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# Design and implementation of social surveys for Regional Report Cards in the Great Barrier Reef catchment

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# Executive summary

Great Barrier Reef (GBR) Regional Report Cards play a critical role in communication and engagement within regional communities, assisting collaborative efforts to improve waterway health, from the catchment to the Reef. Regional Report Card partnerships produce an annual report card, focused primarily on ecosystem health within their component (regional) waterways. The Report Cards contribute to the objectives of the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan)[1], and the establishment of the partnerships represents a foundational activity, to provide monitoring and evaluation for adaptive management. In recent years, their reporting has expanded to include metrics relating to urban water management, and for some regions, has encompassed cultural heritage value condition, socio-economic condition, and the extent of litter pollution. However, a notable gap in monitoring and reporting for Reef 2050 Plan objectives has been the "human dimension" components linked to GBR regional waterways, i.e., the economic, social, cultural and governance attributes of the social-ecological system, their condition and trend, and their causal linkages with biophysical attributes and processes across the GBR and its catchment. Efforts to address human dimension monitoring and assessment gaps have been ongoing, prior to and since the Reef 2050 Plan came into effect in 2015. This has included the design of monitoring frameworks (e.g. Gooch et al. 2019) and the evolution of monitoring programs to contribute to the Reef 2050 Plan Integrated Monitoring and Reporting Program[2] (e.g. SELTMP[3], Paddock to Reef social monitoring[4]).

Regional Report Card partnerships can make a valuable contribution to monitoring and reporting of human dimensions of waterway health. Recognition of this potential by Reef managers, scientists, and by the partnerships themselves led to a program of collaborative work to identify relevant human dimension indicators for monitoring at the regional scale, from October 2020 to June 2021. The outcomes of this work, facilitated by the Office of the Great Barrier Reef (OGBR) and Alluvium Consulting, included the identification of shared goals and objectives of such monitoring, a shared understanding and definition for human dimension indicators, and a preliminary framework for indicator categorisation (Alluvium 2021).

This report documents the process of operationalising some of the identified Regional Report Card human dimension indicators of waterway health, via social surveys that were co-designed by representatives from the Regional Report Card partnerships, management agency staff from OGBR and the Great Barrier Reef Marine Park Authority (GBRMPA), and scientists from CSIRO. Through a series of workshops between August and November 2021 survey metrics were designed, and then implemented via an online survey in November and December 2021 that resulted in a baseline sample of 1877 respondents from four Report Card regions. To facilitate replication of this data collection for cost-effective long-term monitoring, a description of the co-design and implementation process is provided in this report.

[1] Reef 2050 Plan available at: https://www.awe.gov.au/parks-heritage/great-barrier-reef/long-term-sustainability-plan

[2] RIMReP overview description available at: https://www.gbrmpa.gov.au/our-work/reef-strategies/reef-integrated-monitoring-and-reporting-program

[3] SELTMP homepage and data dashboards available at: https://research.csiro.au/seltmp/

[4] Paddock to Reef program social monitoring fact sheet: https://www.reefplan.qld.gov.au/__data/assets/pdf_file/0030/95268/social-monitoring-fact-sheet.pdf

Survey metrics that emerged from the co-design process were categorised into four broad themes: (i) waterway ***uses, benefits and values***, (ii) waterway ***perceptions*** (e.g. perceptions of the beauty, health, problems, and threats associated with regional waterways), (iii) waterway ***stewardship*** (e.g. including participation in actions, and enablers and barriers to participation), and (iv) waterway ***governance*** (e.g. including perceived effectiveness of governance, community participation in governance and trust in management institutions). In this report we present summary results, with some basic statistical comparisons, from the four participating regions, noting that further in-depth analyses for each region will be reported elsewhere, involving and/or led by the individual Regional Report Card partnerships themselves.

Key findings presented in this report from the baseline dataset include a description of the relative use levels of different waterway habitat types within each region, by local residents, including visitation to *freshwater systems*, *estuaries*, the *coastal and inshore marine region*, and *offshore marine region*. The most popular recreation activities in and around regional waterways included *swimming*, *picnics and barbecues*, *wildlife watching and nature appreciation*, *exercising*, and *fishing*. Differences between regions in the popularity of certain recreation activities were notable (e.g. *fishing* was much more popular in the Mackay-Whitsunday-Isaac region, compared with other regions). The highest-rated personal benefits derived from regional waterways included *experiencing nature*, *social opportunities*, and *lifestyle and recreational opportunities*. Across all regions, the highest rated non-monetary values associated with waterways included *supporting biodiversity*, *supporting local recreation*, *existence* value, and *scientific heritage* value.

Across all regions, *freshwater* and *coastal habitats* were perceived to be in *good* to *fair* health by the majority of respondents, while a higher proportion of respondents perceived the health of local *seagrass habitats* and *inshore coral reefs* to be *poor*. Across all regions, the greatest problems perceived to be affecting the health of waterways were *litter and debris*, *chemical pollutants*, *weeds* in and around waterways, *invasive fishes*, *riverbank erosion*, and *coastal erosion*. The greatest threats to regional waterways perceived by respondents across all regions included *climate change*, *land clearing*, *land-based runoff*, *illegal fishing practices*, and *mining activities*. Self-reported participation levels in various waterway stewardship activities were varied, with the highest reported participation in activities requiring the least effort (e.g. appropriate *rubbish disposal*, *responsible fishing*, and *responsible boating* practices). Most respondents shared a *sense of personal responsibility*, and *wanted to do more* to help improve the health of regional waterways; however, a large proportion indicated that they *didn't know how*, and that they *did not have enough time* to contribute to improving waterway health.

Across all regions, overall satisfaction with waterway management was low. Mean rating scores indicated that various industry sectors' use of waterways is perceived to be *not well managed* (e.g. including agriculture, fisheries, aquaculture, ports and shipping, and tourism). Survey respondents gave similarly low rating scores indicating that they *did not feel able to influence*, or *have input to the management* of waterways. *Trust in the science about waterway health* was slightly higher than *trust in the information from management institutions* for regional waterways (e.g. local council, QLD Government, GBRMPA), however the mean scores for both of these metrics were low, suggesting substantial challenges faced by institutions working to improve waterway health in the Great Barrier Reef catchment region.

To facilitate collaboration and build trust in the data, the complete data set has been published in an open-access persistent online repository, and a pilot interactive online data visualisation dashboard has been developed to enable public exploration and visualisation of the dataset and results. At the conclusion of this report we offer a number of practical recommendations for consistent replication of this monitoring.

# 1 Introduction

The Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan; Australian Government 2021) provides the overarching framework for management and protection of the Great Barrier Reef (GBR, the Reef), from 2015 to 2050. The Reef 2050 Plan lays out a set of 20 objectives that, if achieved, will enable realisation of the Plan's vision and outcome of 'Healthy Reef, Healthy People' within its timeframe. Each objective is underpinned by a series of indicators, to enable the assessment of progress towards the objective. The information contributing to these indicators is drawn from a diverse range of monitoring programs. While most objectives refer to a desired state of biophysical values and processes (e.g. for key habitats, ecological communities, and populations of Reef species), five of them refer to 'human dimensions' of the GBR social-ecological system, i.e. the economic, social, cultural and institutional factors that characterise and influence people's relationship with the Reef (Gooch et al., 2019). These human dimension objectives in the current Reef 2050 Plan are:

1. 'Uses of the Reef are ecologically sustainable as the system changes, in turn sustaining economic and social benefits.
2. People maintain or grow their attachment to the Great Barrier Reef.
3. People and communities take individual and collective action to maintain Reef resilience.
4. Intangible and tangible historic heritage and cultural heritage and contemporary cultural values remain intact.
5. Governance systems are inclusive, coherent and adaptive' (Australian Government 2021).

