et al. (2011) and Bagstad et al. (2016) asked respondents to allocate 100 'dollars' among a list of values provided, which compared to the studies mentioned before allows respondents to rank values but not the locations chosen for each value. To the best of my knowledge, no other studies allow participants to assign the same weight to the different places mapped.

When assessing the spatial distribution of values within the GIS (regardless of whether points or polygons are used to collect the information), the identified spatial feature is transformed into a unique discrete or continuous layer. Again, different techniques are used to record and visualise the data within the GIS. One layer per participant can be created and aggregated with further layers from other participants (e.g., Raymond and Brown 2006; Raymond et al. 2009). Alternatively, simple point density can be used to generate raster layers (Brown 2006; McIntyre et al. 2008). The most common method uses kernel density (Brown and Raymond 2007; Alessa et al. 2008; Sherrouse et al. 2011; Bagstad et al. 2016; Brown et al. 2017). The GIS kernel density tool calculates the density of points (i.e., the places identified for each value per respondent) and creates a 'halo' or 'neighbourhood' within a user-defined cell-size and search radius around the marked points where the highest number occurs at the centre and tapers to zero at the edge of the halo (Alessa et al. 2008). The displayed density of each output raster cell is the sum of overlapping kernel surfaces. Figure 4.1 summarises the connectivity between the different methods and spatial analyses that exist within the published literature (see also Figure 1.4 in Chapter 1 and Appendix A).

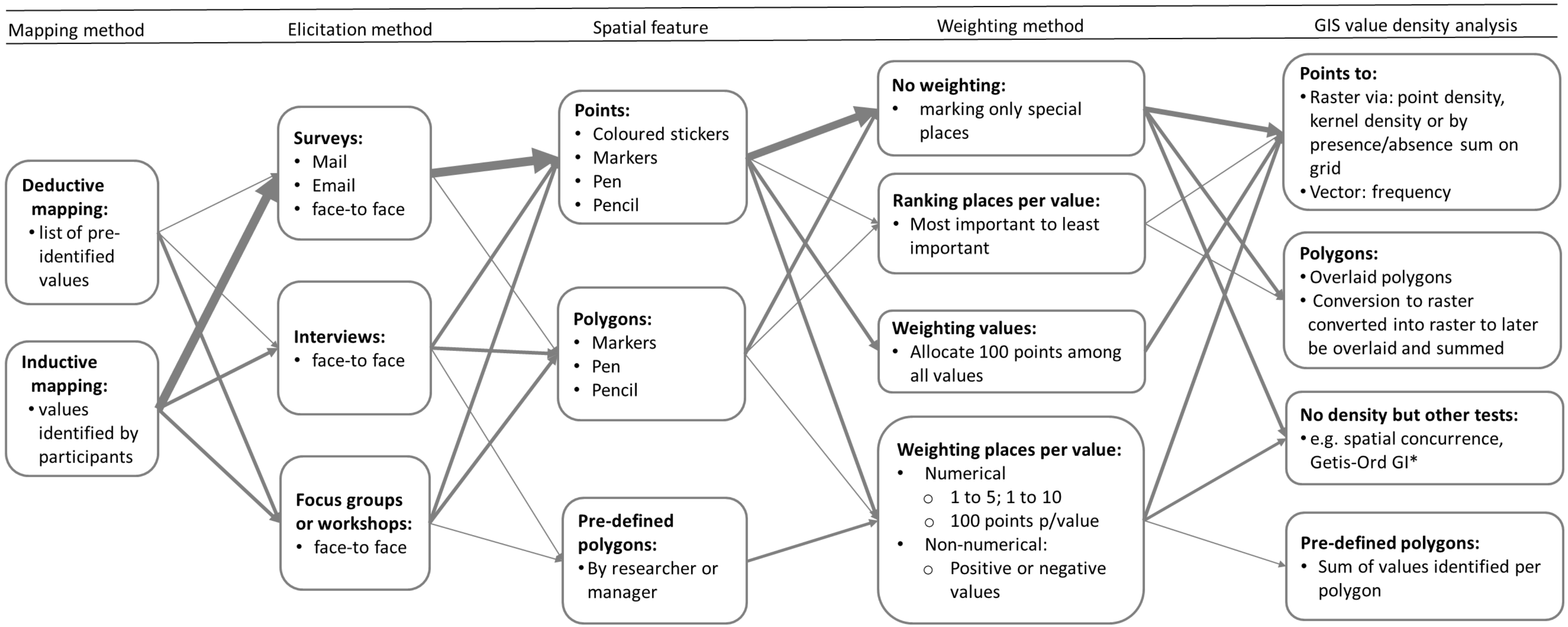


Figure 4.1. Connectivity map illustrating the different values' mapping methods, elicitation methods, spatial features used, weighting methods and GIS analyses. The number of studies employing each of these methods is represented by the connectors' width. Figure constructed from systematic literature review method described in Appendix A and provided in Chapter 1.

Most of the PPGIS studies eliciting perceived spatial values aim to build upon the existing knowledge of the currently used methodologies through specific study cases (e.g., Brown 2005; McIntyre et al. 2008; Sherrouse et al. 2011; Klain and Chan 2012; Morse et al. 2014; Mahboubi et al. 2015; Brown et al. 2017). Some studies go further and explore the identified values' concurrence with the distribution of ecosystem goods and services (e.g., Alessa et al. 2008; Raymond et al. 2009; Bryan et al. 2011; Bagstad et al. 2016) or their concurrence with proposed or existent development areas (Reed and Brown 2003; Brown 2006; Raymond and Brown 2006; Sherrouse et al. 2011; van Riper et al. 2012). These types of studies aim to aid in determining urban development preferences, or use suitability analyses to inform land-use planning and environmental management efforts (van Riper et al. 2012). The sharing of data collection techniques between researchers is common as methodologies evolve.

As mentioned above, several studies have focussed on better informing management and conservation strategies through identifying non-economic societal values using a variety of methods to evaluate the different stages involved in the assessment process. As these studies and Figure 4.1 illustrate, due to the recent development of these geospatial data-collection methodologies and the variety of ways to elicit information (surveys, interviews, or focus groups), construct maps (considering the challenges for both the researcher and the participants), and undertake GIS analyses, there is no standardised method to assess societal values and their non-monetary value yet.

Further complicating the development of a standardised methodology, is that the selection of values to be assessed by the respondents involved in surveys or interviews, is usually controlled via use of a pre-determined list of values (e.g., Brown 2005; Sherrouse et al. 2011; Mahboubi et al. 2015; Brown et al. 2017; Moore et al. 2017). Alternatively, ecosystem services are used (Bryan et al. 2011), which act to limit responses to ensure that comparisons and statistical aggregation can occur in a robust manner (Bryman 2012). An alternative to the use of a pre-determined list of values has been explored in a few studies using interviews, or focus groups (McIntyre et al. 2008; Raymond et al. 2009; Klain and Chan 2012). In these studies, the participants' values were prompted through different questions and later in the same session they were asked to identify, mark and weight, or rank those values in a map (McIntyre et al. 2008; Raymond et al. 2009; Klain and Chan 2012).

4.1.1 Aims and hypotheses

From a global, environmental context, having a standardised method to collect and map societal values will enable an easy comparison between study cases and also the necessary momentum to make this type of assessment an easy tool to be used by managers and decision makers. Given these observations, this chapter's main objective is to test a methodological approach to spatially assess non-monetary societal values (Step 2 from framework: Chapter 1, Figure 1.5) using a series of previously deduced values by different stakeholder groups (see Chapter 2) for the Gladstone Region in Queensland, Australia.

To accomplish this, this chapter will address the following questions:

1. What is the spatial distribution and density of each individual perceived value?
2. Which locations are perceived as the most important areas for cultural, economic, environmental and social values in the Gladstone Region?
3. Are spatial correlations within the cultural, economic, environmental and social values evident?
4. Where do people think future development or non-development should occur?
5. Is this the appropriate approach to determine the most important places for the respondents?

Following these questions, these six hypotheses are explored:

H_{VIII} Areas perceived as the most important for cultural, economic and social values are located around the main population centres.

H_{IX}. The spatial correlation within each of the cultural, economic, environmental and social values are significant.

H_{X}. The spatial correlation is significant only between the cultural and social values.

H_{XI}. Areas chosen for No Future Development and Tourism Development have a strong positive spatial correlation with the cultural, environmental and social values' distribution, and a negative correlation with economic values.

H_{XII}. Areas chosen for Residential Development have a strong positive spatial correlation with the cultural and social values' distribution.

H_{XIII}. Areas chosen for Industry Development have a strong positive spatial correlation with economic values' distribution.

Although the results are particular to the study case area, the general procedure and findings are applicable in other geographical contexts.

4.2 Methods

The approach implemented used the list of values that were identified by 30 members of the community (i.e. deductive method; Chapter 2). These values were then spatial identified/mapped by a random sample of 217 people living in Gladstone through face-to-face surveys (i.e. elicitation method; Chapter 3 and this chapter), using elicited points (i.e. spatial feature). Each point was then weighted using a scale of 1 to 10 importance (i.e. weighting method) and the final results are then analysed using the kernel density tool (i.e. GIS density analysis) (Figure 4.1).

4.2.1 Data collection

The data used in this chapter was collected by the face-to-face surveys addressed in Chapter 3. As presented in Chapter 3, the face-to-face survey was designed to elicit environmental, social, economic and cultural values in four different surveys (Table 4.1), with each respondent taking one survey only. Restricting participants to one survey type, ensured that surveys remained independent.

Table 4.1. Values assessed in each of the four surveys.

Survey	Value
CULTURAL	Natural and human history
	Sacred or spiritually special
	Appreciation or respect for nature
ECONOMIC	Suitable for industry development
	Port facilities
	Commercial shipping
	Commercial fisheries
	Tourism opportunities
	Recreational business opportunities
ENVIRONMENTAL	Habitat for fish
	Habitat for turtles and dugongs
	Habitat for birds
	Habitat for other wildlife
	Maintain the health of the harbour
SOCIAL	Recreational fishing
	Camping
	Other recreation activities
	Scenery, sights and relaxed feeling I get there
	Important for the community
	Future generations
	Good memories with family and friends
	Existence

Participants were given a black and white map of the Gladstone Region printed on A4 sized paper. The map included names of the main coastal towns, islands, and rivers; with no political, administrative or ecological boundaries marked. This restricted information was provided to avoid influencing or biasing answers. This was particularly important given that the

Gladstone Region contains a number of regional and national land and marine parks, and protected areas. The map was at a scale of 1: 800,000, with a zoomed in section of the Gladstone Port scale 1: 250,000 (Appendix C). Each participant was asked to mark, with a point on the map, all the places that they considered important for the corresponding value (Table 4.1). To aid with the process, each value was marked with a different coloured marker.

The approach used here aimed to determine the perceived importance (or 'worth') of each place and value. After all places for a given value were marked on the map, participants were requested to weight the importance of each of those points using an ordinal scale from 1 to 10 (where 1 was least important and 10 was most important). All participants were allowed to mark as many places as desired for each value and weight them freely, meaning they could assign the same or different weights to all places.

After identifying their values on the map and providing a weighting of importance, respondents were then asked to mark with polygons areas on the map where they considered that future development should be prohibited, and where residential, tourism and industrial development (separately) should occur. Again, each area was marked with a different colour. It is important to note that the State Development Area (SDA) was not included in the map given to the respondents, to avoid bias. More details about the survey development, other questions asked during the survey process, and the data collection are presented and discussed in Chapter 3 and Appendix C.

4.2.2 Statistical analyses

4.2.2.1 Representativeness and spatial data saturation

As presented and discussed in Chapter 3, the representativeness of the survey population was assessed, using chi-square (χ^2) goodness of fit tests, against population data collected for the Region by the Australian Bureau of Statistics (ABS). Further details of these analyses and outcomes are provided in Chapter 3, section 3.2.4 and 3.3.1. The analyses used to determine the relationship between the weight given to each point and the respondent's demographics, are also provided in Chapter 3, section 3.2.4.

In order to assess the representativeness of the sample of respondents regarding the geographic location of their values, the data saturation approach was conducted as a *post-hoc* exercise. To reiterate what was presented in Chapter 3, the saturation point is the number of interviews needed to gather all the information about a specific theme (Fusch and Ness 2015). Saturation is reached when no new themes are presented in an interview and this lack of new information occurs for three sequential interviews.

In the context of this chapter, this test was performed from a geographical point of view, where the saturation point is defined by the number of respondents per value when no new spatial locations (i.e., places) are observed (Morse et al. 2014). This test provides a mechanism to determine if sampling effort was sufficient to capture the variety of places where each of the 22 values can be found within the Region. In this chapter, data saturation for each value was examined by creating an attribute table using the already digitised value points collected in Chapter 3 (from ArcMap; see section 5.2.3.1) as a reference. Hence, the geographical places marked by each respondent (ordered by date of survey) is recorded. Following the methods of Francis et al. (2010), a line chart was generated using the number of new places marked by each consecutive participant to identify if the saturation data was reached. Again, following the methods of Francis et al. (2010), the saturation point was considered to be reached when three consecutive respondents did not mark new places on the map. Similarly to Brown and Pullar (2012), the saturation point in this chapter was calculated per value and not per survey, because any of the values within each survey was marked by all of the respondents. Also, the total number of places identified and their location differed among all the values and hence saturation needed to be determined for each value. As a content validity procedure, this test will address the spatial uncertainty of the spatial data elicited.

4.2.2.2 Mapping method assessment

Although given clear instructions on how to mark locations on the map, it was noted that the respondents marked places on the map in diverse ways: i) marking places on the map with points and/or polygons; ii) marking all or some of the values in their survey; and iii) assigning the same or different weights to the values mapped. In order to explore this diversity of data bar charts were used to graph the data. A Cochran's Q test was then used to statistically determine significant differences between the numbers of people mapping all versus some values. The exact McNemar with Bonferroni correction test was used to determine differences between the proportions of people marking each of the values within a survey.

4.2.3 Spatial analyses

4.2.3.1 Density analysis

In order to identify the values' distribution, each participant's map was digitised (using ArcMap v10.2) into a geodatabase as a point feature shapefile. Each point was given a unique identifier based on the respondent's identification number, the unique weight given by the respondent and the type of survey (i.e., cultural, environmental, economic or social) they had completed.

Respondents were asked to mark places with points, however sometimes respondents provided polygons. Given that points and polygons are geometrically dissimilar and points were explicitly requested, only points were used for the analysis of this chapter. Due to this decision, 13% of the respondent data was excluded. The reasons not to include the polygon data were:

a. the purpose of the survey was to collect points and not polygons;
b. the reason for marking polygons is unknown (i.e. maybe the whole area is important, respondents did not want to disclose specific locations or the act of marking specific places was cognitively challenging);
c. points and polygons are geometrically dissimilar, and
d. since the proportion of polygon data is low, further comparisons would not be statistically significant.

To produce density maps for each value the kernel density function in ArcMap was used. This function considers the weight assigned to each point to produce a halo within a user-defined radius. In this case, the kernel density search radius was 5,000 m and the cell size was 500 m, which were the same as that used by Alessa et al. (2008).

The decision to use the same radius as Alessa et al. (2008) was based on the similar extent between the two study areas. The output cell-size was set to 500 m by assuming that the respondents could resolve the locations in the map to approximately 500 m due to the scale of the map that was used in the surveys (Appendix C). As noted by Alessa et al. (2008), the resultant mapped information (size, shape and number of halos) are influenced by the parameters used in the analysis. The final maps were designed so the high-density halos represented the upper third of the weighting range, which allows for standardised comparison between maps (Alessa et al. 2008; Brown and Pullar 2012; Brown and Donovan 2014).

4.2.3.2 Development areas

Development or No Development areas marked on the maps by respondents were examined spatially by identifying the areas where more than 51% of the respondents agreed by counting the number of overlapping polygons. These areas were not given a rank or value during data collection or during post-collection data analysis. The analysis was performed with Feature Manipulation Engine (FME) software, where all input polygons were overlayed and the number of overlapping polygons were counted. The area of each polygon was then calculated and boundary slivers (i.e., gaps between boundary lines) were eliminated to speed up processing and reduce interpolation error. A raster depiction of the polygon layer was created for better visualisation.

4.2.3.3 Spatial Correlations

Following the methods of Brown et al. (2017), a Spearman’s rho correlation coefficient was calculated to determine the: i) spatial concurrences between values’ distribution within the same survey and between surveys; and ii) associations between the future development areas identified by the respondents and the distribution and importance of the values mapped. The coefficients were calculated using the grid cell values of the kernel density maps and the development types' sum of overlapping polygons (now converted into raster). Both rasters (i.e., values' densities and development types) have the same spatial extent and the same number of cells (n = 82,144).

The rho correlation measures the strength and direction of the association between both raster files (Erdey-Heydorn 2008; Basher et al. 2014; Johnson et al. 2016). For example, it can be used to examine areas for future industrial development against the camping value. The resultant coefficient ranges between -1 and +1, where positive values closer to 1 indicate a direct strong spatial relationship. Values closer to 0 indicate no linear relationship. In this study, the correlation coefficients over ±0.7 were considered significant.

4.3 Results

4.3.1 Data representativeness and spatial data saturation

Overall, the sample frame under represents the respondents' socio-demographic factors. Frequencies of gender, education, income, identification and suburb demographic characteristics elicited on these surveys, differed significantly from the proportions estimated by the Australian Bureau of Statistics' 2011 census. The sample was only representative regarding age (see Chapter 3, section 3.3.1).

Nineteen of the 22 values (86%) reached the saturation point (i.e., the number of people needed to be interviewed to reach representativeness) via the collection methods used. Three values ('harbour health maintenance', 'camping' and 'other recreation') did not reach saturation point. The saturation points reached are summarised in Table 4.2. It is important to note that a different number of people marked each value. Also, each value was different in their total number of places and their geographic location.

Table 4.2. The number of people needed to be interviewed/surveyed to reach the data saturation point for each explored value.

Value	No. of marked places	No. people marking each value with points	Data saturation point
Cultural			
Spiritual	23	34	28
Appreciation	28	40	38
Natural and human history	28	43	39
Economic			
Commercial shipping	4	40	10
Port facilities	7	45	10
Commercial fisheries	14	25	15
Industry development	10	37	20
Tourism opportunities	24	47	41
Recreational business	23	46	43
Environmental			
Other wildlife habitat	27	38	23
Turtles and dugong's habitat	18	33	32
Fish habitat	25	35	33
Birds habitat	28	37	35
Harbour health maintenance	26	28	*>28*
Social			
Recreational fishing	22	35	21
Future generations	28	36	31
Existence	29	36	32
Important for community	26	39	35
Good memories	25	38	36
Scenery	25	43	40
Camping	28	35	*>35*
Other recreation	25	43	*>43*

4.3.2 Mapping method

Of the 217 surveys collected, three (1.4%) did not complete the value mapping section of the survey. Reasons recorded for not completing this section included: not knowing the area well enough; not liking the area; and not having a "connection" to the region.

In general, five different characteristics were identified:

1. The proportion of respondents per survey marking all or some of the values;
2. The proportion of respondents marking each value on the map;
3. The proportion of respondents per survey and value marking places with points, polygons or both;
4. The proportion of people per survey that assigned different or equal weights to the values marked on the map; and
5. The number of points used per respondent per value.

Pooling across all surveys, just over half of the respondents (55.3%) marked all the values in their survey; 43.3% marked some values (i.e. at least one); and 1.4% did not mark any values. The social survey had the highest proportion of respondents marking all the values (65%), and the economic survey had the lowest proportion of people marking all the values (38%) (Figure 4.2).

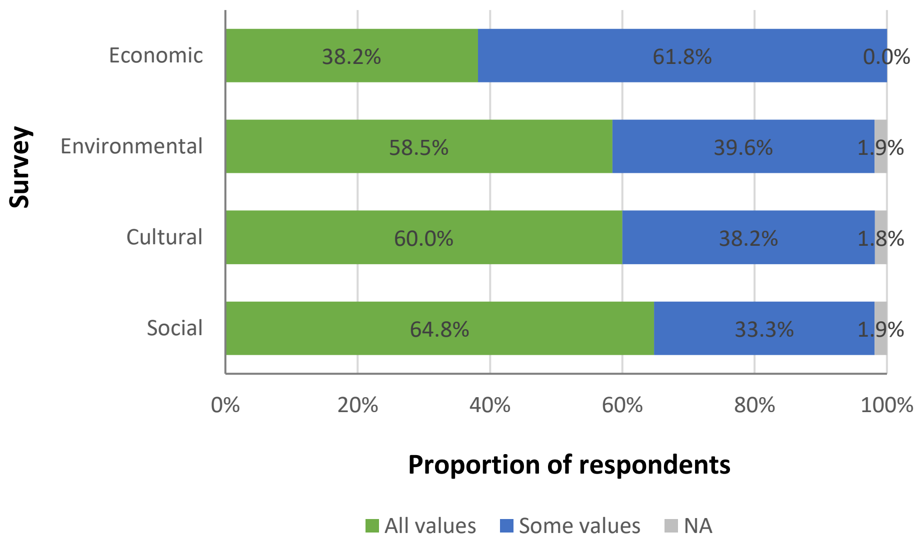


Figure 4.2. Proportion of respondents marking all or some valued places on the provided maps, by type of survey the respondent took. NA: respondents that did not mark any places on the map.

Figure 4.3 provides a further breakdown of the values and their response rates. The values that received the highest response rate per survey were: Appreciation or Respect for Nature (94.5%); Tourism Opportunities (98.2%); Habitat for Other Wildlife (92.7%); and places for Other Recreation (94.5%) (Figure 4.3). Interestingly, the economic values had both the highest (98.2%) and the lowest value response rate (54.5%) among the four different surveys (Figure 4.3).

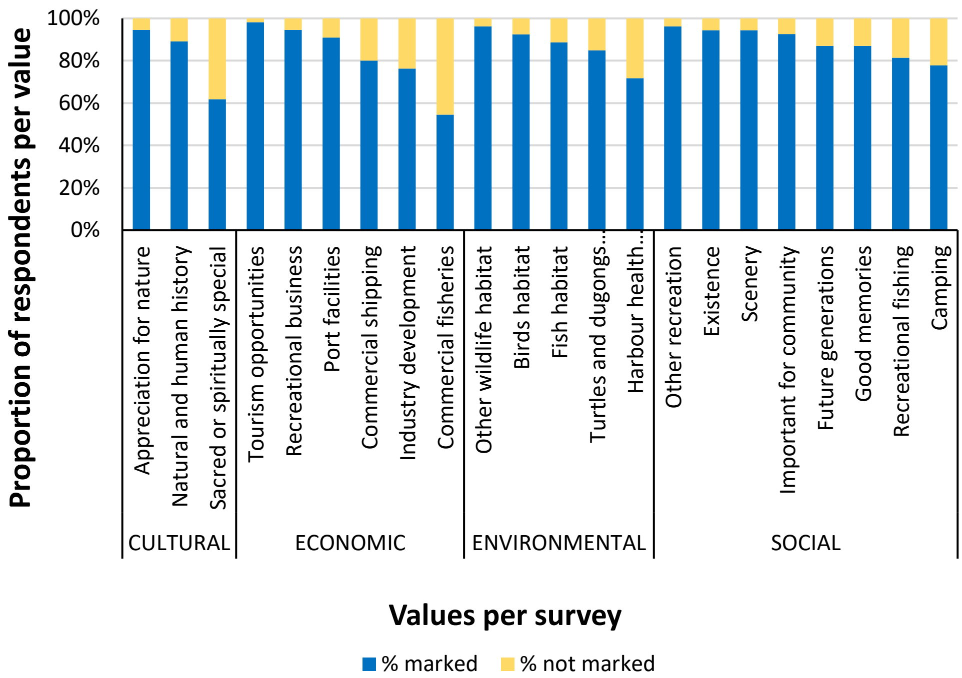


Figure 4.3. Response rate for each value marked on the provided map.

There was a statistically significant difference in the proportion of the people marking values on the map within each of the four different surveys (cultural $\chi^2_{[2]} = 49.515$, $p = 0.000$; economic $p = 0.000$; environmental $p = 0.000$; social $p = 0.001$). The significant differences between specific values (shown in Table 4.3) can be observed in Figure 4.3. For example the difference between the proportions in the cultural values Appreciation and Sacred; the difference between Other Wildlife and Harbour Health in the environmental values; and Other Recreation and Camping from the social values are evident. In the case of economic values, Commercial Fisheries had significant differences with four other values, while Tourism Opportunities had differences with three other values. The specific statistically significant differences between the values with the highest and lowest proportions of respondents marking values within each survey are shown in Table 4.3.

Table 4.3. Statistically significant results of pairwise comparisons on proportion of respondents marking each value or not. *Post-hoc* McNemar analysis.

Values		***p* value (2 sided)**
Cultural		
Sacred or spiritually special	Appreciation for nature	0.000
	Natural and human history	0.000
Economic		
Tourism opportunities	Industry development	0.002
	Commercial shipping	0.006
	Commercial fisheries	0.000
Commercial fisheries	Recreational business	0.000
	Commercial shipping	0.007
	Port facilities	0.000
Environmental		
Other wildlife habitat	Harbour health maintenance	0.000
Social		
Other recreation	Camping	0.002

A quarter (25%) of respondents failed to mark values with points, with 16% only using polygons and a further 6% used both polygons and points (Figure 4.4). Most respondents followed the instructions provided and used points. The economic survey had the highest proportion of respondents marking places with points (85.5%) and the social survey had the lowest proportion of respondents that used points (70.4%). The environmental survey had the highest proportion of respondents that used polygons (20.8%), with the fewest (10.9%) respondents using polygons occurring in the economic survey (Figure 4.4).

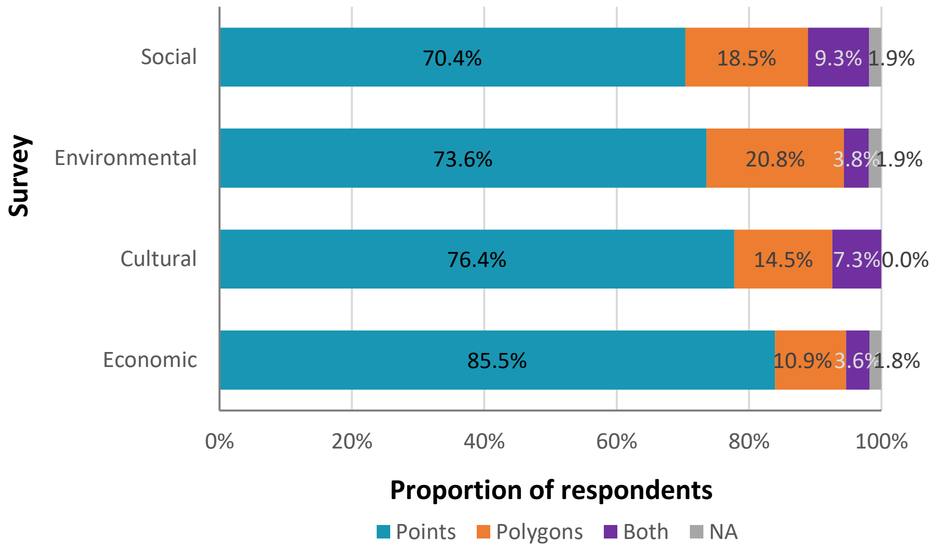


Figure 4.4. Proportion of respondents marking valued places with points, polygons or both, by survey type. NA: respondents that did not mark any places on the map.

At the scale of each value, it is apparent that within the cultural and social surveys, the proportions of respondents marking with point or polygons were less consistent than in the economic and environmental surveys (Figure 4.5). In every environmental value, the proportion of respondents marking polygons is larger than in any other value (Figure 4.5).

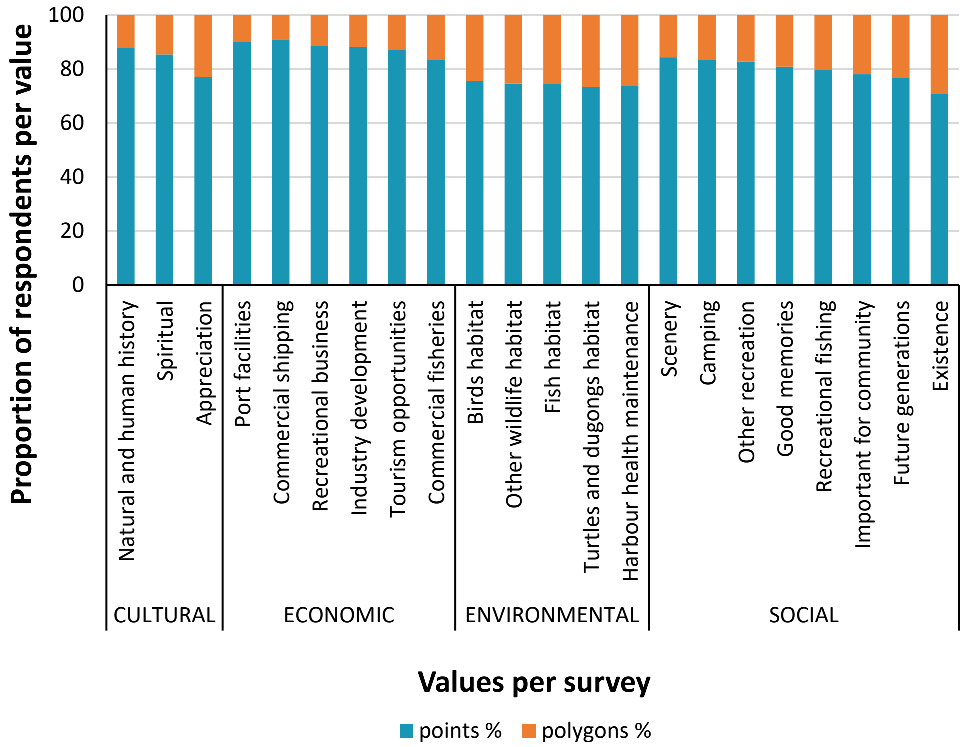


Figure 4.5. Response rate for each value marked on the provided map with points or polygons.

Greater than two thirds of the respondents (69%) assigned different weights (i.e. importance) to each of the values in their survey (Figure 4.6). The economic survey had the highest proportion of respondents assigning different weights to values (81.8%; Figure 4.6). Also in the economic survey the whole range of weights (i.e. 1 to 10) were used for almost all the values (see Chapter 3, Figure 3.1). Alternatively, the environmental survey had the lowest proportion of respondents assigning different weights (54.7%; Figure 4.6), and where the median values assigned were the highest (see Chapter 3, Figure 3.1).

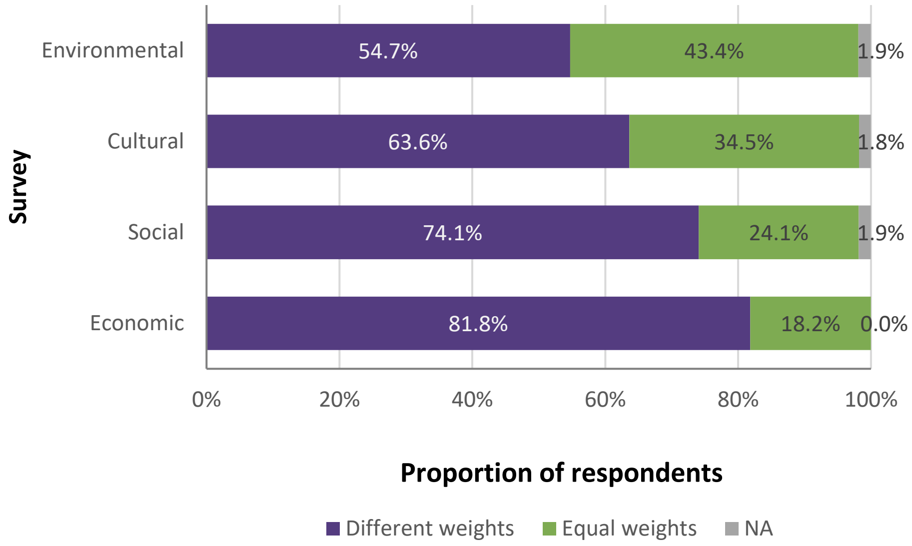


Figure 4.6. Proportion of respondents assigning different or equal weights to the valued places by type of survey. NA: respondents that did not mark any places on the map.

In 14 of the 22 identified values, most respondents (73%) marked 1 or 2 points to identify the value on the map (i.e. most frequent number of points: mode) (e.g. Appreciation for Nature and Birds Habitat) (Figure 4.7). On the other hand, for two values (Tourism Opportunities and Camping), 4 and 5 were the most frequently chosen number of points to identify the values on the map. The range of number of points used by the respondents per value varied widely: from 1 to 5 points for Port Facilities and Commercial Shipping to 1 to 44 points for Fish Habitat (Figure 4.7). Most of the values with wide ranges were skewed by only four to eight "intensive mappers", who marked more than 7 points. The majority of respondents marked only one or two points. Further analysis showed that the "intensive mappers" were mostly women (69%), higher educated (71%), and have been living in the area for more than 11 years (57%).

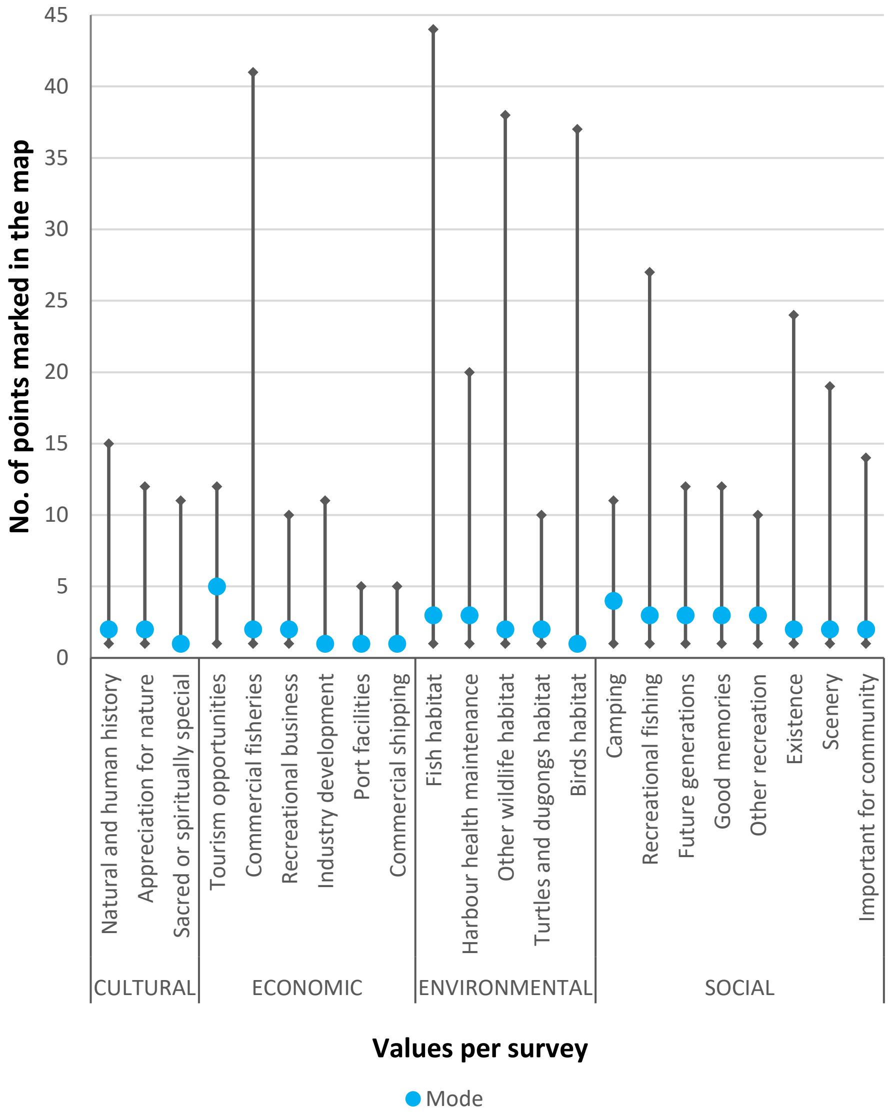


Figure 4.7. Mode and number of points marked on the map per value. Lines show the whole range of number of points used by the respondents.

Additionally, Natural and Human History, Tourism Opportunities, Fish Habitat, and Recreational Fishing, are the values with the highest number of points within each of the four surveys (Table 4.4). In general, the highest median weights are not the same values with the highest number of points or the highest proportion of respondents marking the value in the map (Table 4.4).

Table 4.4. Summary of descriptive statistics on the societal values mapped: proportion of respondents marking each value, total number of points marked per value, median weight (i.e. perceived importance) and mode and maximum number of points marked per respondent.

					Points/respondent	
	Value	**n%**	**No. of points**	**Median weight**	**Mode**	**Maximum**
Cultural	Natural and human history	89.1	174	8	2	15
	Appreciation for nature	94.5	147	8.25	2	12
	Sacred or spiritually special	61.8	72	9	1	11
Economic	Tourism opportunities	94.5	230	8	5	12
	Recreational business	96.4	185	8	2	10
	Commercial fisheries	76.4	147	8	2	41
	Industry development	80.0	86	8	1	11
	Port facilities	52.7	82	9	1	5
	Commercial shipping	90.9	67	8	1	5
Environmental	Fish habitat	86.8	289	9	3	44
	Other wildlife habitat	96.2	235	10	2	38
	Birds habitat	92.5	208	9	1	37
	Harbour health maintenance	71.7	171	10	3	20
	Turtles and dugongs habitat	84.9	103	10	2	10
Social	Recreational fishing	87.0	192	8	3	27
	Scenery	94.4	181	9	2	19
	Important for community	92.6	171	9	2	14
	Future generations	96.3	168	9	3	12
	Existence	77.8	167	9	2	24
	Other recreation	87.0	166	9	3	10
	Good memories	96.3	132	9	3	12
	Camping	85.2	114	9	4	11

4.3.3 Value mapping

The perceived importance of cultural, economic, environmental and social values is mapped in Figures 4.9- 4.12. These figures illustrate the density of both the number of points marked by respondents and the weight assigned to these values. To reiterate what was stated in the methods, places marked by polygons were excluded from these analyses and maps. For visual clarity, the names of places and main roads are not shown on the maps, but can be seen in Figure 4.8, which provides an overview of the Region.

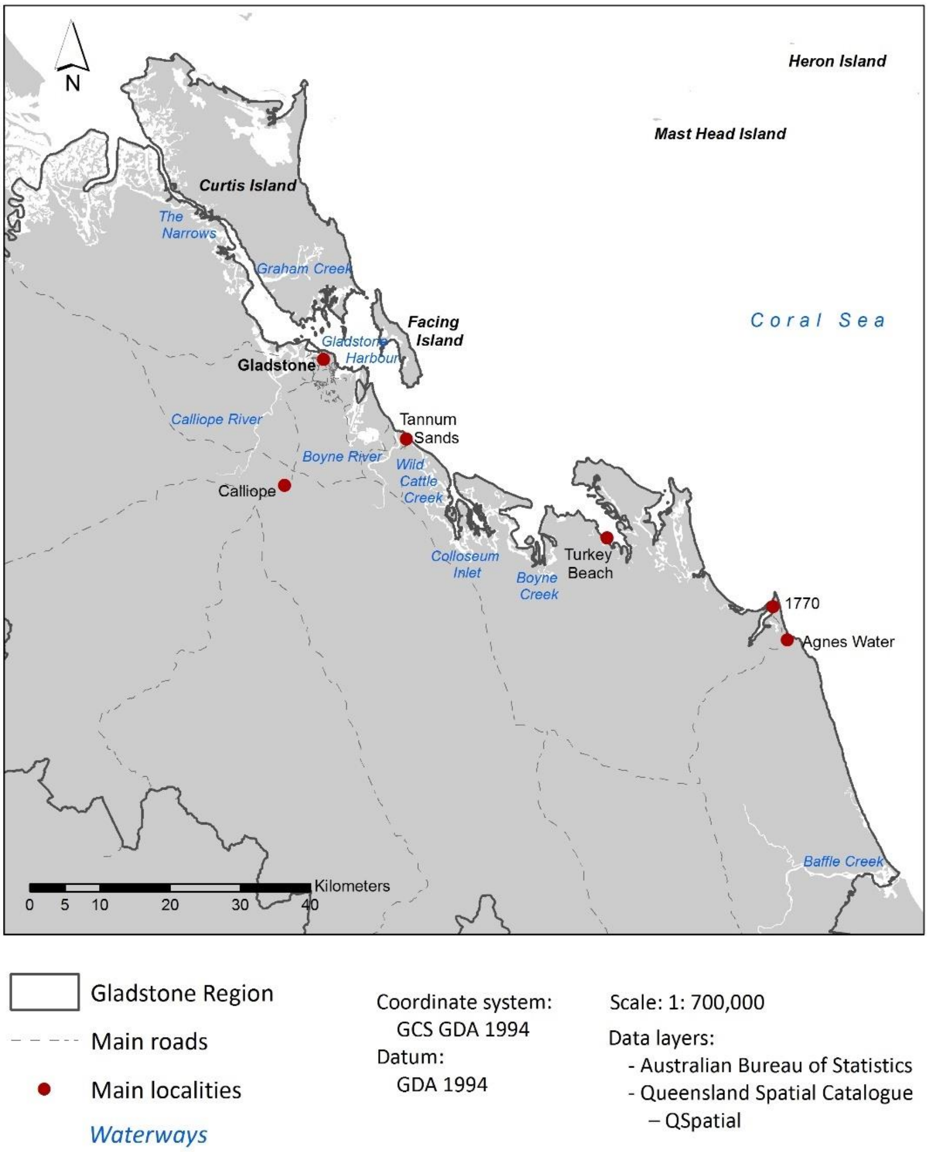


Figure 4.8. Gladstone Region map.

Across all of the surveys, 12 coastal localities and general areas were identified by the respondents as being the most important (i.e., red heat mapped areas; Figure 4.9), results that support H_{VIII} (areas with highest importance are located near population centres). Not all these places were the most important across the four different surveys. For example, in the cultural survey four places were identified as being the most important and of those four, three are shared with the economic survey, two with the environmental survey and three with the social survey. Similarly, in the social survey six different areas were identified as the most important, in the environmental survey seven different areas were identified, and in the economic survey eight areas were identified (Figures 4.9 – 4.12). Of these 12 places, only two (Tannum Sands and Heron Island) were identified as very important at least once in all the four surveys. Noticeably, there are more places with very high importance within the economic values, in comparison to the cultural, environmental and social values. In general, it can be said that the most important places for economic and environmental values coincide with the harbour area, while the cultural and social most important places are located outside the harbour and main city area.

The cultural values were distributed along most of the harbour, islands and coastline (Figure 4.9). The four most important places for the participants were: Heron Island, Tannum Sands, 1770, and Agnes Water, with Gladstone City assigned a medium-high weight as a Sacred or Spiritually Special place. The spatial correlations within the cultural values are high, showing a high distribution similarity, in particular between Natural and Human History and Appreciation for Nature values (Table 4.5).

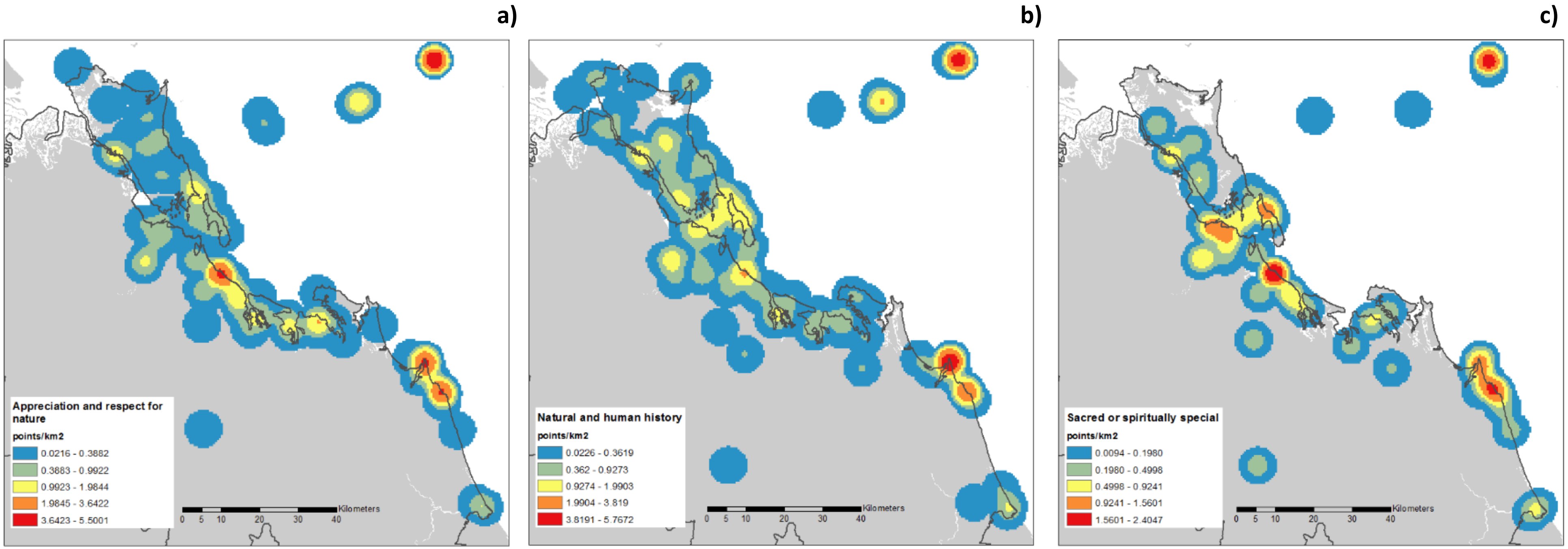


Figure 4.9. Perceived cultural values' importance in the Gladstone Region. Areas in red reflect the places with highest importance, yellow areas are of intermediate importance and blue reflects the lowest importance. Three cultural values are identified and mapped: a) Appreciation for Nature; b) Natural and Human History; c) Sacred and Spiritually Special.