Additional Reef 2050 Plan objectives include the protection of Indigenous cultural heritage, improving recognition of Traditional Owners' rights, and the empowerment of Traditional Owners in Reef management and custodianship. Indicators to address these objectives are detailed in a separate monitoring framework: '*Strong Peoples – Strong Country'* (Jarvis et al., 2019), and dedicated monitoring programs are underway to provide the relevant information for their assessment[5].

To date, monitoring to address indicators for the above five human dimension objectives remains limited; however, efforts are underway to fill critical monitoring gaps, with resourcing provided by the Reef Trust Partnership (RTP), under its Integrated Monitoring and Reporting Component[6]. One of the few dedicated, long-term human dimension monitoring programs is the *Social and Economic Long-Term Monitoring Program* (SELTMP) for the GBR. SELTMP has collected large-scale surveys of GBR communities in 2013, 2017 and 2021, and the original four-year interval between these surveys has been reduced to two-years (with funding provided by the RTP from 2020-2024)

[5] More information is available at: https://www.barrierreef.org/uploads/GRB5162-Fact-Sheet-3-AW4.pdf

[6] RTP IMR website: https://www.barrierreef.org/what-we-do/reef-trust-partnership/integrated-monitoring-and-reporting

to enable greater sensitivity and responsiveness of its metrics to understand the effects of significant events in the GBR region (e.g. societal and/or ecological shocks). The key objectives of SELTMP, updated in 2020, are to:

- Monitor changes in community attitudes towards the GBR, its values and management, and the perceived threats to those values
- Predict attitudinal and behavioural responses to future management interventions in the Reef, and changes in Reef health
- Monitor changes in social and economic well-being of Reef-dependent communities and the benefits they derive from the GBR
- Assess and monitor social and economic vulnerability, and adaptive capacity of GBR communities to changes in Reef condition & the wider system (cf. Hobman et al., 2022).

While SELTMP's *core module* is largely focussed on human dimension attributes of the GBR's marine environment, this *supporting module* ('*Integrated Regional Report Card Human Dimension Monitoring'*) was funded from July 2020 to June 2022 to address an identified monitoring gap for Regional Report Card partnerships in the GBR catchment. Additional social monitoring relevant to agriculture in the GBR catchment is undertaken as part of the *Paddock to Reef Integrated Monitoring, Modelling and Reporting Program*[7] (Paddock to Reef program). This monitoring contributes to evaluating progress towards the *Reef 2050 Water Quality Improvement Plan* (Reef 2050 WQIP)[8] targets, and includes tracking the uptake of agricultural management best practices. Since 2019, this social monitoring has utilised a consistent set of social metrics to assess factors that influence the adoption of particular management practices in different agricultural sectors. These social metrics are linked to land management indicators that apply to an industry-specific risk framework for water quality, and they include attitudes, group norms, perceived behavioural control, motivations, and perceived barriers to practice uptake. These social monitoring data are used to:

- provide project managers and extension staff with a clear understanding of participants' attitudes and motivations associated with involvement in government funded projects, as well as barriers to practice uptake/change
- inform adaptive management of projects, and the design of tailored communications material for landholders
- develop a quantitative measure of a range of social factors that are related to innovation and stewardship
- inform the ongoing progress of agricultural communities
- align with Regional Report Cards to include indicators of social factors that influence adoption.

[7] Further information about *Paddock to Reef* is available at: https://www.reefplan.qld.gov.au/tracking-progress/paddock-to-reef

[8] Further information about the *Reef 2050 WQIP* is available at: https://www.reefplan.qld.gov.au/water-quality-and-the-reef/the-plan

## 1.1 Foundational work to identify human dimension indicators for Regional Report Cards (2020–21)

Regional Report Cards, delivered by 'partnerships' representing major regions of the GBR catchment, provide regional scale monitoring and evaluation that contributes to evaluation of progress towards the objectives of the Reef 2050 Plan[9]. These reporting frameworks are to an extent region-specific, but have a range of overlapping indicators, including those encompassing human dimension components.

Prior to the commencement of this SELTMP supporting module, attempts had been made by some of the report cards to use SELTMP 2017 GBR survey data in a trial to report on some of these indicators (e.g. Healthy Rivers to Reef Partnership 2018). However, it was soon recognised that the SELTMP 2017 sampling design and focus on the marine environment did not provide adequate sub-regional resolution, nor the region-specific data that was required. Technical Working Group discussions in 2018 and 2019 identified a need for regionally focussed and coordinated human dimension monitoring, and it was noted that future iterations of SELTMP could be adapted to address some of these requirements.

Additional foundational work, led by OGBR and Alluvium Consulting, brought together representatives of the regional partnerships, social scientists and other experts in a series of workshops from October 2020 to June 2021, to identify and prioritise human dimension indicators most relevant to the Regional Report Cards (Alluvium 2021). Outcomes of these workshops included a shared understanding of what constitutes a 'human dimension indicator', the identification of mutual objectives for such monitoring involving the regional partnerships, and a preliminary organisational framework for categorising such indicators (see Table 1 below).

[9] For more information about Regional Report Card partnerships, visit: https://www.reefplan.qld.gov.au/tracking-progress/regional-report-cards

**Table 1 Summary of proposed human dimension objectives, indicators, and constructs relevant to Regional Report Cards in the Great Barrier Reef catchment [reproduced from Alluvium 2021, p.4]**

| Objective – Why are we doing this? | Indicator - What are we going to monitor? | Construct - How are we going to measure it? |
|---|---|---|
| **Uses, Benefits and Values**<br><br>*To monitor how people and communities use, value and benefit from (including social, economic and cultural benefits and values) regional waterways.* | Usability and access of waterways | Visitor frequency by demographics |
| | | Waterway usage frequency by demographics |
| | Overall Satisfaction with waterways | Satisfaction with waterway use |
| | | Equitable access to waterways |
| | | Aesthetic perceptions of waterways |
| | Overall place attachment to waterways | Place attachment to waterways |
| | | Number and type of community driven waterway management events (e.g., clean up days, tree planting) |
| | Contribution of waterways to community well being | Wellbeing derived from waterways. |
| | Contribution of waterways to regional economy | Number of employees in healthy waterway dependent industries |
| | | Number of healthy waterway dependent businesses |
| | | Value of healthy waterway dependent industry sectors |
| | Economic value of waterway dependent ecosystem services | Non-use value of waterway dependent ecosystem services |
| **Stewardship and Best Management Practice**<br><br>*To monitor people and communities engagement and participation in regional waterways stewardship (including best management practice), as well as the enablers of stewardship* | Participation in local stewardship and adoption of best practice | Presence and level of participation in citizen science |
| | | Presence and level of participation in waterway focused voluntary community organisations |
| | | Personal stewardship actions |
| | | Existence of stewardship and best management programs |
| | | Adoption of best management practice - agriculture |
| | | Adoption of best management practice - urban sector |
| | | Adoption of best management practice - ports and other industries |
| | Enablers of stewardship | Willingness and capacity to undertake stewardship actions |
| **Governance**<br><br>*To monitor people and communities perceptions related to regional waterway health and waterway management, as well as their contributions to regional waterway management.* | Community sentiment towards waterway management | Trust in the institutions managing waterways |
| | | Support, awareness of, satisfaction with and confidence in defined management (e.g., Reef 2050, WQIPs) |
| | Sectorial/community contributions to waterway management | Perceived opportunity for community participation in waterway management |
| | | Sectorial/community contributions to decision making |
| | Overall perceptions of waterway health/condition | Perception of waterway health/ environmental condition |
| | | Perceptions of threats to waterways (both severity and nominating top 3 threats) |
| | Climate change perceptions | Support for strategies/policies aimed at mitigating climate change |
| | | Perceived impact of climate change on wellbeing and livelihood. |

## 1.2 Objectives of this project

This technical report is a key output from the SELTMP Supporting Module B: 'Integrated Regional Report Card Human Dimension Monitoring' (July 2020 to June 2022). Building on the foundational work described above, and in collaboration with the Regional Report Card partnerships, this project sought to:

1. Design regionally appropriate metrics and a survey instrument(s) that will address relevant Reef 2050 Plan human dimension indicators, including those identified in the 2020-2021 workshops (Alluvium 2021).
2. Collect a baseline dataset using the above survey instrument(s) that can be replicated in a long-term monitoring program.
3. Enhance the Regional Report Card partnerships' capacity to continue the long-term data collection and reporting on regionally relevant human dimensions indicators, to meet their report card and other communication needs, and contribute to monitoring and assessment for the Reef 2050 Plan.

Additional outcomes required of the design and implementation processes included:

- Fit-for-purpose and robust metrics that are consistent with relevant scientific theories and frameworks.
- An agreed subset of 'common core metrics' that can enable comparisons between regions, and with other GBR human dimension monitoring programs (e.g. SELTMP core module, Paddock to Reef), and an improved understanding of public perceptions of waterway condition and threats, that in turn, can be used to inform targeted community engagement and education, and management actions at regional scales.
- Data collection procedures and data governance to enable reliable ongoing use and confidence in the data and results.
- Methods and protocols documented for consistent replication.

In this report we document the process leading to the successful achievement of the above project objectives and outcomes, and provide the relevant contextual information to facilitate ongoing monitoring, and appropriate use of the data by the Regional Report Card Partnerships and other end-users.

## 1.3 Scope and limitations of social surveys

It is important to note that this project was able to address and implement *some* of the human dimension indicators identified in the Reef 2050 Plan and the 2020–21 Alluvium workshops, i.e., those indicators that able to be addressed using self-administered questionnaires (or 'social surveys', as utilised by the SELTMP core module). This method enables reliable monitoring of a wide range of 'subjective' indicators and metrics that encompass people's values, perceptions, attitudes and beliefs, that are relevant to natural resource management and benchmarking of key

performance indicators (Pascoe et al., 2016; Marshall et al., 2016; Marshall et al., 2018). In addition, such survey methods can provide useful information for:

- Evaluating management effectiveness and community support for management policies and initiatives (including institutional trust and 'social licence'; e.g. MacKearcher et al., 2018; Taylor et al., 2019)
- Assessing social impacts of disturbance events (e.g. natural disasters, societal shocks) and potential changes in community attitudes, perceptions, and values for natural resources and policies (e.g. Marshall et al., 2019a; Curnock et al., 2019; Thiault et al., 2021)
- Helping to identify more effective ways of engaging strategically and communicating purposefully with communities to leverage effective natural resource management outcomes (e.g. Gurney et al., 2017; Marshall et al., 2019b; Thiault et al., 2021; Carter et al., 2021).

While broadly useful, social surveys represent just one method of data collection, and as such, cannot address all the identified human dimension information needs for the Reef 2050 Plan or Regional Report Cards. Social survey data is considered subjective by its nature, and the types of questions that can be asked of respondents are limited, due to a number of human cognitive biases and limitations of human memory (Bryman 2012). For example, while it is possible to ask survey respondents about the frequency with which they conduct certain environmentally friendly behaviours, individual responses are usually inaccurate due to 'social desirability bias', i.e. the tendency for people to over-report behavioural traits that are considered socially desirable (Nederhof 1985). Social surveys are therefore unable to objectively measure and quantify human behaviours, and thus multiple lines of evidence, using data obtained from a range of different methods, are required to assess progress towards the Reef 2050 human dimension objectives effectively.

## 1.4 Project timeframe and resourcing

As noted above, this project ran over two financial years, with the first 12 months (F.Y. 2020–21) dedicated to supporting and contributing to the foundational OGBR-led process and workshops, facilitated by Alluvium (2021). Following this, a process to co-design social survey metrics, develop and pilot the survey instruments, and then plan and execute the data collection, took approximately six months (July to December 2021; described in Section 2 below). Effort subsequent to this (January to June 2022) included data curation, preparation of results (in collaboration with the Regional Partnerships), development of an online data visualisation dashboard (described below), and reporting.

Allocated input from two CSIRO scientists for the project duration amounted to approximately 0.4 FTE per year (averaged); however, additional unallocated input was provided by other CSIRO personnel (scientific, technical and administrative support). In addition, the recent outcomes from the 2020–21 *SELTMP core module* re-design and data collection processes were leveraged, helping to enhance the efficient delivery of this supporting module. Approximately $20k of operational

funding from the SELTMP budget was allocated to a contractor to build the online survey and administer the data collection.

### 1.4.1 Partner contributions

A commitment to the survey co-design process was made by the five Regional Report Card partnerships at its commencement[10]. This included a substantial investment of time by key representatives of each partnership (i.e. the Executive Officer and/or Scientific/Technical Officer, Chairperson, Scientific Panel members), who participated in a series of meetings and workshops, reviewed and prepared resource materials, facilitated reviews of the draft surveys by their management committees and/or partners, and took responsibility for promotion of the survey within their region during the data collection phase (via social media and other advertising). A cash co-investment was granted to each partnership by OGBR ($15k per partnership) for operational support of their data collection.

Contributions from other key partners (staff from OGBR and GBRMPA, and other scientists identified in the acknowledgements section), to workshops and the review of draft metrics and survey instruments was also substantial, and was essential to the achievement of the project outcomes.

[10] We note that while five Regional Report Card Partnerships participated in the co-design process, only four were able to participate in the initial data collection over November-December 2021. The fifth partnership (Gladstone Healthy Harbour Partnership) postponed their data collection until early/mid 2022.

# 2 Survey co-design process and outcomes

## 2.1 Methodology

A broad suite of social science theories, frameworks and methods were applied as 'fit-for-purpose' tools to achieve the project objectives and outcomes. Under a broad banner of *Sustainability Science* (see Kates et al., 2001; Swart et al., 2004; Clark 2007), the application of mixed and integrated methods to generate knowledge, to support decision making for the adaptive management of resources within complex social-ecological systems, is increasingly viewed as appropriate and essential (Ostrom 2007; Clark 2007).

The design of human research surveys in an applied context usually draws on theory and examples from a number of social science disciplines, including psychology, sociology, and marketing research. Self-administered questionnaires (or social surveys) are typically used to make statistical inferences about a defined population of people (e.g. residents within a geographic area), and often employ a variety of demographic variables and self-report scales to elicit consistent responses when repeated, thereby allowing the comparison of response distributions between different groups or cohorts. Assuming the survey measures (metrics; questions) and their wording are reliable, the ability to generalize about the population from the survey results will then depend upon the representativeness and size of the sample (Shaughnessy et al. 2011; Bryman 2012).

The process of designing and/or selecting useful and reliable indicators and metrics for long-term monitoring requires in-depth, expert knowledge of the local context and relevant issues, and a clear understanding of the management objectives and policy framework (Holling 1978; Bell & Morse 1999; Miller & Twining-Ward 2005). Numerous additional criteria are recommended for the screening and selection of indicators and metrics. For example, they should:

- be specific, clear, and simple to understand
- be measurable in a quantitative sense
- relate to an achievable/realistic and relevant target, or desired state
- be sensitive to change, and enable the timely detection of trends (Harger & Meyer 1996; Guy & Kilbert 1998; Bell & Morse 1999).

Identifying appropriate indicators and metrics for long-term monitoring in natural resources management requires broad input and review to incorporate the diversity of end-user and stakeholder perspectives and needs. Stakeholder participation is therefore critical, and requires an appropriate participatory process to achieve optimal outcomes (Holling 1978; Grimble & Wellard 1997; Bell & Morse 2003).