Table 4.5. Correlation coefficient (*r*) between cultural values. Coefficients over ±0.7 are significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

Cultural value	**Appreciation for nature**	**Natural and Human History**	**Sacred**
Appreciation for nature	1		
Natural and human history	**0.726***	1	
Sacred	0.697*	0.680*	1

The economic perceived values of the Region were distributed along the coast. These values were mostly concentrated in the city and harbour area, particularly the commercial shipping, industry development and port facilities values (Figure 4.10). The importance of the Port Facilities included areas recognised and used for recreational and/or tourism, and industrial purposes, with industrial purposes deemed most important by respondents. Respondents marked the areas of highest importance for Recreational Business and Tourism Opportunities values as being outside the harbour in Heron Island and Agnes Water (Figure 4.10). Only one pair of values (Tourism and Recreational Business Opportunities) had a high spatial correlation (Table 4.6).

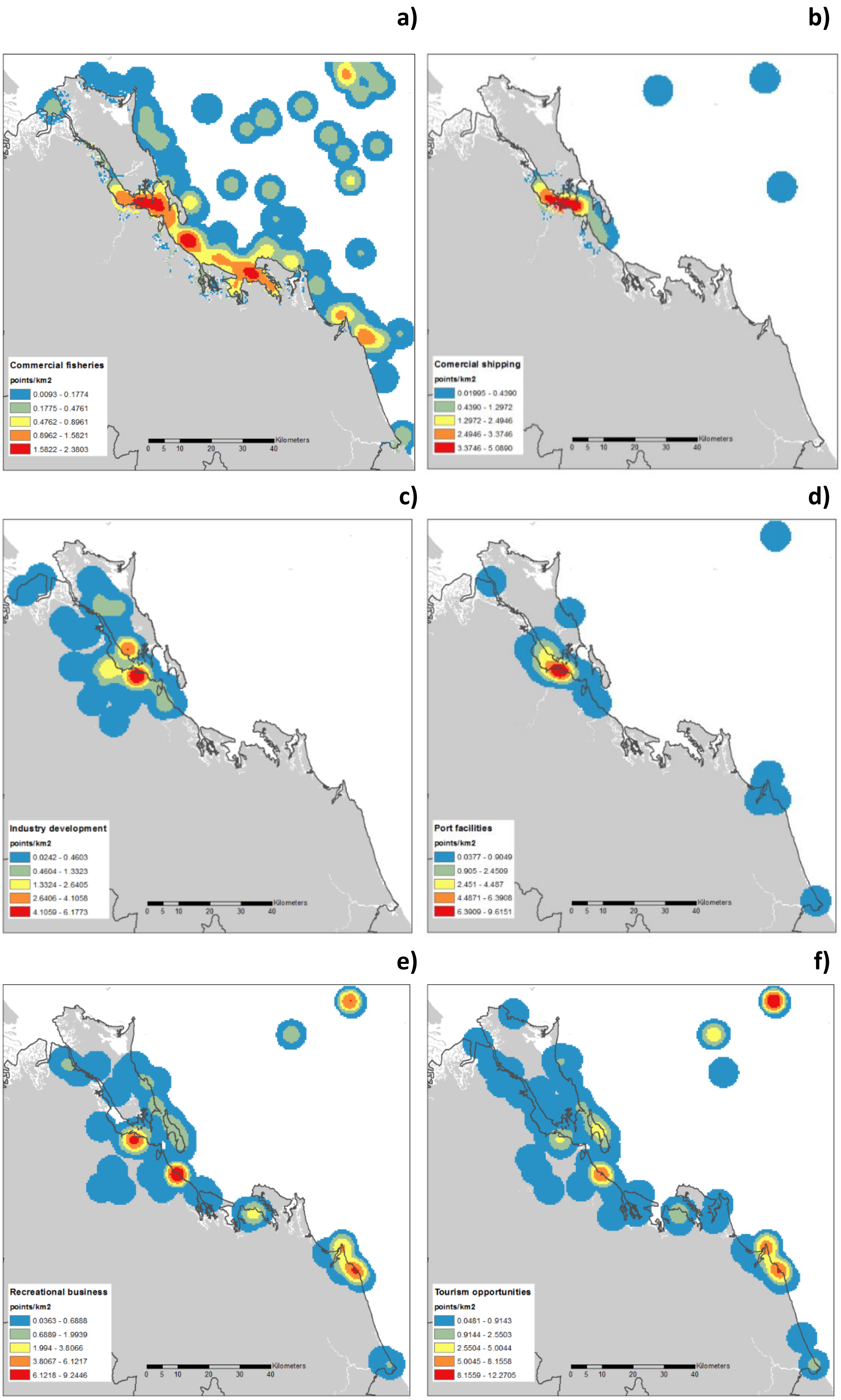


Figure 4.10. Perceived economic values' importance in the Gladstone Region. Areas in red reflect the places with highest importance, yellow areas are of intermediate importance and blue reflects the lowest importance. Six economic values are identified and mapped: a) Commercial Fisheries; b) Commercial Shipping; c) Industry; d) Port Facilities, e) Recreational Business; and f) Tourism Opportunities.

Table 4.6. Correlation coefficient (*r*) between economic values. Coefficients over ±0.7 are significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

Economic values	Comm. Fisheries	Comm. Shipping	Industry	Ports	Rec. business	Tourism
Commercial Fisheries	1					
Commercial Shipping	0.306*	1				
Industry	0.153*	0.392*	1			
Ports	0.370*	0.535*	0.367*	1		
Recreational business	0.437*	0.329*	0.397*	0.561*	1	
Tourism	0.482*	0.317*	0.371*	0.564*	**0.768***	1

Unlike the cultural, economic and social values, there was a more continuous distribution of environmental values marked along the coast by the respondents (Figure 4.11). In general, Heron Island and the port of Gladstone were the identified places with more environmental values marked as important (Figure 4.11). It is also evident that in the Other Wildlife Habitat and for Harbour Health Maintenance maps there are more and large areas of perceived highest importance than the areas for Birds, Fish and Turtles and Dugongs Habitat. Spatial correlations in general were high (much like the cultural values, Table 4.5), but were statistically significant only between the values Birds Habitat and Harbour Health Maintenance (Table 4.7).

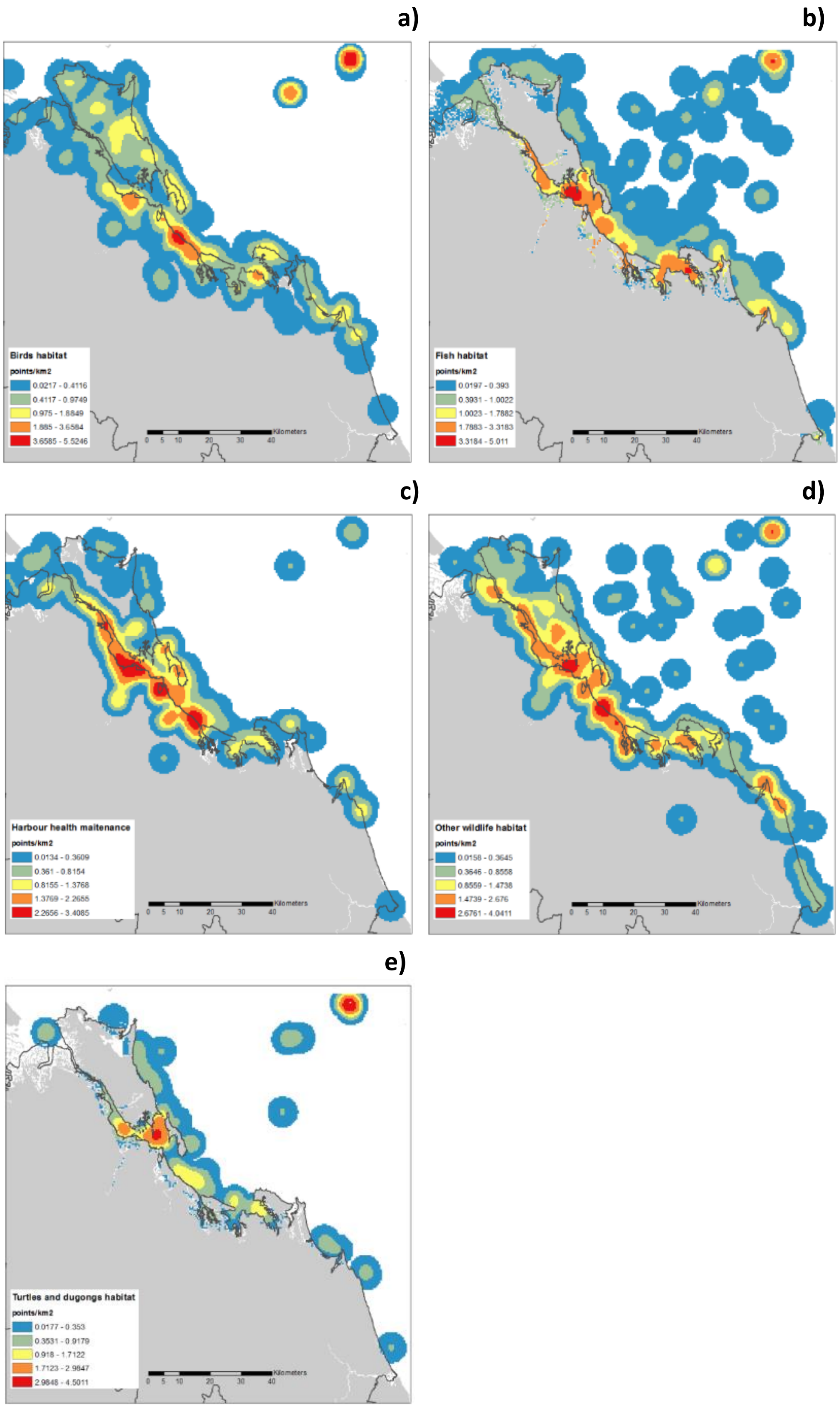


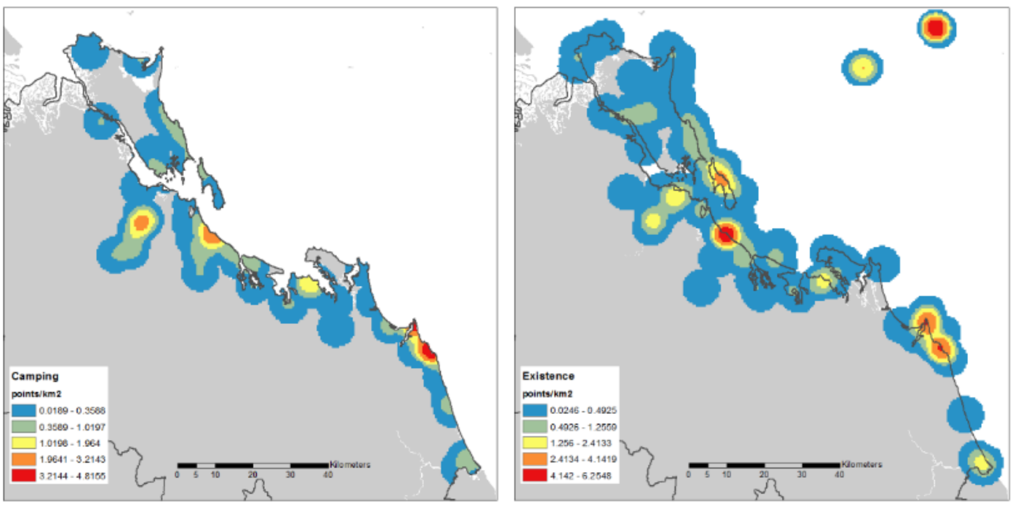
Figure 4.11. Perceived environmental values' importance in the Gladstone Region. Areas in red reflect the places with highest importance, yellow areas are of intermediate importance and blue reflects the lowest importance. Five environmental values were identified and mapped: a) Birds Habitat; b) Fish Habitat; c) Harbour Health Maintenance; d) Other Wildlife habitat; e) Turtle and Dugong Habitat.

Table 4.7. Correlation coefficient (*r*) between environmental values. Coefficients over ±0.7 are significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

Environmental values	Bird habitat	Fish habitat	Harbour health	Wildlife habitat	Turtle/dugong habitat
Bird habitat	1				
Fish habitat	0.622*	1			
Harbour health	**0.756***	0.686*	1		
Wildlife habitat	0.674*	0.640*	0.649*	1	
Turtle/dugong habitat	0.600*	0.615*	0.672*	0.544*	1

The social values' were distributed somewhat continuously along the coast. However, the areas of highest importance are concentrated in specific places (Figure 4.12), rather than as an extensive areas such as seen for the environmental values (Figure 4.11). In general, the most important places are Tannum Sands, 1770, and Agnes Water, which are similar to the important cultural locations. Values noted as having more places of higher importance were Existence, and Important for Future Generations (Figure 4.12).

a) b)



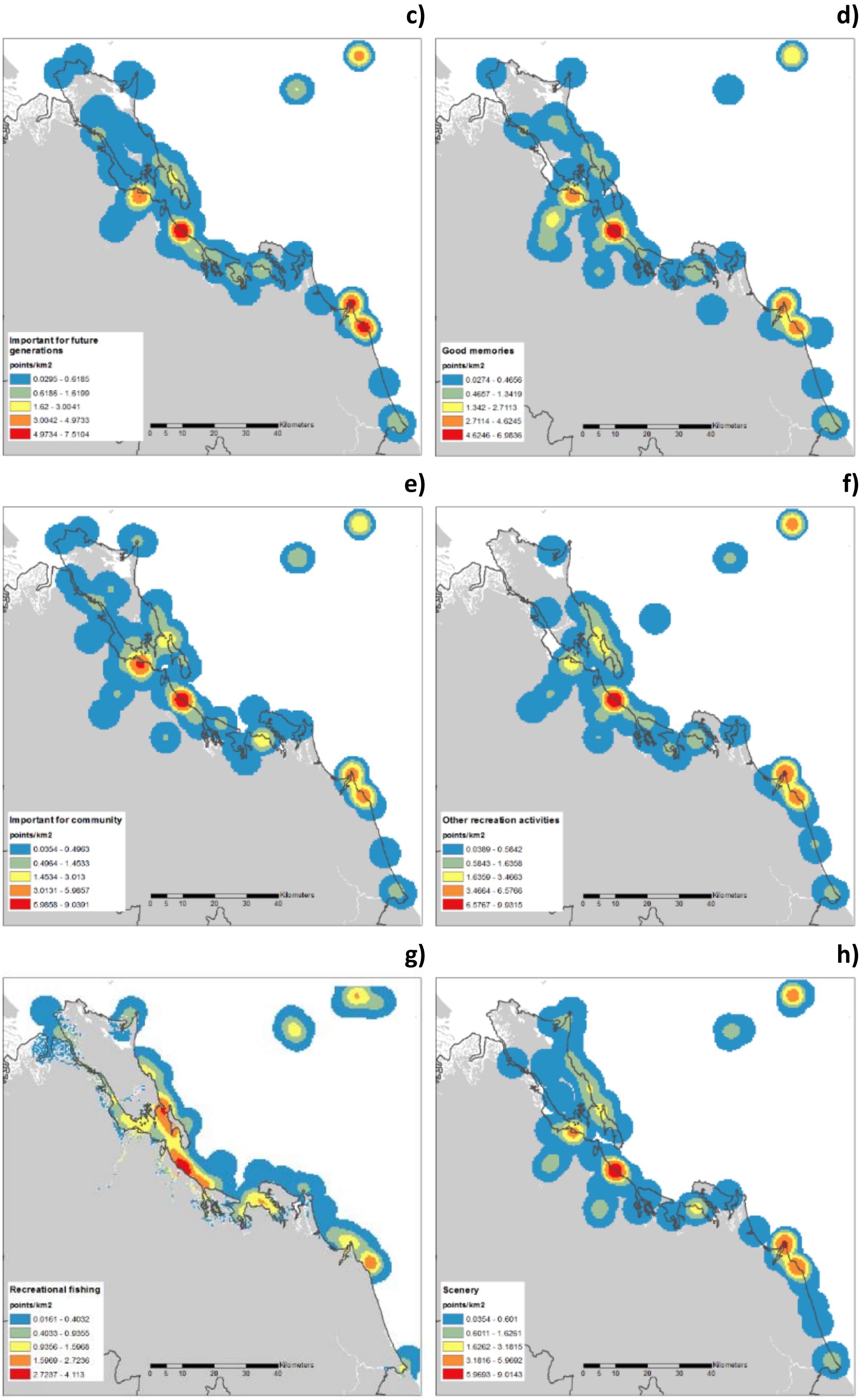


Figure 4.12. Perceived social values' importance in the Gladstone Region. Areas in red reflect the places with highest importance, yellow areas are of intermediate importance and blue reflects the lowest importance. Eight social values were identified and mapped: a) Camping; b) Existence; c) Future Generational Use; d) Good Memories; e) Important for Community; f) Other Recreation; g) Recreational Fishing; h) Scenery.

The social values had more pairwise spatial correlation between values than the other groups of values. This reflected a common area of distribution for six values: Existence, Future Generational Use, Good Memories, Important for Community, Other Recreation Activities, and Scenery (Table 4.8). Scenery was spatially correlated to all the other values, while Camping and Recreational Fishing were less spatially correlated to other values (Table 4.8).

Table 4.8. Correlation coefficient (*r*) between social values. Coefficients over ±0.7 are strong. *Correlation is significant at the 0.01 level (2-tailed). The full name of the values are: Camp = camping; Exist = existence; Fut Gen = future generations; Good Mem = Good memories; Imp Comm = Important for community; Other rec. = Other recreation; Rec Fish = Recreational fishing; Scen = Scenery.

Social values	**Camp**	**Exist**	**Fut Gen**	**Good Mem**	**Imp Comm**	**Other Rec**	**Rec Fish**	**Scen**
Camp.	1							
Exist.	0.676*	1						
Fut. Gen.	0.696*	**0.796***	1					
Good Mem.	**0.714***	**0.736***	**0.780***	1				
Imp. Comm.	0.684*	**0.794***	**0.801***	**0.764***	1			
Other Rec.	0.768*	**0.718***	**0.739***	**0.731***	**0.743***	1		
Rec. Fish.	0.656*	**0.751***	0.672*	0.678*	**0.716***	0.671*		
Scen.	**0.753***	**0.783***	**0.762***	**0.778***	**0.764***	**0.790***	**0.727***	1

Patterns were evident in the spatial correlation analysis among all of the 22 values (Table 4.9). In general, the cultural values (with the exception of Sacred and Spiritually Special) have a strong spatial correlation with some environmental and most social values. There is a strong spatial correlation between the environmental values Birds Habitat, Fish Habitat and Harbour Health Maintenance with the social values Important for Community, Existence and Recreational Fisheries. Of the economic values, only Recreational Business and Tourism Opportunities had strong correlations with social values and the cultural value Natural and Human History. The strong spatial correlations within and between cultural, economic and environmental social values (Tables 4.5 – 4.9) partially support H_{IX} and H_{X} (spatial correlations within and among values are significant) showing the multi-value character of the Region but also possible conflicts.

Table 4.9. Correlation coefficient (*r*) between all values. Coefficients over ±0.7 are strong (bold font). *Correlation is significant at the 0.01 level (2-tailed). Different shades of grey represent the difference between cultural, economic, environmental and social values.

	App.	Nat. Hist.	Sac.	Comm. Fish.	Comm. Shipp.	Ind.	Ports	Rec. bus.	Tour.	Birds	Fish	Harb.	Other wild.	Turt. Dug.	Camp.	Exist.	Fut. Gen.	Good Mem	Imp. Comm.	Other Rec	Rec. Fish.	Scen
App.	1																					
Nat. Hist.	.726*	1																				
Sacred	.697*	.680*	1																			
Comm. Fish.	.486*	.478*	.408*	1																		
Comm. Shipp.	.274*	.282*	.325*	.306*	1																	
Industry	.332*	.353*	.354*	.153*	.392*	1																
Ports	.450*	.459*	.479*	.370*	.535*	.367*	1															
Rec. bus.	.689*	.690*	.659*	.437*	.329*	.397*	.561*	1														
Tourism	.674*	**.718***	.587*	.482*	.317*	.371*	.534*	.768*	1													
Birds	**.728***	**.742***	.585*	.476*	.273*	.449*	.421*	.633*	.683*	1												
Fish	.590*	.603*	.457*	.647*	.262*	.273*	.386*	.512*	.585*	.622*	1											
Harbour	.681*	**.711***	.581*	.570*	.322*	.418*	.492*	.647*	.682*	.756*	.686*	1										
Other wildlife	.635*	.662*	.505*	.539*	.304*	.336*	.423*	.564*	.645*	.674	.640*	.649*	1									
Turt. Dug.	.603*	.607*	.485*	.602*	.334*	.274*	.395*	.589*	.622*	.600*	.615*	.672*	.544*	1								

Table 4.9 Continuation

	App.	Nat. Hist.	Sac.	Comm. Fish.	Comm. Shipp.	Ind.	Ports	Rec. bus.	Tour.	Birds	Fish	Harb.	Other wild.	Turt. Dug.	Camp.	Exist.	Fut. Gen.	Good Mem	Imp. Comm.	Other Rec	Rec. Fish.	Scen
Camping	**.724***	.656*	.621*	.445*	.280*	.283*	.458*	.685*	.675*	.666*	.525*	.581*	.569*	.527*	1							
Existence	**.755***	**.748***	.614*	.552*	.257*	.340*	.455*	.688*	**.710***	**.755***	.629*	**.749***	.657*	.646*	.676*	1						
Fut. Gen.	**.724***	**.721***	.658*	.500*	.319*	.344*	.468*	.688*	**.711***	.697*	.571*	.663*	.636*	.623*	.696*	.796*	1					
Good Mem.	.692*	**.722***	.647*	.432*	.268*	.332*	.441*	**.718***	.677*	.637*	.521*	.613*	.570*	.529*	.714*	.736*	.780*	1				
Imp. Comm.	.698*	**.730***	.652*	.497*	.320*	.392*	.506*	**.723***	.693*	**.717****	.590*	**.702***	.621*	.580*	.684*	.794*	.801*	.764*	1			
Other Rec.	**.732***	.646*	.643*	.459*	.277*	.246*	.463*	**.725***	.684*	.620*	.537*	.619*	.571*	.568*	.768*	.718*	.739*	.731*	.743*	1		
Rec. Fish.	.693*	**.726***	.583*	.639*	.323*	.326*	.508*	.680*	.684*	**.717***	**.708***	**.765***	.648*	.674*	.656*	.751*	.672*	.678*	.716*	.671*	1	
Scenery	**.775***	**.711***	.685*	.510*	.300*	.306*	.484*	**.725***	.699*	**.706***	.584*	.671*	.621*	.633*	.753*	.783*	.762*	.778*	.764*	.790*	.727*	1

The full name of the values are: App. = Appreciation for nature; Nat. Hist. = Natural and human history; Sac. = Sacred and spiritually special; Comm. Fish. = Commercial fisheries; Comm. Ship. Commercial Shipping; Ind. = Industry; Ports = Port facilities; Rec. Bus. = Recreational business; Tour. = Tourism opportunities; Birds = birds habitat; Fish = fish habitat; Harb. = Harbour health; Other wild. = other wildlife habitat; Turt. Dug. = Turtle and dugong habitat; Camp. = camping; Exist. = existence; Fut. Gen. = future generations; Good Mem. = Good memories; Imp Comm. = Important for community; Other rec. = Other recreation; Rec. Fish. = Recreational fishing; Scen. = Scenery.

4.3.4 Development areas

The majority of respondents marked Tourism Development (86%) areas, followed by No Development (81%), Industrial Development (72%) and Residential Development (65%). A detailed analysis of these results, with respondents' comments and their demographics is provided in Chapter 3 (section 3.3.1 and 3.3.4). Herein shows the results and spatial analysis of the areas marked for each of these types of future development.

Respondents' demarcated the largest development/no development area within the No Future Development frame (Figure 4.13a). The State Development Area (SDA) (i.e., area designated by the Queensland State Government for industrial development and materials transportation infrastructure) overlaps with the areas where more than 50% of the respondents would not like to see more development, particularly in the southwest area of Curtis Island (Figure 4.13a).

Tourism Development was the second most common area marked upon the maps (Figure 4.13b). More than half (50%) of the respondents identified six places where they felt that tourism development should occur in the future: Gladstone City, Tannum Sands, Turkey Beach, 1770, Agnes Water, and Heron Island. For future Residential Development (Figure 4.13c), the majority (51%) of respondents identified already existing coastal residential areas as being important for future growth: Gladstone, Tannum Sands, Turkey Beach, 1770, and Agnes Water. Of note, was that three respondents marked Heron Island as an ideal place for future Residential Development. Heron Island is 80 km north-east of Gladstone and currently 50% of the Island is covered by a resort and a research station

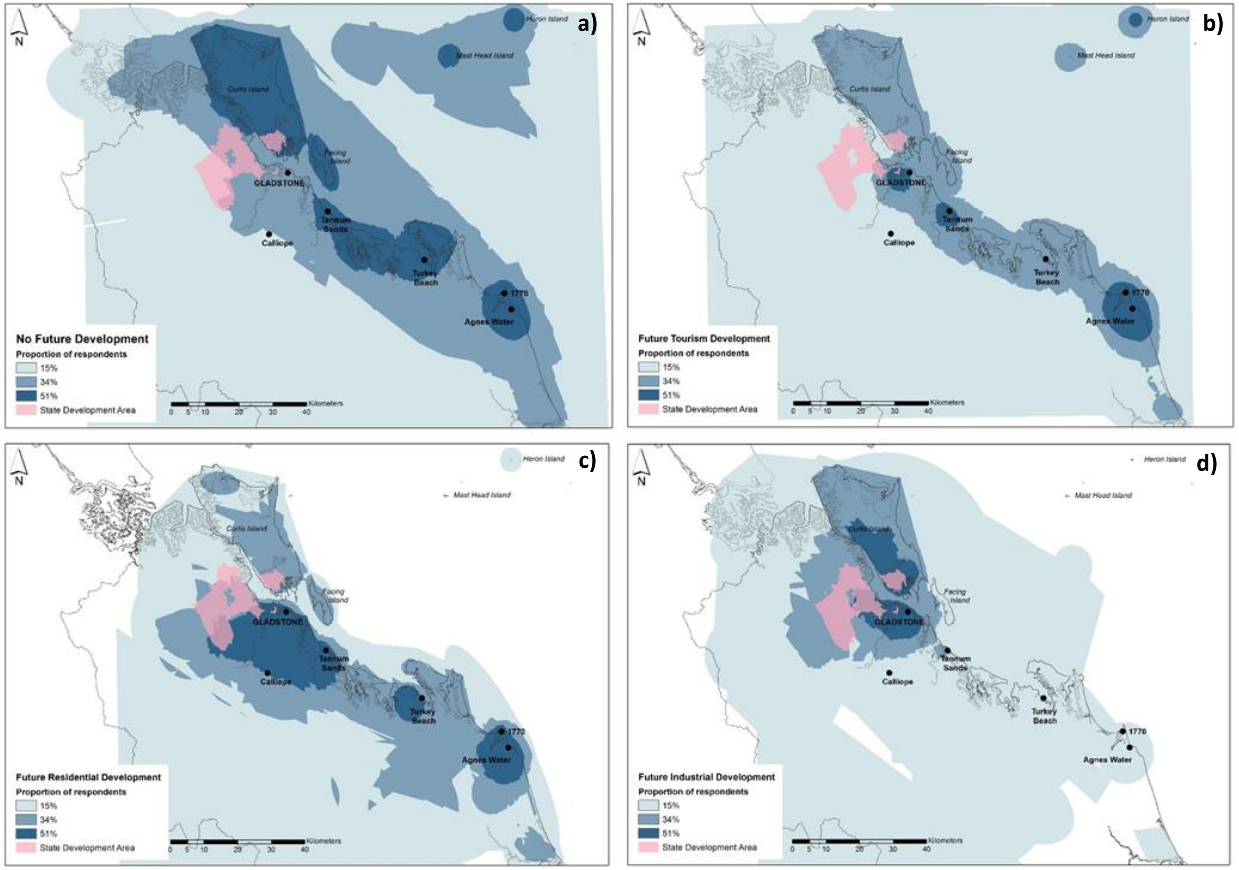


Figure 4.13. Proportion of respondents preferences demarcating future areas of: a) no development; b) tourism development; c) residential development; and d) industrial development in the Gladstone Region. The State Development Area (SDA; highlighted in pink) is the area dedicated for industrial development and materials transportation infrastructure (Data layer: Queensland Spatial Catalogue – QSpatial: State Development Area).

The difference between the future Industrial Development (Figure 4.13d) and the rest of the development maps (Figure 4.13a-c) is conspicuous with respondents providing a relatively spatially restricted area covering Gladstone City and Curtis Island. The majority of respondents identified future Industrial Development areas as ones that are, for the most part, within the already established SDA. Noticeably, Curtis Island was marked as an area for both No Development and Industrial Development by most of the respondents. However, further analysis (Figure 4.14) indicates that respondents marked Curtis Island for either No Future Development or Industrial Development, with a small proportion (4.9%) marking the same area for both options, or marking different sections of the island for each of these two options (e.g. north for no development and the south for development).

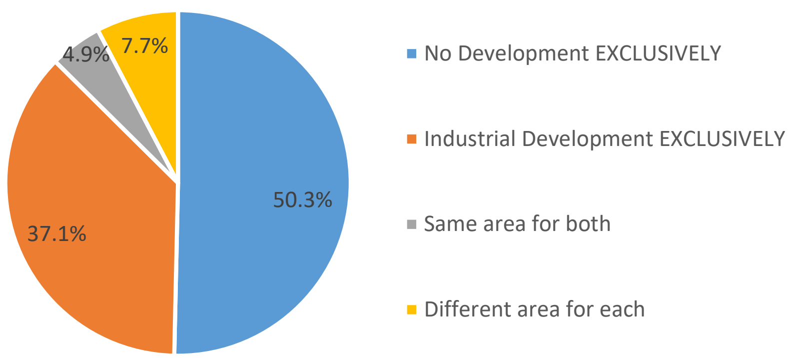


Figure 4.14. Proportion of respondents marking areas for either No Development or Industry Development on Curtis Island.

4.3.4.1 Spatial correlations

Contrary to *a priori* expectations (Hypotheses $_{\mathrm{XI-XIII}}$), the spatial congruency between the future areas for No Development, Tourism, Residential and Industrial Development and the distribution of importance of perceived values was not statistically significant. These results are presented in Appendix G.

Even though H_X was rejected, the correlations followed the tendency predicted: the No Development and Tourism Development distributions had a positive (but moderate) correlation with cultural, environmental and social values. With the economic values the correlation was not negative, but positive weak to moderate. Also, the spatial relationship between the Residential and Industry Developments' distribution and cultural, social and economic values (H_{XI}-H_{XII}) was positive but weak (Appendix G). Noticeably, the correlation between Tourism Development and the Tourism and Recreational Business values was not strong. Likewise, the correlation between Industrial Development and economic values, such as Commercial Shipping, Port Facilities and Industry, was not strong (Appendix G).

In contrast, a strong, positive correlation existed between the areas chosen for No Future Development and Tourism Development. Similarly, a moderately high correlation (but not strong) existed between Industrial Development and Residential Development (Table 4.10).

Table 4.10. Correlation coefficient (*r*) between development options. Coefficients over ±0.7 are strong (bold font). *Correlation is significant at the 0.01 level (2-tailed).

Development Options	No Future	Industrial	Residential	Tourism
No Future	1			
Industrial	0.427*	1		
Residential	0.411*	0.656*	1	
Tourism	**0.937***	0.383*	0.369*	1

4.4 Discussion

This chapter aimed to develop and test a method to spatially assess perceived non-monetary societal values. This included an examination of the spatial distribution of a list of societal values (identified in Chapter 2) elicited using a face-to-face survey, the spatial preferences of distribution of different types of development and their spatial correlation. Results' provide specific outcomes for the Gladstone Region, but also provide insight on the elicitation method itself, as an inclusive tool to be used by managers and decision makers. The first part of the discussion will address the specific results regarding the hypotheses posed, followed by the considerations of the method itself.

4.4.1 Societal values' spatial distribution and correlations

The general distribution of the perceived societal values followed the coastline of the Region. For each value, at least one of the most important places was located around populated areas. This finding supports Hypothesis $_{\mathrm{VIII}}$. This observation is consistent with results from other studies that have found a similar trend (Brown and Raymond 2007; Alessa et al. 2008; McIntyre et al 2008). It is thought that the main reason values are associated with populated areas is accessibility: places with easier access are visited more often and consequently their perceived importance grows through time, particularly for the cultural, economic and social values. In the particular case of the Gladstone Region, Tannum Sands is the preferred recreational beach area for the residents of the city and it is easily accessible by car (i.e. 26 km south of Gladstone City).

In the same way, the areas with no apparent value, may reflect very limited or no accessible areas at least for different social groups (Tyrväinen et al. 2007). For example, even though Mast Head Island and Heron Island are very similar in terms of scenery and ecosystems' representation, Mast Head does not have the tourism facilities that Heron Island has. Heron Island has a resort and is accessible to guests five days a week via a ferry or sea plane. Mast Head is only accessible by personal boats, or by hiring a ferry for big groups. Therefore, perceived importance of Mast Head regarding social, cultural, economic and environmental values is significantly lower than Heron Island. From a decision-maker point of view, areas with no apparent societal values should be considered in this context of accessibility. Mast Head, for example, could signify an area that would benefit from increased public awareness (such as places with high ecosystem importance but low social importance). On the other hand, accessibility may be a good indicator of areas suitable for development given a coincidence of perceived low ecosystem, cultural and social values (van Riper et al. 2012; Bagstad et al. 2016).

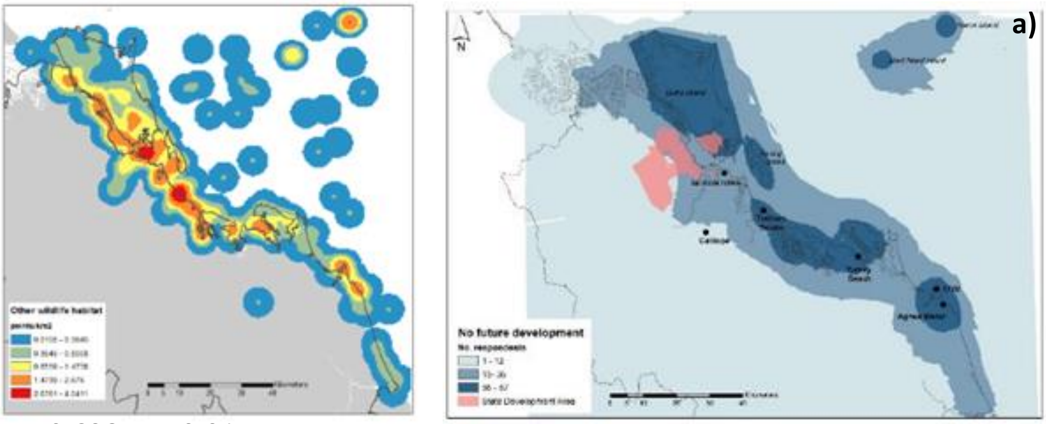
The strong spatial correlations showed that spatial clustering within each of the four groups of values, was evident only within social values (Tables 4.4 - 4.7). This finding rejects Hypothesis $_{\mathrm{IX}}$. On the other hand, social values had more spatial coincidences with elements of the other cultural, environmental and economic values than any of the other groups of values (Table 4.8), results that support Hypothesis $_{X}$. The spatial coincidences within social values and with other values may be indicating that these areas are of particular importance for community wellbeing (Fagerholm et al. 2012). These results also demonstrate that a variety of values co-exist, sometimes clustered but also dispersed throughout the Region. This reinforces the results in Chapter 3, which clearly show the diversity of perceptions in this local community. Moreover, the continuous distribution of the environmental values may be a reflection of their more systemic or non-use character (McIntyre et al. 2008; Cacciapaglia et al. 2012; Morse et al. 2014; Mahboubi et al. 2015; Brown et al. 2017), compared to use values that have more personal meaning, such as 'good memories' or 'sacred and spiritually special'.

The next set of hypotheses (H_{XI}-H_{XIII}) considered that a strong spatial relationship would occur between different types of development and the value's distribution. It is important to take into account that for this study, a correlation higher of 0.7 was considered as strong. This level was defined based on previous studies. The correlation results do not support the hypotheses; therefore all three hypotheses are rejected. In particular, demarcated areas for No Future Development are expected to coincide with cultural, social and environmental values, which was not evident in the outcomes. A spatial coincidence was also expected between Future Tourism Development areas and the economic and social values related to recreation as well as between Industrial Development areas and economic values (Appendix G). These results contrast to previous studies by Brown (2006) and Sherrouse et al. (2011), who demonstrated that scenic, biodiversity, future and intrinsic landscape values matched spatially with places where the respondents stated opposition to development. Within the literature, the opposition to industrial and tourism development comes from a series of residents' concerns, such as damage to the scenery (Brown 2006; Devine-Wright and Howes 2010; Jones and Eiser 2010), wilderness protection, and health and safety issues (Brown 2006; Jenkins-Smith et al. 2011). These same reasons were given by the respondents in this study when choosing areas for No Future Development (see Chapter 3, section 3.3.3), yet the spatial correlations were not significant.

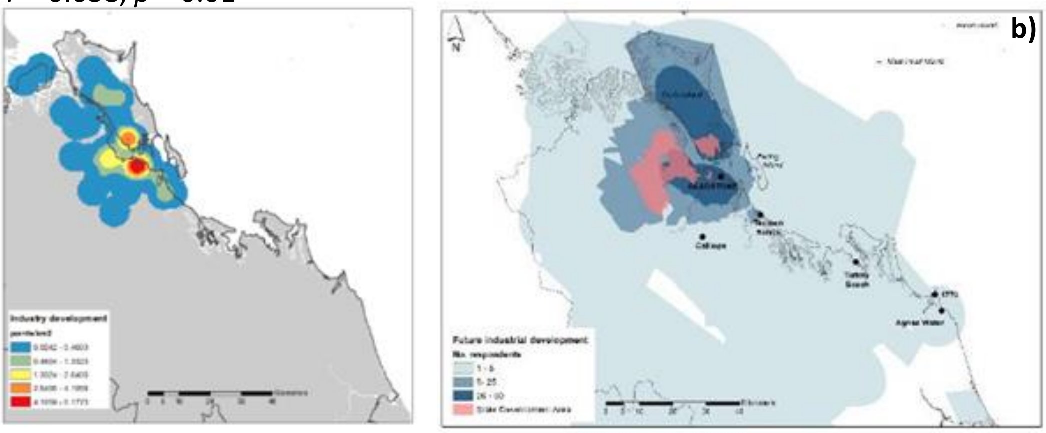
Previous studies have noted that values are not "*reliable in predicting and individual's preference*" for specific developments (Brown and Reed 2000). It appears that respondents do not necessarily make a connection between different types of development and the consequences they may entail for the values previously mapped (Brown and Raymond 2014). To account for this, in this study respondents were asked to take into account all types of values for the questions related to development (see Appendix C). Thus, a shortfall of cognitive linkage, together with a possible wording inaccuracy of the question, or a misunderstanding on what "development" or "no development" implied may have led to the non-significant spatial correlation results reported here. A potential wording inaccuracy may also explain the strong correlation between areas for No Development and Tourism Development (Table 4.8). Yet, it is important to consider that these two types of development categories may entail common values such as scenery, recreation and future use (Brown 2006) and hence a correlation may exist.

Notwithstanding the lack of a strong relationship between the different types of development and the societal values, the spatial correlations did show weak to moderate associations (Appendix G). The correlation coefficient value represents the strength and direction of the association between the values of each pair of pixels (i.e., weights) throughout the whole map. Hence, the coefficient is a generalisation of the relationship of all those variables (Barcelona Field Studies Centre 2017). Therefore, if the high-density distribution of a particular value and the high-density distribution of a given type of development do not match in all areas, the correlation coefficient may not be strong. Importantly, this does not mean that these variables do not concur in particular areas.

To illustrate this point, a couple of examples are shown in Figure 4.15. In Figure 4.15a, the distribution of the 'other wildlife habitat' value and No Development areas are shown next to each other. It can be seen that the general distribution is similar, but the only place where most people agree on zones for No Development and 'other wildlife habitat' is at Tannum Sands. In this case, the correlation coefficient is moderate ($r = 0.638$, $p = 0.01$), instead of strong. Even more evident is the concurrence of the 'industry development' value distribution and areas for Industry Development (Figure 4.15b, r = 0.424, p = 0.01). In this example, the industry development value has a much wider distribution than the Industry Development area, yet the areas of high density are very similar: Gladstone and a section of Curtis Island (Figure 4.15b).



r = 0.638, p = 0.01



r = 0.638, p = 0.01

Figure 4.15. Two examples of values and development options that were expected to be strongly correlated. a) Other wildlife habitat and No Development areas; b) Industry development value and Industrial Development.

The location of areas marked for future Residential and Tourism Development around existing population centres was not unexpected given the well-known tendency of clustering these types of development in traditional land-use planning and the similar results from previous (Brown 2006; Brown and Weber 2013). Noticeably, the areas marked by more of the 51% of respondents for future Residential and Industrial Development are bigger than the existing areas. This could be due to the generalisation observed when marking areas with polygons (Brown and Pullar 2012), but it could also point a possible inclination towards expansion of residential and industrial areas in the future (Brown and

Raymond 2014). Although this could be a signal of potential conflict (Tyrväinen et al. 2007), it does not seem to be the case for Gladstone since there is an apparent agreement on the 'industrial' status of the Region mentioned in both interviews and surveys (see Chapters 2 and 3). Although an agreement exists, only all residents may be aware of this and hence some incongruences may occur.

The spatial correlation test can identify potential conflict or agreement zones. However, the results of this chapter show that it is also important to contextualise the results with the qualitative information from surveys and interviews. For example, if only the correlation results between No Future Development and Future Industrial Development are considered, no possible conflict would be identified. Yet, the visual analysis of the maps and qualitative data do identify that Curtis Island as a potential conflict area. The island was marked as Industrial by almost 50% of the respondents and No Development by the other 50%. The fractured societal perceptions on no development versus future development have recently been demonstrated by Benham (2017). Benham (2017) noted divided support towards the decision to site industrial plants on Curtis Island. Similar comments were also given by the interview participants (Chapter 2) and the survey respondents (Chapter 3) who mentioned the high environmental and social value of Curtis Island, and concerns or a pessimistic agreement regarding the level of industrialisation in the island. Noticeably, even though the SDA covers around 10% of Curtis Island, more than 51% of the respondents marked either the whole island for No Future Development or just a section covering the centre and south west of the island for Future Industrial Development. This could signal a need to consider removing industry already established there, or expanding the SDA. Whatever is the case, it reflects not only a divided public opinion and values, but a lack of knowledge of the existing island zoning, which has both protected and development areas (GHD 2009).

This type of quantitative and qualitative information, along with the values' mapping provides a community, place-specific perspective that can be integrated in conservation programs and land-use planning (van Riper et al. 2012; Bagstad et al. 2016). Spatial mapping of the rich data collected in this thesis and the use of appropriate statistical methodologies should form the basis of an environmental management decision tool (as discussed further in Chapter 5). An analysis of the value mapping approach is also discussed further below.

4.4.2 Value mapping method analysis

Within the literature, societal values have been spatially identified and mapped using a wide variety of approaches (Figure 4.1) and due to their 'recent' appearance in the environmental management scene, no standardised method has been established yet. The main objective of this chapter was to evaluate the efficacy of the spatial methodology applied to assess perceived non-monetary societal values and to create a value mapping approach that moves towards a standardised method.

The act of marking places of importance on a map has proved to be a "cognitively challenging" exercise (Brown et al. 2017). The results of such a task depends on the respondent's characteristics such as familiarity with the area and map literacy (Brown 2012a; Brown and Pullar 2012). Klain and Chan (2012) have also noted that refusal to answer particular questions may be due to fear of the misuse of information or respondents not wanting to identify "culturally sensitive areas". Although reasons for refusing to mark values on a map were not directly elicited in this study, some respondents mentioned not being familiar with the area or the value. Therefore, mapping confidence is also related to other factors such as self-assessed knowledge of the area or stakeholder group (Brown et al. 2015d).

Brown et al. (2017) demonstrated that existence and spiritual values are "*more cognitively challenging mapping construct*[s]" and consequently are marked less frequently than aesthetic, recreation and biological values. This chapter's results coincide with some of the observations from Brown et al. (2017), especially with regards to Sacred and Recreation values. Yet, in other cases (such as Existence or Future Generational Use) my results contrast with Brown et al. (2017), with more (instead of fewer) respondents identifying and spatially marking these values. Similarly, values that could be considered as less cognitively challenging such as Camping or Commercial Fisheries were marked less frequently in my study.

Other, unmeasured, factors may have also influenced these results. In addition to the ‘cognitive challenge’ that some values may pose, it has been suggested that the act of weighting places may diminish the response rate since it requires a personal trade-off analysis by the respondents. Therefore, in order to increase the response rate of each value, future studies could consider not using weighting as suggested by Nielsen-Pincus (2011).

A different mapping behaviour observed in this research compared to other published research was that not all respondents marked places in the map with points. On occasions, polygons were used, even when respondents were clearly instructed to use points (see Appendix C). Polygons are often used in qualitative studies because authors feel that they have the advantage of encompassing more than one value in an area with a defined shape and extent (Klain and Chan 2012; Lowery and Morse 2013; Morse et al. 2014; Brown et al. 2017; Figure 4.1). In this study, environmental values were more frequently demarcated with polygons compared to other values (Figure 4.5 and 4.5).

Different studies suggest that “more systemic attributes” or abstract and conceptual values such as ecosystem services or existence values are better assessed using polygons (e.g., McIntyre et al. 2008; Cacciapaglia et al. 2012; Mahboubi et al. 2015; Brown et al. 2017). These studies also suggest that differences in size and detail of the polygon drawn (i.e., smaller or bigger polygons) is a reflection of the nature of the value being mapped. Thus, more concrete values (such as ‘special personal places’) may result in smaller polygons and systemic values may result in bigger polygons (McIntyre et al. 2008; Cacciapaglia et al. 2012; Morse et al. 2014; Mahboubi et al. 2015; Brown et al. 2017).

To the best of my knowledge, there is no study that has analysed whether it is more appropriate (and therefore more natural to participants) to map systemic or abstract values with polygons and specific values with points. This current study did not aim to gather both mapping features (only points were intentionally elicited and examined), and the decision to include only point data resulted in exclusion of 13% of responses. This mapping behaviour may be due to the respondent’s ability to follow instructions, their uncertainty about the location of values or their lack of knowledge of the area (e.g. Klain and Chan 2012). Also, it is difficult to know if polygons represent a group of multiple points or if the weight is equally distributed in the whole area. In addition, although these observations do not describe the mapping behaviour of the whole sample, they suggest the potential to be used in future place value studies where different mapping features can be evaluated (Brown et al. 2017).

For this study, it was decided to allow participants to mark as many points as they wanted, since respondents may have important knowledge to contribute. I note that in the literature this approach has been argued against. For example, Brown et al. (2012a) notes that giving the respondents a limited number of points to use, may be ”*more egalitarian and valid from a research perspective”*. Further exploration of the results showed that respondents marking more than 50% of the total points per value (i.e., ‘intensive mappers’), influenced the final distribution of the values but not the localisation of the most important places. Therefore, the influence of these respondents could be reduced by increasing the sample size (Brown and Pullar 2012). Coinciding with findings of Fagerholm et al. (2012), in the current study the majority (57%) of the ‘intensive mappers’ had the longest residence time (longer than 11 years), suggesting that they had a deeper understanding (and potentially connection) of the area. However, the majority of the respondents marked only one or two points per value. This coincided again with Fagerholm’s et al. (2012) findings.

Contrary to findings of Brown and Reed (2009), Nielsen-Pincus (2011), and Fagerholm et al. (2012), in this study no relationship between the number of points marked per respondent with the relative importance of the value marked (i.e. the more points, the higher the importance) was statistically evident (Table 5.4). This could be due to the difference in the type of values that were identified and mapped, and to the different weighting methods used (i.e., weighting places in this study or ranking values in previous studies). I would argue that further exploration on the weighting methods (i.e. places vs. values; weights vs. ranks; different weights’ scales; and limited vs. unlimited number of markers) needs to occur before stating that the frequency of values mapped can be used as a “*proxy measure for the perceived importance of values*”, as suggested in these previous studies (Brown and Reed 2009; Nielsen-Pincus 2011; Fagerholm et al. 2012). Given the results of these studies, it has been suggested value mapping studies could be implemented without eliciting importance weights (Nielsen-Pincus 2011). I believe that such an approach may disregard particular differences between geographical locations and may not be appropriate based on the outcomes of my study.

In the same way as with the number of point's allowance, it was decided to allow participants to weight each point in a non-ranking fashion, by pre-supposing that respondents would naturally assign varied weights to different places. The results showed that most respondents tended to assign different weights to the values within their surveys (see Chapter 3, Figures 3.1 and 3.2). A fair proportion of respondents (especially in the environmental survey: 43%) chose to assign the same weight to all of the values (Figure 4.6). Due to the cognitively challenging task of value mapping, it is possible that the respondents may be minimising their effort by assigning same weights to different places or values. This is an established selection strategy that is used by participants to reduce the survey difficulty (Tourangeau et al. 2000) and potentially the time needed the complete a question or survey (Nielsen-Pincus 2011). This could be also the reason for the majority of respondents marking only one or two points per value. Additionally, an obvious conclusion is that the identified and mapped values simply mean that most of those values (no matter their location) are equally important to the respondents. Furthermore, the fact that each respondent answered only one of the four surveys focused on a single value set may have influenced this behaviour. If a single survey with a mix of all values would have been implemented, this behaviour may not have occurred. To determine this, further questions to examine this should be added to the survey instrument that is used to identify and map values.

The analyses of the results in this chapter and comparison against previous studies suggests that different mapping methodologies may capture different respondents' characteristics. Similarly, using an unlimited number of markers and non-ranking weighting of places may enhance our understanding of the perceived importance of values and their distribution. This is why all studies eliciting societal values need to be explicit about the methodology used and their sampling frame because those factors will influence the scope of the outcomes and their significance. In a management context, decisions have to be made based on the trade-offs from the interaction of economic, environmental and socio-cultural aspects in a particular place. Therefore, ranking and mapping societal values is a reasonable course of action. However, considering that values may be equally important might also require further exploration.

The final assessment point of the mapping method developed for this study is regarding the representativeness of the sample used for this study through data saturation analysis. As mentioned in the introduction, few studies have aimed to collect their data in a spatial manner that is representative of the sample frame used. Of the studies that do, data saturation is the common technique used to determine representativeness of spatial data. In this chapter, spatial data saturation was reached in 19 of the 22 values (Table 4.2). Hence, in general the findings presented here reflect a representative sample for the perceived distribution of cultural and economic values but not for the environmental and social values. The studies exploring spatial data saturation have done so for places marked with polygons and the tests were focused on the area covered by them (Morse et al. 2014; Rohrbach et al. 2015), therefore their results could not be used for comparison with this chapter results (which focussed on point data). While data saturation was reached for most values, it is important to remember that the sample was not statistically representative of the entire Region's population (Section 4.3.1), therefore these results should be interpreted with caution. However, the results may be representative of the coastal users, since the survey was implemented in a coastal locality and the Census date is from the whole Gladstone Region.

In a similar manner, but with no mention of data saturation, Brown and Pullar (2012) explored the degree of spatial concurrence using points and polygons for four values to determine the number of respondents needed "*to make meaningful inferences about place significance*". Based on their results, Brown and Pullar (2012) recommend that a minimum of 350 respondents marking points are needed to cover the area comparable to the information given by polygons. In other words, the Brown and Pullar (2012) suggest that the same spatially important areas can be identified with fewer polygons and therefore less numbers of participants. Brown and Pullar (2012) do note that the number of participants needed may change if more values are included in the mapping.

In the same way, I caution that by no means do the results in this chapter suggest that 50 respondents would be enough to reach saturation in a given PPGIS study. Instead, within the confines of my study a sample size of 50 respondents was enough to reach data saturation for 19 of the 22 values that had been identified and were subsequently mapped. Of course, more respondent numbers would aid in reinforcing the inferences that would be evident once data saturation occurs (e.g., Brown and Pullar 2012).

Although saturation is a convincing concept, it has a series of practical restrictions. For example, the saturation point has to be defined *a priori*, but to determine whether the saturation has been reached, the data has to be analysed at a determined point during the data collection, and if it has not been reached then data collection needs to continue. This procedure although optimal, is rarely satisfied within studies due to researchers' restricted time and budget (O'Reilly and Parker 2013). Furthermore, using spatial data saturation analyses in this type of research, adds a level of complexity to the assessment of the values' relative importance and distribution (Morse et al. 2014). The benefits of ensuring that data saturation occurs, is the validation of the results and that the findings can be extrapolated in a robust manner beyond the respondents involved in the study. As such, data saturation adds rigour to the identification and mapping of values.

As mentioned before, the user-defined parameters chosen to perform the spatial analysis (i.e. kernel density) influence the final distribution maps. For instance, the search radius and the high-density halos representing the upper third of the weighting range, affect the size and shape of the hotspots (Alessa et al. 2008). Most studies (including this one) analysing social values' distribution have defined those parameters based on both empirical (Alessa et al. 2008) and heuristic judgement (Alessa et al. 2008; Brown and Pullar 2012; Brown and Weber 2012; van Riper et al. 2012; Brown and Donovan 2014). However, while

Alessa et al. (2008) stated that further work is needed “to determine the optimal search radius” and the optimal threshold to represent the high-density halos (Alessa et al. 2008), this study did not explore the implication of such parameters.

4.4.3 Limitations and recommendations

The value mapping approach developed in this study had a number of limitations that can be easily improved in future studies. One of the main limitations was that the spatial data saturation point was not reached in three of the 22 values mapped. Therefore those results should not be considered as representative of the Gladstone Region. To address this under-representation of those three values (and in general), future studies should keep surveying people at the same time as analysing the data saturation to determine when collected data is sufficient (i.e., data saturation has been reached). This approach implies that researchers would need to collect, transcribe and analyse data during the data collection process in a pro-active way.

The decision to have four different surveys to collect information for each value singularly meant that no direct comparison among the cultural, economic, environmental and social values’ spatial distribution and importance could be done since those were answered by different people. Depending on the qualitative information gathered on interviews and the researchers’ opinion, the number of items to be mapped could be reduced for all four types of values so they could be included in one single survey. By having only one survey it will be more likely to achieve the spatial data saturation and the sample representativeness.

In terms of the particular features from the mapping exercise, to avoid having people marking places with points and polygons, a more restrictive method such as stickers (e.g. Raymond and Brown 2006) is recommended. Additionally, values that are viewed as a whole continuum may have the same importance across the landscape, whereas other values that have personal importance may be place-specific. These two types of values may require different data collection approaches to better inform planning and management. This can be addressed by adding a further question to the survey to clarify this topic.

Furthermore, while the kernel density has been one of the preferred spatial methods to analyse the distribution of values (Figure 4.1), further assessment of this and other density methods should be done in order to identify the most appropriate way to process perceived values' spatial distributions.

4.5 Conclusions

The main objectives of this chapter were to test a methodological approach to spatially assess perceived, non-monetary societal values, and to examine the efficacy of the approach used. This chapter's objectives are included in the framework presented in Chapter 1 by implementing Steps 2d-f (Figure 1.5). The results showed specific results about the Gladstone Region's societal values and the hypotheses tested were appropriate to assess this approach.

In general, the values' distribution occurred along the coastline and the most important areas coincided with the most accessible areas in the Region. A more continuous distribution of environmental values occurred compared to the cultural, economic and social values. This may signal a possible differentiation between the non-use (systemic) and use character of the values mapped. The overall lack of spatial correlations exhibited a wide variety of values co-existing in the Region, sometimes clustered but also dispersed. A diversity of perceptions existed in the local community, particularly for the cultural, economic and environmental values.

The areas marked for the different types of future development options covered not only the coastline but most of the Region. The spatial correlation with the values' distribution was not statistically significant. Similarly, further spatial correlations between the types of development did not show potential conflicts. In both cases this could suggest an absence of potential conflicts. However, a visual comparison between areas marked for future No Development and Industrial Development highlighted the divided respondent opinion regarding the southwest area of Curtis Island. Due to this result, I recommend that mapping future development against values requires both statistical and visual analysis of data together.

The methodological approach to identify the spatial distribution of perceived values was effective for this studies purposes and it proved to be a good option for future societal values' assessment. Nevertheless, while the chosen elicitation method (i.e., face-to-face surveys), the spatial features used (i.e., unlimited number of points), the weighting method (i.e., importance in a scale of 1 to 10), and the GIS density analysis chosen are valid and can be used in a future approach it is important to further explore this and other methods in order to standardise the methodology.

Within this type of research, it is important to take into account that PPGIS surveys represent people's personal perceptions that are subject to each respondent's expertise, opinions and held values. Also, maps created reflect the location of respondent's values in that particular time frame. Temporal influences are unknown, with a longitudinal study needed to investigate if respondents would mark the exact same locations if they were asked to do the same exercise in the future. Within the conservation and management context, this type of information can be used to develop plans that encompass societal values (Raymond and Brown 2006), but it may need to be updated from time to time depending on changing land-use plans and public opinions. Adaptive management needs to occur.

Finally, it is important to recognise that value mapping is one of many different tools that can inform and assist with decision-making. Therefore, value mapping alone should not be viewed as a complete method to elicit information but one of many in the toolbox, so to speak.

Often planning decisions are made with imperfect or incomplete knowledge. Yet, if regional decision makers take into account the different stakeholder's values and their distribution along with land-use plans, an equal ground can be established to understand possible trade-offs or conflicts. This is a positive move towards real, inclusive coastal management where 'subtle combinations' of environment and development can effectively coexist (Loomis and Paterson 2014).

CHAPTER 5

Data synthesis and application of a post-hoc risk assessment

5.1 Introduction

This chapter presents the concluding messages of my PhD research and thesis. It begins with a description of the basis of the study, followed by the main findings and contributions made towards the development of a standardised methodology to assess perceived societal values. To place the identified societal values into a management framework that are in context, a modified risk assessment is designed to examine the results of this study. An assessment of the posed framework and its implementation, and suggested future research directions are the last section that I present within this chapter (and thesis).

5.1.1 Premise of the thesis

Varieties of factors are implicated in causing environmental health deterioration. Most of these factors are caused by human activities, which in turn have triggered the conception of conservation and management ideologies and strategies that have been taking place since the mid-19th century (Callicott 1990; Hinrichsen 1998; Burke et al. 2001). It is in this context of environmental degradation that scientists and managers have been attempting to value nature (i.e. assigning its worth or importance in economic and non-economic terms) (Granek et al. 2010; Farley 2012; Costanza et al. 2014). By valuing nature (either with economic or non-economic methods) a common framework is provided in order to easily compare goods and services to help guide decisions by quantifying trade-offs and reach consensus among stakeholders (Granek et al. 2010; Chan et al. 2011; Farley 2012). If nature can be effectively valued, then we may be able to better understand and maintain the services and goods nature provides that are fundamental for humankind (MEA 2005; Díaz et al. 2015a, b).

To date, most of the valuation effort occurs from an economic point of view (Granek et al. 2010; Farley 2012). Economic valuation has faced many criticisms, primarily because it is based on the utilitarian theory where nature can only be perceived as important for humans (e.g., Resource Conservation Ethic; Norton 2012). As with all science, criticism is the basis of improvement and hence criticism of economic valuation has led to the development of non-economic valuation methods based on expert (Novitzki et al. 1999; MacMillan and Marshall 2006), or societal assessments (Ellis et al. 2007; Visser et al. 2007). Given the diversity of societal values and elicitation methods (e.g. Brown et al. 2004; Tyrvainen et al. 2007; Fagerholm et al. 2009; Alexander et al. 2012; Klain and Chan 2012) the principal aim of this thesis was to develop a framework to identify, map and assess the perceived cultural, economic, environmental and social values. A secondary aim was to demonstrate the utility of a value mapping approach to environmental managers, by creating a weighted risk assessment approach to identify values potentially at risk when faced with a specific hazard, which is covered in this final chapter.

5.2 Summary of findings

This study aimed to develop a framework (Chapter 1) to identify (Chapter 2), assess (Chapter 3) and map societal values (Chapter 4) to further contribute into its possible applications, such as enriching and facilitating risk assessment procedures (section 5.4). As a proof of concept for this framework, Gladstone in central Queensland, Australia, was chosen as the case study. Gladstone provides a good insight into an industrial, coastal city with apparent opposed interests: development versus conservation.

In Chapter 2, nine Gladstone stakeholder groups identified a wide variety of societal values and concerns. Three of the identified values had not been described in previous studies for the Region. These newly identified values were:

- The (spiritual) connection with the environment;
- Inspiration from the environment (both cultural); and
- The importance of the industry for other business (economic value).

Some values and concerns are statistically influenced by a participant's socio-demographic characteristics (i.e., time and place of residence, place of birth, income, gender and generation). However, a stakeholder grouping did not statistically influence their values, concerns, norms and beliefs. This is not surprising, given that the stakeholder groupings were *a priori* categorisations based upon their workplace affiliation. The mid to long term residents of the Region, showed increasing numbers of values and concerns compared to other participants, based on their time of residence. These results suggest that the nine stakeholder groups have more things in common than expected.

The perceived importance or weight that was assigned to all the values tended to be distributed in the higher (more important) end of the scale. ‘Recreational Fishing’ was the only value that has a statistically significant different weight compared to the other identified values. Identified economic values were the only values that were assigned the full range of available weights (from 1 to 10) (Chapter 3). In Chapter 3, regression models were used to explore the influence of the respondents’ socio-demographic characteristics on the weight (or importance) assigned to specific values. Respondents socio-demographic factors statistically influenced almost a quarter (23%; n = 5) of the identified values rated importance. Regression models indicated that the amount of time that participants had lived in the Region and their age clearly influenced how a participant perceived the importance of a value. In general, participants that had lived in the Region for more than 11 years and were older than 46 were more likely to assign higher weights to socio-cultural values (i.e. Sacred or Spiritually Special, Camping, Good Memories and Scenery).

Within the economic values, participants that had lived for less than 5-years in Gladstone and those that were older than 56 were more likely to assign higher importance to ‘Commercial fisheries’ (Chapter 3). Participants typically voiced opinions against further Residential and Industrial Development. These participants provided the reasoning behind their opinions was that there is already enough residential and/or industrial development in the Region.

Participants selected areas for No Development based upon their perceived environmental importance. Future Tourism Development was seen as acceptable and even a better option than Industrial Development.

Participants born in Gladstone, those that are short-term residents and males were more likely to agree with a statement about needing more development. Participants that reside outside of the Region were more likely to suggest that industry should occur inland instead of on the coast, where it currently occurs. Participants living in the metropolitan area were more likely to agree positively with the concept of having more Residential Development. Males were less likely to mention ecotourism as a possible future for the Tourism Development (Chapter 3).

Participant's opinions about the health of the harbour produced mixed results. No socio-demographic factors influenced the participants' perception of whether the harbours environmental health was improving, deteriorating or staying the same. Most of the respondents (especially people with higher education) were familiar with the World Heritage Area term, with half aware that the harbour lies within the GBRWHA. Most of the respondents thought that the activities occurring in the harbour negatively impact upon the Great Barrier Reef health (Chapter 3).

Chapter 4 mapped the spatial distribution of the 22 values. In general, the values occurred along the coastline. The majority of places that respondents demarcated as the most important places for the 22 values coincided with populated and accessible areas in the Region. A difference in the continuity of the environmental compared to the rest of the values' distribution was observed. This difference could be an indication of a possible distinction between the 'non-use' (or systemic) character of the environmental values and the 'use' character of the economic, cultural and social values that were mapped.

There was an overall lack of statistically significant spatial correlations between values. This infers high variability regarding where participants spatially distributed the values and perceived importance of the values across the Region. Thus, the spatial perception of a value locations and its importance may be a highly personalised opinion, with the Region being highly diverse. Additionally, the areas that participants marked for the different types of future development covered not only the coastline but also, most of the Region. In this instance, the spatial correlation with the values' distribution was not statistically significant. This may indicate that potential conflicts regarding future development may not occur, as participants are similar in opinion. I provide this comment noting that this statement is only accurate for values that reached data saturation and hence were representative of the Region. Further spatial correlations between the types of development were not significant. Yet, a visual comparison exhibited a divided opinion amongst the participants when they regarded the southwest area of Curtis Island (Chapter 4).

The approach tested in this thesis aimed to spatially identify societal values and I believe this occurred effectively for objectives of this research. Thus, the mixed-method used, proved to be a good option for:

- identifying societal values (Step 1 of the framework, Figure 1.4) (Chapter 2);
- exploring the influence of respondents' socio-demographics on the importance assigned to the societal values identified in Chapter 2 (Step 2d, 2e of the framework, Figure 1.4) (Chapter 3); and
- eliciting the spatial distribution of societal values' (Step 2d, 2f of the framework, Figure 1.4) (Chapter 4).

5.3 Spatially weighted risk assessment

The societal values data collected and discussed in the preceding chapters was used to examine and map risk in the study region. Effective decision-making requires knowledge of and prior planning to pro-actively and efficiently manage potential threats of hazards to the identified societal values. Therefore, understanding the hazards present (real and potential) in a region and how these hazards may interact with a value enables risk maps to be created in a spatially explicit manner. Hence, this section aims to exemplify how value (i.e., perceived importance) maps can be used to create weighted risk maps. To illustrate this process, an oil spill (hazard) scenario is used as a case study for the Gladstone Region. The oil spill scenario that I have used is based upon the 2006 Global Peace oil spill that occurred in the port of Gladstone. The scenario relies on information from that oil spill (Aston 2006; Andersen et al. 2008; Melville et al. 2009; Taylor and Rasheed 2011), which may not accurately represent the conditions of the port of Gladstone today. But as a scenario, it provides a solid example of how the framework I have created can be implemented. Thus, the risk mapping outcomes are an example only; they do not represent a current risk mapping for an oil spill in this Region.

Risk assessment is a tool used to determine the possible threat that a hazard may pose to the environment, people or a community (Smith 2004). Example of coastal hazards include, sea level rise, coastal erosion, chemical pollutants and contaminants in air, water, soil and food (Smith 2004). Threats can have a spatial and a temporal scale to them but are often considered in a proximal manner when they are an immediate problem. Thus, to help plan and manage potential threats, action plans are created to consider the threat within a certain set of contexts (i.e., scenarios) that can then be used to determine the risk posed (e.g., Lexer et al. 2002; Li et al. 2007; Frazzoli et al. 2010) and develop ways to manage the potential risk. Risk evaluates the likelihood, chance, or frequency of an event (i.e., hazard), and its consequences or impacts (Keey 2003; Smith 2004). In Australia and New Zealand, risk management follows guiding principles stated in the AS/NZS standards that are constantly revised (Standards Australia 2017). In general, the Australian and New Zealand standards suggest that risk assessment follows six steps with an extra step that I added (in italics), which are described further below:

1. Hazard identification;
2. Likelihood analysis;
3. Consequences assessment;
4. Risk analysis;
5. *Spatially weighted risk analysis*
6. Development and implementation of risk management strategies; and
7. Communication of results with stakeholders.

For this case study, an extra step (Step 5) is included in order to incorporate the spatial distribution of the perceived importance of each of the societal values that identified in Chapters 2 and 3, and mapped in Chapter 4.

5.3.1 Step 1: Hazard identification

Hazards are events with the potential for harm in terms of human injury, health, damage to property, damage to the environment, or a combination of these (Smith 2004; Hewitt et al. 2011). In the Gladstone Region, a series of different natural and anthropogenic hazards exist, including:

- severe winds associated with tropical cyclones (Granger and Michael-Leiba 2001);
- storm tide inundations (Granger and Michael-Leiba 2001);

- earthquakes (Granger and Michael-Leiba 2001);
- floods caused by cyclones (Granger and Michael-Leiba 2001; Llewellyn et al. 2013);
- severe thunderstorms (Granger and Michael-Leiba 2001);
- heat weaves (Granger and Michael-Leiba 2001);
- bushfires (Granger and Michael-Leiba 2001);
- landslides (Granger and Michael-Leiba 2001);
- poor air quality (Granger and Michael-Leiba 2001; Llewellyn et al. 2013);
- chemical, biological and physical contaminants (QT and GBRMPA 2000; AMSA 2014);
- hazards associated to shipping activities such as groundings and sinkings, oil spills (QT and GBRMPA 2000; Aston 2006; Llewellyn et al. 2013; AMSA 2014);
- biological invasions (Aston 2006; Campbell and Hewitt 2011; Hewitt et al. 2011);
- mega-faunal impacts (Llewellyn et al. 2013; GBRMPA 2014a, b);
- dredging (Llewellyn et al. 2013; GBRMPA 2014a, b); and
- tourism activities (Becken et al. 2014).

For the purpose of this final chapter and to illustrate how to create risk maps from perceived values importance maps, one current and continuing hazard for the Region was chosen to create a scenario: an oil spill. This hazard was selected based on the intensive and growing shipping activity in the Port of Gladstone and the highlighted risk in the proposed LNG Environmental Impact Statements (GLNG 2009) and the Great Barrier Reef Region Strategic Assessment (GBRMPA 2014b). For scenario development, the grounding event of the bulk carrier *Global Peace* in 2006 was used. *Global Peace* spilled 24.5 tons of heavy oil in Gladstone (Aston 2006), and the subsequent clean-up and monitoring provides a dataset for scenario testing.

5.3.2 Step 2: Likelihood analysis

Likelihood is defined as the probability of an event occurring. It is often determined using a likelihood matrix that distinguishes from rare or infrequent events to likely or frequent events (e.g., Campbell and Gallagher 2007; Hewitt et al. 2011). For this scenario, a likelihood matrix (Table 5.1) was used to determine the probability of oil arriving in area. Based on the distribution of the oil in the harbour during the *Global Peace* oil spill (Andersen et al. 2008; Melville et al. 2009; Taylor and Rasheed 2011) and the predominant currents in the harbour (Herzfeld et al. 2004), the spatial categorization of oil arriving in an area was estimated. Five likelihood polygons were drawn around the 2006 spill area (Figure 5.1) to represent the spectrum of rare to almost certain likelihood of the oil arrival occurring at an area. The 'Almost Certain' polygon was drawn around the final extension of the 2006 *Global Peace* spill and the areas where the strongest surface currents at flood and ebb tide could (and did, Andersen et al. 2008; Melville et al. 2009) disperse the oil. The following levels of likelihood (Likely to Rare) were derived for the Region based upon the direction of the main surface current (Herzfeld et al. 2004). While the marine and coastal areas would be directly affected by the oil spill, the likelihood areas cover land as well. This was in response to the distribution of some values that distribute across land and water (see Chapter 4).

Table 5.1. Likelihood matrix for the arrival of oil in a specific area in Gladstone harbour.

Likelihood	Description
Rare	Oil arrival will only occur in exceptional circumstances
Unlikely	Oil arrival could occur, but is not expected
Possible	Oil arrival could occur
Likely	Oil arrival will probably occur in most circumstances
Almost certain	Oil arrival is expected to occur in most circumstances

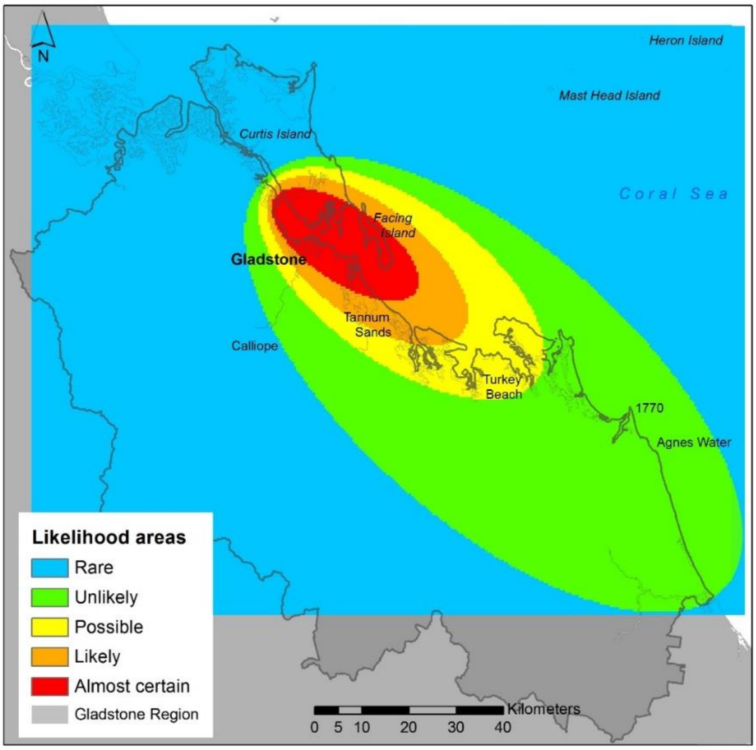


Figure 5.1. Likelihood areas of oil dispersal based on the 2006 *Global Peace* oil spill in Gladstone harbour. NB: affected areas extend across land and water.

5.3.3 Step 3: Consequences assessment

Consequence is the impact or magnitude of an adverse event or hazard, which in this scenario is the impact of an oil spill. Depending on the hazard and the scenario, the consequence has varying levels of impact. For example, the consequence may range from 'moderate' to 'serious' (Wessberg et al. 2008), 'negligible' to 'extreme' (Hewitt et al. 2011) or 'insignificant' to 'significant' (Campbell and Gallagher 2007; Campbell and Hewitt 2013) depending on the temporal or spatial effects and recovery from the harmful event.

The anticipated impact of oil on values is highly varied. As a starting basis, the consequence matrices (cultural, economic, environmental and economic) from Campbell (2008) and Campbell and Hewitt (2013) were used to identify potential impacts that could occur to the perceived societal values in an oil spill scenario. Thus, the types of impacts related to oil spills are summarised in Table 5.2, with values that would be impacted interpreted from the Campbell (2008) and Campbell and Hewitt (2013) consequence matrices noted.

Table 5.2. Known impacts from oil spills identified from the literature. NA denotes no information provided

Impacts	Value(s) impacted	Recovery time	References
Reduced access:			
- Loss of recreational opportunities	Social, Cultural, Economic,	NA	Sugden et al. (2009); Webler and Lord (2010)
Loss of heritage:			
- Loss of identity, traditions and land ownership	Social, Cultural	Up to 12 years	Gill and Picou (2001); Webler and Lord (2010)
Reduced aesthetic values:	Social, Cultural	Up to 15 years	Sugden et al. (2009); Webler and Lord (2010)
Disruption of local economy:			Gill and Picou (2001); Lord et al. (2012); Kim et al. (2014)
- Reduced income due to temporal closure of business - Decrease in income from rental properties	Economic	NA	
Community:	Economic, Social	Up to 12 years	Gill and Picou (2001); Kim et al. (2014); Mayer et al. (2015);
- Conflicts among responsible parties, victims and government - Social fabric damage			
Tourism:	Social,	Up to 3 years	Smith et al. (2011); Cirer-Costa (2015); Susskind et al. (2016)
- Negative public perception - Temporal economic losses	Economic		

Table 5.2 Continuation

Impacts	Value(s) impacted	Recovery time	References
Fisheries: - Reduced fisheries - Negative seafood quality perception	Economic, Social, Cultural	Up to 7 years	Gill and Picou (2001); Kim et al. (2014); Morgan et al. (2016); Ellis et al. (2016); Simon-Friedt et al. (2016)
Human health: - Physical: headaches, nausea, dizziness, fatigue etc. - Psychological: depression, anxiety, stress (concerns about family health, economic loss etc.), Post-traumatic stress disorder (PTSD)	Social	Up to 20 years	Mayer et al. (2015); Arata et al. (2000); Gill et al. (2014); Laffon et al. (2016); Lee et al. (2016)
Environment: - Mangroves' and marshes' seedling mortality and defoliation - Seagrass loss - Birds, sea turtles and mammals mortality - Mobile and sessile invertebrates' mortality and changes in species composition - Trophic changes	Environmental	- More than 6 months - 8 months - More than 5 years - More than 2 years - More than 10 years	Melville et al. (2009); Taylor and Rasheed (2011); Antonio et al. (2011); van der Ham and Mutsert (2014); Andersen et al (2008); Hong et al. (2014); Lei et al. (2015); Capó et al. (2015); Kandalepas et al. (2015); Zengel et al. (2015); Millemann et al. (2015); Vidal and Domínguez (2015); Troisi et al. (2016); Lane et al. (2015); Bernhard et al. (2016); Schaefer et al. (2016); Husseneder et al. (2016); Etnoyer et al. (2016); Brussaard et al. (2016); Zengel et al. (2016); Andrianov et al. (2016)

For the purpose of illustrating how value mapping can be used for risk mapping under a hazard scenario, the consequence of the arrival of oil in a patch was considered to have a 'Major' adverse effect to all value sets. This decision was based on the impacts identified in the literature (Table 5.2). This decision was the most conservative approach based upon the lack of specific data about the levels of impact of this hazard in the Region and its effects on the perceived values of the area.

5.3.4 Step 4: Risk calculation

Risk is the product of likelihood and consequence. In order to spatially map risk, I have assessed the likelihood at each "pixel" and applied the Australia and New Zealand Risk Management Standard (AS/NZS 1999) risk matrix (Standards Australia 1999) (Table 5.3), assuming the consequence level of "Major". The risk outcomes for the tested scenario are bold faced font in Table 5.3 and are spatially explicit in Figure 5.2.

Table 5.3. Risk matrix, where risk is denoted as L = low, M = moderate; H = high; E = extreme (from Standards Australia 1999). Risk outcomes for this scenario are denoted in bold font.

	CONSEQUENCE				
LIKELIHOOD	Insignificant	Minor	Moderate	**Major**	Significant
Rare	L	L	M	**H**	H
Unlikely	L	L	M	**H**	E
Possible	L	M	H	**E**	E
Likely	M	H	H	**E**	E
Almost Certain	H	H	E	**E**	E

Given the previous spatial definition for each of the likelihood areas (Figure 5.1) and the "Major" consequence level for this scenario, the resultant risk is either "High" or "Extreme" depending on the spatial location of the value. This is shown in Figure 5.2, where the areas with an "Almost certain", "Likely" and "Possible" likelihood are in "Extreme" risk, and areas with an "Unlikely" and "Rare" likelihood have a "High" risk.

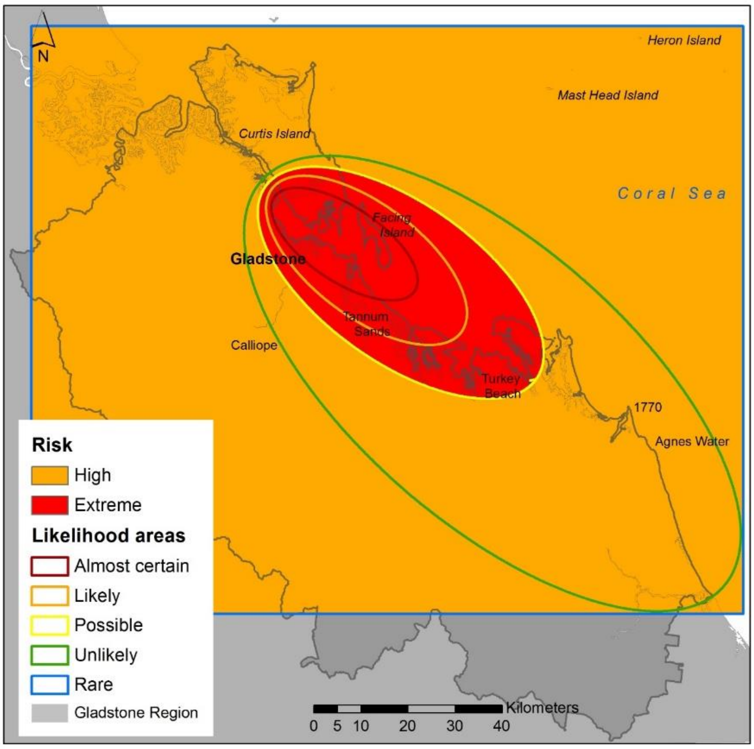


Figure 5.2. Spatial risk map based upon oil dispersal from the 2006 *Global Peace* oil spill in Gladstone harbour, and the "major" consequence that such as spill represents

5.3.5 Step 5: Spatially weighted risk analysis

In order to take into account the individual spatial distributions of the perceived importance of each of the 22 societal values, I used a modified approach to the traditional risk assessment approach. I have added an extra step, where the risk outcomes from step 4 are spatially weighted. This is a new method of assessing risk. This analysis was performed using ArcMap 10.2 and consisted of:

- the reclassification of each value's spatial importance; and
- the final spatial assessment of each value's weighted risk.

The distribution of the perceived importance of each of these values was already measured by using the software's kernel density tool (Chapter 4). However, for this analysis each of the values were re-classified to represent only low, medium and high importance levels. This was accomplished by applying the reclassify tool with equal intervals to each of the 22 values. A graphic example of this procedure is shown in Figure 5.3.

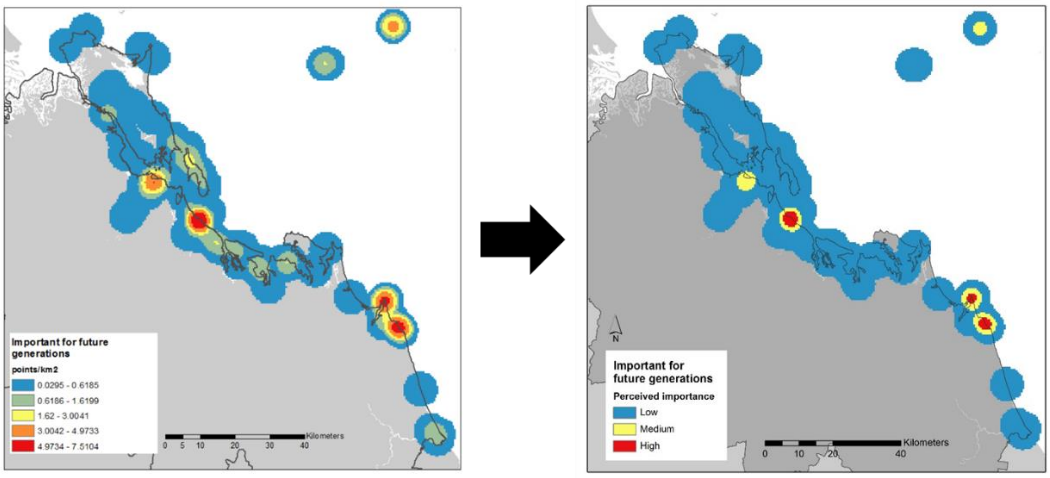


Figure 5.3. Example of the reclassification of the perceived importance distribution for the 'importance for future generations' value. The right-hand graphic is the reclassified importance.

Once this process was finished, the final weighted risk for each value was calculated using a risk matrix built to consider four categories of risk and the three levels of perceived importance (Table 5.4). Consequently, given that the consequence was determined to be "Major" and the risk outcome for it is "High" or "Extreme" (Table 5.3), the final weighted risk outcomes correspond only to those risk levels, which are highlighted in Table 5.4 with a bolded frame. An example of how this last step was spatially performed is shown in Figure 5.4.

Table 5.4. Weighted risk matrix, where risk is denoted as L = low, M = moderate; H = high and E = extreme. The weighted risk levels used in this scenario are highlighted with the bolded frame.

	IMPORTANCE		
RISK	Low	Medium	High
Low	L	L	L
Moderate	L	M	M
High	L	M	H
Extreme	L	H	E

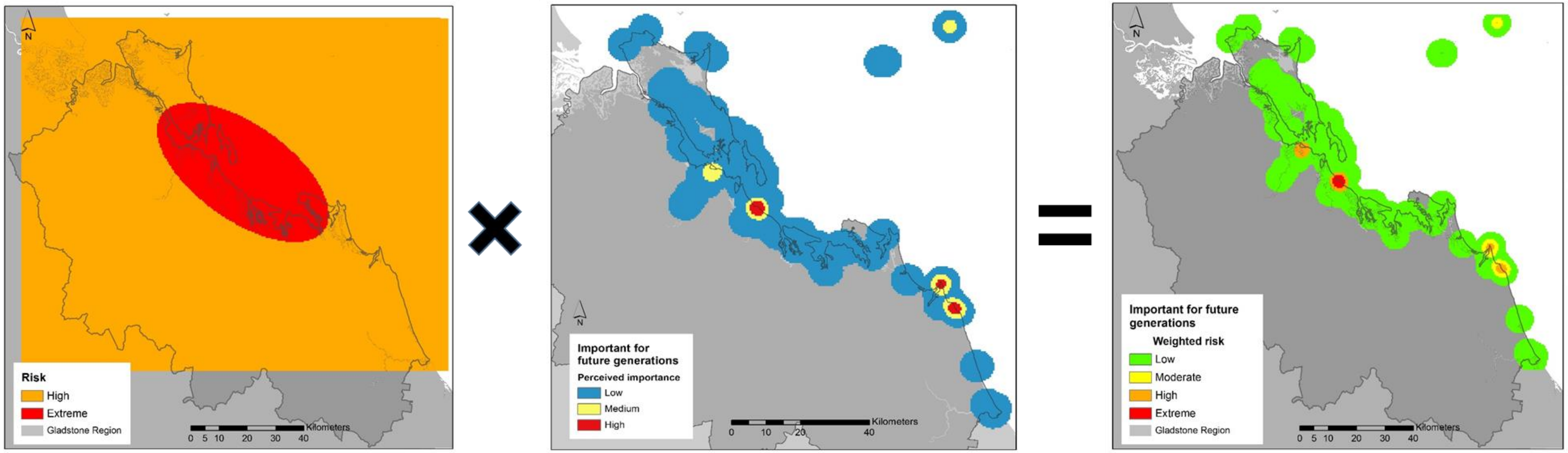
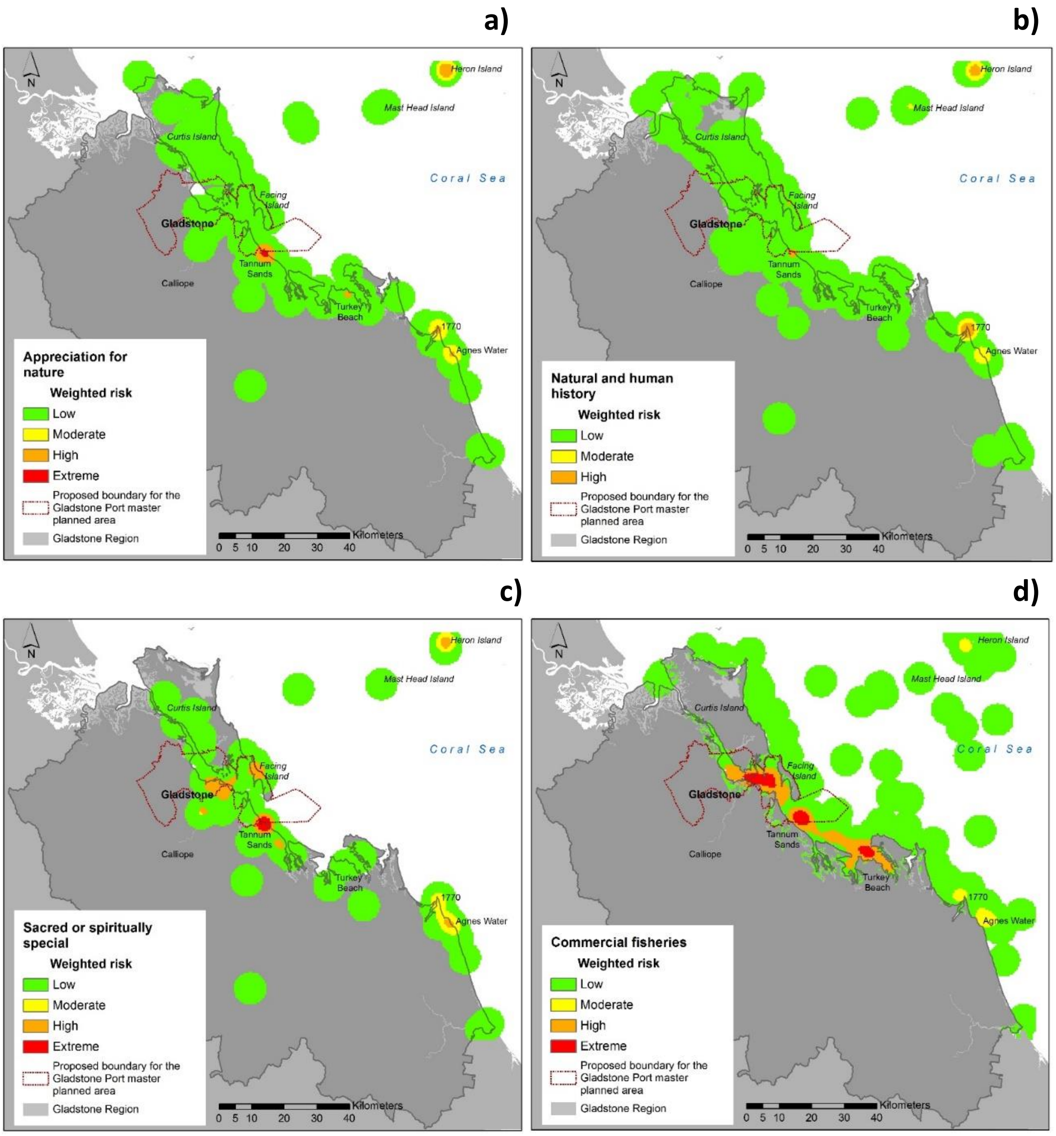


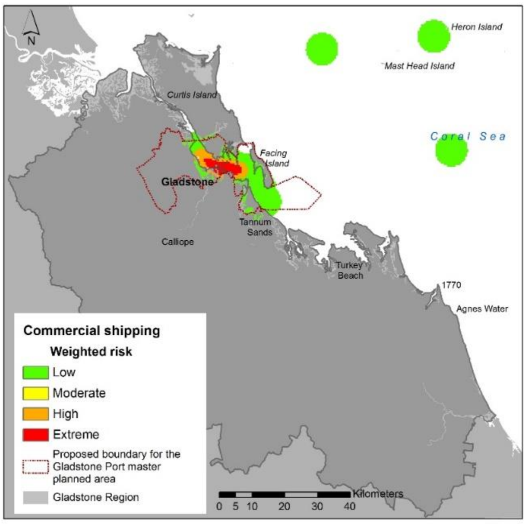
Figure 5.4. Example of the spatial calculation of each value's weighted risk. The spatial risk is multiplied by each value's perceived importance to produce the final outcome.