### 2.1.1 Our approach

In this project, principles of *Participatory Action Research* (cf. Argyris & Schön 1989; McTaggart 1991; Baum et al., 2006) were applied in the collaborative design (co-design) of metrics and survey instruments with each Regional Report Card partnership. Such principles, as applied in this project, included:

- The research process was intended to generate or enable specific actions or outcomes.
- The researcher(s) facilitated the process, and they also became a partner in a shared learning process with other participants.
- The process included a focus on understanding local context and building/strengthening social relationships.
- The process was iterative and reflective, leading to discovery of mutual objectives and beneficial outcomes.
- Intended outcomes of the process included the empowerment of participants to lead and apply the learnings (McTaggart 1991; Baum et al., 2006).

Effective record keeping, transparency, frequent communication (primarily via email), and sharing of resources between regional partnerships was another key feature of the co-design process. An online file sharing platform (DropBox™) was used for organisation, storage and sharing of all reference materials, workshop outputs, draft surveys, and the comments and input contributed by all participants. Continued use of the same online platform after data collection enabled similarly effective sharing of the database and preliminary results.

While representatives of each regional partnership were focussed on building and editing their own survey metrics and instruments, the draft works from other regions were available to be viewed by all throughout the process, and ideas were frequently shared. Organic engagement between the partnerships, and sharing of emergent ideas and examples, was a boon for efficiency, resulting in leapfrogging, rather than parallel (and repetitive) problem solving.

## 2.2 Timeline and activities

A timeline of the key steps and activities in the survey co-design process is presented below (Table 2).

**Table 2 Co-design process and timeline for Regional Report Card social surveys**

| STEP | | DATE(S) | ACTIVITY |
|---|---|---|---|
| **1.** | **Process planning** | July 2020 to August 2021 | Strategic engagement with key partners, review of literature and monitoring metrics relevant to Reef 2050 Plan and Alluvium (2021) report, preparation of supporting materials, workshop scheduling. |
| **2.** | **Kick-off workshop** | 16 August 2021 | • Introductions of key partners.<br>• Review of background processes and foundational work.<br>• Setting objectives and desired outcomes, scope, and limitations.<br>• Identifying potential end-users and uses.<br>• Overview of proposed process and commitment of key partners.<br>• Review of available resources, setting tasks for commencement.<br>• Q&A. |
| **3.** | **Co-design workshops (one-on-one)** | Mid-August to late October 2021 | A series of 30 'one-on-one' online workshops (i.e. involving representatives from one regional partnership at a time, with CSIRO researchers) were held over ten weeks, focussed on identifying survey metrics relevant to the region.<br>• Establishment of regional waterway zones, relevant context, and key issues to be considered in survey design.<br>• Candidate metrics (survey questions) reviewed and selected/adapted from other example surveys, or in some cases newly designed, to address relevant objectives and indicators from the Reef 2050 Plan and Alluvium (2021) report.<br>• Frequent idea and knowledge sharing between regions (facilitated by researchers + independently between regions), enabled a convergence in understandings of metrics, and efficient problem solving (i.e. via leapfrogging, rather than reinvention). |
| **4.** | **Core metrics review workshop #1** | 27 September 2021 | Participation by representatives of all regional partnerships + management agencies (OGBR, GBRMPA).<br>• Recap on objectives, timeline, process and progress.<br>• Reflections and feedback to date from each Regional Partnership.<br>• Review of common metrics and their alignment to Reef 2050 and Alluvium (2021) indicators + adaptation of the indicator framework.<br>• Begin prioritisation of metrics (noting that a limited number could be deployed in the final survey instrument).<br>• Review forthcoming steps, including approval processes, preparations and roles for data collection. |
| **5.** | **Core metrics review workshop #2** | 12 October 2021 | As above; continued identification, fine-tuning, and prioritisation of 'common core metrics' – completed.<br>• Overview of sampling strategy and task allocation to prepare for data collection.<br>• Interim M&E feedback sought from participants, on the co-design process to date (via short survey, emailed) |
| **6.** | **ISP review & endorsement** | 27 October 2021 | The proposed 'common core' metrics were presented to the Reef 2050 Independent Science Panel for their review feedback and endorsement.<br>• Endorsement received + feedback and recommendations from the ISP were incorporated into several revised metrics. |
| **7.** | **ESC review** | 4 November 2021 | Near-final draft survey instrument (for one region) and sampling strategy were reviewed and noted by the Reef 2050 Executive Steering Committee. |
| **8.** | **Online survey build and pilot testing** | 25 October to 19 November 2021 | • Contractor engaged by researchers to build the online survey.<br>• Comms staff engaged by partnerships to prepare promotional materials<br>• Extensive pilot testing by researchers, partnerships, and end-users.<br>• Multiple rounds of edits and fine-tuning prior to launch. |
| **9.** | **Data collection** | 22 November to 17 December 2021 | Two pathways were used to recruit respondents in each region (online panel participants + advertised recruitment)<br>• Partnerships were responsible for their own advertising and promotion to boost recruitment in their region. |
| **10.** | **Data curation, analysis & reporting** | January to May 2022 | Raw data + updated database versions and preliminary results distributed to partnerships from early January to May.<br>• Final verified database published in persistent online repository.<br>• Online data visualisation dashboards designed, built, and piloted.<br>• Ongoing engagement and assistance provided to partnerships with analyses, interpretation and presentation of results. |

## 2.3 Survey metrics

In this section we describe the key outcome of the co-design process – survey metrics that were deployed in data collection within the participating regions in November and December 2021 (see Appendix A) – and show their alignment to relevant objectives and indicators in the Reef 2050 Plan, and in the Alluvium (2021) framework. The final survey instruments (MS Word™ versions) for each region, along with a copy of the survey dataset, can be downloaded from the CSIRO Data Access Portal[11]. Emerging from the co-design process was an organisational framework, adapted from Alluvium's suggested indicator types (Table 1 above), in which the metrics were categorised under four broad themes:

1. Waterway **uses, benefits, and values**[12]
2. Waterway **perceptions** (of waterway beauty, health, problems, threats)
3. Waterway **stewardship** (self-reported actions, motivation, and capacity)
4. Waterway **governance** (satisfaction, participation, perceived fairness, and trust)

We note that some of the metrics within each of the above categories may be useful for contributing to reportable indices (i.e. with grades) within the Regional Report Cards, while others are intended to provide important context and/or contribute to a descriptive narrative that can support the interpretation of indices or grades[13]. Some of the metrics are considered useful for understanding sub-groups of residents within a region (e.g. recreation groups and/or attitudinal groups) and can therefore provide insights to assist with targeted engagement and communication campaigns. Finally, some metrics were added to assist with monitoring community awareness of the Regional Report Cards and the partnerships themselves.

Below we provide a description the 'common core' metrics that were included in all four regional surveys; however, we note that additional metrics were included in some regions' survey instruments, as they were deemed relevant and important to the specific region. The question numbers for common core metrics remain the same in all survey instruments.

### Use of rating scales and categorical responses

Where appropriate, for several of the core metrics within the surveys, we utilised ten-point Likert-type scales for the following reasons:

1. In social surveys, the highest levels of statistical test-retest reliability and discriminating power are achieved with rating scale lengths between seven and ten points (Preston & Colman 2000).
2. Five and seven-point scales in social surveys are prone to a higher incidence of cross-cultural and response-style biases (Dolnicar et al. 2011; Dawes 2008).

[11] Database and survey instruments available at: https://data.csiro.au/collection/csiro%3A54871v1

[12] Colour coding is used here for ease of visual recognition of the four categories of metrics in subsequent sections and tables.

[13] Noting that a separate process, beyond the scope of this project and report, is required to select appropriate metrics for inclusion in report card grades, and to establish decision rules for grade increments (i.e. what scores constitute an A, B, C, etc.) and confidence levels.