The importance of this process is that it may highlight areas with high or medium importance by assigning them a “Moderate”, “High” or “Extreme” weighted risk, even when the spatial risk is ”Moderate”. This can be observed in Figure 5.3.

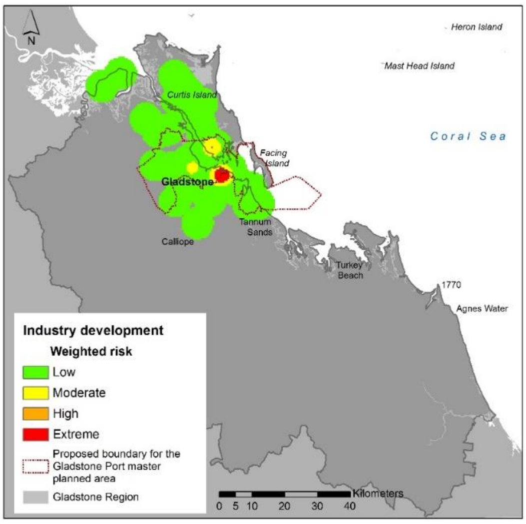
Finally, the resultant weighed risk of each of the 22 values are mapped in Figure 5.5. The risk maps presented are based on the tested hazard scenario (oil spill) and do not represent real risk. These maps merely illustrate how risk mapping could occur using the spatial perceived importance of societal values. The risk maps include the proposed (extended) boundary for the Gladstone Port as an example of what the risk maps could be used for (see Step 6). The extension of the port area was part of the port master plan that was developed in 2016, and mandated under the *Sustainable Ports Development Act* 2015.



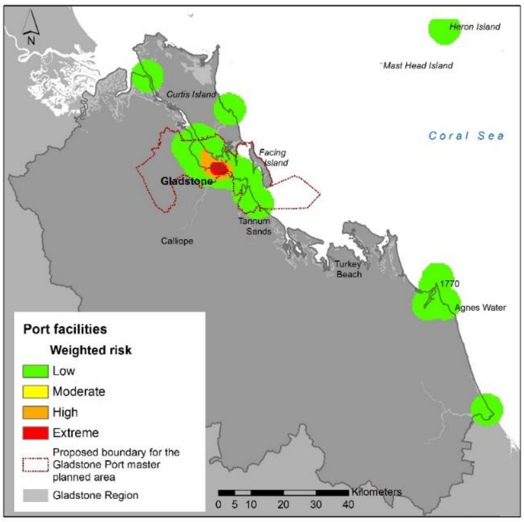
e)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Commercial shipping
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

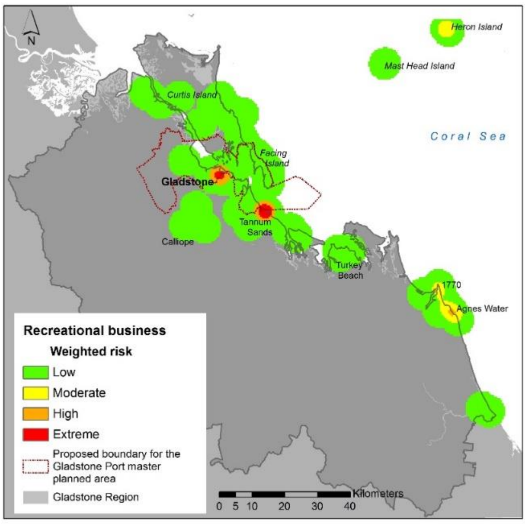
f)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Industry development
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

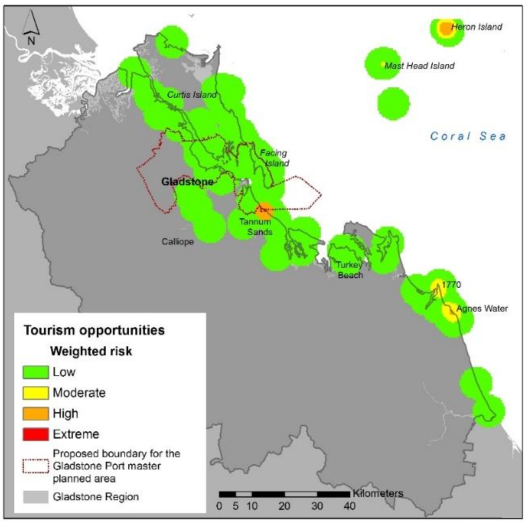
g)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Port facilities
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

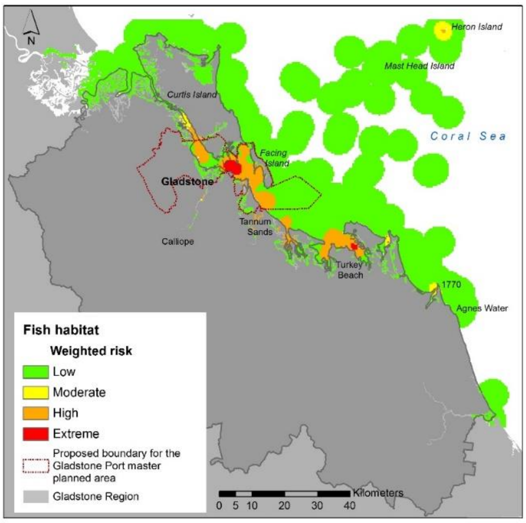
h)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Recreational business
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

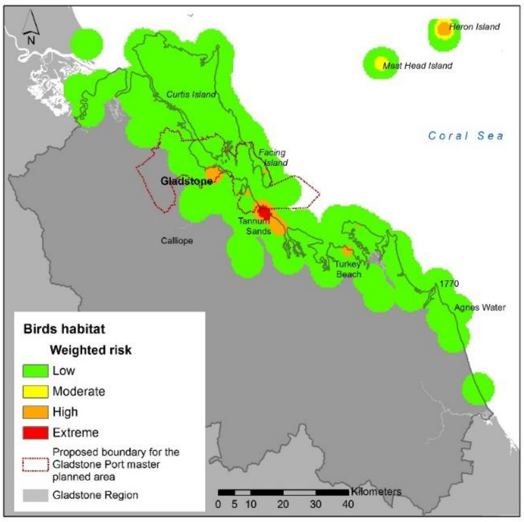
i)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Tourism opportunities
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

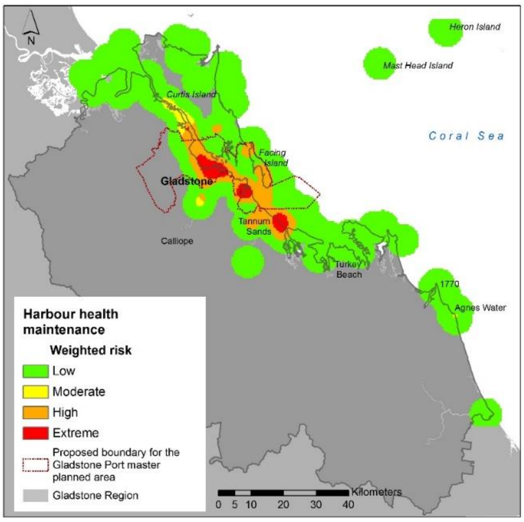
j)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Fish habitat
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

k)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Birds habitat
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

l)


N
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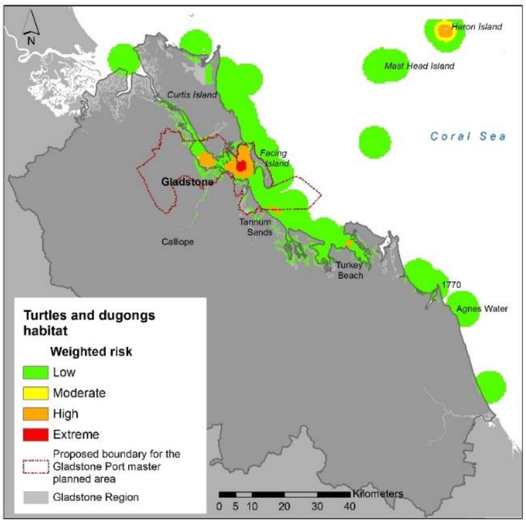
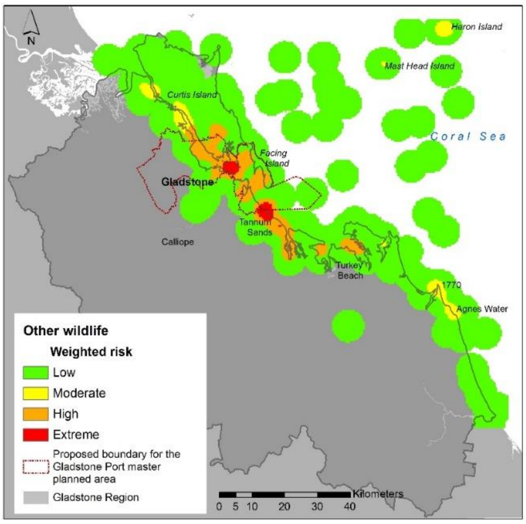
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Harbour health maintenance
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

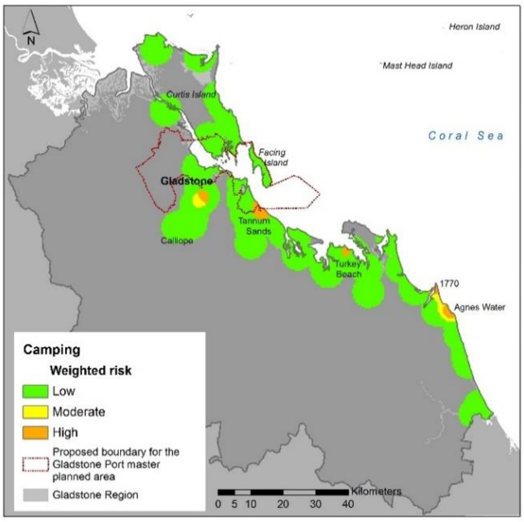
m)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Turtles and dugongs habitat
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

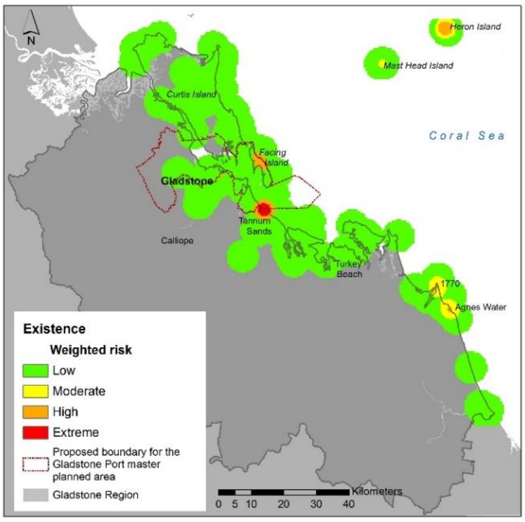
n)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Other wildlife
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

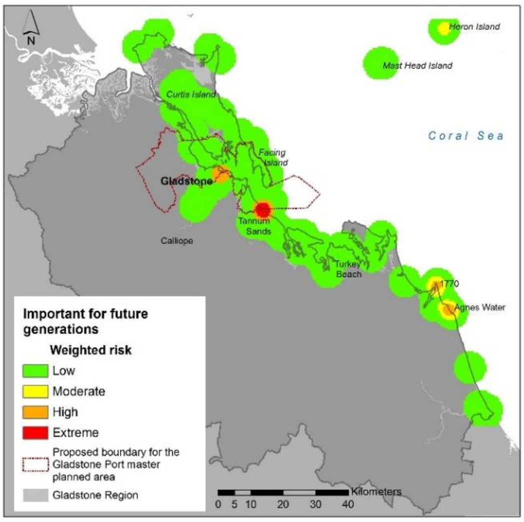
o)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Camping
Weighted risk
Low
Moderate
High
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

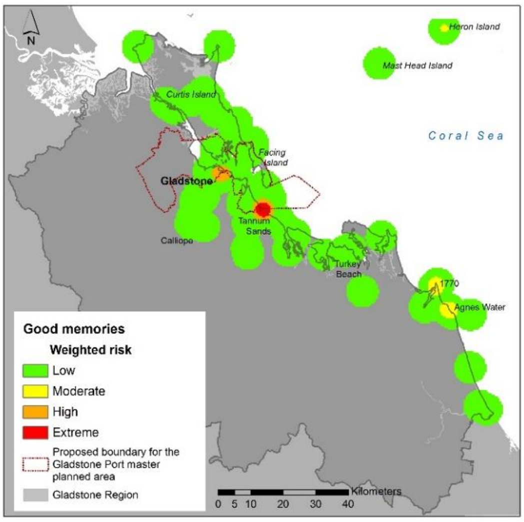
p)


N
Heron Island
Mast Head Island
Curtis Island
Coral Sea
Facing Island
Gladstone
Tannum Sands
Calliope
Turkey Beach
1770
Agnes Water
Existence
Weighted risk
Low
Moderate
High
Extreme
Proposed boundary for the Gladstone Port master planned area
Gladstone Region
0 5 10 20 30 40 Kilometers

q)



r)



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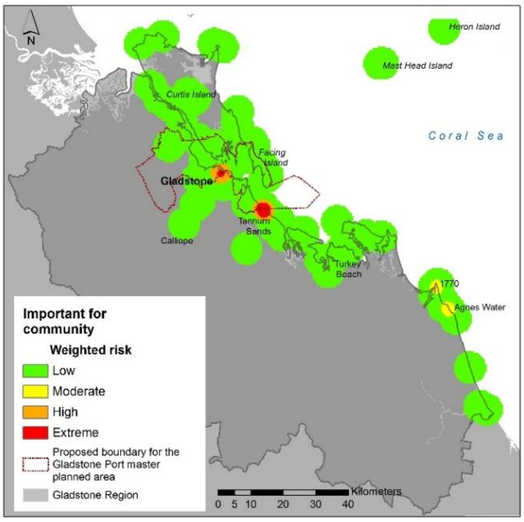
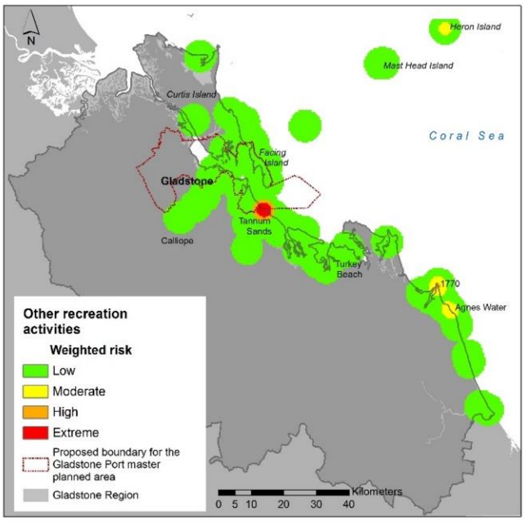
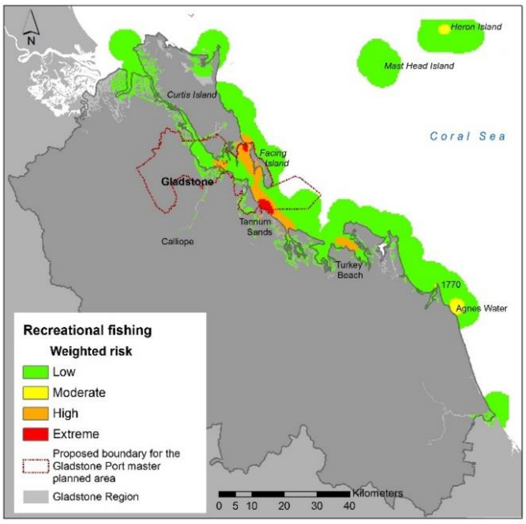


t)



u)



v)

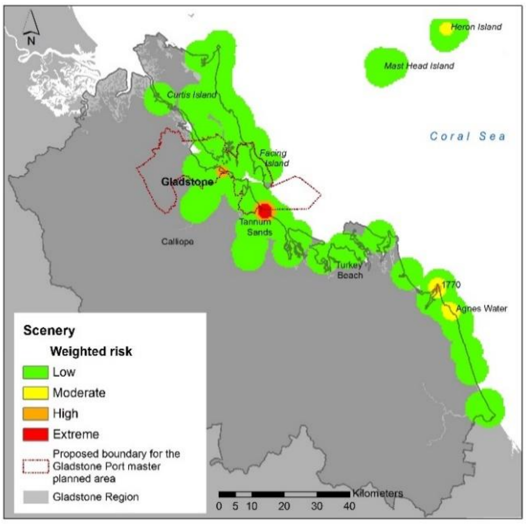


Figure 5.5. Weighted risk maps created for the identified perceived societal values in Gladstone Region. The individual maps represent the following weighted risk to values: a) Appreciation for nature; b) Natural and human history; c) Sacred and spiritually special; d) Commercial fisheries; e) Commercial fisheries; f) Industry; g) Port facilities, h) Recreational business; i) Tourism

opportunities; j) Birds habitat; k) Fish habitat; l) Harbour health maintenance; m) Other wildlife habitat; n) Turtle and dugong habitat; o) Camping; p) Existence; q) Future generations; r) Good memories; s) Important for community; t) Other recreation; u) Recreational fishing; and v) Scenery.

5.3.6 Step 6. Development and implementation of risk management strategies

In the particular case of the Gladstone Region and its port, the results of this study case assessment are useful in identifying and mapping the economic, environmental, cultural and social values. This type of information is required for the environmental management framework that must be included in the Master Plan of the Gladstone Port, under the *Sustainable Ports Development Act* 2015 and the *Environmental Protection Act* 1994. The purpose of the Sustainable Ports Act is to:

> "*… provide for the protection of the Great Barrier Reef World Heritage Area through… long-term planning for priority ports to provide a strategic and coordinated approach to managing economic, environmental, cultural and social values*". (http://www.statedevelopment.qld.gov.au/industry-development/sustainable-ports-development-act-2015.html)

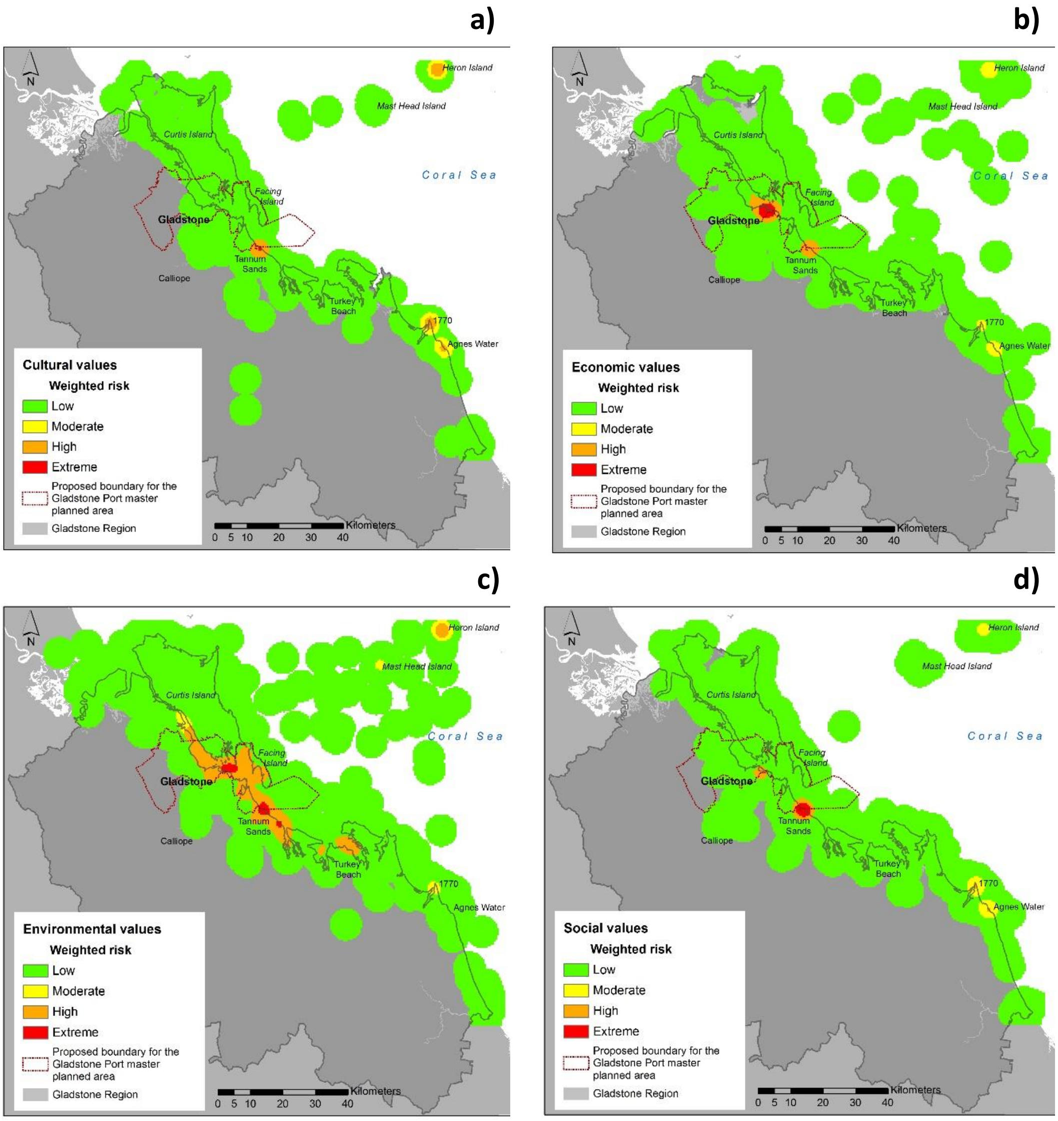
The value and weighted risk mapping approach that is illustrated here could be useful given that the protection of "coastal resources and their values" has to be considered in local and regional planning instruments as stated in the Coastal Protection State Planning Regulatory Provision (2013), under the *Sustainable Planning Act* 2009. Furthermore, considering that the Port of Gladstone lies within the Great Barrier Reef World Heritage Area the risk assessment approach developed in this study may be applicable to assess risk in a clear and transparent manner that is spatially relevant. This approach would aid in identifying and managing risks to the World Heritage values as required under the *Environment Protection and Biodiversity Conservation Regulations* 2000 within the *Environment Protection and Biodiversity Conservation Act 1999*.

I note that a general oil spill risk assessment has already been developed for the Queensland coasts and the Great Barrier Reef Marine Park in accordance with the national and international legal framework (QT and GBRMPA 2000). In the QT and GBRMPA (2010) report, seven navigational routes within the Queensland coasts were the areas with the highest oil spill risk: Prince of Wales Channel, Inner route north of Cape Flattery, Cape Flattery, Great North East Channel, Whitsunday Islands, Hydrographers Passage and Moreton Bay. In that same study, the Gladstone Region has a low to medium (acceptable) risk level (QT and GBRMPA 2000). In that study, the likelihood took into account the shipping intensity, past events, and expert advice, while the consequence comprised the environmental and socioeconomic vulnerability (QT and GBRMPA 2000). However, the assessment recognises that "*further analysis is required within individual ports*" (QT and GBRMPA 2000). Even though the QT and GBRMPA (2000) assessment is comprehensive in its use of existing data and expert opinions, the extent and the scale of the area assessed is bigger.

Therefore, in comparison with other areas with high vessel traffic and high relevance of the cultural and economic activities within Queensland, such as Moreton Bay or Whitsunday Islands, the (lower) risk level for the Gladstone area is comprehensible, but regionally the risk might be different. In addition, the social factors taken into account only covered the traditional use by the Aboriginal groups of each area (QT and GBRMPA 2000). Having this in mind, the risk assessment in this thesis adds a higher level of detail regarding the spatial scale. Additionally, the assessment presented in this thesis, although the risk is undertaken using a scenario, the identified and mapped societal values are more comprehensive and the importance of these societal values from the community perspective is framed.

Management strategies need to be constructed to consider current and future development and environmental management objectives of the local, state and federal government. This needs to occur in concert with communities. This thesis and final risk weighting clearly illustrates how such an approach can occur. The approach outline not only illustrates a practical incorporation of societal values into the risk assessment framework, but the approach also provides a useful, geographical visualisation that aids the identification of societal values and potential risks within a specific area.

Furthermore, by understanding that resources are limited and that decision-making in the risk management context is usually informed by single specific outcome (or in this case one map), the weighted risk maps could be simplified. Therefore, in order to have a general overview of the societal values four maps could be constructed to spatially identify the cultural, environmental, economic and social “hotspots” at risk (Figure 5.6a to d), or even one map, comprising all 22 values’ weighted risk (Figure 5.6e).



e)

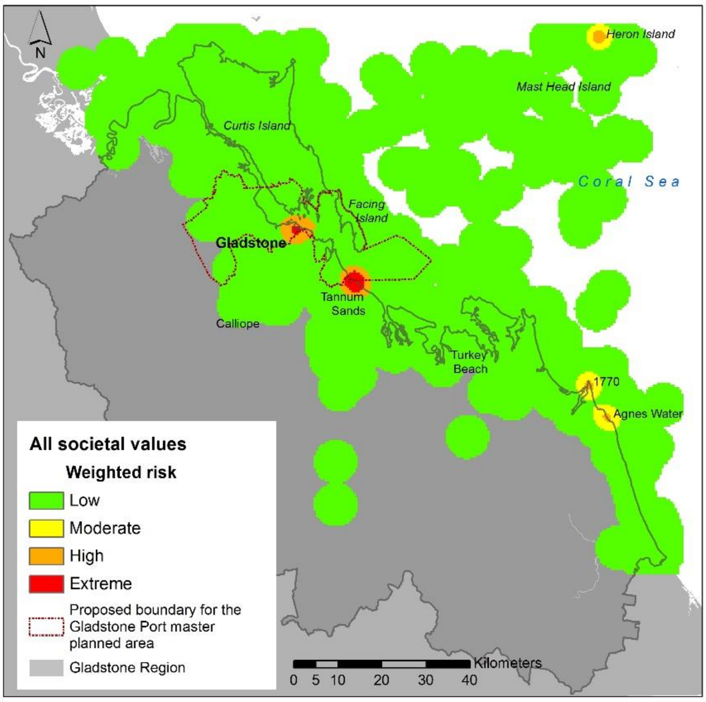


Figure 5.6. General weighted risk maps created for the identified societal values in Gladstone Region, where: a) is cultural values; b) is economic values; c) is environmental values; d) is social values; and e) represents all societal values depicted together.

Even though the more general weighted risk maps (Figure 5.6) can be used to prioritise the use of resources, it is important to take into account that they represent a simplified version of all 22 values' risk. For example, the risk maps for cultural, social and economic values (Figures 5.6a, b, d) assess the risk depicted in areas such as the Facing Island, Turkey Beach, or the harbour from the Sacred or Spiritually Special, Commercial Fisheries and the Recreational Fishing values' weighted risk combined (Figures 5.5c, d, u). Furthermore, the risk map summarising all 22 values (Figure 5.6e), particularly highlights the risk in the harbour depicted in the environmental map (Figure 5.6c). Therefore, a careful decision-making process should follow by balancing the spatial differences that are present.

5.3.7 Step 7. Communication of results with stakeholders.

To effectively manage risks, it is important to communicate the assessment outcomes to communities or the different stakeholder groups within the Region.

This last step ensures that people understand the risk assessment outcomes, its inherent uncertainties and the risk management decisions associated with it (Beer and Ziolkowski 1995; Reckelhoff-Dangel and Petersen 2007). At the same time, risk communication enables a two-way communication where the community and stakeholder views can be incorporated into the outcomes.

Within this context, the risk mapping procedure and outcomes of this study could be used by environmental and resource managers to improve decision making. Risk mapping provides the opportunity to be pro-actively informed (the maps can be developed in advance) in hazards such as oil spills, or any other natural or anthropogenic hazards that can be assessed. The utility of this approach is that the community is engaged and their values are incorporated into an approach that is statistically robust, that can spatially map values and their importance, and the values can be used to assess risk in a manner that has meaning for the community. This method also encourages transparency as the values and the risks are clearly mapped. Furthermore, it is in this moment when some of the shortcomings of the study could be addressed. For instance, the visualisation of values and their risks may persuade the participants to identify valued areas underrepresented by previous participants due to lack of familiarity or fear of misuse of the information.

Thus, the outcomes of the risk analysis of this study could be useful in two different ways for decision makers:

- Management decisions can be made based on the generalised weighted risk maps (Figure 5.5a to d), or map (Figure 5.5e); and/or
- Individual weighted risk value maps (Figure 5.4) can be used in the communication process with the community in order to explain all the nuances involved by including the different values taken into account when making decisions.

5.4 General framework assessment

5.4.1 Desirable features and study limitations

This thesis framework was developed on the understanding that having an inclusive approach where societal values (i.e. the benefits from nature to people) should be identified and valued by the community itself. This brings transparency and accessibility to the process. Furthermore, by acknowledging that cultural values (in particular) are difficult to assess in economic terms (Chan et al. 2012), this study supported the idea that non-economic valuation methods should be explored in order to capture the different ways in which the importance of tangible and intangible values can be expressed (Díaz et al. 2015a). With this in mind, this study aimed to provide an example of a standardised framework to assess societal values.

One of the main benefits of having a common approach is that a shared general methodology may enhance collaboration by directing efforts towards collective goals. Although a unified framework has been proposed and accepted for the conceptualisation of values by the Millennium Ecosystem Assessment (MEA 2005), and more recently by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz et al. 2015a, b), an established approach to assess and map societal values has not been proposed as yet. This is due mainly to the 'recent' inclusion of societal values in the management and conservation picture, but also to the wide variety of methods that have and can be used to spatially identify these values (e.g., Brown and Kyttä 2014; Brown and Fagerholm 2015; see also Appendix A).

The framework suggested here, incorporates qualitative and quantitative value-assessment aspects that are neglected in other studies that spatially assess societal values (see Appendix A). One aspect absent from many other studies is the use of an inductive approach where societal values are identified by the community itself. Even though the relevance of these values has been recognised internationally (e.g. Díaz et al. 2015a), and the bottom-up approach for their identification has been acknowledged (Brown et al. 2014b), the societal values are often assessed using a top-down approach, where values are pre-defined without community participation. Although this may come across as a contradictory approach, it may occur for different reasons such as time and budget limitations or the specific research objectives.

Hence, the mixed-method used in this framework provides an integral set of data that enables the accurate identification of values but also ensures statistical representativeness can occur. The importance of statistical representativeness should not be overlooked, as it enables confident generalisations and predictions about the community's perceived values and its importance. The bottom-up approach also enables elicitation of other information about related issues such as concerns that could be used in the consultation process to address management decisions and their subsequent trade-offs. Another desirable feature of this framework is the exploration of the influence of socio-demographic characteristics on the importance assigned to values. By gathering statistically representative data, the results are used to support management processes by targeting the right public in the planning, communication, and/or consultation stages of any development or conservation projects.

Additionally, this framework included an uncommon feature to address and acknowledge uncertainty in the elicited spatial data. In general, uncertainty is defined as the inability to determine the characteristics of a system (Mahmoud et al. 2009) or the sources of ambiguity within the input and output data and results (Lechner et al. 2014). In this study, the spatial uncertainty was addressed by testing the spatial data saturation, to determine the optimal sample size (i.e., saturation point) where no new spatial information is generated. This approach is a content validity procedure. Furthermore, uncertainty was also addressed by assessing the qualitative saturation point in the data obtained through interviews (Chapter 2), and by testing the statistical representativeness of the sample (Chapter 3).

Lastly, in order to demonstrate the potential use of the identified values and their spatial distribution, a modified risk assessment and associated mapping is proposed. The advantage of the spatially weighted risk assessment developed within this framework is that it could support the identification and the effective communication of management and conservation decisions to stakeholders and communities.

While these are the features that provided a strong framework basis, it is important to acknowledge that (as mentioned and discussed throughout the thesis) the designed framework had a number of limitations. Most of these were related to the small sample size of respondents and can be easily addressed in future studies:

- Lack of Aboriginal representation. Ideally, the in-depth interviews would have included representatives from the Aboriginal stakeholder group present in the Gladstone Region. I met individuals on three different occasions with one of the representatives of the Gidarjil Development Corporation (http://www.gidarjil.com.au/). Yet, the time was insufficient to be introduced to some of the local Aboriginal representatives. Unfortunately, due to the time constraints for this study, I was forced to continue without their participation. Future research in this space must engage and collaborate with Aboriginals.
- Small survey sample size. Due to the resultant sample size, the results regarding the relationship between the perceived importance assigned to values and the respondents' demographics outcomes is discussed and presented cautiously. A larger sample size (estimate sample size of 1,049 ± 3%) will overcome such issues in future.
- Similarly, due to the small sample size the spatial data saturation was not reached for three of the 22 values. As discussed in Chapter 4, this can be addressed by assessing data saturation in parallel with the data collection process.

Therefore, these study results cannot be generalised as the views of the whole Gladstone community. The thesis does however, produce an approach to identifying and mapping perceived societal values and to develop appropriate risk maps.

5.4.2 Potential challenges and recommendations for management

The assessment of this framework suggests that alternative methodologies are needed to elicit societal values. The acknowledgement of these values could help to make necessary trade-off decisions faced by managers, but a framework like this could face potential challenges. For example, the acknowledgement and incorporation of societal values into management and conservation plans at national and international levels has increased since the Millennium Ecosystem

Assessment (MEA 2005). However, the actual (economic) valuation and adoption of methods and values into management decisions by the public sector has proved difficult and slow (e.g., Laurans et al. 2013; Brown and Kyttä 2014; Ruckelshaus et al. 2015). This may be due to the number of authorities and their varied interests, the novelty of the decision process and the concepts and methods behind it (Ruckelshaus et al. 2015), as well as the lack of incentives to implement novel procedures, or a culture of risk avoidance (Mulgan and Albury 2003).

Challenges faced by studies aiming to support spatial planning decisions are identified by Ruckelshaus et al. (2015). Based on their experience with different governments, the researchers found that the characterisation of different scenarios, the use of multiple metrics (e.g., monetary or biophysical) and the number of authorities involved become even more challenging when spatial elements are added (Ruckelshaus et al. 2015).

Despite the fact that most of the valuation efforts have been aimed towards assigning monetary value to nature (Christie et al. 2008; Granek et al. 2010; OECD 2011; Chan et al. 2012), the use of economic valuation "*has been less important than anticipated*" (Ruckelshaus et al. 2015). At the same time, non-economic valuation approaches have been acknowledged to be more comprehensive in terms of the wide spectrum of values that they can elicit (i.e., tangible and intangible values) and their possible applications (Christie et al. 2008; Kenter 2014). However, more than being mutually exclusive, economic and non-economic methods can complement each other. The adoption of non-economic valuation approaches, like the one suggested in this framework, can contribute to decision making by illustrating how different decisions may affect the benefits from nature that are important for the community (Ruckelshaus et al. 2015), as well as evaluate policies and management decisions (Kenter 2014).

By acknowledging that decision making in an adaptive environmental management context involves continuous assessment, monitoring, impact evaluations and consultation with stakeholders (Bennett et al. 2005; Armitage et al. 2010; Dutra et al. 2015), I modified the structure of the framework applied in this thesis to a more complete approach that could be used in future studies. This adapted framework is now illustrated in Figure 5.6.

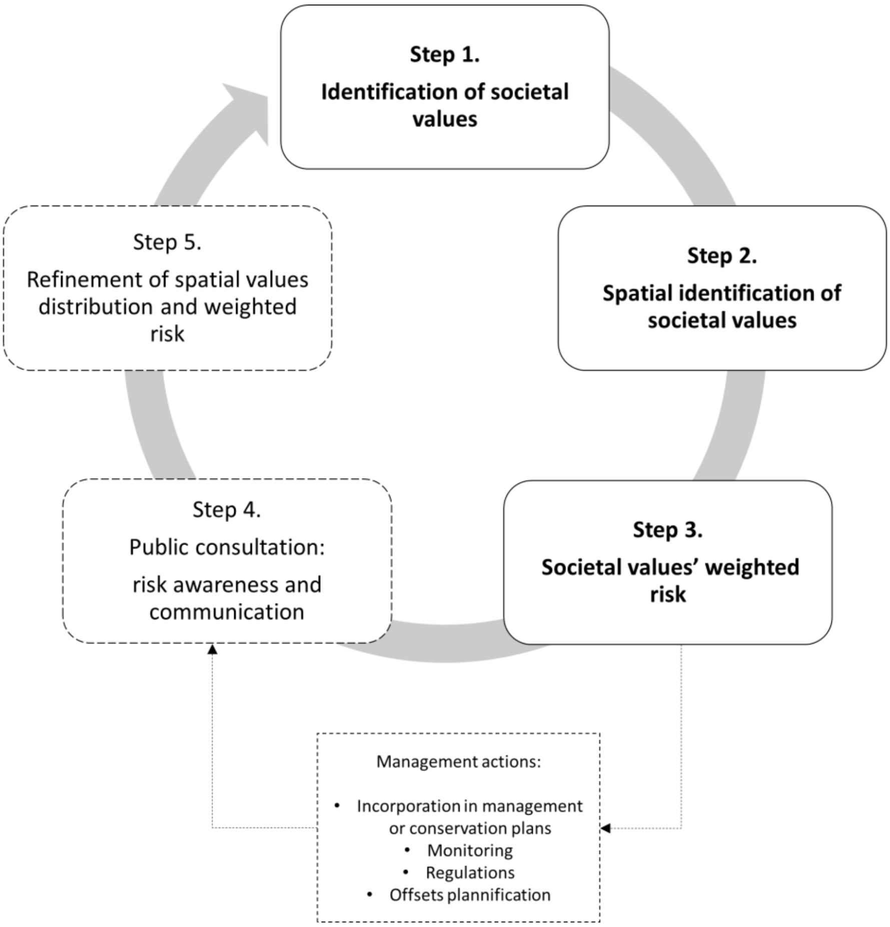


Figure 5.7. Modified framework to identify and assess societal values. Steps taken in this thesis are highlighted in bold font.

5.5 Directions for future research

While the framework used has the previously mentioned advantages, I recognise that there are other approaches that could and should be explored in order to build the most appropriate methodology to assess societal values. The results of this thesis highlighted features that could be improved in future research such as:

- The inclusion of questions (in both the qualitative and quantitative elicitation steps) that may give a better panorama of the factors influencing people's values. Some examples are: sources of information, social connections, previous access to environmental education, if respondents have children and if they or a family member depends economically on industry, place attachment, and pro-environmental behaviour;

- As the study was not longitudinal, future research is needed to determine change in the perceived societal values through time. This is especially important in areas where the population is in constant flux due to boom development periods.

Based on the results of this study and the existent literature regarding the spatial identification of perceived values, it is evident that further testing is needed in order to have a standardised approach, for example:

- Testing different importance scales to elicit a wider variety of places of importance and/or their change through time such as 1 to 100, -10 to +10 or low, medium high frames;
- Given that the use of weighting for each place and the ranking of all values respond to different questions (i.e., which place is more/less important and which value is less/more important), further analysis should be made to explore the nuances between both methods;
- While most studies used a limited number of markers per value, this study suggested the use of unlimited points to mark valued places on a map. As a consequence, respondents in this study marked as many as 44 places. Testing the difference between these two methods would help to determine which elicitation method is more appropriate;
- Future research is required to examine if the frequency of values marked in a map can be used as a proxy to establish its importance. While some studies have suggested this is the case, the findings in this study does not support that idea; and
- Conducting research to assess the difference and best use of different spatial features (i.e., points or polygons). The results from this research suggests that points and polygons were preferred depending on the type of value mapped.

Finally, the use of alternative methodologies could be used to explore perceived values in different ways, for example:

- Different methodologies may result in different elicited values, therefore more information on the difference on the use of individual interviews and other methods such as the Delphi approach could be explored;
- Furthermore, when the final value and risk maps are presented to the community, the Q methodology (McKeown and Thomas 1988; Cairns et al. 2014) or the citizens jury method (Aldred and Jacobs 2000) could be applied in order to achieve both the communication/consultation and refinement of maps to be used for decision-making;
- More information is needed to understand the differences between developed and developing countries, or indigenous and non-indigenous communities, in terms of the types of societal values and how they are conceived. While the difference may be evident, it may entail the use and development of different approaches for their assessment.

5.6 Conclusion

The assessment and spatial identification of perceived societal values is a relatively recent approach. It was born from the need for a more comprehensive methodology to allow the incorporation of other perceptions and knowledge systems into environmental management decisions (MEA 2005; Díaz et al. 2015a). However, due to the novelty of the approach, a standardised method is yet to be developed. In this context, this thesis can help the development of such a standardised framework. The framework developed and presented in this thesis can be used by other researchers, government officials, and community groups to improve management decision-making.

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APPENDICES

Appendix A. Methodology and results for systematic literature review

This appendix provides the background methodology that was followed for the systematic literature review discussed in Chapter 1, section 1.3.4.3.2, and summarised in Figure 1.4. A systematic review was undertaken to identify and collect information from published research on the different methods used to collect societal perceived values. To accomplish this the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology was applied (Liberati et al. 2009). A meta-analysis was not undertaken but a qualitative approach was followed. The following summarises the PRISMA steps that were undertaken:

1. Published literature was searched via the SCOPUS database. Two searches were undertaken.
    - Search 1: The first search contained only two keywords (i.e., 'social values' and 'GIS') and it was limited to articles published from 2000 to 2015. Progressive filtering was applied by:
        i. excluding irrelevant Subject Areas (e.g., 'medicine' or 'dentistry') and keywords (e.g., 'artificial neural network' and 'earthquake';
        ii. searching for the keywords 'PPGIS' or 'landscape values' or 'social' or 'cultural values';
        iii. excluding irrelevant keywords such as: 'economics' and 'artificial intelligence'; and
        iv. removing articles not relevant by title and abstract analysis.
    - Search 2: The second search was undertaken by using the keywords of the articles from the first search: 'social values' or 'landscape value' or 'cultural ecosystem values' and 'GIS' and 'participation' and 'public', limited again only to articles published from 2000 to 2015. Progressive filtering was applied by:
        i. Removing duplicated references with the first search; and

ii. Removing articles not relevant by title and abstract analysis.

2. Relevant published articles were included via snowball sampling, where articles referenced in the identified papers from the first two searches were then searched.

Search 1 returned a total of 441 articles. The filtering steps identified and then excluded articles based on the following subject areas: medicine, engineering, business, arts, multidisciplinary, dentistry, energy, biochemistry, economics, nursing, chemical engineer, materials science, mathematics, pharmacology, physics, astronomy, psychology, chemistry, neuroscience, immunology and undefined. The filter also excluded the keywords: artificial neural network, cost benefit analysis, earthquake, analytical hierarchy process, agricultural production, water supply, water resource, United Kingdom, spatial variation, spatial data, soil conservation, socio economics, socioeconomic conditions and segregation. This filter step reduced the returns to 194 articles. The titles of some of the returned articles were still irrelevant, therefore a second word search filter was performed within these results, with the search terms including the words "PPGIS OR landscape values OR social OR cultural values". This search returned 111 records. Of these 111 articles, an initial search revealed that irrelevant topics were still included. Hence a further filtering was applied to exclude the following keywords: far east, erosion, environmental indicator, environmental impact, environmental factor, environmental economics, ecosystem functions, economic analysis, ecological sensitivity, ecological security, ecological modelling, ecological impact, cost-benefit analysis, connectivity, conceptual framework, cartography, anthropogenic effect, alternative agriculture, algorithm, watershed, sustainability, spatio-temporal analysis, risk assessment, RS, population growth, planning method, Guangdong, grass land, environmental impact assessment, decision analysis, computer simulation, central Europe, artificial intelligence, sensitivity analysis, population statistics, parks, modelling, habitat fragmentation, habitat conservation, geomorphology, environment quality, environment monitoring, ecotourism, ecosystem, deforestation, agricultural land, economics, economic development, data set, urban development and article. This filter returned 45 records, of which only 10 were considered after assessing their abstracts.

Search 2 included the keywords: "social values OR landscape values OR cultural ecosystem services AND GIS AND participation AND public", with the same document type and published years used in Search 1. This search returned 33 records and after excluding irrelevant articles based on abstract assessment a total of 21 articles were left. Search 1 and 2 were combined (n = 31) and after duplicate articles 27 records were left. The snowballing reference search of the final 27 records then identified an extra 25 records. Table A.1 summarises these final 52 records from the SCOPUS search.

Table A.1. Summary of methods used to elicit and map societal values in the literature that was identified via a PRISMA search of the Scopus database (search limited to 2000-2015).

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Mail survey	Landscape values	Terrestrial/ Protected			100 points among all values		Brown and Reed 2000
Deductive	Mail survey	Landscape values	Terrestrial/ Protected	Points	Stickers	100 points among all values	(G) Point density	Reed and Brown 2003
Deductive	Mail survey	Landscape values	Terrestrial-Marine/	Points	Stickers (up to 3 per value)	100 points among all values	(G) Point density	Brown, G. G. et al. 2004
Deductive	Focus group	Landscape values	Protected	Polygons		14 hotspots ranked individually and by group	(G) Sum of grid cells	
Deductive	Mail survey	Landscape values	Terrestrial-Marine/	Points	Stickers (up 6 per value)	100 points among all values	(G) Point density	Brown 2005
			Protected			100 points per value		
Deductive	Mail survey	Landscape values	Terrestrial-Marine/ Protected-Not protected	Points	Stickers (up to 6 per value)	100 points per value	(A) Nearest neighbour	Brown 2006
Inductive	Interview	Social values	Terrestrial/ Protected	Polygons		No weighting	(G) Polygons' overlapping	Black and Liljebald 2006
Deductive	Mail survey	Landscape values	Terrestrial-Marine/ Protected	Points	Stickers (up to 5 per value)	100 points per value	(G) Point density	Raymond and Brown 2006

Table A.1. Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Mail and face-to-face survey	Landscape values	Coastal/ Protected	Points	Stickers (up to 6 per value)	100 points per value	(G) Kernel density	Brown and Raymond 2007
Deductive	Mail survey	Social values	Terrestrial/ Not protected	Predetermined polygons		Positive/negative values	(G) Polygons' overlapping	Tyrvainen et al. 2007
Deductive	Mail survey	Landscape values	Terrestrial-Marine/ Protected- Not protected	Points	Stickers (up to 6 per value)	100 points per value	(G) Kernel density	Alessa et al. 2008
Deductive	Interview	Social values	Terrestrial-Marine/ Not protected	Polygons	Indefinite number	No weighting	(G) Sum of grid cells	Fagerholm et al. 2009
Inductive	Focus group	Place values	Terrestrial/ Protected	Polygons	Indefinite number	No weighting	(A) Overlapping layers' visualisation	Hall et al. 2009
Inductive	Focus group	Social values	Terrestrial/ Not protected	Points		No weighting	(G) Point density	McIntyre et al. 2008
Inductive	Mail survey			Points		No weighting	(G) Point density	
Deductive	Interview	Ecosystem services	Terrestrial/ Protected- Not protected	Points		Points: 40 positive, 10 negative	(G) Sum of (raster) layers	Raymond et al 2009

Table A.1 Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Interview	Ecosystem services	Terrestrial/ Protected- Not protected	Points		Points: 40 positive, 10 negative	(G) Sum of (raster) layers	Bryan et al 2011
Deductive	Mail survey	Landscape values	Terrestrial-Riparian/ Protected- Not protected	Points	Stickers (up to 6 per value)	100 points per value	(G) Kernel density/ (A) Getis–Ord Gi*	Zhu et al. 2010
Deductive	Workshop and survey	Landscape values	Terrestrial-Coastal/ Protected- Not protected	Points	Stickers (up to 6 per value)	100 points per value	(G) Kernel density/ (A) Nearest neighbour	Raymond and Brown 2011
Deductive	Mail survey	Landscape values	Terrestrial/ Protected- Not protected	Points	Stickers (up to 6 per value)	100 points per value	(A) Cluster analysis	Nielsen-Pincus 2011
Deductive	Mail survey	Landscape values	Terrestrial-Coastal/ Protected- Not protected	Points		No weighting	No density	Novaczek et al. 2011
deductive	Interview	Ecosystem services (modified)	Coastal-Marine/ Not protected	Predetermined grid		No weighting	(G) Sum of grid cells/ (A) Local Moran's I	Ruiz-Frau et al. 2011
Deductive	Mail survey	Landscape values	Terrestrial/ Protected	Points	Stickers (up to 4 per value)	100 points among all values	(G) Kernel density; SOLVES	Sherrouse et al 2011

Table A.1 Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Workshop	User values	Marine/ Not protected	Predetermined grid		1 to 10 for each place	(G) Sum of grid cells	Alexander et al. 2012
Deductive	Online survey	Ecosystem services	Terrestrial/ Protected	Points	Indefinite number	No weighting	No density	Brown et al 2012b
Deductive	Mail survey	Landscape values	Terrestrial-Coastal/	Points		No weighting	No density	Brown and Pullar 2012
Deductive	Mail survey	Landscape values	Protected- Not protected	Polygons		No weighting	No density	
Deductive	Online survey	Landscape values	Terrestrial-Coastal/ Protected- Not protected	Points		No weighting	(G) Point density per landscape class	Brown and Brabyn 2012
Deductive	Interview	Landscape services	Terrestrial/ Public	Points	Indefinite number	No weighting	(G) Kernel density/ (A) Intensity, richness, diversity (H')	Fagerholm et al. 2012
Deductive	Focus group	Landscape services		Points		Ranking places after 6 months		
Deductive	Interview	Ecosystem services	Marine/ Not protected	Polygons		100 points per value/100 points for threats	(G) Sum of grid cells	Klain and Chan 2012

Table A.1 Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Mail survey	Landscape values	Terrestrial-Coastal-Marine/ Not protected	Points		100 points among all values	(G) Kernel density	van Riper et al. 2012
Deductive	Mail and face-to-face survey	Cultural ecosystem services	Terrestrial-Riparian-Coastal/ Not protected	Predetermined polygons		1 to 5 for each place	(A) Post-mapping assessment by visitors	Casado-Arzuaga et al 2014
Deductive	Focus group	Important places	Terrestrial-Coastal/ Protected- Not protected	Polygons	Indefinite number	No weighting	(G) Polygons' overlapping	Lowery and Morse 2013
Deductive	Interview	Ecosystem services and disservices	Terrestrial/ Protected	Predetermined polygons		Positive/negative values	(A) Intensity, richness, diversity (H')	Plieninger et al. 2013
Inductive	Workshop	Ecosystem services defined by interviewees	Terrestrial/ Protected- Not protected	Polygons		No weighting	(G) Polygons' overlapping	Ramirez-Gomez et al. 2015

Table A.1 Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Deductive	Mail survey	Landscape values	Terrestrial/ Protected	Points		No weighting	(A) Spatial concurrence (phi coefficient); Getis–Ord Gi*	Brown et al. 2014b
Inductive	Workshop	Landscape values defined by interviewees		Points		No weighting		
Deductive	Online survey	Landscape values	Terrestrial-Coastal/ Protected	Points	Indefinite number	No weighting	(G) Frequency counts/ conflict index	Brown et al. 2014a
Deductive	Mail survey	Landscape values	Terrestrial/ Protected	Points		No weighting	(A) Nearest neighbour; Spatial concurrence (phi coefficient)	Brown and Donovan 2014
Deductive	Mail survey	Landscape values	Terrestrial-Coastal/ Protected- Not protected	Points	Stickers (up to 6 per value)	No weighting	(G) Point density/ (A) Getis-Ord Gi*	Brown and Raymond 2014
Deductive	Mail survey	Species habitat	Terrestrial-Coastal-Marine/ Not protected	Points		No weighting	(G) Kernel density	Cox et al. 2014
Deductive	Workshop	Ecosystem services	Terrestrial-Coastal/ Protected	Points	Indefinite number	No weighting	(G) Point density	Palomo et al. 2014

Table A.1 Continuation

Mapping method	Elicitation method	Values' terminology	Study area: type of environment/ conservation status	Spatial feature	Other characteristics of the spatial features	Weighting of values and/or places	GIS values' density method (G)/ Alternative analyses (A)	Reference
Inductive	Interview	Landscape values	Terrestrial/ Public	Points		No weighting	(G) Kernel density	Scolozzi et al. 2014
Deductive	Mail survey	Landscape values	Terrestrial/ Protected	Points		100 points among all values	(G) Kernel density; SOLVES 2.0	Sherrouse et al 2014
Deductive	Face to face survey (tablets)	Landscape values	Terrestrial-Coastal-Marine/ Protected	Points		100 points among all values	(G) Kernel density/SOLVES	Van Riper and Kyle 2014
Deductive	Mail survey	Social values	Terrestrial-Coastal/ Not protected	Points	Indefinite number	No weighting	(G) Spatial prioritization	Whitehead et al. 2014
Deductive	Online survey	Ecosystem values	Terrestrial/ Protected- Not protected	Points	Indefinite number	No weighting	(A) Visual distribution of points within national parks	Brown et al. 2015a
Deductive	Online survey	Ecosystem values	Terrestrial/ Protected-Public	Points	Indefinite number	No weighting	(G) Density of values per grid cell (2km)	Brown et al. 2015b
Deductive	Online and mail survey	Landscape values	Terrestrial-Coastal/ Protected	Points	Indefinite number	No weighting	(G) Cluster analysis and kernel density	Brown et al. 2015c

Table A.1 Continuation

Deductive	Online survey	Landscape values	Terrestrial-Coastal/ Protected	Points	Indefinite	No weighting	(G) Polygons' overlapping; Kernel density	Brown et al. 2015d
		Place attachment		Polygons	One	No weighting		
Deductive	Interview	Ecosystem services (modified)	Terrestrial-Riparian/ Protected- Not protected	Polygons		No weighting	(G) Polygons' overlapping	Darvill and Lindo 2015
Deductive	Online and mail survey	Landscape values (modified)	Terrestrial-Coastal/ Protected- Not protected	Points		No weighting	(G) Kernel density; point density/ (A) Getis-Ord Gi*	Karimi et al. 2015
Deductive	Mail survey	Ecosystem values	Terrestrial-Coastal/ Not protected	Points	Stickers (up to 6 per value)	No weighting	(G) Frequency counts	Lechner et al. 2015
Deductive	Interview	Landscape values	Marine/ND	Polygons		1300 points allocated in 33 tokens of different weights	(G) Polygons' overlapping	Mahboubi et al 2015
Deductive	Workshop	Ecosystem services	Terrestrial-Riparian/ Protected- Not protected	Polygons	Present and past distribution	No weighting	(G) Polygons' overlapping	Ramirez-Gomez et al. 2015
Inductive	Interview	Social values	Terrestrial-Coastal-Marine/ Protected-Not protected	Polygons	Up to 5 per value	No weighting	(G) Polygons' overlapping	Strickland-Munro et al 2016

Appendix B. Interview protocol

The interview starts with:

· Consent form and confidentially agreement

· Project description: The aim of this project is to identify, assess and map the perceived environmental, economic, social and cultural values of the marine and coastal environment of the Gladstone region. This information will be used to create a more holistic picture of the extent to which the marine environment benefits people and to define areas that are potentially at risk.

· Overview of interview (the interview consists of 15 questions)

· A reminder that this is an exploration and there are no right or wrong answers

1. Were you born in the Gladstone region?
   - **a.** Yes__________
   - **b.** No __________*, how long have you lived in the area? What brought you to Gladstone?*

   Probe:

   Is your job related to the marine environment?

   What do you like about the area? … Fishing, camping, swimming, diving, surfing, hiking, motocross…

   What does living in the Gladstone region mean to *you*?

   Could you explain what you mean by…?

2. When thinking about the marine environment in the Gladstone region, which places do you like to visit in your spare time?

   Probe:

   What are the places that are of greatest importance to you?

   Why?

When you visit those areas what activities do you like to do? *These are in-part 'doing' or 'being' sort of questions. If they answer with doing, then try to obtain specifics – if fishing, is it flat water or stream; native or exotic fish, fly or spinning.*

- I will describe a scenario about the area you just mentioned and I would like you to answer some questions having this in mind: imagine that [the name of the place] suffers [floods every 5 years or an oil spill or the amount of people visiting the place doubles]

Would it change the way you use the area? Would you be concerned by these scenarios? Why?

When you think about the place now, what is it about that site pops to your mind immediately?

What aspect of the environment do you enjoy the most? The water, the trees, the biodiversity, the landscape?

3. Do you go to the places you just mentioned more frequently alone or with others?

If you go with others, who do you most often go with?

<u>Probe:</u>

Is it the same if you go there [the reverse] [alone/with other people]?

Would it be the same if you visit this place with work colleagues?

Are there places in the coastal/marine environment that are important to your job?

4. Are there places in the Gladstone region that are important to your community?

<u>Probe:</u>

Could you tell me a particular experience or event that happens/happened in that place?

5. Are there particular experiences associated with the Gladstone region that you hope your kids and/or youth in your community will experience?

<u>Probe:</u>

What are these?

What experiences were important to previous generations (your parents and grandparents)?

What experiences will be important for future generations?

Any of these experiences is important across generations? Why?

How much of the experiences do you think is related to the state of the environment?

6. From your point of view as a [industry/government/education] worker, what aspects of the region's development do you consider are vital for its long-term prosperity?

   Industry diversification

   Good schools

   Good health care facilities

   Childcare facilities

   Tourism industry increase

   Good roads transport infrastructure

   Enhancement of local commerce

   (Better/more) entertaining/cultural places

   Maintaining a healthy marine environment

   Do you think there's room for expansion of other economic sectors such as tourism, fisheries or aquaculture?

7. Do you think the environment's health and your own wellbeing are connected in any way?

   For example: the Colorado River Delta located in the border between the US and Mexico is an area with lakes, swamps, estuaries, flood plains, streams and springs which are the habitat for a big diversity of fresh and marine water plants and animals. In this place the main activities are agriculture and fishing, but since the river damming the quality and amount of water reaching the Delta has decreased collapsing most of the economic activity of the area.

   If so, can you describe that link? How does it work? How do you know it exists? How strong is that link?

Is what you describe here for yourself also true for your community – that its well-being might also be linked to the environment's health?

Can you think of any examples that demonstrate or speak to that relationship?

8. Do you think the environmental health in the Gladstone region is currently improving, deteriorating or staying the same?
    - If you think the health is [improving/deteriorating/staying the same], what do you think has led to this level?
    - How often do you think about this level of health? Daily, weekly, monthly, yearly, never
    - When did you notice this level of health?

If they answer that the health is deteriorating ask:

- How do you think we have to address the current situation/problems of the region?
- Do you have any ideas how to fix this?
- What about the government? Do you think regulations should be enforced or changed?
- Feel free to recommend or think out loud about anything that's important that way

9. If problems in the environment were to occur, do you believe that the whole community should contribute to the cost of addressing problem(s), regardless of whether the community have caused the problem or not?

    Probe:

    Could you tell me and example of how do you think the community or the industry should address this situation?

    (give an example of a place where people is willing to pay if that money is used on environmental protection)

10. Do you believe that the increasing development of the Gladstone region will impact the environment?

How will it impact the environment? *Think for example a second period of channel dredging is needed or a second marina is built in the Port or a new extractive industry is planned to establish in Curtis Island*

How do you think this would impact in the aspects of the environment that you mentioned before? (Q 2)

11. In the Gladstone region there are different stakeholder groups such as sport fishers, shipping, traditional owners, marine tourism and industry. Do you believe certain groups should be managed differently from how they are now?

    What groups?

    For each group you've identified, how should they be managed differently?

12. Do you know the Gladstone Port lies within the boundary of the Great Barrier Reef World Heritage Area?

    What do you think about this?

    How do you believe this impact the region's development?

    How do you believe the region is perceived internationally?

13. We have been talking about the social and environmental values about the region, but now I want to talk about spiritual values. Spiritual values connected to place are difficult to define, but I generally associate it with places that are powerful because the place inspires me to be aware of forces or entities larger than me and cannot be experienced everywhere.

    Can you describe or speak to me about experiences of this kind that might be associated with a physical place in this region? You can be as general or specific as you like about both the feeling or experience and the places with which you associate those experiences.

14. Has a place in the Gladstone region ever provided you with ideas or images that you think could or does inspire art or some other visual or creative form?
15. Do you have anything else you would like to add to the information you've already provided?

Finally, to help examine the information collected, can I please collect some background data from you?

- What year were you born?
- What is your area of full-time residence?
- What gender do you identify with?
- What is your highest level of education completed?
- Could you please indicate your approximate annual income?
  - $1 to $20,000
  - $20,001 to $60,000
  - $60,001 to $100,000
  - $100,001 to $200,000
  - More than $200,000
- What is your occupation?
- Would you describe yourself as:
  - Aboriginal
  - Torres Strait Islander
  - South Sea Islander
  - None of the above
- Do you identify with any of the following religions:
  - Christianity
  - Catholicism
  - Judaism
  - Islam
  - Hinduism
  - Other (please list)

Appendix C. Survey protocol

In order to be succinct, the first question of each of the four surveys (i.e. cultural, economic, environmental, and social) is presented at the beginning. Questions 2 to 17 are the same in the four surveys. Please note that this research started at Central Queensland University and I followed my primary researcher supervisors to the University of Waikato. However, all human research occurred while I was enrolled at Central Queensland University and was covered by their ethics committee approval. Please note that sections of the survey and the associated data collected are not fully represented in the thesis (i.e., I collected a lot of data and most of it is in the thesis but some of the data was not used).

Survey tool

My name is Paola Rodriguez. I am a PhD Candidate at the Central Queensland University. I am conducting this survey to identify and map the locations of the places you value in the marine and coastal environment in the Gladstone Region. This study has been approved by the CQUniversity Australia Human Research Ethics Committee. Please contact the CQU Office of Research (tel 0749 23 2603 or email ethics@cqu.edu.au) should there be any concerns about the nature and/or conduct of this research project.

The survey will take about 15 minutes to complete.

1. **The first question is focused on CULTURAL VALUES. Cultural values refer to how important are for you different aspects of cultural heritage.**

a. Mark in the map with a point or an X the places that you value according to the list. Please mark as many places as you want.

b. Please score each place on a scale of 1-10 points (where 1 = Least Important, and 10 = Most Important)

	Least important Most important
a. I value these places because they have natural and human history	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
b. I value these places because they are sacred or spiritually special	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
c. I value these places because there I feel appreciation or respect for nature	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10

1. **The first question is focused on ECONOMIC VALUES. Economic values refer to how important are for you different economic activities.**

a. Mark in the map with a point or an X the places that you value according to the list. Please mark as many places as you want.

b. **Please score each place on a scale of 1-10 points** (where 1 = Least Important, and 10 = Most Important)

	Least important Most important
a. I value these places because they are suitable for industry development	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
b. I value these places because they provide port facilities	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
c. I value these places because they provide appropriate commercial shipping	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
d. I value these places because they are important for commercial fisheries	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
e. I value these places because they provide tourism opportunities	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
f. I value these places because they provide recreational business opportunities	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10

1. **The first question is focused on ENVIRONMENTAL VALUES. Environmental values** refer to how important are for you different aspects of the ecosystem.

a. **Mark in the map with a point or an X the places that you value according to the list. Please mark as many places as you want.**

b. **Please score each place on a scale of 1-10 points** (where 1 = Least Important, and 10 = Most Important)

	Least important Most important
a. I value these places because they provide habitat for fish	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
b. I value these places because they provide habitat for turtles and dugongs	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
c. I value these places because they provide habitat for birds	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
d. I value these places because they provide habitat for other wildlife	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
e. I value these places because they help to maintain the health of the harbour	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10

1. **The first question is focused on SOCIAL VALUES. Social values refer to how important are for you the activities and interaction within the community and the physical space and the feelings it produces.**

a. **Mark in the map with a point or an X the places that you value according to the list. Please mark as many places as you want.**

b. **Please score each place on a scale of 1-10 points** (where 1 = Least Important, and 10 = Most Important)

	Least important Most important
a. I value these places because they provide the opportunity for recreational fishing	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
b. I value these places because they provide the opportunity for camping	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10

c. I value these places because they provide the opportunity for other recreation activities	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
d. I value these places for its scenery, sights and relaxed feeling I get there	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
e. I value these places because they are important for the community	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
f. I value these places because they provide future generations the opportunity to appreciate Gladstone as it is	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
g. I value these places because I feel closely related to them (good memories with family and friends)	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10
h. I value these places because they exist, not matter what I or others think or how they use it	1 - 2 - 3 -- 4 - 5 -- 6- - 7- - 8 - 9 - 10

Please now consider all the economic, cultural, social and environmental values when undertaking the following tasks and questions. Answer these from your own personal perspective.

2. **Identify areas in the map where future development should be permanently prohibited**

   Why?

   ____

3. **Identify areas in the map where residential development should occur (with appropriate permits and consent)**

4. **Identify areas in the map where tourism development should occur (with appropriate permits and consent)**

5. **Identify areas in the map where industrial development should occur (with appropriate permits and consent)**

6. **How much do you agree with the following statement?**

   The environmental health of the harbour is currently improving

   (Please circle ONE)

Totally agree	Slightly agree	Neutral	Slightly disagree	Totally disagree

7. **Are you familiar with the term World Heritage Area?** *(Please tick ONE)*

☐ Yes ☐ No ☐ Unsure

8. **Is the Port of Gladstone is within the Great Barrier Reef World Heritage Area?** *(Please tick ONE)*

☐ Yes ☐ No ☐ Unsure

9. **Do activities in the Port of Gladstone affect the Great Barrier Reef?** *(Please tick ONE)*

☐ Yes ☐ No ☐ Unsure

Below, thirteen values are described. The explanation of each value is given in the brackets following each value. Please indicate how important each value is for you **AS A GUIDING PRINCIPLE IN YOUR LIFE**.

Use the rating scale below:

0 means the value is not important at all, it is not relevant as a guiding principle for you.

3 means the value is important.

6 means the value is very important.

1 is for rating any values opposed to the principles that guide you.

7 is for rating a value of supreme importance as a guiding principle in your life (*ordinarily there are no more than two such values*)

The higher the number (0, 1, 2, 3, 4, 5, 6), the more important the value is as a guiding principle in **YOUR** life. Try to distinguish as much as possible between the values by using different numbers.

	opposed to my values	*not impor-tant*	*important*					*very impor-tant*	*of supreme importan ce*
EQUALITY (equal opportunity for all)	-1	0	1	2	3	4	5	6	7
RESPECTING THE EARTH (harmony with other species)	-1	0	1	2	3	4	5	6	7
SOCIAL POWER (control over others, dominance)	-1	0	1	2	3	4	5	6	7
UNITY WITH NATURE (fitting into nature)	-1	0	1	2	3	4	5	6	7
A WORLD AT PEACE (free of war and conflict)	-1	0	1	2	3	4	5	6	7
WEALTH (material possessions, money)	-1	0	1	2	3	4	5	6	7
AUTHORITY (the right to lead or command)	-1	0	1	2	3	4	5	6	7
SOCIAL JUSTICE (correcting injustice, care for the weak)	-1	0	1	2	3	4	5	6	7
PROTECTING THE ENVIRONMENT (preserving nature)	-1	0	1	2	3	4	5	6	7
INFLUENTIAL (having an impact on people and events)	-1	0	1	2	3	4	5	6	7
HELPFUL (working for the welfare of others)	-1	0	1	2	3	4	5	6	7
PREVENTING POLLUTION (protecting natural resources)	-1	0	1	2	3	4	5	6	7
AMBITIOUS (hard-working, aspiring)	-1	0	1	2	3	4	5	6	7

10. Were you born in the Gladstone region? *(Please tick ONE)*

☐ Yes ☐ No ☐ Unsure ☐ Choose not to answer

11. Is your area of full time residency Gladstone? *(Please tick ONE)*

☐ Yes ☐ No ☐ Unsure ☐ Choose not to answer

If yes, for how long have you lived in the Gladstone region?

In what suburb do you currently live in? _______________

If not, what is your area of full time residency? ________________

12. What is your age? *(Please circle ONE)*

18-25	26-35	36-45	46-55	56-65	65 or over	Choose not to answer

13. What is your gender? *(Please tick ONE)*

☐ Male ☐ Female ☐ Choose not to answer

14. What is your highest level of education completed? *(Please circle ONE)*

Primary school	High school	University	Postgraduate	Other qualification	Choose not to answer

15. Could you please indicate your approximate individual annual income?
(Please circle ONE)

$1 - $18,200	$18,201 - $37,000	$37,001 - $80,000	$80,001 - $180,000	$180,001+	Choose not to answer

16. What is your occupation? ___________________________

17. Do you identify or describe yourself as: *(Please circle ONE)*

Australian Aboriginal	Torres Strait Islander	South Sea Islander	First Nations from another country	None of the above


Heron Island
Mast Head Island
Curtis Island
The Narrows
Graham Creek
Facing Island
Gladstone
Calliope River
South Trees Inlet
Tannum Sands
Boyne River
Wild Cattle Creek
Hummock Hill Island
Rodds Peninsula
Colosseum Inlet
Turkey Beach
Boyne Creek
1770
Agnes Water
Baffle Creek
Curtis Island
Facing Island
Gladstone
Tannum Sands

Appendix D. Assessment of different analyses' approaches and data collection of societal values and opinions

D.1. Introduction

The valuation of the environment's goods and services it is mostly done through economic methods. More recently, however, non-economic methods have been developed to assess societal values in a more comprehensive way (e.g. Raymond et al. 2014; Chan et al. 2016). One such example is the development of a method that spatially represents the societal importance of values: these maps are created to aid in enhancing or identifying spatial conservation priorities and have been identified as Participatory Geographic Information Systems (PPGIS) (e.g. Brown et al. 2004; Alessa et al. 2008; Bryan et al. 2011; Klain and Chan 2012).

New methods are also exploring and testing different quantitative approaches to identifying the assigned importance of societal values by using different scales (e.g., 1 to 100 or 1 to 10) that aim to cover the lowest to the highest level of perceived importance (see Section 4.1.2 below). Given that the influence of an individual's socio-demographic characteristics is known to influence their held and assigned values and behaviour (Dunlap and Van Liere 1978; Stern et al. 1993; Guagnano and Markee 1995; Dietz et al 2005; Chapters 2 and 3 where age, residence time, gender, income and place of birth had an influence on respondents held and assigned values), it is expected that these characteristics are related to the perceived importance of societal values as well. Therefore, this Appendix will address how socio-demographic factors are assessed within a statistical relevant context and how these factors have been incorporated in the societal value mapping literature.

D.1.1. Bivariate or multivariable analyses for socio-demographics?

Within the social sciences one of the most common type of research question posed is the one trying to explain relationships or causes and consequences of a social phenomenon. In other words, trying to understand the factors that may influence or cause a given phenomenon (Denscombe 2009). To do this, the unit of analysis mostly used are the individuals and by describing and analysing these individuals' characteristics and interactions, a phenomenon can be explained

(Babbie 2012). Some of the most common individual's characteristics studied are age, gender, education, ethnicity, occupation, or income (i.e., socio-demographics). Characteristics such as their socio-demographics, held values, values orientation, and place attachment influence an individual's preferences, concerns, attitudes and perception of the environment (e.g. Dunlap and Van Liere 1978; Stern et al. 1993; Guagnano and Markee 1995; Klineberg et al. 1998).

In order to know whether, or not, an individuals' socio-demographics are related or influencing peoples' attitudes, quantitative analyses need to occur. But, the type of analyses depends on the nature of the variables used and the research question being addressed (Bryman 2012). For example, if the research question were to determine if a certain factor is related to a concern or perception, a bivariate statistical analysis would be appropriate. Alternatively, if the research question addresses two or more factors that influence the same concern or perception, then a multivariable analysis would be an appropriate option (Babbie 2012). Using an inappropriate test may lead to the wrong interpretation of results (i.e., accepting non-significant results when they may be significant and vice versa) and therefore, may not provide an appropriate answer to the research question (Godfrey 1985; Cousens 1988; Zobel et al. 1988; Mathews et al. 1990).

The assessment of the relationship of socio-demographic characteristics with preferences or perceptions given by choosing one answer within a scale (e.g. 1-100), or using a Likert scale, has been done through both bivariate (e.g. Trenouth et al. 2012; Mullins and Soetanto 2013; Aust et al. 2016) and multivariable (e.g. Chatman et al. 1998; Agho et al. 2010; Dobbie 2013) analyses. Studies assessing attitudes and perceptions using Likert or 'Likert-type' scales in relation to socio-demographic factors use a slightly different analytical approach. The relative importance (or weight) given to the elicited values is treated either as continuous or ordinal data (e.g. Sodhi et al 2010; Mobley 2015). When the data is considered continuous and mean values are calculated, t-test, Analysis of Variance (ANOVA), correlation, or linear regression are used (Guagnano and Markee 1995; Mullins and Soetanto 2013; Visschers and Siegrist 2014; Mobley 2015; Aust et al. 2016). When the data is treated as ordinal, Mann Whitney, Kruskal-Wallis, logistic and ordinal regression and more complex methods such as fixed or mixed effects regression models have been used (Sodhi et al. 2010; Karanth and Nepal 2012; Martín-López et al. 2012; Visschers and Siegrist 2014).

Even though these different approaches may respond to different research questions, it can be argued that when examining preferences and rankings more than one factor may influence a person's answer. These factors may include a person's already held values and combinations of socio-demographic characteristics (Lockwood 1999; Dietz et al. 2005). Therefore, multivariable analysis should be applied to the data in order to test the effect of groups of variables upon the answers provided. Additionally, Jamieson (2004) has argued that Likert-type scale data must be considered as ordinal data and therefore, the appropriate analyses must be more carefully selected.

D.1.2. Importance of societal values

In general, most of the studies that have elicited information on the importance of societal values have done so by asking respondents to:

- spatially identify the values on a map;
- assign relative importance (or weight) to the value; or
- assign relative importance to each of the places marked for that value (e.g. Brown 2005; Brown and Raymond 2007; Alessa et al. 2008; Sherrouse et al. 2011).

There are also a few examples where the elicitation occurs in a non-spatially explicit manner (e.g. Brown and Reed 2000). Within these examples of the literature, a broad variety of weighting approaches have been explored and can be summarised as follows:

1. Spatially explicit:
    a) Weight each place marked per value with a:
        - Numerical scale:

- 1 to 5, or 1 to 10, where 1 is least important and 5 (or 10) is most important (e.g. Fagerholm et al. 2012; Alexander et al. 2012);
- 100 points per value, where 100 points are distributed among the geographical places chosen for each value (e.g. Brown 2005; Brown and Raymond 2007; Alessa et al. 2008);

- Non-numerical scale:
  - Positive or negative weight, where each value could have either a positive or negative importance (e.g. Bryan et al 2011; Plieninger et al. 2013);

b) Weight values:

- Numerical scale:
  - 100 points are distributed across values (not geographical places) (e.g. Sherrouse et al. 2011; Klain and Chan 2012); and

c) Rank places marked per value:

- Ranks from most important to least important (e.g. Brown et al. 2004; Casado-Arzuaga et al. 2014).

2. Non-spatially explicit:

d) Weight values:

- Numerical scale:
  - Use a numerical weighting of 0 to 100 points, where 100 points are distributed among a list of values (e.g. Larson et al. 2013b);
- Non-numerical scale:
  - Positive or negative weights are given to each value (e.g. Sodhi et al. 2010; Martín-López et al. 2012);

e) Rank values:

- Ranks from most important to least important (e.g. Zoderer et al. 2016)

Within these spatially explicit studies, only two have analysed the relationship between the importance assigned to the values and the respondents' socio-demographics by using bivariate (Brown and Reed 2009) and multivariable analyses (Plieninger et al. 2013). In the non-spatially explicit studies, there are more examples of the assessment of the relationship of the non-economic quantitative importance assigned to societal values and the influence of socio-demographic factors, but the statistical analyses used vary from bivariate (Martín-López et al. 2012) to multivariable (Sodhi et al. 2010; Larson et al. 2013b; Zoderer et al. 2016). Thus, consistency of approach is missing.

Although, there is a great variety of societal values' weighting methods, there is a distinct lack of exploration on the use of statistical methods to appropriately address research questions including socio-demographic complexity. The need to develop statistically appropriate and robust elicitation methods is addressed within this Appendix. Figure 1.4, in Chapter 1, explains the variety of methods used in the literature to spatially assess and analyse societal values. This Appendix will investigate the utility of bivariate versus multivariable approaches to data analysis.

D.1.3. Aims and hypotheses

As described above, a wide variety of methodologies have been developed and tested to elicit and assess non-monetary societal values. The sampling design, data collection and analyses methods of the current methodologies differ because they need to meet their studies particular objectives (i.e., they are study specific). Yet, no standardised solution (or method) exists to elicit and analyse this type of data. Hence, this Appendix focusses on a comparison of two statistical analysis approaches. The aim is that the outcomes of this Appendix will help inform and improve how socio-demographic data is analysed and interpreted.

The context of this Appendix tests if the complexity of the statistical analyses would affect the interpretation of how socio-demographic factors influence respondents' perceptions. Thus, the main objective of this Appendix is to assess the differences between two statistical methodological approaches (i.e., bivariate and multivariable), by using the same group of socio-demographic factors in both analyses. In order to do this, the multinomial tests analysed for this Appendix are the same as the regressions already reported in Chapter 3.

Two hypotheses are examined:

- **H_{D-I}**: There is no difference between the results from the bivariate and multivariable statistical analyses used to determine the influence of six socio-demographic factors (age, gender, education, residence time, place of residence and place of birth) on the level of importance respondents allocated to elicited values; and
- **H_{D-II}**: There is no difference between the results of the bivariate and multivariable statistical analyses used to determine the influence of six socio-demographic factors (age, gender, education, residence time, place of residence, and place of birth) on answers allocated to categorical questions.

D.2. Methods

Quantitative and qualitative data collected in Chapter 3 (see Appendix C) was used to assess the differences between two statistical analysis approaches. These two different approaches are referred to as bivariate and multivariable analyses. The bivariate analyses comprised tests that examined one socio-demographic factor at a time (Kruskal-Wallis, Mann Whitney, and Chi-square). The multivariable analyses analysed six socio-demographic factors at a time (ordinal and multinomial logistic regressions).

The surveys used to collect the data are explained in Chapter 3 (and Appendix C). Specific information for the following analyses is based upon the respondents':

i. importance (i.e., weights) of identified values';
ii. opinions about development in the Gladstone Region;
iii. knowledge of the region and the Great Barrier Reef World Heritage Area (GBRWHA); and
iv. socio-demographic information: age, gender, education, residence time, place of residence and place of birth.

All data was analysed in SPSS 22.0 (Statistical Package for the Social Sciences). A comprehensive description of the survey development, data collection, data grooming, and exploratory data analysis is provided in Chapter 3, section 3.2.

D.2.1. Data analysis

All analyses that were undertaken treated each of the 22 identified values separately. This approach was used because it was considered that the values were independent from each other, with different factors capable of influencing the assigned weights. Each of the values were tested against the six socio-demographic factors. As mentioned in Chapter 3, in order to have only one weight per value for each respondent, median values were calculated and used.

D.2.1.1. Bivariate analyses: Kruskal-Wallis, Wilcoxon-Mann Whitney, Chi-square

To test for significant relationships between socio-demographic factors and the importance (i.e. median weights) given to the values mapped by each respondent (Hypothesis $_{D\text{-}I}$) either Kruskal-Wallis or Wilcoxon-Mann Whitney tests were conducted. These same analyses were applied to responses for the Likert-scaled question where respondents were asked if they agreed with a statement about the environmental health of the Gladstone harbour (see Appendix C). Dunn's multiple comparison test was used for *post hoc* multiple comparison testing when Kruskall-Wallis results were statistically significant.

A Chi-square (χ^2) test of independence was used to test for significant relationships with socio-demographics within the qualitative questions (categorical data; Hypothesis $_{D\text{-}II}$): specifically questions that examined future development areas (questions 2-5), and questions focussed upon the knowledge and perception of the GBRWHA (questions 7-9; see Appendix C). Since these questions were the same within the four different surveys (as described in Chapter 3), the data was pooled and the analyses were made across all respondents.

D.2.1.2. Multivariable analyses: Ordinal regression and Multinomial logistic regression

For each of the 22 societal values, associations of a group of the six socio-demographic factors with the importance assigned (i.e., median weights) were tested using multivariable ordinal regressions (Hypothesis $_{D\text{-}I}$), where odds ratios

(ORs) and 95% confidence intervals were estimated. As mentioned above, the tests analysed for this section are the same as the regressions reported in Chapter 3. To assess if the regression model accurately predicted the variation of the weights assigned by the respondents to each value, the model fit, pseudo R-square and test of parallel lines were considered (see section 3.2.4.3, in Chapter 3).

The association between categorical data from respondents' opinions about development areas (questions 2-5), and knowledge of the GBRWHA (questions 7-9, Appendix C), with the respondents' socio-demographic factors was tested via multinomial logistic regression (Hypothesis $_{\text{D-II}}$). Again, since these questions were worded the same within the four different surveys that were implemented, the data was pooled and analyses were done with the responses from all the respondents. In this case, the 'type of survey' (i.e., cultural, economic, environmental or social) was included as an extra factor in the analysis. As described in Chapter 3, respondents were asked to indicate upon a map where they thought different types (No Development, Residential, Tourism and Industrial Development) of development should, or should not, occur (described further in Chapter 4) and their reasons for such locations. Within this Appendix, the analysis focusses upon the relationship of the respondents' reasons for the chosen areas of development with their socio-demographic characteristics.

D.3. Results

D.3.1. Bivariate analysis

D.3.1.1.1. Importance assigned to values

The results showed that the importance assigned to the cultural and economic values did not have a statistically significant relationship with the socio-demographic factors tested (Table D.1). Alternatively, one (of five) environmental value, and seven (of eight) social values had statistically significant relationships with three socio-demographic factors (Table D.1).

The importance assigned to the environmental value Other Wildlife (excluding fish, birds, turtles and dugongs), was statistically influenced by respondents' level of education (U = 212, p = 0.04, Table D.1). The importance given to the social values of Camping, Future Generations Use, Good Memories, Recreational Fishing, Recreation (other than camping and fishing), and Scenery, was statistically influenced by the age of the respondent. Time of residence significantly influenced the importance that respondents gave to Existence and Recreation (other than camping and fishing) values (Table D.1). Importance assigned to Future Generational Use, Good Memories and Recreation (other than camping and fishing) values were also statistically influenced by the respondent's place of residence (i.e. metropolitan, non-metropolitan area, or outside the Region) (Table D.1).

Post hoc results indicated no statistically significant differences for age categories when considering Camping values, and time of residence for Good Memories and Other Recreation values. Yet, respondents' living in the Region for 11 to 40 years assigned more importance to the Existence value than short-term residents (0 to 5 years; Dunn's multiple comparison test p = 0.035). Furthermore, respondents' age 56 to 65 assigned statistically significant higher importance to Future Generational Use (Dunn's multiple comparison test p = 0.004), Other Recreation (Dunn's multiple comparison test p = 0.038), Recreational Fishing (Dunn's multiple comparison test p = 0.010) and Scenery (Dunn's multiple comparison test p = 0.028) values than respondents' aged 18 to 25. Also, respondents' older than 66 assigned higher importance to Good Memories (Dunn's multiple comparison test p = 0.004) than respondents aged 18 to 25 years.

Table D.1. Summary of results from the Kruskal-Wallis (age, residence time and place of residence) and the Wilcoxon-Mann Whitney (gender, education and place of birth) tests. Statistically significant results are in bold and italicised font.

	Value	**Age**			**Residence time**			**Place of residence**			**Gender**		**Education**		**Place of birth**	
		χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	*U*	*p*	Z	*p*	Z	*p*
Cultural	Appreciation for nature	9.17	5	0.10	3.97	4	0.41	0.33	2	0.85	296.5	0.52	270.5	0.22	183.0	0.13
	Natural and human history	9.95	5	0.08	5.42	4	0.25	0.13	2	0.94	265.5	0.78	241.0	0.25	193.5	0.50
	Sacred or spiritually special	8.20	5	0.15	7.33	4	0.12	0.36	2	0.83	107.5	0.47	117.5	0.34	111.0	0.72
Economic	Commercial fisheries	4.02	5	0.55	4.17	4	0.38	0.57	2	0.75	93.5	0.77	76.5	0.25	43.0	0.58
	Commercial shipping	3.58	5	0.61	2.75	4	0.60	2.48	2	0.29	232.5	0.86	216.5	0.91	43.0	0.38
	Industry development	6.74	5	0.24	1.46	4	0.83	0.57	2	0.75	197.0	0.56	213.5	0.95	57.0	0.41
	Port facilities	9.13	5	0.10	5.47	4	0.24	0.41	2	0.82	269.5	0.47	272.5	0.71	44.0	0.72
	Recreational business	4.95	5	0.42	0.54	4	0.97	0.20	2	0.91	292.5	0.47	300.0	0.62	117.5	1.00
	Tourism opportunities	5.84	5	0.32	0.58	4	0.97	0.03	2	0.98	344.0	0.82	259.5	0.15	111.0	0.72
Environmental	Birds habitat	1.26	5	0.94	6.34	4	0.18	1.57	2	0.46	217.0	0.08	217.0	0.14	171.5	0.54
	Fish habitat	1.80	5	0.88	8.09	4	0.88	5.44	2	0.66	199.5	0.89	189.5	0.90	165.5	0.87
	Harbour health maintenance	2.54	5	0.77	0.93	4	0.92	0.18	2	0.91	166.0	0.72	146.0	0.54	109.0	0.63
	Other wildlife habitat	7.05	5	0.22	5.22	5	0.27	5.36	2	0.07	270.5	0.31	212.0	***0.04***	151.5	0.31
	Turtles and dugongs habitat	5.40	5	0.37	6.20	4	0.19	2.30	2	0.32	246.0	0.88	174.0	0.10	160.0	0.65

Table D.1. Continuation

	Value	Age			Residence time			Place of residence			Gender		Education		Place of birth	
		χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	*U*	*p*	Z	*p*	Z	*p*
	Camping	11.83	5	***0.04***	5.73	4	0.22	2.38	2	0.31	167.0	0.22	159.0	0.31	71.5	0.84
	Existence	9.43	5	0.09	10.14	3	***0.02***	4.66	2	0.10	268.0	0.31	255.0	0.31	130.0	0.88
	Future generational use	15.06	5	***0.01***	9.08	4	0.06	5.27	2	0.07	236.0	0.45	237.5	0.83	108.0	0.62
	Good memories	14.67	5	***0.01***	10.12	4	***0.04***	5.21	2	0.07	259.0	0.87	189.0	0.13	121.5	0.96
	Important for community	5.44	5	0.36	6.59	4	0.16	5.06	2	0.08	214.0	0.06	268.0	0.80	120.0	0.71
	Other recreation	12.07	5	***0.03***	12.71	4	***0.01***	5.55	2	0.06	296.0	0.56	215.0	0.05	93.5	0.18
Social	Recreational fishing	12.90	5	***0.02***	5.22	4	0.27	1.29	2	0.52	209.0	0.61	227.0	0.94	110.0	0.89
	Scenery	12.61	5	***0.03***	6.45	4	0.17	2.00	2	0.37	283.0	0.52	223.5	0.11	128.0	0.83

D.3.1.2. Views on development areas

From the six socio-demographic factors tested, only place of residence, gender, and time of residence had a statistically significant relationship with the respondents' comments about the different types of future development (Table D.2). Of the four types of development, only Tourism Development did not show a statistically significant relationship with any of the socio-demographic factors (Table D.2).

Table D.2. Summary of results from the Chi-square test of independence. Statistically significant results are in bold and italicised font.

Types of future development	**Age**			**Residence time**			**Place of residence**			**Gender**			**Education**			**Place of birth**		
	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*
No development	36.60	45	0.81	42.69	36	0.21	33.77	18	***0.01***	20.43	9	***0.02***	12.77	9	0.17	16.36	9	0.06
Residential	25.17	25	0.45	36.53	20	***0.01***	41.58	10	***0.00***	8.81	5	0.12	5.68	5	0.34	6.08	5	0.30
Tourism	20.11	25	0.74	20.44	20	0.43	14.90	10	0.14	10.19	5	0.07	9.26	5	0.10	3.77	5	0.58
Industrial	31.55	35	0.64	28.78	28	0.42	27.67	14	***0.02***	17.73	7	***0.01***	8.58	7	0.29	3.28	7	0.86

As mentioned in Chapter 3, the data analysed in this section correspond to the questions eliciting the reasoning behind the spatial localisation of areas for future development. Since these were open ended questions it is important to note that sometimes the 'reasons' given were either in favour or against the specific type of development.

The respondents' rationale for where No Development should occur were coded into 10 categories (see Chapter 3, Table 3.7). The majority of respondents mentioned the importance of the environment, aesthetic reasons and that there is already enough development in the area as the main reasons to choose areas for No Development (Figure D.1).

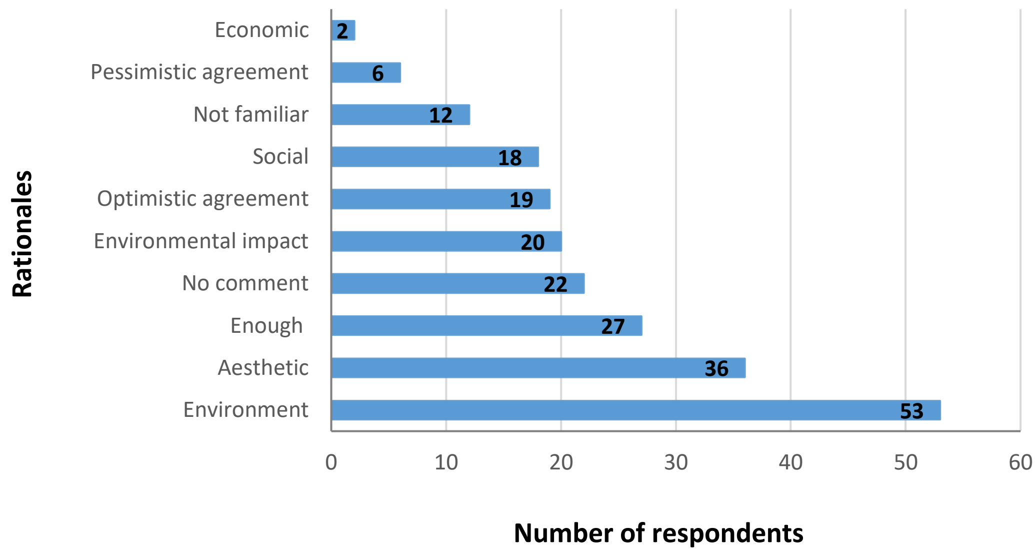

Figure D.1. Number of respondents per comment category as to why development should not occur.

Respondents' place of residence had a statistically significant relationship with the rationales given for No Development ($\chi^2_{[18]} = 33.77$, $p = 0.01$). The importance of the environment was the most mentioned reason for marking areas as No Development, followed by 'aesthetic' reasons within all place of residence categories (Figure D.2). It is noticeable that respondents from the metropolitan area mentioned more often that the Region has 'enough' development (therefore no more is needed) and provided 'social' reasons, compared to respondents from the non-metropolitan area and those living outside the Region (Figure D.2).