3. For bi-polar constructs (e.g. agree–disagree), even-numbered scales do not provide a mid-point (odd-numbered scales do, which is usually interpreted as a neutral option), and thus they present respondents with a 'forced choice' that is closer to one end of the scale. This can be advantageous, as it enables subsequent analyses to include the aggregation of responses for binary comparisons (Weijters et al., 2010).
4. Methodological experiments comparing survey rating scales of differing lengths have shown that survey respondents' preferences are the highest for 10-point scales (Preston & Colman 2000).

For some types of questions, however, the use of fewer, clearly defined categories as response options is appropriate and necessary. For example, when asking non-experts to provide an assessment of ecosystem health, a 10-point scale can introduce false precision and/or confuse respondents, while the use of simple and unambiguous categories (such as 'poor', 'fair', and 'good') can help to reduce respondents' cognitive burden, and generate more reliable results (Bryman 2012). Categorical response-type questions were therefore used where appropriate, for several of the core metrics, as described in subsequent sections.

Two additional core questions utilised an open-ended text response:

- Q.4: '*What are the first words that come to mind when you think of waterways in the ___ region?*'
- Q.10: '*What is your favourite waterway to visit in the ___ region?*'

These questions were deemed valuable for providing a holistic appraisal of residents' sentiments towards their region's waterways, and were considered useful for community engagement purposes by the regional partnerships.

### 2.3.1 Waterway uses, benefits, and values

These metrics, shown in Section One of the survey instrument (Q.5–12, Appendix A), were designed to quantify relative use levels of different waterways, identify the most popular activities undertaken within them, and elicit a relative measure of respondents' personally derived benefits, and the personal values they hold for waterways within their region of residence. For ease of communication and to elicit relative use levels for different types of waterways within each region, the waterways were grouped into four zones. The zones included:

- ***Freshwater systems***, encompassing all rivers, creeks, freshwater wetlands and dams in the region
- ***Estuaries,*** encompassing the lower reaches of creeks and rivers that are tidal, where salt and freshwater mix, including mangroves and saltmarsh
- ***Coast and inshore marine,*** encompassing inshore marine areas, including the coasts and inner Great Barrier Reef waters and islands
- ***Offshore marine,*** encompassing areas beyond the inner islands to the outer boundary of the Great Barrier Reef Marine Park.

We note that the jurisdictional boundaries of the four Regional Report Cards varied, and in the case of the Fitzroy region, only three zones were used (offshore marine was excluded). Infographic maps were produced by each of the regions, and were used in the online surveys to orientate survey respondents to these zones, prior to answering questions about their use/visitation levels. An example 'orientation' map is provided below (Figure 1). Maps for each region are included in their respective survey instruments.


**Figure 1 Example infographic map used in the Mackay-Whitsunday-Isaac regional survey, depicting four waterway zones of interest within the reporting region [Source: Mackay-Whitsunday-Isaac Healthy Rivers to Reef Partnership, 2021 survey]**

The survey metrics used to measure *benefits* and *values* included a series of items (statements) that were rated by respondents on a ten-point scale (from: 1 = '*very strongly disagree*' to 10 = '*very strongly agree*', and: 1 = '*I don't value this at all*' to '*I value this extremely highly*'). The use of such rating scales enables ranking of the items to understand their relative importance to local residents, and enables the statistical evaluation of differences between regions, and over time periods, for longer-term trend analyses.

Core survey items relating to benefits derived from regional waterways (Q.11, Appendix A) included:

- Their (the waterways') contribution to local residents' quality of life and wellbeing
- Contribution to local residents' lifestyle and recreation

- Contribution to social opportunities (with family and friends)
- Provision of fish and seafood for personal consumption
- Enabling or contributing to cultural practices
- Enabling residents to experience and interact with nature
- Provision of domestic water supply
- Contribution to health and livelihood.

*Place values* are a key motivating factor in people's support for natural resource management policies and conservation initiatives (Ford et al., 2009; Marshall et al., 2019c; Le et al., 2022). Defined as an '*enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence*' (Rokeach 1973, p.5), place values for environmental settings can be highly diverse within a community, while some values can be widely shared among communities at different scales – particularly for iconic ecosystems like the Great Barrier Reef (Gurney et al., 2017; Marshall et al., 2019b,c). Survey items relating to local residents' personal values associated with waterways (and relative importance assigned to non-monetary values; Q.12, Appendix A) included:

- Their (the waterways') value for supporting biodiversity
- Their existence value
- Their value as a setting for local community recreational opportunities
- Their value as a setting for passing down knowledge and traditions
- Their Indigenous cultural heritage values
- Their tourism attraction value
- Their local economic value
- Their scientific heritage value
- Their value for recreational fishing
- Their icon value (i.e. nationally and/or internationally recognised places such as World Heritage Areas)
- Their value to local industry (e.g. agriculture, mining, ports and shipping).

Note that the wording of items/statements in the survey instrument differs to that in the dot points above, to ensure ease of understanding and consistent responses across diverse regional populations.

### 2.3.2 Waterway perceptions

People's perceptions and beliefs about the current state of an environmental setting or place (e.g. whether or not it is healthy and/or aesthetically beautiful), and associated problems and threats to that setting/place, are a key factor in their rational decision making to accept and/or support management objectives and initiatives – such as efforts to improve GBR water quality, or address climate change (Ford et al., 2014; Gobster et al., 2016; Thiault et al., 2021; Le et al., 2022).

The majority of metrics within this category were grouped in Section Two of the survey instrument (Q.13–15, Appendix A), and were designed to elicit residents' perceptions of: (a) the relative ***health*** of seven different habitat types, using simple, mutually exclusive categories (1 = *poor*, 2 = *fair*, 3 = *good*, 4 = '*not applicable (have not visited)*', or 5 = '*I don't know*'; see Q.13), (b) the extent to which particular issues represented a ***problem*** for waterways in the region (12 core items, with categorical responses including: 1 = '*not a problem at all*', 2 = '*a small problem*', 3 = '*a moderate problem*', 4 = '*a big problem*', 5 = '*a very big problem*', and 6 = '*I don't know*'; Q.14), and (c) the extent to which particular issues or factors represented a current ***threat*** to waterways in the region (10 core items, with categories including: 1 = '*does not represent a threat at all*', 2 = '*a minor threat*', 3 = '*a moderate threat*', 4 = '*a serious threat*', 5 = '*represents an extremely serious threat*', and 6 = '*I don't know*'). Issues that were included as core items within these question types were selected collaboratively, with expert advice, based on an in-depth understanding of local context and issues facing waterways in the regions.

The distinction between *problems* and *threats* and the inclusion of both sets of metrics was considered important. *Problems* represented issues that had manifested, with observable effects in waterways, while *threats* represented drivers or causal factors leading to current or imminent problems. It is important to note that public perceptions of environmental threats and problems are highly varied, and such perceptions can (and often do) differ from scientific consensus. Such perceptions can also change over time, and are influenced by high profile disturbance events (e.g. a cyclone, mass coral bleaching, oil spill), media and social representations, and trust in science and governance. Understanding such public perceptions can help to inform communication and engagement strategies that aim to foster public support for management policies or actions (Thiault et al., 2021; Curnock et al., 2019).

One additional metric, included with items in Section One of the survey (Q.11, Appendix A) sought to elicit respondents' ratings of the ***aesthetic beauty*** of their region's waterways: '*The natural beauty of waterways in the ___ region is outstanding*' (rating of agreement on 10-point scale). The wording chosen reflected that of the World Heritage Criterion (vii) for Outstanding Universal Value (OUV), which requires a property to '*contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*' (UNESCO 2021). It is important to note that while this metric provides an indicative measure of community perceptions of regional waterways' aesthetic value (which can change over time), it cannot serve as an objective measure of biophysical characteristics or attributes that contribute to aesthetic value (or OUV) in any specific place or setting. Adequate monitoring of aesthetic values requires different methods and a focus on specific sites or locations (Curnock et al., 2020; Pert et al., 2020), and to date such monitoring has not been implemented within the GBRWHA or its catchment.

### 2.3.3 Waterway stewardship

The selection of metrics in this category was informed by relevant literature (see review by Dyer et al. 2021), and stewardship metrics that had been applied in other programs (e.g. Paddock to Reef social monitoring, SELTMP core survey). Dyer and others' (2021) review of stewardship concepts and contributing factors, relevant to the GBR context, identified three broad, fundamental and interrelated components that contribute to stewardship outcomes: *motivations*, *capacity*, and *action*. An expanded conceptual model of stewardship by Bennett et al. (2018) identifies a number of attributes within these, and other contextual components, some of which can be measured and monitored using social surveys to assist in the evaluation of progress towards stewardship goals in an applied context (see Figure 2 below).

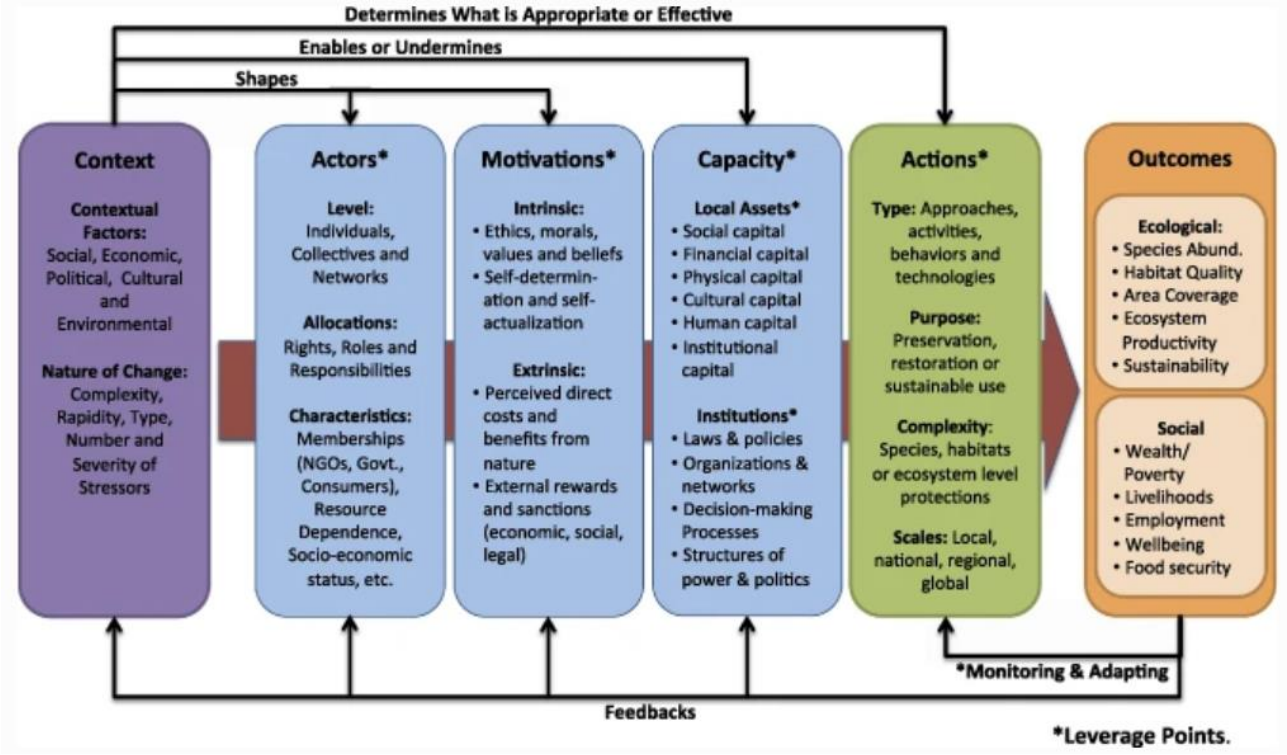



Figure 2 Bennett et al. (2018) analytical framework for local environmental stewardship

In our surveys we used nine core metrics to elicit respondents' stewardship ***actions***, via participation in defined 'environmentally friendly' activities in or around waterways (Q.16, Appendix A), including:

- Responsible anchoring (for respondents who have or use a boat)
- Responsible fishing (for respondents who go fishing)
- Responsible waste disposal
- Reporting suspicious activities to relevant authorities
- Reporting invasive or pest species to relevant authorities
- Contributing to environmental monitoring programs (e.g. citizen science)

- Participating in local environmental clean-ups
- Participating in local environmental restoration
- Responsible four-wheel driving.

Additional metrics were included in the surveys for some regions, specifying environmentally friendly activities in the home setting that can impact local waterways (e.g. see the Townsville Waterways Survey). We note that specific agricultural best practices were not included in the list of stewardship actions, as such items had been utilised in the SELTMP GBR survey, and duplication in this survey was deemed unnecessary.

The question wording and structure sought to identify whether or not the respondent performed the behaviour (Y/N), and if not, relevant reasons that could provide useful insights for waterway managers. Response categories included: 1 = '*I do this*', 2 = '*I don't do this – I was not aware of this action*', 3 = '*I don't do this – I don't think this action is effective*', 4 = '*I don't do this – other reasons (e.g. no opportunities, time, etc.)*', and 5 = '*this is not applicable to me*'.

The subsequent survey question included eight core metrics (Q.17, Appendix A) designed to evaluate factors relevant to respondents' ***motivations*** and ***capacity*** to participate in waterway stewardship, including respondents':

- self-efficacy (i.e. belief that one's own actions are effective)
- outcome expectancy (i.e. hope or belief in the achievability of a goal)
- sense of personal responsibility
- personal motivation/desire to act
- individual capacity (both time and knowledge) to act
- social norms (both *descriptive*: i.e. the belief that other people are taking action, and *injunctive*: i.e. the belief that other people support the action).

The above metrics were presented as a series of first-person statements, to be given a rating by respondents on a 10-point Likert scale (1 = '*very strongly disagree*', 10 = '*very strongly agree*').

In a simple sense, these metrics can be considered to be either *enablers* or *barriers* to local stewardship (e.g. a lack of individual capacity is an obvious barrier). Additional metrics in other sections of the survey should also be considered as relevant ***context*** to respondents' stewardship. For example, we could assume (or hypothesise) that respondents' perceptions of waterway *health*, *problems* and *threats* affecting waterways, and respondents' *trust* in waterway science and management institutions are correlated with participation in stewardship actions, as well as their support for management initiatives to improve waterway health and resilience.

### 2.3.4 Waterway governance

In Section Four of the survey instrument(s), we employed 13 core metrics (Q.18 and 19, Appendix A) to address relevant indicators in the Alluvium (2021) framework and Reef 2050 Plan. Twelve were presented as a series of first-person statements, to be scored on a 10-point agreement rating scale (as per previous metrics), followed by the question: '*any additional comments about waterway management?*' with space provided for open-ended text responses. The core metrics included:

- overall satisfaction with local waterway management
- satisfaction with the management of different industry/sectoral uses of regional waterways (including tourism, agriculture, fisheries, aquaculture, ports and shipping, and where relevant, mining)
- perceived fairness of decision making for waterway management (i.e. procedural fairness)
- perceived fairness of access rights to waterways (i.e. distributive fairness)
- perceived ability to influence local waterway management (i.e. sense of agency, in governance context)
- perceived ability to have input to management processes (i.e. voice, in a governance context)
- trust in the institutions that manage waterways (via a proxy 'trust in information received from such institutions')
- trust in the science about waterway health and management.

Metrics similar to these have been applied in numerous other contexts, including the SELTMP core module survey (see Hobman et al. 2022), and while they are derived from psychology and environmental management literature, they are necessarily adapted to a local context (Bennett & Satterfield 2018). Comparability of such metrics between cases or subjects, however, is important to enable the evaluation of relative performance (i.e. benchmarking), and in this case our metrics closely align with those used in the SELTMP core module, to enable such comparisons.