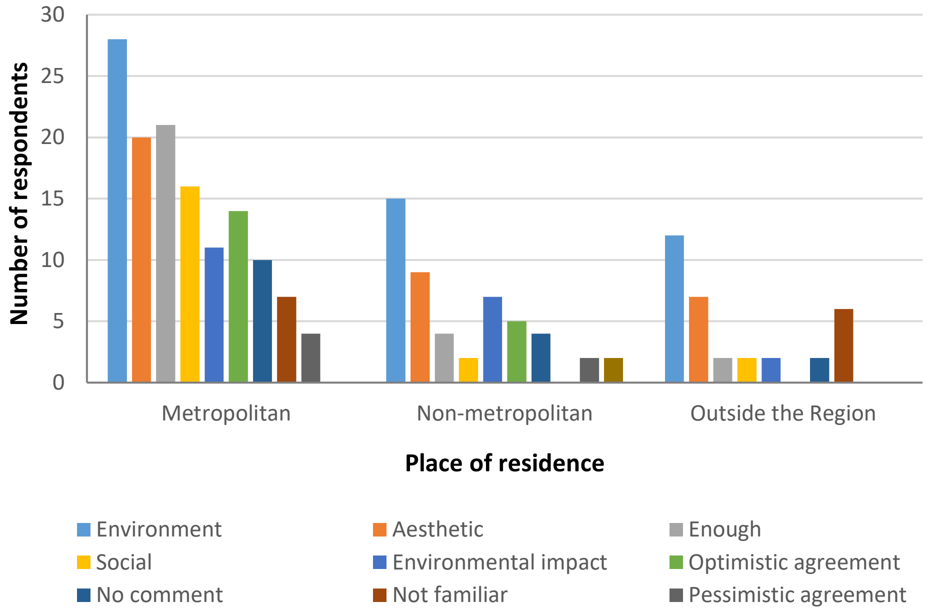

Figure D.2. The number of respondents that provided different reasons for their selection of areas where No Development should occur based upon place of residence.

Gender statistically influenced where respondents felt that No Development areas should be located ($\chi^2_{[9]} = 20.426$, $p = 0.015$). 'Environment' and 'aesthetic' where the reasons that No Development should occur most mentioned by both genders, but males mentioned more often optimistic agreement and not being familiar enough with the area to give a comment (i.e., uncertainty) more frequently than women (Figure D.3). Alternatively, females mentioned that the Region has 'enough' development, social, environmental impact, and pessimistic agreement as reasons and comments related to No Development more frequently than males. Economic impact was the only rational mentioned at similar frequencies between the genders (Figure D.3).

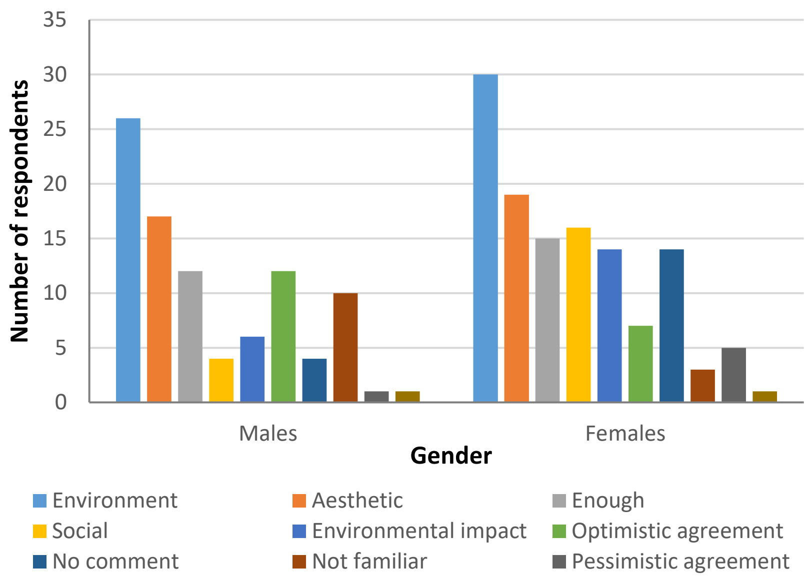

Figure D.3. Number of respondents that provided different reasons for their selection of areas where No Development should occur based upon gender.

The rationales given by respondents as to where Residential Development areas should occur were coded into six different categories (see Chapter 3, Table 3.8; Figure D.4). Most of the respondents (64%) did not mention any reason to choose these areas, but the majority of the respondents that did give a reason, mentioned that there was already enough residential development in the Region and that it should not occur in areas where it was not already present (Figure D.4).

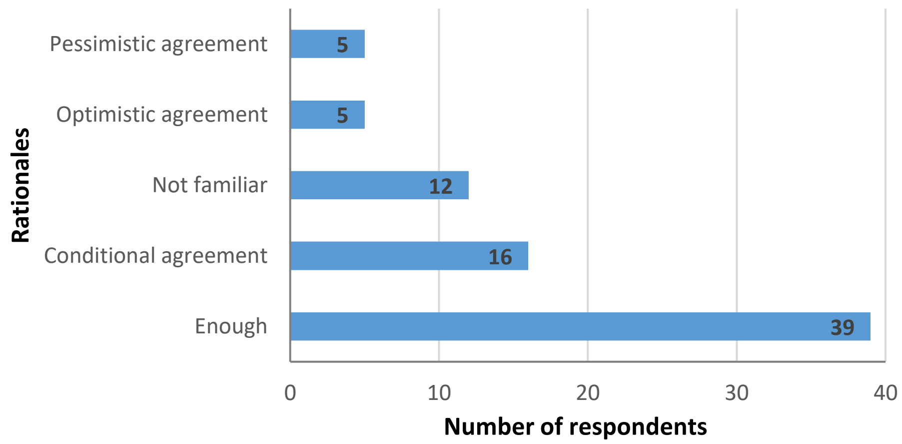

Figure D.4. Number of respondents per comments about Residential Development.

Residence time ($\chi^2_{[20]}$ = 36.52, p = 0.01) and place of residence ($\chi^2_{[10]}$ = 41.57, p < 0.001) were the only factors that had a statistically significant relationship with the rationales given about Residential Development (Table D.2). All respondents living in the area for 0 to more than 40 years were most likely to mention that there is enough residential development in the Region followed by stating conditional agreement than respondents not living in the area. Also, respondents not living in the area were more likely to mention pessimistic agreement comments than respondents living in the area for 0 to more than 40 years (Figure D.5).

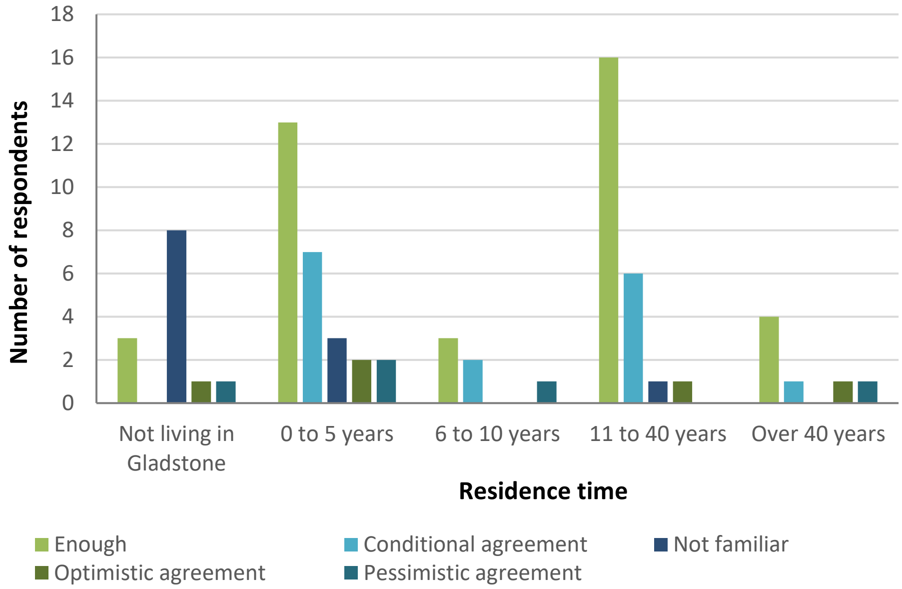

Figure D.5. Number of respondents that provided different comments about their selection of areas where Residential Development should occur based upon place of residence.

Additionally, the respondents living in the Region (i.e. metropolitan and non-metropolitan areas) were more likely to mention that there is enough residential development in the Region than respondents residing outside the Region. Metropolitan residents mentioned more often their conditional, optimistic and pessimistic agreement towards residential development than respondents in non-metropolitan areas and living outside the Region (Figure D.6).

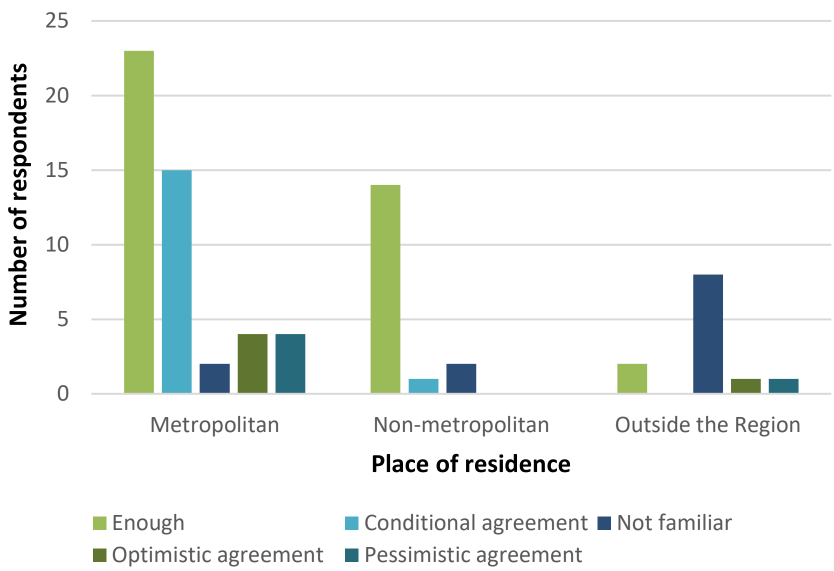

Figure D.6. Number of respondents that provided different comments about their selection of areas where Residential Development should occur based upon place of residence.

The respondents' reasoning behind selection of Industrial Development areas were coded into seven different categories (see Chapter 3, Table 3.10). The majority of respondents (52%) did not provide any comment when asked where Industrial Development should occur. The majority of those that did respond to this question, mentioned that there was already enough Industrial Development in the Region, followed by respondents thinking that it could occur but inland instead of at the coastal area (Figure D.7).

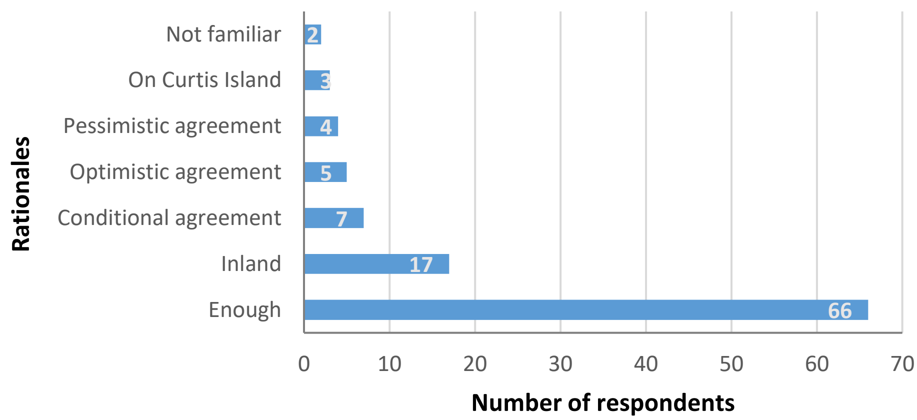

Figure D.7. Number of respondents per comments about Residential Development.

Only two socio-demographic factors statistically influenced the respondents' comments about Industrial Development in the Region: place of residence ($\chi^2_{[14]}$ = 27.66, p = 0.02) and gender ($\chi^2_{[7]}$ = 17.735, p = 0.013). Respondents living in the Region were more likely to comment that 'enough' Industrial Development had occurred in the Region, compared to the respondents living outside the Region. Metropolitan residents were also more likely to mention that industry should occur but inland, or increase its distribution but with conditions, than non-metropolitan area residents or those living outside the Region (Figure D.8).

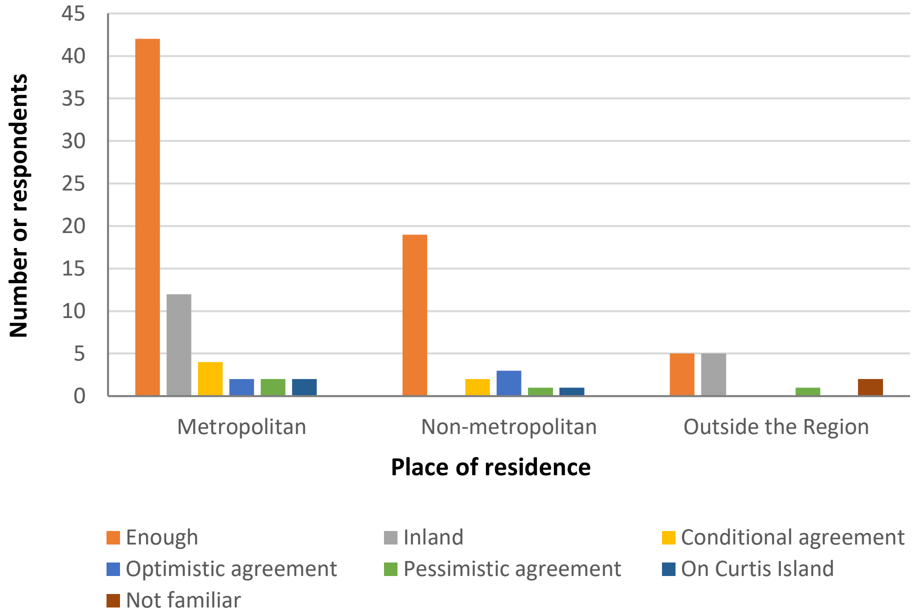

Figure D.8. Number of respondents that provided different comments about their selection of areas where Industrial Development should occur based upon place of residence.

Female respondents tended to state that 'enough' Industrial Development had occurred in the Region, as well as that it should occur inland, giving conditional agreement or stating that it should occur on Curtis Island (Figure D.4). Although the proportions were small, males tended to more frequently express 'positive agreement' and 'passive agreement' than females (Figure D.4).

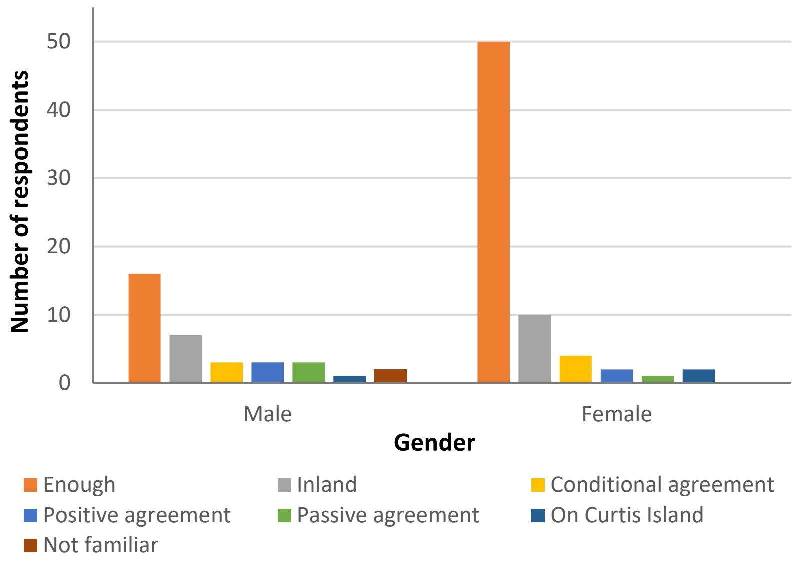

Figure D.9. Number of respondents that provided different reasons for their selection of areas where Industrial Development should occur based upon gender.

D.3.1.3. Perceived environmental health and knowledge about the Port of Gladstone

Four of the six socio-demographic factors tested (age, residence time, education, and place of birth) had a statistically significant relationship with respondent's perceptions of the environmental health of the harbour, familiarity with the WHA term, and knowledge of the GBRWHA boundaries (Tables D.3 and D.4).

Table D.3. Summary of results from the Kruskal-Wallis (age, residence time and place of residence) and Wilcoxon-Mann Whitney (gender, education and place of birth) tests. Statistically significant results are in bold and italicised font.

	Age			**Residence time**			**Place of residence**			**Gender**		**Education**		**Place of birth**	
	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	*U*	*p*	*U*	*p*	*U*	*p*
Perceived environmental health of the harbour	5.01	5	0.41	12.78	4	***0.01***	0.72	2	0.70	5236.0	0.39	5463.0	0.79	2413.0	***0.04***

Table D.4. Summary of results from the Chi-square test of independence. Statistically significant results are in bold and italicised font.

Questions	**Age**			**Residence time**			**Place of residence**			**Gender**			**Education**			**Place of birth**		
	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*	χ^2	df	*p*
Familiarity with the WHA term	37.31	10	***0.00***	12.28	8	0.14	4.19	4	0.38	1.89	2	0.40	15.43	2	***0.00***	2.69	2	0.26
GBRWHA boundaries	20.91	10	***0.02***	16.38	8	***0.04***	0.91	4	0.92	5.55	2	0.06	0.31	2	0.86	0.48	2	0.79
Impact of harbour activities in GBR	12.48	10	0.25	7.27	8	0.51	3.39	4	0.50	3.40	2	0.18	0.34	2	0.85	3.55	2	0.17

Respondent’s perceptions of environmental health of the harbour differed statistically depending on the length of time that a respondent had been living in Gladstone ($\chi^2_{[4]} = 12.78$, $p = 0.01$) and if they were born in the Gladstone Region ($U = 2413.0$, $p = 0.04$). *Post-hoc* analysis showed that opinions given by respondents that have lived in Gladstone for more than 40 years, were statistically significant different to people that have lived in the areas for less than 40 years (Table D.5). Similarly, opinions between those that had lived in Gladstone for greater than 40 years statistically differed from those respondents that do not live in Gladstone (Table D.5).

Table D.5. Summary of *post-hoc* analyses (Dunn's multiple comparison test) indicating the statistically significant differences between the different residence time categories.

	0-5 years		**6-10 years**		**11-40 years**		**More than 40 years**	
	Z	*p* value	Z	*p* value	Z	*p* value	Z	*p* value
Not living in Gladstone	-6.965	1.00	6.324	1.00	-6.085	1.000	-55.409	***0.016***
0-5 years			16.967	1.000	0.881	1.000	-48.444	***0.021***
6-10 years					-12.409	1.000	-61.733	***0.032***
11-40 years							-49.324	***0.018***

In general, respondents that have resided in Gladstone for more than 40 years were more likely to indicate that they were more optimistic that the harbour health was improving. Also, respondents not living in the Region and short-term residents (0 to 5 years) were more likely to be unsure about the harbour health (Figure D.10a). There was a statistically significant difference between people born in Gladstone as opposed to those respondents born elsewhere (Figure D.10a, b). Gladstone born respondents were more optimistic about the improving health of the Gladstone harbour (Figure D.10b).

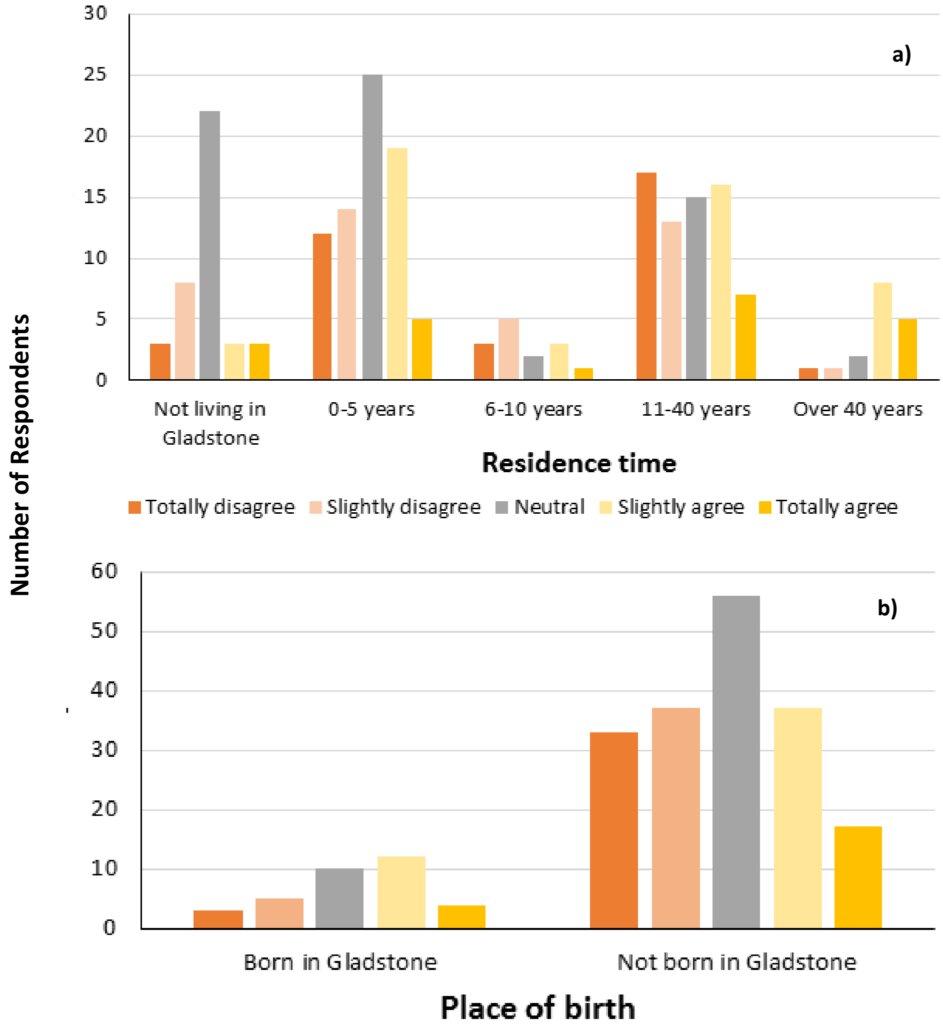

Figure D.10. Respondents' Likert scale responses about the environmental health of Gladstone harbour as a factor of: a) residence time; and b) if a respondent was born in Gladstone.

Familiarity with the World Heritage Area (WHA) term was statistically significant influenced by a respondents age ($\chi^2_{[10]}$ = 37.314, p < 0.001), and the level of education they have attained ($\chi^2_{[2]}$ = 15.433, p < 0.001). For example, respondents aged 18-25 showed greater variability in their familiarity with the WHA term. This age group also had the highest proportion of people not being familiar with the term (Figure D.11a). For all other age related categories, most of the respondents stated that they felt that they knew the WHA term (Figure D.11a). Additionally, respondents with higher education levels attained were also more likely to be aware of the WHA term (Figure D.11b).

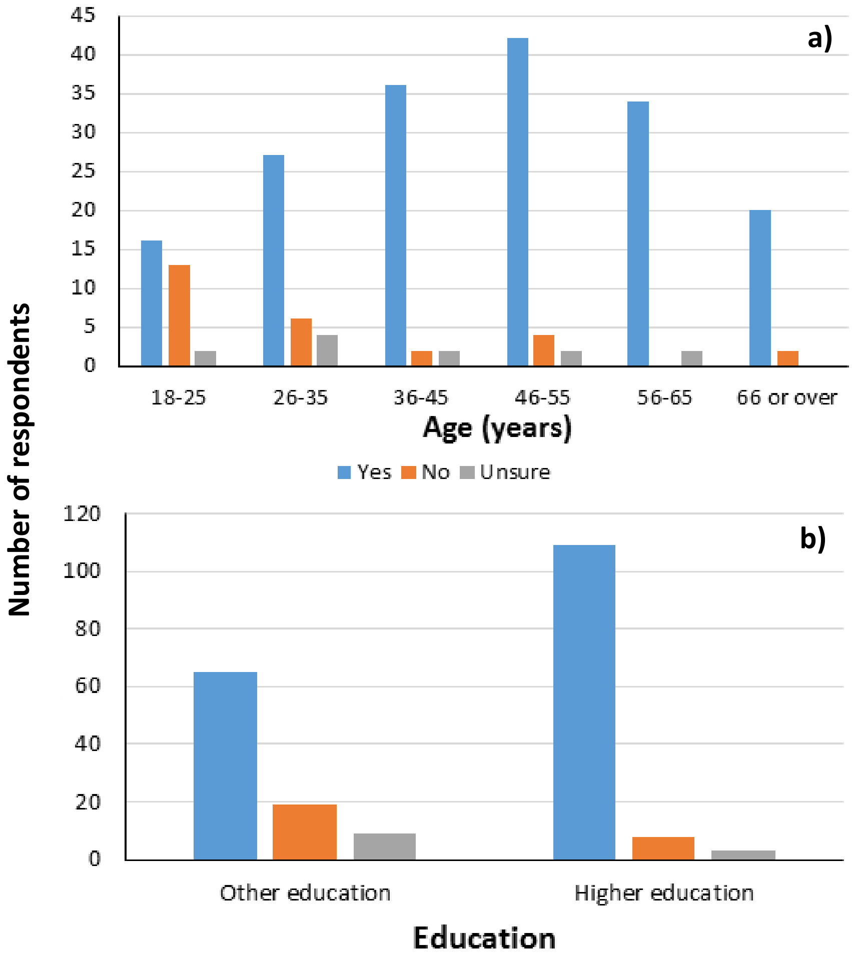

Figure D.11. Respondents' familiarity with the World Heritage Area (WHA) term by: a) age, and c) level of education attained.

Age ($\chi^2_{[10]}$ = 20.91, p = 0.02) and residence time ($\chi^2_{[10]}$ = 16.38, p = 0.04) were the only factors that had a statistically significant relationship with respondents' awareness of the fact that the Port of Gladstone lies within the Great Barrier Reef World Heritage Area (Figure D.12). Accurate awareness (i.e., those that knew that the port is within the GRBWHA, as opposed to those that thought it is not in the GBRWHA, appeared to be positively correlated with age. Younger respondents were more likely to admit that they were unsure of whether the port was in the GBRWHA (Figure D.12a). Alternatively, awareness appeared to be negatively related to the time living in the Region, but the pattern is not clear (Figure D.12b). Finally, there were no statistically significant patterns with regards to a respondent's perceptions about the influence of activities that occur in the port and if these activities affect the GBR (Table D.4).

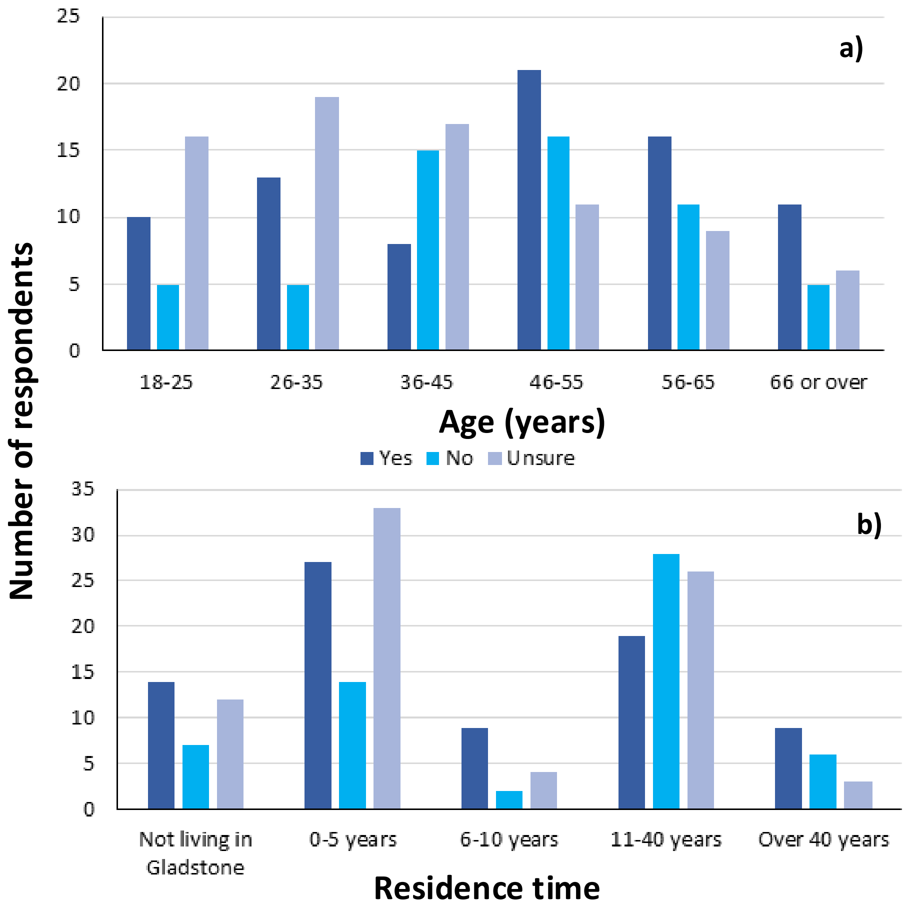

Figure D.12. Respondents' awareness about the Port of Gladstone lying within the GBWHA by: a) age, and b) residence time.

D.3.2. Multivariable analyses

D.3.2.1. Importance assigned to values

The results of the ordinal regression models are summarised in Table D.3. The selected group of socio-demographic factors predicted the weights given to the places mapped, but for only five of the 22 identified values assessed (Table D.6). As mentioned before, the tests and results for this section are the same as the results described in Chapter 3 in order to compare them with the bivariate tests. The model fit, pseudo R-square and test of parallel lines for each model are summarised in Table D.6 and full models' results are on Appendix E.

Table D.6. Ordinal regression model fitting, pseudo R-square and test of parallel lines for each value modelled. Successful models are marked with in bold and italic fonts.

Survey	Value name	Model fitting *p*-value	Goodness-of-fit (Pearson's)	Parallel lines test	Nagalkerke R^2	Cells with zero frequencies
Cultural	Appreciation of nature	0.174	0.989	0.490	0.306	86.1%
	Natural and human history	0.182	0.000	0.677	0.311	86%
	Sacred or spiritual	***0.048***	***0.000***	***0.996***	***0.510***	***88.9%***
Economic	***Commercial fisheries***	***0.025***	***0.000***	***0.619***	***0.609***	***87%***
	Commercial shipping	0.072	0.206	0.992	0.415	86.6%
	Industry development	0.399	0.893	0.075	0.283	86.9%
	Port facilities	0.090	0.120	0.955	0.367	87.1%
	Recreational business	0.452	0.400	0.006	0.243	87.7%
	Tourism opportunities	0.349	0.001	1.000	0.259	89%

Table D.6 Continuation

Survey	Value name	Model fitting *p*-value	Goodness-of-fit (Pearson's)	Parallel lines test	Nagalkerke R^2	Cells with zero frequencies
Environmental	Birds habitat	0.391	0.695	0.000	0.264	83.9%
	Fish habitat	0.035	1.000	0.000	0.438	77.5%
	Harbour health	0.880	0.104	0.740	0.206	78.2%
	Other wildlife	0.215	0.727	0.000	0.313	70.6%
	Turtle and dugong habitat	0.258	0.978	0.731	0.328	76.8%
Social	***Camping***	***0.002***	***0.000***	***1.000***	***0.539***	***87.3%***
	Existence	0.015	1.000	0.000	0.414	82.5%
	Future generations	0.000	0.968	0.005	0.588	83%
	Good memories	***0.000***	***1.000***	***1.000***	***0.960***	***83.8%***
	Important for community	0.061	1.000	0.997	0.389	85%
	Other recreation	0.002	1.000	0.027	0.494	88.3%
	Recreational fishing	0.010	0.005	0.002	0.486	88%
	Scenery	***0.024***	***0.986***	***0.241***	***0.410***	***83.6%***

Residence time and age were the only two (out of six) socio-demographic factors that had a statistical influence on the results. In this case respondents:

a) living in the Region for:
   - 11 - 40 years were statistically more likely to give higher weights to places with Sacred or Spiritual values (OR = 90.833, p = 0.007);
   - 0 - 5 years were statistically more likely to give higher weights to the Commercial Fishing value (OR = 352.737, p = 0.018);
   - 0 - 5 and 6 - 10 years and those that do not live in the area (OR < 0.001, p < 0.001) were statistically more likely to assign lower weights to places related to the social values of Camping (OR < 0.001, p < 0.001), Good Memories (OR < 0.001, p < 0.001) and Scenery (OR < 0.001, p < 0.001); and

b) respondents aged:
   - 18-25 were statistically less likely to give high weights to places with Sacred or Spiritual values (OR = 0.017, p = 0.024);
   - 56-65 were more likely to give higher weights to the Commercial Fishing value (OR = 192.313, p = 0.022);
   - 18 – 55 were statistically more likely to assign lower weights to places related to Camping (18 – 24: OR = 0.001, p = 0.001; 26 – 35: OR = 0.005, p = 0.016; 36 – 45: OR = 0.003, p = 0.004; 46 – 55: OR = 0.011, p = 0.015); and
   - 56-65 were statistically more likely to assign higher weights to places mapped for Scenery (OR = 18.668, p = 0.030).

D.3.2.2. Development areas

Multinomial logistic regression results showed that the group of socio-demographic factors predicted the respondents' comments and reasons about future No Development and Residential Development and fitted the data. On the other hand, the factors did not predict the comments given about future Tourism Development (Table D.7).

Table D.7. Summary of multinomial logistic regression model fitting, goodness of fit and pseudo R-square for each value modelled. Statistically significant models are marked in bold and italic fonts.

Types of future development	Model fitting *p*-value	Goodness-of-fit (Pearson's)	Nagalkerke R^2
No development	***< 0.001***	***1.000***	***0.671***
Residential	***0.002***	***1.000***	***0.504***
Tourism	***0.009***	***1.000***	***0.568***
Industrial	0.011	1.000	0.563

The regression models showed that different groups of socio-demographic factors influenced the reasons and comments that respondents provided for questions focussed upon future development in the Gladstone Region. It is important to note that although the likelihood ratio suggested that some socio-demographic factors were statistically significant factors, *post-hoc* results did not find a significant different, therefore only the significant results are described (Table D.8).

Table D.8. Socio-demographic factors of respondents determining their opinions about different future development. Statistically significant factors are indicated by the check mark.

	Types of future development			
Factors	No development	Residential	Tourism	Industrial
Place of birth	✓		✓*	
Residence time	✓		✓*	✓
Place of residence	✓*	✓	✓*	
Age				
Gender	✓		✓	
Education	✓		✓*	✓*

* *Post-hoc* tests showing no statistically significant results.

The outcomes of the model for the No Development comments suggest that respondents within certain socio-demographic categories were more likely to "agree" to have more development areas (i.e. optimistic agreement) than, for example, stating that the environment or aesthetics are more important, or that there is enough development already and therefore no more development should occur. This trend was characteristic of people born in Gladstone (OR = 0.032, p = 0.010), living in the area for 0 to 5 years (OR = 0.051, p = 0.036), and males (OR = 0.097, p = 0.006). Additionally, people with "other education" were more likely to have no opinion either in favour of, or contrary to places with No Development. Specifically, these respondents were less likely to express that 'we have enough development' (OR = 0.071, p = 0.003), or give social (OR = 0.035, p = 0.001), environmental (OR = 0.082, p = 0.002), aesthetic (OR = 0.137, p = 0.020), environmental impact reasons (OR = 0.057, p = 0.002) than having a clear opinion (Table D.8; see the full models' results in Appendix F).

The regression model for the Residential Development comments did fit the data, and it showed that only the respondents' place of residence had an influence on those comments (p = 0.006). Metropolitan residents were more likely to agree with the possibility of an increase in residential development in the future than stating that the Region has already enough (OR = 2.268E-7, p < 0.001) or that it could occur but with appropriate regulations (i.e., conditional agreement) (OR = 2.656E-7, p < 0.001 (Appendix F).

The comments about future Tourism Development in the Region were statistically influenced by the respondents' gender (p = 0.030). In this case, males were less likely to mention that Tourism Development should keep occurring if more ecotourism-type development was to be increased (OR = 0.027, p = 0.024), or that this type of development could occur anywhere (OR = 0.071, p = 0.038) as compared to stating that there is already enough Tourism Development in the Gladstone Region (Appendix F).

The regression model for comments about Industrial Development did fit the data, and the only factor with statistically significant results was place of residence (p = 0.001). Within this model, respondents living outside the Gladstone Region were more likely to 'agree' with future Industrial Development but believe it should occur far away from the coast (i.e., inland), than stating that this type of development could keep occurring but with more regulations (OR =1.035×10^8, $p < 0.001$) (Appendix F).

D.3.2.3. Perceived environmental health and knowledge about the Port of Gladstone

To assess the hypothesis that a group of factors influence the perception on the environmental health of the harbour (H_{D-I}), an ordinal regression model was used. In this case, the data did not fit the model, therefore none of the socio-demographic factors influenced the responses about the perceived health of the harbour (Table D.9).

Table D.9. Ordinal regression model fitting, pseudo R-square and test of parallel lines for the question about perceived harbour health.

	Model fitting *p*-value	**Goodness-of-fit (Pearson's)**	**Parallel lines test**	**Nagalkerke R^2**	**Cells with zero frequencies**
Perceived environmental health of the harbour	0.055	0.006	0.143	0.141	76.9%

The potential influence of respondents' socio-demographics on their knowledge about the GBRWHA was examined via multinomial logistic regressions. The model for the familiarity with the WHA term did fit the data ($p < 0.001$) (Table D.10). The only factor with significant *post-hoc* results was level of education attained ($p < 0.001$). In this case, respondents with 'other education', were more likely to say that they were not familiar with (OR = 18.987, $p = 0.001$), or were unsure (OR = 20.683, $p = 0.004$) about the WHA term compared to respondents with 'higher education' (Appendix F).

Table D.10. Summary of multinomial logistic regression model fitting, goodness of fit and pseudo R-square for each value modelled. Statistically significant models are marked in bold and italic fonts.

Questions	**Model fitting *p*-value**	**Goodness-of-fit (Pearson's)**	**Nagalkerke R^2**
Familiarity with the WHA term	***< 0.001***	***1.000***	***0.548***
GBRWHA boundaries	***0.048***	***0.157***	***0.232***
Impact of harbour activities in GBR	0.311	0.520	0.218

The model pertaining to whether respondents were aware that the Port of Gladstone lies with the GBRWHA gave accurate predictions and fit the data ($p < 0.05$). However, only 23% of the variance was explained. Gender was the only statistically significant factor ($p = 0.008$), where males were more likely to think that the port is not located within the GBRWHA boundaries (Appendix F). The last model was focussed on the effect of activities in the port on the GBR, but the data did not provide accurate predictions (Table D.10).

D.4. Discussion

Both hypothesis (D-I and D-II) were rejected based upon the results presented in this Appendix. Specifically, the bivariate and multivariable tests did not produce the same outcomes regarding the influence of socio-demographic factors in the respondents' importance assigned to values and their opinions and knowledge about the Region. This emphasises the fact that choice of statistical tests is an important consideration when designing a sampling program to elicit societal values.

It can be argued that bivariate and multivariable analyses should be applied to meet the need of specific research questions and objectives being asked, which are most likely different, and therefore their results are not comparable. For example, Kruskal-Wallis and Mann Whitney analyses are used to test a hypothesis and find significant differences among categories within a population, while ordinal regression models the factors and predict the likelihood of an outcome. Alternatively, while regressions predict outcomes, it has been claimed that the ordinal regression is an 'extension' of Kruskal-Wallis and Mann-Whitney analyses since those can be easily obtained from the regression models (Harrell 2001).

The case for the chi-square test for independence and logistic regression is different, however. The chi-square test is used to find if two categorical variables are associated, and the logistic regression models the categorical variable to predict the probability of an outcome. Hence, the results from both of these analyses explain different facets of a dataset or questions being asked, and therefore comparisons between both analyses are impractical. Within the literature focussed on identifying and mapping values both bivariate and multivariable statistical analyses have been used (Brown and Reed 2009; Sodhi et al. 2010; Martin-Lopez et al. 2012; Larson et al. 2013b; Plieninger et al. 2013; Zoderer et al. 2016).

To create a standardised method to identify and map values, especially when mapping values across cultural, social, economic and environmental factors, requires a sampling design that collects information efficiently to meet the questions being asked, coupled with a robust statistical approach that will aid in interpretation of the data. The important question to ask when creating a standardised method is whether the statistical approach should be bivariate or multivariable. The findings from this Appendix suggest that even when almost the same socio-demographic factors had an influence within a set of questions (i.e., importance of values, opinions about development and perception and knowledge of the harbour), the actual significant results varied depending on the specific value or question. Therefore, I argue that having a standardised method using the multivariable approach is more useful to managers and decision-makers. This is because this approach considers the combined influence of the variables, which would help with understanding nuances between different socio-demographic combos e.g. a young long-term resident versus an older long-term resident. To further explore this, a detailed description of these results are discussed in the next section.

D.4.1. Coincidences and discrepancies

Both the bivariate and multivariable analyses coincided on identifying statistically important socio-demographic factors in the same three (of the 22) values. All of these three values are social values (see Figure D.13). Discrepancies occurred between the bivariate versus multivariable analyses for the importance of values as follows:

- bivariate analyses indicated that one environmental and four social values were significant to the respondents; and
- multivariable analyses indicated that one cultural and one economic value had significant relationships with respondents' socio-demographics (Figure D.11).

Thus, although there was some overlap, the two models being examined did not provide the same outcomes for a values importance as noted by the respondents.

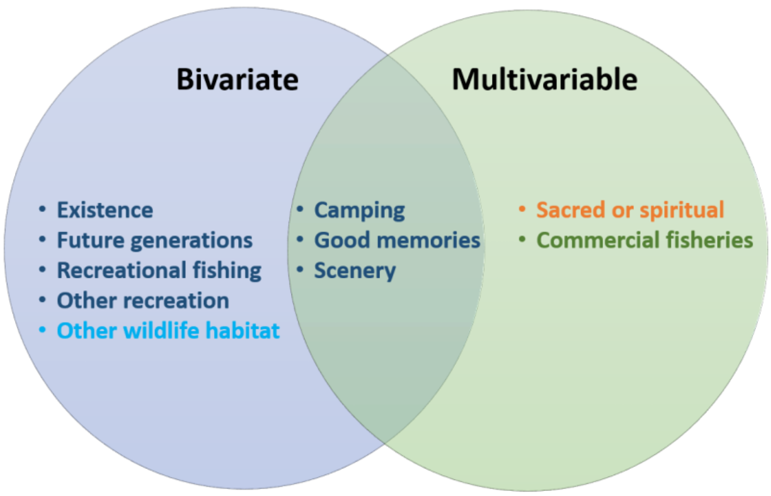

Figure D.13. Venn diagram illustrating values that had statistically significant results when using bivariate and/or multivariable statistical analyses. Dark blue font denotes social values; light blue font denotes environmental values; yellow font denotes cultural values; and green font denotes economic values.

In general, it can be concluded that the respondent's age, time of residence, gender, and education were the socio-demographic factors that had an influence in most cases. Among the values that had significant statistical results in both types of analyses (i.e., overlapped in the middle section of the Venn diagram;

Figure D.13), two socio-demographic factors had a significant relationship or influence on the values' perceived importance: i) residence time; and ii) age. Of these, age was consistently present across those values, and place of residence was only significant in the bivariate analysis (Table D.11).

Table D.11. Socio-demographic factors that were statistically significant across the bivariate (B) and multivariable (M) analyses focussed upon respondents' perceived level of importance given to the identified values.

	Camping		**Scenery**		**Good memories**	
Factor	B	M	B	M	B	M
Age	✓	✓	✓	✓	✓	
Residence time		✓		✓	✓	✓

The rest of the values from the Venn diagram (Figure D.13) also had statistically significant results, but either in the bivariate or multivariable analyses only. Among these, three factors (age, residence time, and level of education) were statistically significant in either bivariate or multivariable analyses (Table D.12). In this case, it is important to note that education had statistically significant results in the bivariate analyses, but was not significant in any of the multivariable analyses. This could be related to the fundamental difference between tests, where a factor can be significant when tested individually but when tested with other factors in a multivariable analysis it can become redundant (Greenland et al. 2000).

Table D.12. Socio-demographic factors that were statistically significant across either the bivariate or multivariable analyses focussed upon respondents' perceived level of importance given to the identified values.

Factor	Other recreation	Existence	Recreational fishing	Future generations	Other wildlife	Sacred	Commercial fishing
	Bivariate					Multivariable	
Residence time	✓	✓				✓	✓
Age	✓		✓	✓		✓	✓
Education					✓		

Results were not as consistent (as the level of importance of values) between the two statistical analyses when examining the respondents' views about the different types of development in the Gladstone Region. The two different tests had few coincidental outcomes (Table D.13). Gender was a significant influence within both analyses when respondents commented about no further development and industry development areas. Similarly, both statistical analyses indicated that level of education was a significant factor for respondents when considering where tourism development should occur (Table D.13). The other significant factors did not match between both analyses, nor were they consistent across those questions (Table D.13).

Table D.13. Socio-demographic factors that were statistically significant across either the bivariate (B) or multivariable (M) analyses focussed upon respondents' views about development in the region.

	Areas with No Development		Industry Development		Residential Development		Tourism Development	
Factor	B	M	B	M	B	M	B	M
Gender	✓	✓	✓	✓				
Education		✓					✓	✓
Residence time		✓						✓
Place of birth		✓				✓		
Place of residence						✓		

Congruency in bivariate and multivariable statistical analyses when determining the factors influencing a respondent's knowledge and perception of the region occurred for residence time (when considering environmental health of the harbour), and age (when considering familiarity with the WHA term and knowledge of whether the port lies within the GBRWHA boundaries) (Table D.14).

Table D.14. Socio-demographic factors that were statistically significant across either the bivariate or multivariable analyses focussed upon respondents' knowledge and perception of the port.

	Harbour's health		**Familiarity with WHA**		**Port within the GBRWHA**		**Activities in the port affect the GBR**	
Factor	B	M	B	M	B	M	B	M
Residence time	✓	✓	✓					
Age		✓	✓	✓	✓	✓		
Place of birth	✓							
Gender				✓		✓		
Education		✓	✓					

Thus, the results of this study illustrate that outcomes focussed on socio-demographic factors that influence a respondent's comments will not always coincide when using bivariate or multivariable statistical analyses. This lack of congruency is most likely due to the redundancy of factors (Greenland et al. 2000). Regression tests are designed to identify the factors that are more likely to predict an outcome, and in this case, even when six factors were modelled together, only two or three were consistently significant depending on the group of questions. Additionally, as mentioned before, the statistical test chosen has to be related to the research question. In this thesis, one of the main questions is which of these factors influence the importance assigned to values. Given that it is known that held and assigned values are influenced by not only one but multiple factors (e.g. Stern et al 1993; Guagnano and Markee 1995; Vorkinn and Riese 2001; Hamilton et al. 2010; Twenge et al. 2012), the appropriate statistical test should be multivariable for both ordinal and categorical data.

D.4.2. Regression results' limitations

Two issues regarding the data from this survey were encountered while testing the ordinal and logistic regression models. The first issue was that in the final models, a high percentage of cells had zero frequencies due to the number of categories of the dependent variable (i.e. median values for the weights assigned to values) and the number of factors (independent variables) used (Table D.7). As a result, the goodness of fit became an unreliable test although in some instances this test indicated a good fit with the data. This was a problem for all regressions undertaken; even so if the model fit and the test of parallel lines results were satisfactory, the resultant model was considered to be statistically significant, although a careful interpretation of the results had to occur (Minetos and Polyzos 2010; Monyai et al. 2016).

The second issue was that in most of the cases where the regression models had statistically significant results, most of the odds ratio values were either large (i.e. nine digits) or small (less than 0.001). This could be a signal of statistical bias due to a small sample size leading to sparse data and the use of many independent variables that could interact to increase negligible estimates, or that are redundant and therefore should be eliminated (Greenland et al. 2000). Additionally, the confidence interval of the odds ratio values was large for most of the models, which means that the difference of (for example) the weights assigned to recreational fishing by respondents within the age range of 55-65 and people older than 66, could be either very small (e.g. weights of 10 compared to 9), or very large (e.g. weights of 10 compared to 1).

As a consequence of these issues the results need to be interpreted with some level of caution, although the model fitting, the likelihood ratios (for logistic regressions), the test of parallel lines (for ordinal regressions) and the proportion of variance in the outcome (Nagalkerke R^2) tell us that the model fits the data well (Table D.7). Even so, it is important to note that (even when using careful interpretation) the regression models still suggest that there are a number factors that affect the respondents' responses. Both concerns (high percentage of cells with zero frequencies and large or small odds ratios) are directly influenced by the small sample size of the respondent pool (Greenland et al.

2000). Among the few studies analysing the influence of socio-demographic factors on societal values, only a few have expressed limitations regarding sample sizes and hence their results (Sodhi et al. 2010; Larson et al. 2013b). But the same precautious interpretation is needed for other studies where (due to other methodological limitations) their sample sizes are also small (e.g. Zoderer et al. 2016).

Since the bivariate and multivariable analyses are used to answer different questions, either one or the other analysis type would be suitable to analyse the studies reported in the literature that elicit people's preferences or perceptions (e.g. Kuhar et al. 2009; Gierlach et al. 2010; Ibrahim et al. 2010; Meldrum et al. 2015). However, in research where the importance given to cultural, economic, environmental and social values are elicited, multivariable analyses (i.e. regressions or generalised linear models) would be the most appropriate method to analyse the data. Unlike hypothesis tests, regression models can assess the magnitude of effects, integrate repeated measurements within subjects, and assess the factors as a group, which in some cases may be significant on an individual basis (i.e. in a bivariate test) but not within the group with other factors. Also "*predictive modelling is often desirable even when prediction is not the main goal*" because hypothesis testing is a by-product of the resultant model (Harrell 2001).

Moreover, it is important to acknowledge that other regression tests could be used to assess ordinal data depending on the particular characteristics of the data set and sample size. Some of the societal values' studies testing the influence of socio-demographics have used a different type of regression analyses. Of these, mixed effect regressions and cumulative link mixed models have been used under the premise of having repeated measures for each value (Sodhi et al. 2010; Zoderer et al. 2016), although their results had to be assessed cautiously due to small sample sizes (Sodhi et al. 2010). In this thesis, the data could have been analysed under the repeated measures premise, but due to the small sample size the mixed method was not able to give appropriate results. On the other hand, Larson et al. (2013b) used ordinary least squares regression, but this method is used when the data is normally distributed, which was not the case for this study.

D.5. Conclusions

Although the results of the bivariate and multivariable analyses of ordinal data were not exactly the same, they often selected the same factors as being influential in the analyses. The results from the bivariate and multivariable analyses of categorical data showed a less consistent group of socio-demographic factors influencing respondents' opinions about the Region. For this thesis, the most appropriate test was the multinomial analysis given the possibility of discarding redundant factors, and also because it allowed to integrate the idea that the perceived importance of values can be influenced by a wide variety of factors.

Appendix E. Statistically significant ordinal regression models

Table E.1. Socio-demographic differences in the respondents' perceived importance (weighting) for the 'Sacred or spiritually special' value. Coefficients/odds ratios are shown in bold and italic font.

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std. Error**	**Wald**	**df**	**Sig**	**Exp B**	**Lower Bound**	**Upper Bound**
[MEDIAN = 4.5]		-4.327	2.396	3.263	1	0.071	0.013	0	1.445
[MEDIAN = 5.0]		-3.417	2.232	2.344	1	0.126	0.033	0	2.604
[MEDIAN = 6.0]		-2.755	2.162	1.623	1	0.203	0.064	0.001	4.407
[MEDIAN = 6.5]		-2.273	2.128	1.141	1	0.286	0.103	0.002	6.673
[MEDIAN = 7.0]		-1.108	2.085	0.283	1	0.595	0.33	0.006	19.646
[MEDIAN = 8.0]		0.475	2.096	0.051	1	0.821	1.608	0.026	97.824
[MEDIAN = 9.0]		1.757	2.118	0.688	1	0.407	5.797	0.091	368.349
[MEDIAN = 9.5]		1.959	2.121	0.853	1	0.356	7.095	0.111	453.293
[Place of birth=1]	Yes (Born in GLD)	1.606	1.29	1.551	1	0.213	4.983	0.398	62.423
[Place of birth =2]	No	0			0		1		
[Residency time=0]	Does not live in GLD	2.723	2.22	1.505	1	0.220	15.231	0.196	1181.64
[Residency time=1]	0-5 years	2.407	1.654	2.117	1	0.146	11.102	0.434	284.112
[Residency time=2]	6-10 years	1.461	2.315	0.398	1	0.528	4.311	0.046	402.683
[Residency time=3]	11-40 years	***4.509***	1.662	7.357	1	***0.007***	***90.833***	3.493	2362.081
[Residency time=4]	More than 40 years	0			0		1		

Table E.1 Continuation

[Place of residence=0]	Does not live in GLD	0			0		1		
[Place of residence=1]	Metropolitan area	-0.87	1.042	0.697	1	0.404	0.419	0.054	3.229
[Place of residence=2]	Non metropolitan area	0			0		1		
[Age=1]	18-25 years	***-4.102***	1.812	5.126	1	***0.024***	***0.017***	0	0.576
[Age=2]	26-35 years	0.425	2.05	0.043	1	0.836	1.53	0.028	84.987
[Age=3]	36-45 years	-2.489	1.662	2.244	1	0.134	0.083	0.003	2.155
[Age=4]	46-55 years	-0.451	1.515	0.089	1	0.766	0.637	0.033	12.395
[Age=5]	56-65 years	-1.413	1.779	0.631	1	0.427	0.243	0.007	7.96
[Age=6]	Over 66 years	0			0		1		
[Gender=1]	Male	-1.111	0.862	1.661	1	0.197	0.329	0.061	1.783
[Gender=2]	Female	0			0		1		
[Education=1]	Other education	1.536	1.045	2.161	1	0.142	4.646	0.599	36.011
[Education=2]	Higher education	0			0		1		

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Table E.2. Socio-demographic differences in the respondents' perceived importance (weighting) for the Commercial Fishing value. Coefficients/odds ratios are shown in bold and italic font.

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std. Error**	**Wald**	**df**	**Sig**	**Exp B**	**Lower Bound**	**Upper Bound**
[MEDIAN = 1.0]		2.412	2.784	0.751	1	0.386	11.155	0.048	2613.119
[MEDIAN = 3.0]		4.197	2.754	2.323	1	0.127	66.5	0.301	14686.81
[MEDIAN = 5.0]		4.745	2.788	2.898	1	0.089	115.045	0.488	27143.54
[MEDIAN = 6.0]		5.452	2.846	3.67	1	0.055	233.317	0.881	61763.02
[MEDIAN = 7.0]		6.322	2.931	4.652	1	0.031	556.66	1.781	174014.3
[MEDIAN = 8.0]		8.107	3.095	6.859	1	0.009	3317.745	7.692	1431098
[MEDIAN = 9.0]		8.83	3.137	7.923	1	0.005	6834.915	14.605	3198696
[Place of birth=1]	Yes (Born in GLD)	2.328	1.693	1.892	1	0.169	10.262	0.372	283.236
[Place of birth =2]	No	0			0		1		
[Residence time=0]	Does not live in GLD	4.492	2.371	3.588	1	0.058	89.321	0.856	9321.988
[Residence time=1]	0-5 years	***5.866***	2.49	5.551	1	***0.018***	***352.737***	2.681	46410.13
[Residence time=2]	6-10 years	-20.45	0		1		0	0	0
[Residence time=3]	11-40 years	3.178	1.881	2.853	1	0.091	23.995	0.601	958.236
[Residence time=4]	More than 40 years	0			0		1		

Table E.2. Continuation

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std. Error**	**Wald**	**df**	**Sig**	**Exp B**	**Lower Bound**	**Upper Bound**
[Place of residence=0]	Does not live in GLD	0.381	2.609	0.021	1	0.884	1.463	0.009	243.095
[Place of residence=1]	Metropolitan area	-1.601	1.115	2.062	1	0.151	0.202	0.023	1.793
[Place of residence=2]	Non metropolitan area	0			0		1		
[Age=1]	18-25 years	2.53	2.442	1.073	1	0.3	12.55	0.105	1503.849
[Age=2]	26-35 years	2.233	1.915	1.36	1	0.244	9.325	0.219	397.775
[Age=3]	36-45 years	3.171	2.616	1.469	1	0.225	23.83	0.141	4017.92
[Age=4]	46-55 years	3.559	2.145	2.753	1	0.097	35.112	0.525	2350.374
[Age=5]	56-65 years	***5.259***	2.303	5.216	1	***0.022***	***192.313***	2.108	17546.11
[Age=6]	Over 66 years	0			0		1		
[Gender=1]	Male	-1.11	1.445	0.59	1	0.442	0.33	0.019	5.597
[Gender=2]	Female	0			0		1		
[Education=1]	Other education	1.923	1.202	2.559	1	0.11	6.838	0.649	72.092
[Education=2]	Higher education	0			0		1		

Table E.3. Socio-demographic differences in the respondents' perceived importance (weighting) for the 'camping' value. Coefficients/odds ratios are shown in bold and italic font.

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std.Error**	**Wald**	**df**	**Sig**	**Exp_B**	**Lower Bound**	**Upper Bound**
[MEDIAN = 2.0]		-27.764	2.695	106.112	1	0.000	0.000	0.000	0.000
[MEDIAN = 5.0]		-26.841	2.536	112.032	1	0.000	0.000	0.000	0.000
[MEDIAN = 6.0]		-25.854	2.418	114.349	1	0.000	0.000	0.000	0.000
[MEDIAN = 6.5]		-25.496	2.385	114.305	1	0.000	0.000	0.000	0.000
[MEDIAN = 7.0]		-24.114	2.279	111.939	1	0.000	0.000	0.000	0.000
[MEDIAN = 8.0]		-23.008	2.212	108.15	1	0.000	0.000	0.000	0.000
[MEDIAN = 9.0]		-22.381	2.182	105.215	1	0.000	0.000	0.000	0.000
[MEDIAN = 9.5]		-21.992	2.166	103.084	1	0.000	0.000	0.000	0.000
[Place of birth=1]	Yes (Born in GLD)	0.189	1.722	0.012	1	0.913	1.208	0.041	35.336
[Place of birth =2]	No	0			0		1		
[Residence time=0]	Does not live in GLD	***-22.055***	1.74	160.604	1	***0.000***	***0.000***	0.000	0.000
[Residence time=1]	0-5 years	***-17.399***	1.022	290	1	***0.000***	***0.000***	0.000	0.000
[Residence time=3]	11-40 years	-17.322	0.000		1		0.000	0.000	0.000

Table E.3. Continuation

Factor	Categories	Estimate	Std.Error	Wald	df	Sig	Exp_B	95% Confidence interval	
								Lower Bound	Upper Bound
[Residence time=4]	More than 40 years	0			0		1		
[Place of residence=0]	Does not live in GLD	0.000			0		1		
[Place of residence=1]	Metropolitan area	0.194	1.177	0.027	1	0.869	1.214	0.121	12.19
[Place of residence=2]	Non metropolitan area	0			0		1		
[Age=1]	18-25 years	***-7.400***	2.229	11.021	1	***0.001***	***0.001***	0.000	0.048
[Age=2]	26-35 years	***-5.293***	2.206	5.759	1	***0.016***	***0.005***	0.000	0.379
[Age=3]	36-45 years	***-5.863***	2.038	8.275	1	***0.004***	***0.003***	0.000	0.154
[Age=4]	46-55 years	***-4.475***	1.835	5.948	1	***0.015***	***0.011***	0.000	0.415
[Age=5]	56-65 years	-1.329	1.573	0.715	1	0.398	0.265	0.012	5.771
[Age=6]	Over 66 years	0			0		1		
[Gender=1]	Male	-0.700	0.739	0.899	1	0.343	0.496	0.117	2.111
[Gender=2]	Female	0			0		1		
[Education=1]	Other education	-0.319	0.813	0.154	1	0.695	0.727	0.148	3.579
[Education=2]	Higher education	0			0		1		

Table E.4. Socio-demographic differences in the respondents' perceived importance (weighting) for the 'good memories' value. Coefficients/odds ratios are shown in bold and italic font.

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std. Error**	**Wald**	**df**	**Sig**	**Exp B**	**Lower Bound**	**Upper Bound**
[MEDIAN = 5.0]		-77.672	6928.806	0	1	0.991	0.000	0.000	
[MEDIAN = 6.0]		-60.433	4910.787	0	1	0.990	0.000	0.000	
[MEDIAN = 7.0]		-59.564	4910.787	0	1	0.990	0.000	0.000	
[MEDIAN = 8.0]		-58.31	4910.787	0	1	0.991	0.000	0.000	
[MEDIAN = 8.5]		-57.994	4910.787	0	1	0.991	0.000	0.000	
[MEDIAN = 9.0]		-56.634	4910.786	0	1	0.991	0.000	0.000	
[Place of birth=1]	Yes (Born in GLD)	-2.193	1.599	1.881	1	0.170	0.112	0.005	2.563
[Place of birth =2]	No	0			0		1		
[Residence time=0]	Does not live in GLD	-54.479	4910.786	0	1	0.991	0.000	0.000	
[Residence time=1]	0-5 years	***-16.874***	1.067	250.211	1	***0.000***	***0.000***	0.000	0.000
[Residence time=2]	6-10 years	***-17.603***	2.143	67.45	1	***0.000***	***0.000***	0.000	0.000
[Residence time=3]	11-40 years	-15.68	0		1		0.000	0.000	0.000
[Residence time=4]	More than 40 years	0			0		1		

Table E.4. Continuation

Factor	Categories	Estimate	Std. Error	Wald	df	Sig	Exp B	95% Confidence interval Lower Bound	Upper Bound
[Place of residence=0]	Does not live in GLD	0.000			0		1		
[Place of residence=1]	Metropolitan area	-1.238	1.222	1.026	1	0.311	0.29	0.026	3.18
[Place of residence=2]	Non metropolitan area	0			0		1		
[Age=1]	18-25 years	-39.751	4910.786	0	1	0.994	0.000	0.000	
[Age=2]	26-35 years	-38.151	4910.786	0	1	0.994	0.000	0.000	
[Age=3]	36-45 years	-38.915	4910.786	0	1	0.994	0.000	0.000	
[Age=4]	46-55 years	-38.610	4910.786	0	1	0.994	0.000	0.000	
[Age=5]	56-65 years	-2.549	1.982	1.653	1	0.199	0.078	0.002	3.805
[Age=6]	Over 66 years	0			0		1		
[Gender=1]	Male	-1.027	0.752	1.863	1	0.172	0.358	0.082	1.565
[Gender=2]	Female	0			0		1		
[Education=1]	Other education	-1.180	0.864	1.867	1	0.172	0.307	0.056	1.670
[Education=2]	Higher education	0			0		1		

Table E.5. Socio-demographic differences in the respondents' perceived importance (weighting) for the 'scenery' value. Coefficients/odds ratios are shown in bold and italic font.

								95% Confidence interval	
Factor	**Categories**	**Estimate**	**Std. Error**	**Wald**	**df**	**Sig**	**Exp B**	**Lower Bound**	**Upper Bound**
[MEDIAN = 5.0]		-21.743	1.258	298.812	1	0.000	0.000	0.000	0.000
[MEDIAN = 6.0]		-21.472	1.236	301.801	1	0.000	0.000	0.000	0.000
[MEDIAN = 6.5]		-21.243	1.221	302.8	1	0.000	0.000	0.000	0.000
[MEDIAN = 7.0]		-19.927	1.167	291.515	1	0.000	0.000	0.000	0.000
[MEDIAN = 8.0]		-19.163	1.155	275.5	1	0.000	0.000	0.000	0.000
[MEDIAN = 9.0]		-18.438	1.156	254.377	1	0.000	0.000	0.000	0.000
[Place of birth=1]	Yes	-0.014	1.341	0	1	0.991	0.986	0.071	13.664
[Place of birth =2]	No	0			0		1		
[Residence time=0]	Does not live in GLD	***-19.961***	1.111	323.006	1	***0.000***	***0.000***	0.000	0.000
[Residence time=1]	0-5 years	***-18.969***	0.909	435.92	1	***0.000***	***0.000***	0.000	0.000
[Residence time=2]	6-10 years	***-18.854***	2.072	82.796	1	***0.000***	***0.000***	0.000	0.000
[Residence time=3]	11-40 years	-18.757	0		1		0.000	0.000	0.000
[Residence time=4]	More than 40 years	0			0		1		

Table E.5 Continuation

Factor	Categories	Estimate	Std. Error	Wald	df	Sig	Exp B	95% Confidence interval	
								Lower Bound	Upper Bound
[Place of residence=0]	Does not live in GLD	0.000			0		1		
[Place of residence=1]	Metropolitan area	0.150	0.966	0.024	1	0.877	1.161	0.175	7.715
[Place of residence=2]	Non metropolitan area	0			0		1		
[Age=1]	18-25 years	-1.240	1.213	1.045	1	0.307	0.289	0.027	3.117
[Age=2]	26-35 years	-0.198	1.151	0.03	1	0.864	0.821	0.086	7.824
[Age=3]	36-45 years	-0.584	1.218	0.23	1	0.632	0.558	0.051	6.070
[Age=4]	46-55 years	0.613	1.08	0.322	1	0.571	1.846	0.222	15.342
[Age=5]	56-65 years	***2.927***	1.351	4.693	1	***0.030***	***18.668***	1.322	263.663
[Age=6]	Over 66 years	0			0		1		
[Gender=1]	Male	-0.226	0.628	0.129	1	0.719	0.798	0.233	2.731
[Gender=2]	Female	0			0		1		
[Education=1]	Other education	-0.257	0.707	0.132	1	0.716	0.773	0.194	3.089
[Education=2]	Higher education	0			0		1		

Appendix F. Statistically significant logistic regression models

1. Areas where future development should be permanently prohibited (No Development)

Table F.1. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	600.338[a]	0.000	0	0.000
Place of birth	623.111[b]	22.773	9	***0.007***
Residency time	655.450[b]	55.112	36	***0.022***
Place of residence	637.462	37.124	18	***0.005***
Age	653.297[b]	52.959	45	0.194
Gender	618.363[b]	18.024	9	***0.035***
Education	622.574[b]	22.236	9	***0.008***
Survey	641.196[b]	40.858	27	***0.042***

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

b. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

Table F.2. Socio-demographic differences in respondents' opinion about areas for No Development. Coefficients/odds ratios are shown in bold and italic font.

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	Intercept		0.991	2.467	0.161	1	0.688			
	[Place of birth=1]	Yes (Born in GLD)	-3.452	1.332	6.715	1	0.01	0.032	0.002	0.431
	[Place of birth =2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	16.112	3990.979	0	1	0.997	9937570	0	.[c]
	[Residency time=1]	0-5 years	-2.653	1.67	2.523	1	0.112	0.07	0.003	1.86
	[Residency time=2]	6-10 years	-0.935	2.09	0.2	1	0.655	0.392	0.007	23.609
	[Residency time=3]	11-40 years	-0.594	1.489	0.159	1	0.69	0.552	0.03	10.224
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
Social	[Place of residence=0]	Does not live in GLD	-1.024	3938.227	0	1	1	0.359	0	.[c]
	[Place of residence=1]	Metropolitan area	1.239	1.071	1.338	1	0.247	3.453	0.423	28.198
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	3.184	2.197	2.101	1	0.147	24.147	0.326	1789.12
	[Age=2]	26-35 years	0.948	2.031	0.218	1	0.641	2.58	0.048	138.229
	[Age=3]	36-45 years	0.059	1.902	0.001	1	0.975	1.061	0.026	44.137
	[Age=4]	46-55 years	0.662	1.829	0.131	1	0.717	1.939	0.054	69.906
	[Age=5]	56-65 years	-0.072	1.8	0.002	1	0.968	0.931	0.027	31.69
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	***-2.333***	0.851	7.513	1	***0.006***	***0.097***	0.018	0.514
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-1.529	0.848	3.253	1	0.071	0.217	0.041	1.142
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		1.537	1.213	1.606	1	0.205	4.649	0.432	50.06
	[Survey=Economic]		1.003	1.186	0.716	1	0.397	2.728	0.267	27.86
	[Survey=Environmental]		1.077	1.234	0.761	1	0.383	2.935	0.261	32.966
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
Environment	Intercept		5.209	1.739	8.973	1	0.003			
	[Place of birth=1]	Yes (Born in GLD)	***-2.645***	1.071	6.099	1	***0.014***	***0.071***	0.009	0.579
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	15.38	3990.979	0	1	0.997	4780269	0	.[c]
	[Residency time=1]	0-5 years	***-2.975***	1.418	4.4	1	***0.036***	***0.051***	0.003	0.823
	[Residency time=2]	6-10 years	-1.631	1.852	0.776	1	0.379	0.196	0.005	7.379
	[Residency time=3]	11-40 years	-1.061	1.232	0.743	1	0.389	0.346	0.031	3.867
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-0.372	3938.227	0	1	1	0.689	0	.[c]
	[Place of residence=1]	Metropolitan area	-0.486	0.74	0.432	1	0.511	0.615	0.144	2.622
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	2.404	1.789	1.805	1	0.179	11.069	0.332	369.19
	[Age=2]	26-35 years	0.726	1.588	0.209	1	0.647	2.068	0.092	46.517
	[Age=3]	36-45 years	-0.559	1.484	0.142	1	0.707	0.572	0.031	10.484
	[Age=4]	46-55 years	-0.517	1.44	0.129	1	0.719	0.596	0.035	10.026
	[Age=5]	56-65 years	-1.658	1.402	1.398	1	0.237	0.19	0.012	2.976
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	***-1.544***	0.662	5.444	1	***0.02***	***0.213***	0.058	0.781
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.69	0.678	1.034	1	0.309	0.502	0.133	1.896
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.528	0.91	0.336	1	0.562	0.59	0.099	3.513
	[Survey=Economic]		-0.635	0.894	0.505	1	0.477	0.53	0.092	3.056
	[Survey=Environmental]		-0.225	0.915	0.06	1	0.806	0.799	0.133	4.798
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	Intercept		3.155	1.816	3.019	1	0.082			
	[Place of birth=1]	Yes (Born in GLD)	-1.373	1.096	1.57	1	0.21	0.253	0.03	2.17
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	16.644	3990.979	0	1	0.997	16913643	0	.[c]
	[Residency time=1]	0-5 years	-1.765	1.484	1.413	1	0.234	0.171	0.009	3.141
	[Residency time=2]	6-10 years	-2.141	1.96	1.193	1	0.275	0.118	0.003	5.479
	[Residency time=3]	11-40 years	-1.187	1.287	0.85	1	0.356	0.305	0.024	3.804
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
Aesthetic	[Place of residence=0]	Does not live in GLD	-0.896	3938.227	0	1	1	0.408	0	.[c]
	[Place of residence=1]	Metropolitan area	-0.655	0.802	0.668	1	0.414	0.519	0.108	2.5
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	1.935	1.838	1.108	1	0.292	6.922	0.189	253.795
	[Age=2]	26-35 years	0.414	1.634	0.064	1	0.8	1.513	0.062	37.182
	[Age=3]	36-45 years	-1.558	1.578	0.975	1	0.323	0.211	0.01	4.637
	[Age=4]	46-55 years	-0.646	1.482	0.19	1	0.663	0.524	0.029	9.576
	[Age=5]	56-65 years	-2.647	1.526	3.007	1	0.083	0.071	0.004	1.412
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	***-1.642***	0.718	5.223	1	***0.022***	***0.194***	0.047	0.791
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.174	0.719	0.059	1	0.808	0.84	0.205	3.434
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		1.425	1.008	2	1	0.157	4.158	0.577	29.957
	[Survey=Economic]		0.244	1.058	0.053	1	0.818	1.276	0.16	10.147
	[Survey=Environmental]		1.373	1.041	1.739	1	0.187	3.949	0.513	30.404
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
Economic	Intercept		-31.797	763.322	0.002	1	0.967			
	[Place of birth=1]	Yes (Born in GLD)	24.867	832.348	0.001	1	0.976	6.3E+10	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	22.184	4591.186	0	1	0.996	4.31E+09	0	.[c]
	[Residency time=1]	0-5 years	25.543	1161.641	0	1	0.982	1.24E+11	0	.[c]
	[Residency time=2]	6-10 years	27.633	3323.158	0	1	0.993	1E+12	0	.[c]
	[Residency time=3]	11-40 years	26.152	849.577	0.001	1	0.975	2.28E+11	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	15.845	4635.22	0	1	0.997	7606647	0	.[c]
	[Place of residence=1]	Metropolitan area	-22.773	560.492	0.002	1	0.968	1.29E-10	0	.[c]
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-46.678	924.061	0.003	1	0.96	5.35E-21	0	.[c]
	[Age=2]	26-35 years	-26.456	923.52	0.001	1	0.977	3.24E-12	0	.[c]
	[Age=3]	36-45 years	-25.826	869.681	0.001	1	0.976	6.08E-12	0	.[c]
	[Age=4]	46-55 years	-25.25	659.056	0.001	1	0.969	1.08E-11	0	.[c]
	[Age=5]	56-65 years	-22.008	781.482	0.001	1	0.978	2.77E-10	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-3.113	858.456	0	1	0.997	0.044	0	.[c]
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-2.957	704.203	0	1	0.997	0.052	0	.[c]
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		20.371	904.479	0.001	1	0.982	7.03E+08	0	.[c]
	[Survey=Economic]		20.869	905.875	0.001	1	0.982	1.16E+09	0	.[c]
	[Survey=Environmental]		0.128	488.269	0	1	1	1.136	0	.[c]
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Environment impact	Intercept		2.783	2.101	1.755	1	0.185			
	[Place of birth=1]	Yes (Born in GLD)	-1.193	1.231	0.939	1	0.332	0.303	0.027	3.385
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	18.638	3990.979	0	1	0.996	1.24E+08	0	.[c]
	[Residency time=1]	0-5 years	-0.636	1.803	0.124	1	0.724	0.529	0.015	18.129
	[Residency time=2]	6-10 years	0.458	2.211	0.043	1	0.836	1.581	0.021	120.413
	[Residency time=3]	11-40 years	0.427	1.596	0.071	1	0.789	1.532	0.067	35.007
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-2.733	3938.227	0	1	0.999	0.065	0	.[c]
	[Place of residence=1]	Metropolitan area	-1.054	0.865	1.484	1	0.223	0.349	0.064	1.9
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.992	2.058	0.232	1	0.63	2.696	0.048	152.094
	[Age=2]	26-35 years	-0.052	1.792	0.001	1	0.977	0.95	0.028	31.86
	[Age=3]	36-45 years	-0.796	1.671	0.227	1	0.634	0.451	0.017	11.935
	[Age=4]	46-55 years	-0.045	1.608	0.001	1	0.978	0.956	0.041	22.331
	[Age=5]	56-65 years	-1.911	1.614	1.402	1	0.236	0.148	0.006	3.498
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	***-1.943***	0.796	5.955	1	***0.015***	***0.143***	0.03	0.682
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-1.046	0.812	1.657	1	0.198	0.352	0.072	1.727
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		0.494	1.059	0.217	1	0.641	1.638	0.206	13.051
	[Survey=Economic]		-1.779	1.394	1.628	1	0.202	0.169	0.011	2.596
	[Survey=Environmental]		0.669	1.055	0.402	1	0.526	1.953	0.247	15.453
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
	Intercept		2.071	2.218	0.872	1	0.35			
	[Place of birth=1]	Yes (Born in GLD)	***-3.685***	1.464	6.338	1	***0.012***	***0.025***	0.001	0.442
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
Enough	[Residency time=0]	Does not live in GLD	17.325	3990.979	0	1	0.997	33423652	0	.[c]
	[Residency time=1]	0-5 years	-2.096	1.742	1.449	1	0.229	0.123	0.004	3.734
	[Residency time=2]	6-10 years	1.078	2.077	0.269	1	0.604	2.938	0.05	172.065
	[Residency time=3]	11-40 years	0.16	1.605	0.01	1	0.921	1.174	0.051	27.254
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-1.713	3938.227	0	1	1	0.18	0	.[c]
	[Place of residence=1]	Metropolitan area	0.892	0.895	0.995	1	0.319	2.441	0.423	14.094
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.927	2.151	0.186	1	0.666	2.527	0.037	171.269
	[Age=2]	26-35 years	0.878	1.765	0.247	1	0.619	2.405	0.076	76.54
	[Age=3]	36-45 years	0.585	1.617	0.131	1	0.718	1.795	0.075	42.741
	[Age=4]	46-55 years	0.889	1.579	0.317	1	0.573	2.434	0.11	53.766
	[Age=5]	56-65 years	-1.51	1.602	0.889	1	0.346	0.221	0.01	5.096
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-1.122	0.73	2.361	1	0.124	0.326	0.078	1.362
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.827	0.771	1.151	1	0.283	0.437	0.097	1.981
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.276	0.979	0.08	1	0.778	0.759	0.111	5.169
	[Survey=Economic]		-1.421	1.034	1.889	1	0.169	0.242	0.032	1.831
	[Survey=Environmental]		-0.685	1.027	0.445	1	0.505	0.504	0.067	3.771
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	Intercept		3.565	2.165	2.711	1	0.1			
	[Place of birth=1]	Yes (Born in GLD)	-2.902	1.662	3.046	1	0.081	0.055	0.002	1.429
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	-19.175	5235.039	0	1	0.997	4.70E-09	0	.[c]
	[Residency time=1]	0-5 years	-0.893	1.985	0.202	1	0.653	0.409	0.008	20.04
	[Residency time=2]	6-10 years	-16.954	2516.158	0	1	0.995	4.34E-08	0	.[c]
	[Residency time=3]	11-40 years	-1.128	1.759	0.411	1	0.521	0.324	0.01	10.176
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
No comment	[Place of residence=0]	Does not live in GLD	35.36	5192.237	0	1	0.995	2.27E+15	0	.[c]
	[Place of residence=1]	Metropolitan area	-0.422	1.035	0.166	1	0.684	0.656	0.086	4.986
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-1.482	2.262	0.429	1	0.512	0.227	0.003	19.144
	[Age=2]	26-35 years	-0.773	1.836	0.177	1	0.674	0.462	0.013	16.865
	[Age=3]	36-45 years	-2.058	1.749	1.385	1	0.239	0.128	0.004	3.932
	[Age=4]	46-55 years	-2.927	1.763	2.756	1	0.097	0.054	0.002	1.696
	[Age=5]	56-65 years	***-4.183***	1.76	5.647	1	***0.017***	***0.015***	0	0.481
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	***-2.727***	1	7.443	1	***0.006***	***0.065***	0.009	0.464
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	1.815	0.945	3.692	1	0.055	6.141	0.964	39.107
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-16.375	1375.392	0	1	0.991	7.74E-08	0	.[c]
	[Survey=Economic]		0.209	1.102	0.036	1	0.85	1.232	0.142	10.689
	[Survey=Environmental]		0.81	1.127	0.516	1	0.472	2.248	0.247	20.481
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
	Intercept		-15.742	1943.801	0	1	0.994			
	[Place of birth=1]	Yes (Born in GLD)	0.424	2.52	0.028	1	0.866	1.528	0.011	213.384
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
Not familiar	[Residency time=0]	Does not live in GLD	1.253	2564.044	0	1	1	3.502	0	.[c]
	[Residency time=1]	0-5 years	-0.122	2.643	0.002	1	0.963	0.885	0.005	157.177
	[Residency time=2]	6-10 years	-16.134	3024.301	0	1	0.996	9.84E-08	0	.[c]
	[Residency time=3]	11-40 years	-16.612	1552.714	0	1	0.991	6.10E-08	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	32.415	0	.	1	.	1.2E+14	1.2E+14	1.2E+14
	[Place of residence=1]	Metropolitan area	15.94	1943.799	0	1	0.993	8367153	0	.[c]
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.354	2.505	0.02	1	0.888	1.424	0.011	193.138
	[Age=2]	26-35 years	1.278	2.14	0.357	1	0.55	3.591	0.054	238.179
	[Age=3]	36-45 years	-2.328	2.3	1.024	1	0.312	0.098	0.001	8.855
	[Age=4]	46-55 years	-0.891	2.052	0.189	1	0.664	0.41	0.007	22.897
	[Age=5]	56-65 years	-1.59	2.099	0.573	1	0.449	0.204	0.003	12.488
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-0.188	0.996	0.036	1	0.85	0.829	0.118	5.831
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.46	0.93	0.245	1	0.621	1.584	0.256	9.809
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.097	1.241	0.006	1	0.938	0.907	0.08	10.327
	[Survey=Economic]		0.421	1.209	0.121	1	0.728	1.524	0.143	16.289
	[Survey=Environmental]		-1.238	1.517	0.666	1	0.415	0.29	0.015	5.672
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Pessimistic agreement	Intercept		-32.861	4847.765	0	1	0.995			
	[Place of birth=1]	Yes (Born in GLD)	-21.048	2674.585	0	1	0.994	7.22E-10	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	15.882	6275.748	0	1	0.998	7896587	0	.[c]
	[Residency time=1]	0-5 years	11.95	3373.403	0	1	0.997	154805.4	0	.[c]
	[Residency time=2]	6-10 years	-3.405	5467.636	0	1	1	0.033	0	.[c]
	[Residency time=3]	11-40 years	15.48	3373.403	0	1	0.996	5281951	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-0.715	5664.881	0	1	1	0.489	0	.[c]
	[Place of residence=1]	Metropolitan area	1.246	1.538	0.657	1	0.418	3.478	0.171	70.808
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	20.577	3481.519	0	1	0.995	8.64E+08	0	.[c]
	[Age=2]	26-35 years	18.624	3481.519	0	1	0.996	1.23E+08	0	.[c]
	[Age=3]	36-45 years	16.916	3481.519	0	1	0.996	22204411	0	.[c]
	[Age=4]	46-55 years	16.386	3481.519	0	1	0.996	13073570	0	.[c]
	[Age=5]	56-65 years	15.594	3481.519	0	1	0.996	5920330	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.2 Continuation

Reason	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	-2.767	1.476	3.516	1	0.061	0.063	0.003	1.134
	[Gender=2]	Female	0^b	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	1.311	1.343	0.953	1	0.329	3.709	0.267	51.56
	[HighEduc=2]	Higher education	0^b	.	.	0	.	.	.	.
	[Survey=Cultural]		0.961	1.873	0.263	1	0.608	2.614	0.067	102.745
	[Survey=Economic]		0.208	1.781	0.014	1	0.907	1.231	0.038	40.373
	[Survey=Environmental]		2.441	1.779	1.883	1	0.17	11.485	0.352	375.177
	[Survey=Social]		0^b	.	.	0	.	.	.	.

a. The reference category is: Optimistic agreement.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

2. Areas where Residential Development should occur

Table F.3. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	308.256[a]	0.000	0	0.000
Place of birth	317.850	9.594	5	0.088
Residency time	331.416	23.160	20	0.281
Place of residence	332.952	24.696	10	***0.006***
Age	340.928	32.672	25	0.139
Gender	312.136	3.880	5	0.567
Education	314.289	6.033	5	0.303
Survey	333.007	24.750	15	0.053

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table F.4. Socio-demographic differences in respondents' opinion about areas for Residential Development. Coefficients/odds ratios are shown in bold and italic font.

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Enough	Intercept		48.288	2074.903	0.001	1	0.981			
	[Place of birth=1]	Yes (Born in GLD)	-1.839	2.371	0.601	1	0.438	0.159	0.002	16.573
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	16.202	3012.621	0	1	0.996	10874378	0	.[c]
	[Residency time=1]	0-5 years	0.193	2.158	0.008	1	0.929	1.213	0.018	83.272
	[Residency time=2]	6-10 years	15.498	4907.17	0	1	0.997	5376307	0	.[c]
	[Residency time=3]	11-40 years	0.977	2.053	0.226	1	0.634	2.656	0.047	148.626
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-32.04	3012.622	0	1	0.992	1.22E-14	0	.[c]
	[Place of residence=1]	Metropolitan area	***-15.299***	0.486	990.087	1	***0***	***2.27E-07***	8.74E-08	5.88E-07
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	9.053	4409.752	0	1	0.998	8547.757	0	.[c]
	[Age=2]	26-35 years	-15.325	2.227	47.377	1	0	2.21E-07	2.81E-09	1.74E-05
	[Age=3]	36-45 years	2.476	2762.545	0	1	0.999	11.891	0	.[c]
	[Age=4]	46-55 years	-13.911	2.028	47.059	1	0	9.09E-07	1.71E-08	4.84E-05
	[Age=5]	56-65 years	-14.865	0.892	277.807	1	0	3.50E-07	6.10E-08	2.01E-06
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	-1.575	1.877	0.704	1	0.402	0.207	0.005	8.199
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.558	1.394	0.16	1	0.689	1.746	0.114	26.846
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-16.666	2074.902	0	1	0.994	5.78E-08	0	.[c]
	[Survey=Economic]		-17.785	2074.902	0	1	0.993	1.89E-08	0	.[c]
	[Survey=Environmental]		0.54	0.562	0.922	1	0.337	1.716	0.57	5.164
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
	Intercept		45.18	2074.903	0	1	0.983			
	[Place of birth=1]	Yes (Born in GLD)	-3.819	2.594	2.168	1	0.141	0.022	0	3.54
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
Conditional agreement	[Residency time=0]	Does not live in GLD	18.038	3012.622	0	1	0.995	68195216	0	.[c]
	[Residency time=1]	0-5 years	-0.495	2.465	0.04	1	0.841	0.609	0.005	76.418
	[Residency time=2]	6-10 years	15.294	4907.17	0	1	0.998	4387882	0	.[c]
	[Residency time=3]	11-40 years	0.673	2.337	0.083	1	0.773	1.959	0.02	191.093
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-49.958	6243.806	0	1	0.994	2.01E-22	0	.[c]
	[Place of residence=1]	Metropolitan area	-12.839	1.149	124.926	1	0	2.66E-06	2.80E-07	2.52E-05
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	11.416	4409.752	0	1	0.998	90761.93	0	.[c]
	[Age=2]	26-35 years	-15.019	2.453	37.483	1	0	3.00E-07	2.45E-09	3.68E-05
	[Age=3]	36-45 years	2.305	2762.545	0	1	0.999	10.024	0	.[c]
	[Age=4]	46-55 years	-13.944	2.254	38.278	1	0	8.79E-07	1.06E-08	7.29E-05
	[Age=5]	56-65 years	-14.395	1.343	114.839	1	0	5.60E-07	4.03E-08	7.80E-06
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-0.531	1.92	0.076	1	0.782	0.588	0.014	25.369
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.497	1.527	0.106	1	0.745	0.608	0.03	12.136
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-15.042	2074.902	0	1	0.994	2.93E-07	0	.[c]
	[Survey=Economic]		-18.794	2074.902	0	1	0.993	6.88E-09	0	.[c]
	[Survey=Environmental]		1.402	0.854	2.692	1	0.101	4.062	0.761	21.67
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	Intercept		16.038	4823.048	0	1	0.997			
	[Place of birth=1]	Yes (Born in GLD)	-20.828	2617.635	0	1	0.994	9.01E-10	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	-2.711	2300.379	0	1	0.999	0.066	0	.[c]
	[Residency time=1]	0-5 years	-4.483	3.272	1.877	1	0.171	0.011	1.85E-05	6.896
	[Residency time=2]	6-10 years	14.744	4907.17	0	1	0.998	2530840	0	.[c]
	[Residency time=3]	11-40 years	-19.983	2363.554	0	1	0.993	2.10E-09	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
Pessimistic agreement	[Place of residence=0]	Does not live in GLD	1.957	0	.	1	.	7.08	7.08	7.08
	[Place of residence=1]	Metropolitan area	3.454	2300.378	0	1	0.999	31.636	0	.[c]
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	12.421	6722.375	0	1	0.999	247938.9	0	.[c]
	[Age=2]	26-35 years	-15.654	5805.929	0	1	0.998	1.59E-07	0	.[c]
	[Age=3]	36-45 years	20.736	4614.892	0	1	0.996	1.01E+09	0	.[c]
	[Age=4]	46-55 years	3.733	3696.698	0	1	0.999	41.796	0	.[c]
	[Age=5]	56-65 years	1.695	3696.698	0	1	1	5.446	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	-0.598	2.287	0.068	1	0.794	0.55	0.006	48.652
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-2.416	2.64	0.838	1	0.36	0.089	0.001	15.757
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-17.516	2074.902	0	1	0.993	2.47E-08	0	.[c]
	[Survey=Economic]		-20.864	2074.903	0	1	0.992	8.69E-10	0	.[c]
	[Survey=Environmental]		0.183	1.5	0.015	1	0.903	1.2	0.063	22.717
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
	Intercept		16.073	5655.722	0	1	0.998			
	[Place of birth=1]	Yes (Born in GLD)	-17.268	3104.191	0	1	0.996	3.17E-08	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
Not familiar	[Residency time=0]	Does not live in GLD	31.663	5283.245	0	1	0.995	5.64E+13	0	.[c]
	[Residency time=1]	0-5 years	15.39	4340.138	0	1	0.997	4826559	0	.[c]
	[Residency time=2]	6-10 years	12.263	8425.213	0	1	0.999	211691.3	0	.[c]
	[Residency time=3]	11-40 years	14.521	4340.138	0	1	0.997	2023983	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-29.157	3012.622	0	1	0.992	2.17E-13	0	.[c]
	[Place of residence=1]	Metropolitan area	***-16.199***	1.221	175.898	1	***0***	***9.22E-08***	8.42E-09	1.01E-06
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	26.625	5318.936	0	1	0.996	3.66E+11	0	.[c]
	[Age=2]	26-35 years	-0.924	2974.085	0	1	1	0.397	0	.[c]
	[Age=3]	36-45 years	18.181	4059.166	0	1	0.996	78708275	0	.[c]
	[Age=4]	46-55 years	1.438	2974.085	0	1	1	4.211	0	.[c]
	[Age=5]	56-65 years	-1.532	2974.084	0	1	1	0.216	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-1.978	2.121	0.869	1	0.351	0.138	0.002	8.849
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	1.235	1.536	0.647	1	0.421	3.439	0.169	69.777
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-14.742	2074.902	0	1	0.994	3.96E-07	0	.[c]
	[Survey=Economic]		-18.41	2074.902	0	1	0.993	1.01E-08	0	.[c]
	[Survey=Environmental]		1.372	1.344	1.043	1	0.307	3.944	0.283	54.919
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
No comment	Intercept		49.942	2074.902	0.001	1	0.981			
	[Place of birth=1]	Yes (Born in GLD)	-1.623	2.332	0.484	1	0.487	0.197	0.002	19.075
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	15.048	3012.621	0	1	0.996	3430882	0	.[c]
	[Residency time=1]	0-5 years	0.643	2.103	0.094	1	0.76	1.903	0.031	117.356
	[Residency time=2]	6-10 years	14.963	4907.17	0	1	0.998	3150167	0	.[c]
	[Residency time=3]	11-40 years	1.158	2	0.336	1	0.562	3.185	0.063	160.517
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-29.515	3012.621	0	1	0.992	1.52E-13	0	.[c]
	[Place of residence=1]	Metropolitan area	-15.055	0	.	1	.	2.90E-07	2.90E-07	2.90E-07
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	9.93	4409.751	0	1	0.998	20542.22	0	.[c]
	[Age=2]	26-35 years	-16.78	2.053	66.816	1	0	5.16E-08	9.22E-10	2.88E-06
	[Age=3]	36-45 years	0.936	2762.545	0	1	1	2.55	0	.[c]
	[Age=4]	46-55 years	-14.926	1.848	65.252	1	0	3.29E-07	8.81E-09	1.23E-05
	[Age=5]	56-65 years	-16.152	0	.	1	.	9.66E-08	9.66E-08	9.66E-08
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.4. Continuation

Q3Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	**Upper Bound**
	[Gender=1]	Male	-1.01	1.847	0.299	1	0.585	0.364	0.01	13.608
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.638	1.362	0.219	1	0.639	1.893	0.131	27.321
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-16.227	2074.902	0	1	0.994	8.96E-08	0	.[c]
	[Survey=Economic]		-18.34	2074.902	0	1	0.993	1.08E-08	0	.[c]
	[Survey=Environmental]		0.427	0	.	1	.	1.532	1.532	1.532
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

a. The reference category is: Optimistic agreement.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

3. Areas where Tourism Development should occur.

Table F.5. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	169.749[a]	0.000	0	0.000
Born in GLD	188.305	18.556	5	***0.002***
Time in GLD	201.276	31.527	20	***0.049***
Place of residence	191.675	21.926	10	***0.015***
Age	202.649[b]	32.900	25	0.134
Gender	182.093[b]	12.343	5	***0.030***
Education	183.109[b]	13.359	5	***0.020***
Survey	187.121[b]	17.372	15	0.297

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

b. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

Table F.6. Socio-demographic differences in respondents' opinion about areas for Tourism Development. Coefficients/odds ratios are shown in bold and italic font.

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	Intercept		-10.893	3075.281	0	1	0.997			
	[Place of birth=1]	Yes (Born in GLD)	20.966	1493.936	0	1	0.989	1.27E+09	0	.[b]
	[Place of birth=2]	No	0[c]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	2.693	2017.055	0	1	0.999	14.783	0	.[b]
	[Residency time=1]	0-5 years	3.945	2.613	2.278	1	0.131	51.667	0.308	8665.462
	[Residency time=2]	6-10 years	4.126	4119.888	0	1	0.999	61.899	0	.[b]
	[Residency time=3]	11-40 years	5.06	2.616	3.74	1	0.053	157.603	0.934	26585.63
	[Residency time=4]	More than 40 years	0[c]	.	.	0	.	.	.	.
Ecotourism	[Place of residence=0]	Does not live in GLD	25.833	2029.526	0	1	0.99	1.66E+11	0	.[b]
	[Place of residence=1]	Metropolitan area	0.796	1.597	0.249	1	0.618	2.218	0.097	50.725
	[Place of residence=2]	Non metropolitan area	0[c]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-19.964	3225.98	0	1	0.995	2.14E-09	0	.[b]
	[Age=2]	26-35 years	22.386	3546.86	0	1	0.995	5.28E+09	0	.[b]
	[Age=3]	36-45 years	8.634	3075.281	0	1	0.998	5620.275	0	.[b]
	[Age=4]	46-55 years	7.498	3075.281	0	1	0.998	1803.759	0	.[b]
	[Age=5]	56-65 years	8.297	3075.281	0	1	0.998	4011	0	.[b]
	[Age=6]	Over 66 years	0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Optimistic agreement	[Gender=1]	Male	***-3.613***	1.604	5.075	1	***0.024***	***0.027***	0.001	0.625
	[Gender=2]	Female	0[c]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	2.991	1.949	2.355	1	0.125	19.913	0.436	908.843
	[HighEduc=2]	Higher education	0[c]	.	.	0	.	.	.	.
	[Survey=Cultural]		-2.967	1.749	2.877	1	0.09	0.051	0.002	1.586
	[Survey=Economic]		-1.445	2.118	0.465	1	0.495	0.236	0.004	14.98
	[Survey=Environmental]		-0.762	1.912	0.159	1	0.69	0.467	0.011	19.775
	[Survey=Social]		0[c]	.	.	0	.	.	.	.
	Intercept		17.025	1974.56	0	1	0.993			
	[Place of birth=1]	Yes (Born in GLD)	18.683	1493.936	0	1	0.99	1.3E+08	0	.[b]
	[Place of birth=2]	No	0[c]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	13.396	1594.989	0	1	0.993	657336.1	0	.[b]
	[Residency time=1]	0-5 years	3.126	2.584	1.463	1	0.226	22.779	0.144	3608.339
	[Residency time=2]	6-10 years	3.28	3743.594	0	1	0.999	26.57	0	.[b]
	[Residency time=3]	11-40 years	4.19	2.614	2.569	1	0.109	66.035	0.393	11096.41
	[Residency time=4]	More than 40 years	0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	13.834	1610.731	0	1	0.993	1018441	0	.[b]
	[Place of residence=1]	Metropolitan area	0.365	1.469	0.062	1	0.804	1.44	0.081	25.653
	[Place of residence=2]	Non metropolitan area	0[c]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-35.546	2450.936	0	1	0.988	3.65E-16	0	.[b]
	[Age=2]	26-35 years	-2.846	2649.858	0	1	0.999	0.058	0	.[b]
	[Age=3]	36-45 years	-18.181	1974.56	0	1	0.993	1.27E-08	0	.[b]
	[Age=4]	46-55 years	-19.892	1974.56	0	1	0.992	2.30E-09	0	.[b]
	[Age=5]	56-65 years	-18.567	1974.56	0	1	0.992	8.64E-09	0	.[b]
	[Age=6]	Over 66 years	0[c]	.	.	0	.	.	.	.
	[Gender=1]	Male	***-2.643***	1.273	4.31	1	***0.038***	***0.071***	0.006	0.863
	[Gender=2]	Female	0[c]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	1.887	1.917	0.969	1	0.325	6.601	0.154	282.97
	[HighEduc=2]	Higher education	0[c]	.	.	0	.	.	.	.
	[Survey=Cultural]		-1.672	1.607	1.083	1	0.298	0.188	0.008	4.381
	[Survey=Economic]		-0.196	1.927	0.01	1	0.919	0.822	0.019	35.871
	[Survey=Environmental]		-0.73	1.892	0.149	1	0.7	0.482	0.012	19.664
	[Survey=Social]		0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Not familiar	Intercept		-37.066	5925.765	0	1	0.995			
	[Place of birth=1]	Yes (Born in GLD)	26.552	4722.648	0	1	0.996	3.4E+11	0	.[b]
	[Place of birth=2]	No	0[c]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	59.882	5762.288	0	1	0.992	1.01E+26	0	.[b]
	[Residency time=1]	0-5 years	27.375	5455.033	0	1	0.996	7.74E+11	0	.[b]
	[Residency time=2]	6-10 years	52.435	7586.526	0	1	0.994	5.92E+22	0	.[b]
	[Residency time=3]	11-40 years	19.981	4457.065	0	1	0.996	4.76E+08	0	.[b]
	[Residency time=4]	More than 40 years	0[c]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-9.038	0	.	1	.	0	0	0
	[Place of residence=1]	Metropolitan area	-14.127	1236.181	0	1	0.991	7.33E-07	0	.[b]
	[Place of residence=2]	Non metropolitan area	0[c]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-26.778	4312.606	0	1	0.995	2.35E-12	0	.[b]
	[Age=2]	26-35 years	-10.281	4609.308	0	1	0.998	3.43E-05	0	.[b]
	[Age=3]	36-45 years	-9.736	3757.406	0	1	0.998	5.91E-05	0	.[b]
	[Age=4]	46-55 years	-10.534	3757.406	0	1	0.998	2.66E-05	0	.[b]
	[Age=5]	56-65 years	-8.985	3852.956	0	1	0.998	0	0	.[b]
	[Age=6]	Over 66 years	0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
No room for tourism	[Gender=1]	Male	13.27	1131.678	0	1	0.991	579473.4	0	.[b]
	[Gender=2]	Female	0[c]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-13.05	1346.435	0	1	0.992	2.15E-06	0	.[b]
	[HighEduc=2]	Higher education	0[c]	.	.	0	.	.	.	.
	[Survey=Cultural]		5.773	3136.385	0	1	0.999	321.437	0	.[b]
	[Survey=Economic]		-9.157	3629.269	0	1	0.998	0	0	.[b]
	[Survey=Environmental]		7.377	3136.385	0	1	0.998	1598.197	0	.[b]
	[Survey=Social]		0[c]	.	.	0	.	.	.	.
	Intercept		-64.579	16901.81	0	1	0.997			
	[Place of birth=1]	Yes (Born in GLD)	-86	9461.65	0	1	0.993	4.47E-38	0	.[b]
	[Place of birth=2]	No	0[c]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	38.117	8905.862	0	1	0.997	3.58E+16	0	.[b]
	[Residency time=1]	0-5 years	-79.364	8272.45	0	1	0.992	3.41E-35	0	.[b]
	[Residency time=2]	6-10 years	41.406	18557.19	0	1	0.998	9.6E+17	0	.[b]
	[Residency time=3]	11-40 years	-79.458	8239.673	0	1	0.992	3.10E-35	0	.[b]
	[Residency time=4]	More than 40 years	0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-117.455	5433.11	0	1	0.983	9.77E-52	0	.[b]
	[Place of residence=1]	Metropolitan area	-26.28	9157.765	0	1	0.998	3.86E-12	0	.[b]
	[Place of residence=2]	Non metropolitan area	0[c]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	26.513	5347.815	0	1	0.996	3.27E+11	0	.[b]
	[Age=2]	26-35 years	20.597	12344.53	0	1	0.999	8.81E+08	0	.[b]
	[Age=3]	36-45 years	58.025	2384.085	0.001	1	0.981	1.58E+25	0	.[b]
	[Age=4]	46-55 years	29.453	4955.993	0	1	0.995	6.18E+12	0	.[b]
	[Age=5]	56-65 years	6.554	20953.77	0	1	1	701.81	0	.[b]
	[Age=6]	Over 66 years	0[c]	.	.	0	.	.	.	.
	[Gender=1]	Male	74.842	9255.817	0	1	0.994	3.19E+32	0	.[b]
	[Gender=2]	Female	0[c]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-19.654	4469.904	0	1	0.996	2.91E-09	0	.[b]
	[HighEduc=2]	Higher education	0[c]	.	.	0	.	.	.	.
	[Survey=Cultural]		18.44	4910.997	0	1	0.997	1.02E+08	0	.[b]
	[Survey=Economic]		19.92	5387.23	0	1	0.997	4.48E+08	0	.[b]
	[Survey=Environmental]		-4.975	4910.997	0	1	0.999	0.007	0	.[b]
	[Survey=Social]		0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
No comment	Intercept		17.609	1974.559	0	1	0.993			
	[Place of birth=1]	Yes (Born in GLD)	19.926	1493.935	0	1	0.989	4.5E+08	0	.[b]
	[Place of birth=2]	No	0[c]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	15.833	1594.988	0	1	0.992	7516677	0	.[b]
	[Residency time=1]	0-5 years	4.36	2.101	4.306	1	0.038	78.235	1.274	4805.687
	[Residency time=2]	6-10 years	19.292	3016.72	0	1	0.995	2.39E+08	0	.[b]
	[Residency time=3]	11-40 years	4.667	2.271	4.224	1	0.04	106.379	1.242	9112.606
	[Residency time=4]	More than 40 years	0[c]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	12.205	1610.73	0	1	0.994	199719	0	.[b]
	[Place of residence=1]	Metropolitan area	1.554	1.337	1.351	1	0.245	4.73	0.344	65.015
	[Place of residence=2]	Non metropolitan area	0[c]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-20.186	1974.561	0	1	0.992	1.71E-09	0	.[b]
	[Age=2]	26-35 years	-3.79	2649.858	0	1	0.999	0.023	0	.[b]
	[Age=3]	36-45 years	-19.026	1974.56	0	1	0.992	5.46E-09	0	.[b]
	[Age=4]	46-55 years	-19.883	1974.56	0	1	0.992	2.32E-09	0	.[b]
	[Age=5]	56-65 years	-18.384	1974.56	0	1	0.993	1.04E-08	0	.[b]
	[Age=6]	Over 66 years	0[c]	.	.	0	.	.	.	.

Table F.6. Continuation

Q4Reason[a]	Factors	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	-1.323	1.084	1.49	1	0.222	0.266	0.032	2.228
	[Gender=2]	Female	0[c]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	3.268	1.806	3.276	1	0.07	26.252	0.763	903.747
	[HighEduc=2]	Higher education	0[c]	.	.	0	.	.	.	.
	[Survey=Cultural]		-2.78	1.421	3.825	1	0.05	0.062	0.004	1.006
	[Survey=Economic]		-0.322	1.736	0.034	1	0.853	0.725	0.024	21.751
	[Survey=Environmental]		-0.653	1.691	0.149	1	0.699	0.52	0.019	14.321
	[Survey=Social]		0[c]	.	.	0	.	.	.	.

a. The reference category is: We have enough development.

b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

4. Areas where Industrial Development should occur

Table F.7. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	345.314[a]	0.000	0	0.000
Place of birth	349.553[b]	4.239	7	0.752
Residence time	386.533[b]	41.219	28	0.051
Place of residence	382.244[b]	36.930	14	***0.001***
Age	394.677[b]	49.362	35	0.054
Gender	359.146	13.832	7	0.054
Education	363.847[b]	18.533	7	***0.010***
Survey	383.355[b]	38.041	21	***0.013***

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

b. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

Table F.8. Socio-demographic differences in respondents' opinion about areas for Industrial Development. Coefficients/odds ratios are shown in bold and italic font.

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
We have enough development	Intercept		2.418	2.145	1.271	1	0.26			
	[Place of birth=1]	Yes (Born in GLD)	-0.44	1.494	0.087	1	0.768	0.644	0.034	12.036
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	-0.48	1.971	0.059	1	0.808	0.619	0.013	29.466
	[Residence time=1]	0-5 years	-0.95	1.632	0.339	1	0.561	0.387	0.016	9.473
	[Residence time=2]	6-10 years	17.85	9358.204	0	1	0.998	56520269	0	.[c]
	[Residence time=3]	11-40 years	0.938	1.628	0.332	1	0.565	2.554	0.105	62.045
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-0.325	1.987	0.027	1	0.87	0.723	0.015	35.527
	[Place of residence=1]	Metropolitan area	0.009	1.144	0	1	0.994	1.009	0.107	9.509
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	17.804	0.821	469.777	1	0	53948943	10784418	2.7E+08
	[Age=2]	26-35 years	0.979	1.744	0.315	1	0.575	2.661	0.087	81.203
	[Age=3]	36-45 years	1.464	1.793	0.667	1	0.414	4.323	0.129	145.167
	[Age=4]	46-55 years	0.904	1.578	0.329	1	0.567	2.47	0.112	54.398
	[Age=5]	56-65 years	-0.221	1.549	0.02	1	0.886	0.801	0.039	16.685
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	-0.462	0.985	0.22	1	0.639	0.63	0.091	4.345
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.352	0.895	0.155	1	0.694	0.703	0.122	4.065
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.04	1.549	0.001	1	0.98	0.961	0.046	20.009
	[Survey=Economic]		-0.838	1.37	0.374	1	0.541	0.433	0.03	6.336
	[Survey=Environmental]		-0.582	1.348	0.186	1	0.666	0.559	0.04	7.853
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
Inland	Intercept		-36.776	2.227	272.576	1	0			
	[Place of birth=1]	Yes (Born in GLD)	-0.621	1.798	0.119	1	0.73	0.538	0.016	18.253
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	***19.778***	2.288	74.737	1	***0***	***3.88E+08***	4385550	3.44E+10
	[Residence time=1]	0-5 years	***17.982***	1.598	126.675	1	***0***	***64471524***	2814714	1.48E+09
	[Residence time=2]	6-10 years	18.044	11030.99	0	1	0.999	68634099	0	.[c]
	[Residence time=3]	11-40 years	19.486	0	.	1	.	2.9E+08	2.9E+08	2.9E+08
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	18.455	2.556	52.117	1	0	1.04E+08	690329.7	1.55E+10
	[Place of residence=1]	Metropolitan area	19.244	0	.	1	.	2.28E+08	2.28E+08	2.28E+08
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	17.743	1.431	153.805	1	0	50800325	3076403	8.39E+08
	[Age=2]	26-35 years	1.21	2.127	0.324	1	0.569	3.353	0.052	216.652
	[Age=3]	36-45 years	-0.132	2.243	0.003	1	0.953	0.876	0.011	71.056
	[Age=4]	46-55 years	-1.048	2.119	0.244	1	0.621	0.351	0.006	22.331
	[Age=5]	56-65 years	0.485	1.942	0.062	1	0.803	1.625	0.036	73.111
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-0.176	1.144	0.024	1	0.878	0.839	0.089	7.903
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.671	1.048	0.41	1	0.522	0.511	0.066	3.988
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		1.167	1.695	0.474	1	0.491	3.212	0.116	88.939
	[Survey=Economic]		0.505	1.544	0.107	1	0.744	1.657	0.08	34.157
	[Survey=Environmental]		-0.608	1.542	0.156	1	0.693	0.544	0.027	11.172
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Optimistic agreement	Intercept		-54.147	5793.783	0	1	0.993			
	[Place of birth=1]	Yes (Born in GLD)	-17.845	4351.846	0	1	0.997	1.78E-08	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	***19.507***	2.813	48.099	1	***0***	***2.96E+08***	1195954	7.35E+10
	[Residency time=1]	0-5 years	***15.19***	1.887	64.829	1	***0***	***3951742***	97942.87	1.59E+08
	[Residency time=2]	6-10 years	17.226	11899.21	0	1	0.999	30270163	0	.[c]
	[Residency time=3]	11-40 years	17.826	0	.	1	.	55175580	55175580	55175580
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-23.781	8477.511	0	1	0.998	4.70E-11	0	.[c]
	[Place of residence=1]	Metropolitan area	-1.686	1.978	0.726	1	0.394	0.185	0.004	8.951
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	24.512	7267.74	0	1	0.997	4.42E+10	0	.[c]
	[Age=2]	26-35 years	2.707	6544.177	0	1	1	14.978	0	.[c]
	[Age=3]	36-45 years	22.047	4452.355	0	1	0.996	3.76E+09	0	.[c]
	[Age=4]	46-55 years	21.069	4452.355	0	1	0.996	1.41E+09	0	.[c]
	[Age=5]	56-65 years	20.704	4452.355	0	1	0.996	9.81E+08	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	3.057	1.874	2.661	1	0.103	21.256	0.54	836.343
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.699	1.817	0.148	1	0.7	0.497	0.014	17.481
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		16.285	3707.35	0	1	0.996	11820964	0	.[c]
	[Survey=Economic]		16.28	3707.35	0	1	0.996	11757742	0	.[c]
	[Survey=Environmental]		16.891	3707.35	0	1	0.996	21670962	0	.[c]
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
	Intercept		86.766	5779.377	0	1	0.988			
	[Place of birth=1]	Yes (Born in GLD)	-15.986	2840.475	0	1	0.996	1.14E-07	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
On Curtis Island	[Residence time=0]	Does not live in GLD	-123.729	28007.28	0	1	0.996	1.84E-54	0	.[c]
	[Residence time=1]	0-5 years	-103.226	5409.254	0	1	0.985	1.48E-45	0	.[c]
	[Residence time=2]	6-10 years	-141.445	12295.74	0	1	0.991	3.73E-62	0	.[c]
	[Residence time=3]	11-40 years	-100.036	4073.978	0.001	1	0.98	3.59E-44	0	.[c]
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-39.088	28601.03	0	1	0.999	1.06E-17	0	.[c]
	[Place of residence=1]	Metropolitan area	-55.106	2373.201	0.001	1	0.981	1.17E-24	0	.[c]
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	61.747	5861.601	0	1	0.992	6.55E+26	0	.[c]
	[Age=2]	26-35 years	60.37	4402.008	0	1	0.989	1.65E+26	0	.[c]
	[Age=3]	36-45 years	45.735	4080.36	0	1	0.991	7.28E+19	0	.[c]
	[Age=4]	46-55 years	-29.31	5096.015	0	1	0.995	1.87E-13	0	.[c]
	[Age=5]	56-65 years	-11.891	4042.905	0	1	0.998	6.85E-06	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-12.585	1018.165	0	1	0.99	3.42E-06	0	.[c]
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-87.15	3988.798	0	1	0.983	1.42E-38	0	.[c]
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-115.967	4820.861	0.001	1	0.981	4.33E-51	0	.[c]
	[Survey=Economic]		-42.312	3977.348	0	1	0.992	4.21E-19	0	.[c]
	[Survey=Environmental]		12.889	970.658	0	1	0.989	395993	0	.[c]
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Not familiar	Intercept		-60.15	33237.7	0	1	0.999			
	[Place of birth=1]	Yes (Born in GLD)	6.46	30148.57	0	1	1	639.134	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	56.553	30298.49	0	1	0.999	3.63E+24	0	.[c]
	[Residency time=1]	0-5 years	16.878	33536.57	0	1	1	21376276	0	.[c]
	[Residency time=2]	6-10 years	37.36	35025.42	0	1	0.999	1.68E+16	0	.[c]
	[Residency time=3]	11-40 years	18.198	33529.78	0	1	1	80067897	0	.[c]
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	-20.232	0	.	1	.	1.63E-09	1.63E-09	1.63E-09
	[Place of residence=1]	Metropolitan area	-21.116	6765.722	0	1	0.998	6.75E-10	0	.[c]
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	-12.632	7502.831	0	1	0.999	3.27E-06	0	.[c]
	[Age=2]	26-35 years	-13.791	7579.426	0	1	0.999	1.03E-06	0	.[c]
	[Age=3]	36-45 years	-0.401	6787.513	0	1	1	0.67	0	.[c]
	[Age=4]	46-55 years	11.961	6760.221	0	1	0.999	156453.7	0	.[c]
	[Age=5]	56-65 years	-17.158	12364.64	0	1	0.999	3.53E-08	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	11.513	6109.974	0	1	0.998	99985.83	0	.[c]
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-14.887	1829.571	0	1	0.994	3.43E-07	0	.[c]
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		30.233	6504.795	0	1	0.996	1.35E+13	0	.[c]
	[Survey=Economic]		-11.977	6509.159	0	1	0.999	6.29E-06	0	.[c]
	[Survey=Environmental]		3.165	6436.043	0	1	1	23.68	0	.[c]
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
No comment	Intercept		2.843	2.093	1.845	1	0.174			
	[Place of birth=1]	Yes (Born in GLD)	-0.726	1.492	0.237	1	0.626	0.484	0.026	9.004
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residency time=0]	Does not live in GLD	***-19.255***	1.964	96.126	1	***0***	***4.34E-09***	9.25E-11	2.04E-07
	[Residency time=1]	0-5 years	-0.378	1.604	0.055	1	0.814	0.685	0.03	15.906
	[Residency time=2]	6-10 years	17.541	9358.204	0	1	0.999	41477663	0	.[c]
	[Residency time=3]	11-40 years	1.118	1.609	0.483	1	0.487	3.06	0.131	71.65
	[Residency time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	19.557	0	.	1	.	3.12E+08	3.12E+08	3.12E+08
	[Place of residence=1]	Metropolitan area	0.213	1.135	0.035	1	0.851	1.238	0.134	11.45
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	17.445	0	.	1	.	37690053	37690053	37690053
	[Age=2]	26-35 years	0.314	1.74	0.033	1	0.857	1.369	0.045	41.466
	[Age=3]	36-45 years	0.406	1.782	0.052	1	0.82	1.501	0.046	49.294
	[Age=4]	46-55 years	-0.067	1.566	0.002	1	0.966	0.935	0.043	20.126
	[Age=5]	56-65 years	-0.944	1.527	0.382	1	0.537	0.389	0.02	7.764
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	0.593	0.966	0.376	1	0.54	1.809	0.272	12.019
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.397	0.88	0.204	1	0.652	1.488	0.265	8.34
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.31	1.517	0.042	1	0.838	0.734	0.038	14.341
	[Survey=Economic]		-0.966	1.334	0.524	1	0.469	0.381	0.028	5.201
	[Survey=Environmental]		-1.316	1.321	0.993	1	0.319	0.268	0.02	3.568
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Pessimistic agreement	Intercept		-33.232	12022.43	0	1	0.998			
	[Place of birth=1]	Yes (Born in GLD)	-18.687	3981.74	0	1	0.996	7.66E-09	0	.[c]
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	11.818	8252.662	0	1	0.999	135667.4	0	.[c]
	[Residence time=1]	0-5 years	12.378	8252.662	0	1	0.999	237419	0	.[c]
	[Residence time=2]	6-10 years	13.898	13715.08	0	1	0.999	1086450	0	.[c]
	[Residence time=3]	11-40 years	15.844	8252.661	0	1	0.998	7606262	0	.[c]
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	1.216	0	.	1	.	3.374	3.374	3.374
	[Place of residence=1]	Metropolitan area	0.295	2.019	0.021	1	0.884	1.343	0.026	70.326
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	19.647	11106.51	0	1	0.999	3.41E+08	0	.[c]
	[Age=2]	26-35 years	20.81	8742.564	0	1	0.998	1.09E+09	0	.[c]
	[Age=3]	36-45 years	1.039	10551.32	0	1	1	2.826	0	.[c]
	[Age=4]	46-55 years	1.066	10135.84	0	1	1	2.905	0	.[c]
	[Age=5]	56-65 years	18.149	8742.563	0	1	0.998	76203035	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.8. Continuation

Q5Reason[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
	[Gender=1]	Male	1.281	1.626	0.621	1	0.431	3.6	0.149	87.11
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	-0.105	1.628	0.004	1	0.948	0.9	0.037	21.899
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		1.783	2.309	0.597	1	0.44	5.95	0.064	549.472
	[Survey=Economic]		-17.137	3668.066	0	1	0.996	3.61E-08	0	.[c]
	[Survey=Environmental]		-0.781	2.127	0.135	1	0.714	0.458	0.007	29.603
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

a. The reference category is: Conditional agreement.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

5. Question 7: Are you familiar with the term World Heritage Area?

Table F.9. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	128.352[a]	.000	0	0.000
Place of birth	130.151	1.799	2	0.407
Residence time	156.348	27.997	8	***0.000***
Place of residence	134.886	6.534	4	0.163
Age	158.954	30.602	10	***0.001***
Gender	129.614	1.262	2	0.532
Education	156.710	28.359	2	***0.000***
Survey	147.589	19.237	6	0.004

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table F.10. Socio-demographic differences in respondents' familiarity with the WHA term. Coefficients/odds ratios are shown in bold and italic font.

Q7[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
No	Intercept		-5.382	1.958	7.554	1	0.006			
	[Place of birth=1]	Yes (Born in GLD)	1.306	1.163	1.26	1	0.262	3.691	0.377	36.101
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	***-16.582***	2.255	54.09	1	***0***	***6.29E-08***	7.57E-10	5.22E-06
	[Residence time=1]	0-5 years	3.35	2.28	2.159	1	0.142	28.498	0.327	2485.186
	[Residence time=2]	6-10 years	0.299	2.056	0.021	1	0.884	1.348	0.024	75.82
	[Residence time=3]	11-40 years	-0.684	1.777	0.148	1	0.7	0.504	0.016	16.406
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
	[Place of residence=0]	Does not live in GLD	19.522	0	.	1	.	3.01E+08	3.01E+08	3.01E+08
	[Place of residence=1]	Metropolitan area	0.556	0.856	0.422	1	0.516	1.743	0.326	9.322
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.998	1.296	0.593	1	0.441	2.713	0.214	34.425
	[Age=2]	26-35 years	-0.245	1.312	0.035	1	0.852	0.783	0.06	10.247
	[Age=3]	36-45 years	-2.078	1.556	1.784	1	0.182	0.125	0.006	2.642
	[Age=4]	46-55 years	-1.973	1.377	2.051	1	0.152	0.139	0.009	2.069
	[Age=5]	56-65 years	-20.294	5171.859	0	1	0.997	1.54E-09	0	.[c]
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.10. Continuation

Q7[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	-0.451	0.652	0.48	1	0.488	0.637	0.178	2.283
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	***2.981***	0.752	15.737	1	***0***	***19.716***	4.52	86.011
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-1.461	0.933	2.452	1	0.117	0.232	0.037	1.444
	[Survey=Economic]		0.667	0.809	0.68	1	0.41	1.948	0.399	9.507
	[Survey=Environmental]		1.39	0.781	3.167	1	0.075	4.013	0.869	18.536
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
Unsure	Intercept		-23.329	2.093	124.256	1	0			
	[Place of birth=1]	Yes (Born in GLD)	-0.628	1.379	0.207	1	0.649	0.534	0.036	7.962
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	-56.552	15043	0	1	0.997	2.75E-25	0	.[c]
	[Residence time=1]	0-5 years	0.448	1.382	0.105	1	0.746	1.566	0.104	23.494
	[Residence time=2]	6-10 years	-1.851	1.805	1.052	1	0.305	0.157	0.005	5.403
	[Residence time=3]	11-40 years	-2.206	1.69	1.704	1	0.192	0.11	0.004	3.023
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.10. Continuation

Q7[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	95% Confidence Interval for Exp(B) Upper Bound
	[Place of residence=0]	Does not live in GLD	37.591	13722.34	0	1	0.998	2.12E+16	0	.[c]
	[Place of residence=1]	Metropolitan area	-0.079	0.964	0.007	1	0.935	0.924	0.14	6.108
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	***19.061***	1.458	170.848	1	***0***	***1.9E+08***	10885701	3.31E+09
	[Age=2]	26-35 years	***19.42***	1.178	271.944	1	***0***	***2.72E+08***	27004334	2.73E+09
	[Age=3]	36-45 years	***17.914***	1.222	214.973	1	***0***	***60234564***	5493644	6.6E+08
	[Age=4]	46-55 years	***17.395***	1.192	212.804	1	***0***	***35856312***	3463879	3.71E+08
	[Age=5]	56-65 years	17.959	0	.	1	.	63048576	63048576	63048576
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	-0.759	0.805	0.888	1	0.346	0.468	0.097	2.27
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	***3.05***	1.048	8.465	1	***0.004***	***21.12***	2.706	164.846
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		0.86	1.319	0.426	1	0.514	2.364	0.178	31.343
	[Survey=Economic]		1.426	1.36	1.099	1	0.294	4.161	0.29	59.81
	[Survey=Environmental]		3.236	1.345	5.786	1	0.016	25.434	1.821	355.244
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

a. The reference category is: Yes.
b. This parameter is set to zero because it is redundant.
c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.
Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

6. Question 8: Is the Port of Gladstone within the Great Barrier Reef World Heritage Area?

Table F.11. Likelihood ratio test for the logistic regression. Statistically significant results are identified by bold and italic font.

Effect	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept	364.991[a]	0.000	0	0.000
Place of birth	365.845	0.854	2	0.652
Residence time	377.028	12.037	8	0.150
Place of residence	367.645	2.654	4	0.617
Age	382.921	17.930	10	0.056
Gender	374.737	9.746	2	***0.008***
Education	365.523	0.532	2	0.766
Survey	368.269	3.278	6	0.773

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table F.12. Socio-demographic differences in respondents' awareness of the GBRWHA boundaries. Coefficients/odds ratios are shown in bold and italic font.

Q8[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	Intercept		-1.899	0.984	3.724	1	0.054			
	[Place of birth=1]	Yes (Born in GLD)	0.299	0.648	0.212	1	0.645	1.348	0.378	4.804
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	1.171	1.274	0.846	1	0.358	3.226	0.266	39.144
	[Residence time=1]	0-5 years	-0.07	0.823	0.007	1	0.933	0.933	0.186	4.679
	[Residence time=2]	6-10 years	-0.254	1.085	0.055	1	0.815	0.776	0.092	6.511
	[Residence time=3]	11-40 years	1.201	0.732	2.692	1	0.101	3.324	0.792	13.957
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.
No	[Place of residence=0]	Does not live in GLD	-1.527	1.215	1.578	1	0.209	0.217	0.02	2.353
	[Place of residence=1]	Metropolitan area	0.343	0.486	0.499	1	0.48	1.409	0.544	3.654
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.388	0.909	0.183	1	0.669	1.475	0.248	8.753
	[Age=2]	26-35 years	0.105	0.843	0.016	1	0.901	1.111	0.213	5.799
	[Age=3]	36-45 years	1.767	0.779	5.14	1	0.023	5.853	1.271	26.96
	[Age=4]	46-55 years	0.776	0.705	1.213	1	0.271	2.173	0.546	8.643
	[Age=5]	56-65 years	0.725	0.726	0.997	1	0.318	2.065	0.497	8.573
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.

Table F.12. Continuation

Q8[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Gender=1]	Male	***1.148***	0.419	7.493	1	***0.006***	***3.15***	1.385	7.165
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.107	0.406	0.07	1	0.791	1.113	0.502	2.469
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.433	0.56	0.597	1	0.44	0.649	0.216	1.945
	[Survey=Economic]		-0.052	0.571	0.008	1	0.928	0.95	0.31	2.909
	[Survey=Environmental]		-0.726	0.559	1.684	1	0.194	0.484	0.162	1.448
	[Survey=Social]		0[b]	.	.	0	.	.	.	.
Unsure	Intercept		-1.328	0.971	1.872	1	0.171			
	[Place of birth=1]	Yes (Born in GLD)	0.565	0.618	0.837	1	0.36	1.76	0.524	5.908
	[Place of birth=2]	No	0[b]	.	.	0	.	.	.	.
	[Residence time=0]	Does not live in GLD	1.716	1.227	1.957	1	0.162	5.564	0.502	61.611
	[Residence time=1]	0-5 years	1.017	0.904	1.266	1	0.261	2.766	0.47	16.273
	[Residence time=2]	6-10 years	0.16	1.048	0.023	1	0.879	1.173	0.151	9.14
	[Residence time=3]	11-40 years	1.176	0.815	2.084	1	0.149	3.242	0.657	16.005
	[Residence time=4]	More than 40 years	0[b]	.	.	0	.	.	.	.

Table F.12. Continuation

Q8[a]	Factor	Categories	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
	[Place of residence=0]	Does not live in GLD	-0.903	1.052	0.738	1	0.39	0.405	0.052	3.183
	[Place of residence=1]	Metropolitan area	0.109	0.473	0.053	1	0.818	1.115	0.441	2.816
	[Place of residence=2]	Non metropolitan area	0[b]	.	.	0	.	.	.	.
	[Age=1]	18-25 years	0.973	0.766	1.616	1	0.204	2.647	0.59	11.869
	[Age=2]	26-35 years	0.793	0.7	1.285	1	0.257	2.211	0.561	8.719
	[Age=3]	36-45 years	1.297	0.733	3.127	1	0.077	3.657	0.869	15.388
	[Age=4]	46-55 years	-0.163	0.685	0.057	1	0.811	0.849	0.222	3.252
	[Age=5]	56-65 years	-0.022	0.694	0.001	1	0.975	0.979	0.251	3.815
	[Age=6]	Over 66 years	0[b]	.	.	0	.	.	.	.
	[Gender=1]	Male	0.053	0.393	0.018	1	0.892	1.055	0.488	2.277
	[Gender=2]	Female	0[b]	.	.	0	.	.	.	.
	[HighEduc=1]	Other education	0.271	0.375	0.525	1	0.469	1.312	0.629	2.734
	[HighEduc=2]	Higher education	0[b]	.	.	0	.	.	.	.
	[Survey=Cultural]		-0.631	0.504	1.567	1	0.211	0.532	0.198	1.429
	[Survey=Economic]		-0.21	0.524	0.161	1	0.688	0.81	0.29	2.262
	[Survey=Environmental]		-0.51	0.496	1.057	1	0.304	0.601	0.227	1.588
	[Survey=Social]		0[b]	.	.	0	.	.	.	.

a. The reference category is: Yes.

b. This parameter is set to zero because it is redundant.

Note: B = coefficient; SE = standard error; Wald = Wald chi-square value; Sig = 2-tailed p-value used in testing the null hypothesis that the coefficient (parameter) is 0; Exp(B) = odds ratio.

Appendix G. Non-significant spatial correlations between development options and values

Table G.1. Correlation coefficient (*r*) between the No Future Development option and cultural values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	No Future Development	Appreciation for nature	Natural and Human History	Sacred
No Future Development	1.000			
Appreciation for nature	.535*	1.000		
Natural and Human History	.565*	.726*	1.000	
Sacred	.428*	.697*	.680*	1.000

Table G.2. Correlation coefficient (*r*) between the No Future Development option and economic values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	No Future Development	**Commercial Fisheries**	**Commercial Shipping**	**Industry**	**Ports**	**Recreational business**	**Tourism**
No Future Development	1.000						
Commercial Fisheries	.505*	1.000					
Commercial Shipping	.222*	.306*	1.000				
Industry	.332*	.153*	.392*	1.000			
Ports	.301*	.370*	.535*	.367*	1.000		
Recreational business	.459*	.437*	.329*	.397*	.561*	1.000	
Tourism	.526*	.482*	.317*	.371*	.534*	.768*	1.000

Table G.3. Correlation coefficient (*r*) between the No Future Development option and environmental values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	No Future Development	**Bird habitat**	**Fish habitat**	**Harbour health**	**Wildlife habitat**	**Turtle/dugong habitat**
No Future Development	1.000					
Bird habitat	.659*	1.000				
Fish habitat	.633*	.622*	1.000			
Harbour health	.569*	.756*	.686*	1.000		
Wildlife habitat	.638*	.674*	.640*	.649*	1.000	
Turtle and dugong habitat	.472*	.600*	.615*	.672*	.544*	1.000

Table G.4. Correlation coefficient (*r*) between the No Future Development option and social values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	No Future Development	Camping	Existence	Future generations	Good memories	Important for community	Other recreation	Recreational fishing	Scenery
No Future Development	1.000								
Camping	.508*	1.000							
Existence	.564*	.676*	1.000						
Future generations	.498*	.696*	.796*	1.000					
Good memories	.472*	.714*	.736*	.780*	1.000				
Important for community	.524*	.684*	.794*	.801*	.764*	1.000			
Other recreation	.471*	.768*	.718*	.739*	.731*	.743*	1.000		
Recreational fishing	.557*	.656*	.751*	.672*	.678*	.716*	.671*	1.000	
Scenery	.520*	.753*	.783*	.762*	.778*	.764*	.790*	.727*	1.000

Table G.5. Correlation coefficient (*r*) between the Residential Development option and cultural values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Residential Development	**Appreciation for nature**	**Natural and Human History**	**Sacred**
Residential Development	1.000			
Appreciation for nature	.413*	1.000		
Natural and Human History	.421*	.726*	1.000	
Sacred	.365*	.697*	.680*	1.000

Table G.6. Correlation coefficient (*r*) between the Residential Development option and economic values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Residential Development	Commercial Fisheries	Commercial Shipping	Industry	Ports	Recreational business	Tourism
Residential Development	1.000						
Commercial Fisheries	.072*	1.000					
Commercial Shipping	.113*	.306*	1.000				
Industry	.330*	.153*	.392*	1.000			
Ports	.237*	.370*	.535*	.367*	1.000		
Recreational business	.372*	.437*	.329*	.397*	.561*	1.000	
Tourism	.388*	.482*	.317*	.371*	.534*	.768*	1.000

Table G.7. Correlation coefficient (*r*) between the Residential Development option and environmental values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Residential Development	**Bird habitat**	**Fish habitat**	**Harbour health**	**Wildlife habitat**	**Turtle/dugong habitat**
Residential Development	1.000					
Bird habitat	.460*	1.000				
Fish habitat	.139*	.622*	1.000			
Harbour health	.338*	.756*	.686*	1.000		
Wildlife habitat	.255*	.674*	.640*	.649*	1.000	
Turtle and dugong habitat	.222*	.600*	.615*	.672*	.544*	1.000

Table G.8. Correlation coefficient (*r*) between the Residential Development option and social values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Residential Development	**Camping**	**Existence**	**Future generations**	**Good memories**	**Important for community**	**Other recreation**	**Recreational fishing**	**Scenery**
Residential Development	1.000								
Camping	.457*	1.000							
Existence	.395*	.676*	1.000						
Future generations	.375*	.696*	.796*	1.000					
Good memories	.396*	.714*	.736*	.780*	1.000				
Important for community	.381*	.684*	.794*	.801*	.764*	1.000			
Other recreation	.369*	.768*	.718*	.739*	.731*	.743*	1.000		
Recreational fishing	.341*	.656*	.751*	.672*	.678*	.716*	.671*	1.000	
Scenery	.379*	.753*	.783*	.762*	.778*	.764*	.790*	.727*	1.000

Table G.9. Correlation coefficient (*r*) between the Residential Development option and cultural values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Tourism Development	Appreciation for nature	Natural and human history	Sacred
Tourism Development	1.000			
Appreciation for nature	.550*	1.000		
Natural and human history	.565*	.726*	1.000	
Sacred	.457*	.697*	.680*	1.000

Table G.10. Correlation coefficient (*r*) between the Residential Development option and economic values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Tourism Development	Commercial Fisheries	Commercial Shipping	Industry	Ports	Recreational business	Tourism
Tourism Development	1.000						
Commercial Fisheries	.523*	1.000					
Commercial Shipping	.240*	.306*	1.000				
Industry	.316*	.153*	.392*	1.000			
Ports	.316*	.370*	.535*	.367*	1.000		
Recreational business	.472*	.437*	.329*	.397*	.561*	1.000	
Tourism	.534*	.482*	.317*	.371*	.534*	.768*	1.000

Table G.11. Correlation coefficient (*r*) between the Residential Development option and environmental values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Tourism Development	Bird habitat	Fish habitat	Harbour health	Wildlife habitat	Turtle and dugong habitat
Tourism Development	1.000					
Bird habitat	.628*	1.000				
Fish habitat	.640*	.622*	1.000			
Harbour health	.544*	.756*	.686*	1.000		
Wildlife habitat	.652*	.674*	.640*	.649*	1.000	
Turtle and dugong habitat	.471*	.600*	.615*	.672*	.544*	1.000

Table G.12. Correlation coefficient (*r*) between the Residential Development option and social values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Tourism Development	**Camping**	**Existence**	**Future generations**	**Good memories**	**Important for community**	**Other recreation**	**Recreational fishing**	**Scenery**
Tourism Development	1.000								
Camping	.523*	1.000							
Existence	.566*	.676*	1.000						
Future generations	.507*	.696*	.796*	1.000					
Good memories	.485*	.714*	.736*	.780*	1.000				
Important for community	.522*	.684*	.794*	.801*	.764*	1.000			
Other recreation	.492*	.768*	.718*	.739*	.731*	.743*	1.000		
Recreational fishing	.554*	.656*	.751*	.672*	.678*	.716*	.671*	1.000	
Scenery	.531*	.753*	.783*	.762*	.778*	.764*	.790*	.727*	1.000

Table G.13. Correlation coefficient (*r*) between the Industrial Development option and cultural values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Industry Development	Appreciation for nature	Natural and human history	Sacred
Industry Development	1.000			
Tourism Development	.335*	1.000		
Appreciation for nature	.377*	.726*	1.000	
Natural and human history	.253*	.697*	.680*	1.000

Table G.14. Correlation coefficient (*r*) between the Industrial Development option and economic values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Industry Development	Commercial Fisheries	Commercial Shipping	Industry	Ports	Recreational business	Tourism
Industry Development	1.000						
Commercial Fisheries	.112*	1.000					
Commercial Shipping	.132*	.306*	1.000				
Industry	.424*	.153*	.392*	1.000			
Ports	.192*	.370*	.535*	.367*	1.000		
Recreational business	.311*	.437*	.329*	.397*	.561*	1.000	
Tourism	.320*	.482*	.317*	.371*	.534*	.768*	1.000

Table G.15. Correlation coefficient (*r*) between the Industrial Development option and environmental values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Industry Development	Bird habitat	Fish habitat	Harbour health	Wildlife habitat	Turtle and dugong habitat
Industry Development	1.000					
Bird habitat	.467*	1.000				
Fish habitat	.265*	.622*	1.000			
Harbour health	.402*	.756*	.686*	1.000		
Wildlife habitat	.269*	.674*	.640*	.649*	1.000	
Turtle and dugong habitat	.273*	.600*	.615*	.672*	.544*	1.000

Table G.16. Correlation coefficient (*r*) between the Industrial Development option and social values. Coefficients over ±0.7 were considered significant (bold font). *Correlation is significant at the 0.01 level (2-tailed).

	Industry Development	**Camping**	**Existence**	**Future generations**	**Good memories**	**Important for community**	**Other recreation**	**Recreational fishing**	**Scenery**
Industry Development	1.000								
Camping	.309*	1.000							
Existence	.350*	.676*	1.000						
Future generations	.307*	.696*	.796*	1.000					
Good memories	.296*	.714*	.736*	.780*	1.000				
Important for community	.343*	.684*	.794*	.801*	.764*	1.000			
Other recreation	.256*	.768*	.718*	.739*	.731*	.743*	1.000		
Recreational fishing	.308*	.656*	.751*	.672*	.678*	.716*	.671*	1.000	
Scenery	.280*	.753*	.783*	.762*	.778*	.764*	.790*	.727*	1.000