As noted earlier (Section 1.3), a key limitation of social surveys as a method for monitoring and assessment of governance, is that public perceptions can be highly varied, and do not represent an objective viewpoint. Clearly, multiple methods, lines of evidence and a wide range of reliable data will be essential for comprehensive evaluations, and substantial gaps become apparent in the following section, which shows the alignment of our survey metrics to relevant Reef 2050 Plan objectives and indicators.

Nonetheless, social surveys, and metrics such as those above can provide valuable insights for managers of waterways (e.g. by revealing community groups that feel more/less empowered and/or satisfied with waterway management), and can contribute to performance benchmarking, as well as helping to inform communication and engagement strategies (Bennett 2016).

## 2.4 Alignment of metrics to Reef 2050 objectives and indicators

In the following tables (Tables 3–7) we show how the survey metrics align with and contribute to monitoring of relevant Reef 2050 'human dimension' objectives and indicators. The colour coding scheme from above is used to show the four categories/types of metrics.

**Table 3 Alignment of Regional Report Card social survey metrics to the Reef 2050 Plan objective: 'Uses of the Reef are ecologically sustainable as the system changes, in turn sustaining economic benefits to people'**

| **OBJECTIVE 1:** USES OF THE REEF ARE ECOLOGICALLY SUSTAINABLE AS THE SYSTEM CHANGES, IN TURN SUSTAINING ECONOMIC AND SOCIAL BENEFITS | | |
|---|---|---|
| **REEF 2050 INDICATORS ALIGNED TO ABOVE OBJECTIVE:** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
| **Reef benefits are sustained and maintained within the ecologically sustainable limits of the whole system as it changes for Reef dependent users and industries: recreational and tourism visitors; recreational and commercial fisheries; and research.** | • **Waterway use frequency by zone** (categories of use level for 3 or 4 waterway zones, depending on region)<br>• **Participation in specific recreation activities in waterways** (11 core items, Y/N indicates participation)<br>• **Personal benefits derived from waterways** (12 core items; rating scale indicates level of agreement) | **Q.5–8**<br>**Q.9**<br>**Q.11** |
| Recreational and commercial fishery benefits are sustained and maintained within the ecologically sustainable limits of the whole system as it changes. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| The number of businesses transitioned to green energy and/or using other reef sustaining measures continues to rise. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| **The adoption of environmental best practice for the Reef is increased by agriculture; reef recreational users; industry and urban sector; and marine industries** | • **Participation in specific waterway stewardship behaviours** (9 core items; categories include Y/N response, and reasons for non-participation) | **Q.16** |
| The number of reef-dependent industries with low climate risk/vulnerability ratings is increased. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| Adaptive capacity of Reef users continues to improve. | *Currently out of scope for Regional Report Cards.*<br>• *This indicator is being partly addressed by the SELTMP core module.* | *See Hobman et al. (2022)* |
| Reef-dependent and reef-associated industries are undertaken in ways that protect the health of the Reef. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| Improved economic confidence in the Great Barrier Reef Region. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| **Improved level of knowledge of ecological thresholds.** | • **Perceptions of waterway health** (7 core items representing major habitat types; categories indicate perceived health level)<br>• **Perceptions of waterway problems** (12 core items representing specific issues; rating scale indicates perceived level of problem presented by each issue)<br>• **Perceptions of waterway threats** (11 core items representing specific potential threats; categories indicate perceived threat level) | **Q.13**<br>**Q.14**<br>**Q.15** |

Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

**Table 4 Alignment of Regional Report Card social survey metrics to the Reef 2050 Plan objective: 'People maintain or grow their attachment to the Great Barrier Reef'**

| **OBJECTIVE 2:** PEOPLE MAINTAIN OR GROW THEIR ATTACHMENT TO THE GREAT BARRIER REEF | | |
|---|---|---|
| **REEF 2050 INDICATORS ALIGNED TO ABOVE OBJECTIVE:** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
| **Community health, wellbeing, satisfaction associated with the Great Barrier Reef is maintained or improved.** | • **Personal benefits derived from waterways** (12 core items; rating scale indicates level of agreement)<br>• **Proportion of household income dependent on regional waterways** (categories indicate income dependence)<br>• **Perceptions of waterway health** (7 core items representing major habitat types; categories indicate perceived health level)<br>• **Satisfaction with waterway management and sense of agency** (12 core items; rating scale indicates level of agreement) | **Q.11**<br>**Q.20**<br>**Q.13**<br>**Q.18** |
| **For (i) Great Barrier Reef region residents**, (ii) the Australian public, and (iii) International community: | *NB. Scope for Regional Report Cards is limited to GBR region residents (within specific regions).* | |
| **Wellbeing and satisfaction associated with the Great Barrier Reef is maintained or improved.** | • **As above** (four broad metrics each with multiple core items) | **As above** |
| **Attachment and identity associated with the Reef is maintained or improved.** | • **Place attachment** ('*The waterways in my region are an important part of why I choose to live here'*; rating of agreement) | **Q.11** (item within) |
| **Pride in the Reef is maintained or improved.** | • **Pride in waterways** ('*I am proud of the local waterways in my region'*; rating of agreement) | **Q.11** (item within) |
| **Non-use values for the Reef are maintained or improved.** | • **Personal values associated with waterways** (12 core items; rating scale indicates extent to which attribute is valued) | **Q.12** |

Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

**Table 5 Alignment of Regional Report Card social survey metrics to the Reef 2050 Plan objective: 'People and communities take individual and collective action to maintain Reef resilience'**

| **OBJECTIVE 2:** PEOPLE AND COMMUNITIES TAKE INDIVIDUAL AND COLLECTIVE ACTION TO MAINTAIN REEF RESILIENCE | | |
|---|---|---|
| **REEF 2050 INDICATORS ALIGNED TO ABOVE OBJECTIVE:** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
| **Levels of community awareness and education about the Great Barrier Reef is maintained or improved.** | • **Perceptions of waterway health** (7 core items representing major habitat types; categories indicate perceived health level) | **Q.13** |
| | • **Perceptions of waterway problems** (12 core items representing specific issues; rating scale indicates perceived level of problem presented by each issue) | **Q.14** |
| | • **Perceptions of waterway threats** (11 core items representing specific potential threats; categories indicate perceived threat level) | **Q.15** |
| Opportunities for community leadership and stewardship are increased and supported. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| **Multiple dimensions of community capacity for stewardship are maintained or improved.** | • **Enabling and inhibiting factors influencing stewardship** (8 core items; rating scale indicates level of agreement) | **Q.17** |
| | • **Sense of agency** ('*I feel I personally have some influence over how local waterways are managed';* rating of agreement) | **Q.18** (item within) |
| | • **Trust in waterway science and management institutions** (2 core items; rating of agreement) | **Q.18** (items within) |
| **Adoption of stewardship practices by the community are maintained or improved.** | • **Participation in specific waterway stewardship behaviours** (9 core items; categories include Y/N and reasons for non-participation) | **Q.16** |
| Skill gaps are closed. *Note: needs to be refined to clarify what this is intended to refer to. Where known, baseline period will be specified.* | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |

Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

**Table 6 Alignment of Regional Report Card social survey metrics to the Reef 2050 Plan objective: 'Intangible and tangible historic heritage and contemporary cultural values remain intact'**

| **OBJECTIVE 2:** INTANGIBLE AND TANGIBLE HISTORIC HERITAGE AND CONTEMPORARY CULTURAL VALUES REMAIN INTACT | | |
|---|---|---|
| **REEF 2050 INDICATORS ALIGNED TO ABOVE OBJECTIVE:** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
| **Contemporary cultural and heritage connections promote a sense of place associated with Great Barrier Reef coastal communities.** | • **Personal values associated with waterways** (12 core items; rating scale indicates extent to which attribute is valued) | **Q.12** |
| Protection of tangible historic maritime heritage assets (e.g. lighthouses and shipwrecks) is maintained or improved. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| **Aesthetic values scores are maintained or improved.** | • **Aesthetic perceptions of waterways** ('*The natural beauty of waterways in the ___ region is outstanding'*; rating of agreement) | **Q.11** (item within) |

Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

**Table 7 Alignment of Regional Report Card social survey metrics to the Reef 2050 Plan objective: 'Governance systems are inclusive, coherent and adaptive'**

| **OBJECTIVE 2:** GOVERNANCE SYSTEMS ARE INCLUSIVE, COHERENT AND ADAPTIVE | | |
|---|---|---|
| **REEF 2050 INDICATORS ALIGNED TO ABOVE OBJECTIVE:** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
| • Availability of integrated knowledge sets is improved.<br>• Extent to which integrated knowledge sets are used in decision making is improved.<br>• Management of integrated knowledge sets is improved.<br>• Integrated monitoring and reporting across social and ecological reef systems is improved. | *These indicators are considered beyond the current scope of Regional Report Cards, and are unable to be addressed using these social surveys; however:*<br>• Regional Report Cards and these social surveys can contribute data and knowledge towards integrated monitoring and reporting under the Reef 2050 Plan. | N/A |
| Support for decision-making improves, including:<br>• Integrated monitoring and reporting, data management and decision support.<br>• **Planning, management and decision making is more inclusive of rights and interests of stakeholders, Traditional Owners and communities**<br>• Capacity for adaptive and anticipatory management increases<br>• Policy and program coherence between tiers of government and portfolio areas is improved<br>• Satisfaction with governance and management increases<br>• Co-management with Traditional Owners increases.<br>Where known, baseline period will be specified | • **Perceptions of procedural fairness, sense of agency, ability to have input to management** (3 core items; rating of agreement) | **Q.18** (items within) |
| • Organisational and collective capacity for adaptive management and decision-making increases.<br>• Policy and program coherence (between tiers of government and between portfolio areas) is improved.<br>• Risk rating of key governance domains is maintained or reduced. | *Currently out of scope for Regional Report Cards and/or unable to be addressed using these social surveys* | N/A |
| **Community satisfaction with governance and management in maintained or improved.** | • **Satisfaction with waterway management, sense of agency, trust in science and management institutions** (12 core items; ratings of agreement) | **Q.18** |

Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

## 2.5 Alignment of metrics to the Alluvium (2021) framework

In the table below (Table 8) we show how the survey metrics align with and contribute to monitoring of the indicators identified in Alluvium (2021). The above colour coding is retained, and it is important to that some metrics contribute to monitoring for more than one indicator.

Table 8 Alignment of Regional Report Card social survey metrics to indicators arising from Alluvium (2021)

| **ALLUVIUM (2021) PROPOSED INDICATORS & CONSTRUCTS (cf. Table 1 above, column 2)** | **RELEVANT SURVEY METRIC(S)** (Broad description; *see survey instrument for item wording*) | **SURVEY QUESTION NUMBER** (refer to Appendix A) |
|---|---|---|
| **Usability and access of waterways**<br>• Visitor frequency by demographics<br>• Waterway usage frequency by demographics | • **Respondent demographic variables** (e.g. age categories, gender, employment sector, postcode)<br>• **Waterway use frequency by zone** (categories of use level for 3 or 4 waterway zones)<br>• **Participation in specific recreation activities in waterways** (11 core items, Y/N response) | **Q.1–3, 20–24**<br>**Q.5–8**<br>**Q.9** |
| **Overall satisfaction with waterways**<br>• Satisfaction with waterways use<br>• Equitable access to waterways<br>• Aesthetic perceptions of waterways | • **Satisfaction with waterway management, perception of fair access** (multiple core items; rating of agreement)<br>• **Perceptions of waterway health** (7 core items; categories of perceived health level)<br>• **Aesthetic perception of waterways** (1 core item; agreement rating scale) | **Q.18**<br>**Q.13**<br>**Q.11** (item within) |
| **Overall place attachment to waterways**<br>• Place attachment to waterways<br>• *Number and type of community driven waterway management events (e.g. clean up days, tree planting)** | • **Place attachment** (1 core item; agreement rating) | **Q.11** (item within) |
| **Contribution of waterways to community wellbeing**<br>• Wellbeing derived from waterways | • **Personal benefits derived from waterways** (12 core items; rating scale for level of agreement) | **Q.11** |
| ***Contribution of waterways to regional economy****<br>• *Number of employees in healthy waterway dependent industries**<br>• *Number of healthy waterway dependent businesses**<br>• *Value of healthy waterway dependent industry sectors** | | N/A |
| ***Economic value of waterway dependent ecosystem services****<br>• Non-use value of waterway dependent ecosystem services | • **Personal values of waterways** (12 core items) | **Q.12** |
| **Participation in local stewardship and adoption of best practice**<br>• Presence and level of participation in citizen science<br>• Presence and level of participation in waterways focussed voluntary community organisations<br>• Personal stewardship actions<br>• *Existence of stewardship and best management programs**<br>• *Adoption of best management practice – agriculture**<br>• *Adoption of best management practice – urban sector**<br>• *Adoption of best management practice – ports and other industries** | • **Participation in specific waterway stewardship behaviours** (9 core items; categories include Y/N and reasons for non-participation) | **Q.16** |
| **Enablers of stewardship**<br>• Willingness and capacity to undertake stewardship actions | • **Enabling and inhibiting factors influencing stewardship** (8 core items; rating of agreement) | **Q.17** |
| **Community sentiment towards waterway management**<br>• Trust in the institutions managing waterways<br>• Support, awareness of, satisfaction with and confidence in defined management (e.g. Reef 2050, WQIPs) | • **Satisfaction with waterway management, trust in science and management institutions** (multiple core items; ratings of agreement) | **Q.18** (items within) |
| **Sectoral/community contributions to waterway management**<br>• Perceived opportunity for community participation<br>• Sectoral/community contributions to decision making | • **Perceptions of procedural fairness, sense of agency, ability to have input to management** (3 core items; rating of agreement) | **Q.18** (items within) |
| **Overall perceptions of waterway health/condition**<br>• Perception of waterway health/environmental condition<br>• Perceptions of threats to waterways | • **Perceptions of waterway health, problems, and threats** (31 core items) | **Q.13–15** |
| **Climate change perceptions**<br>• Support for strategies/policies aimed at mitigating climate change<br>• *Perceived impact of climate change on wellbeing and livelihood** | • **Perceptions of waterway threats** (1 core item)<br>• **Satisfaction with waterway management, trust in science and management institutions** (multiple core items; ratings of agreement) | **Q.13** (item within)<br>**Q.18** (item within) |

**Indicator was unable to be addressed using social surveys, and requires different methods to be monitored adequately.*
Colour coding: blue text = uses, benefits and values; green = perceptions; orange = stewardship; purple = governance.

# 3 Data collection, curation, and analyses

## 3.1 Preparation for data collection

In the latter stages of the survey co-design process, feedback was sought from each regional partnership and participating staff from OGBR, for project M&E purposes, prior to the finalisation of surveys and commencement of data collection. This feedback indicated that all parties were satisfied with the co-designed metrics and draft surveys, and that they felt they had been engaged appropriately in the design process.

As outlined in Table 2, two workshops were held to review and fine-tune the 'common core' metrics, and after subsequent reviews by the Reef 2050 Independent Science Panel[14], the Reef 2050 Executive Steering Committee[15], and by the Chairs and/or members of each Regional Report Card partnership, a market research company[16] was contracted to build and administer the survey online. Over a four-week period, draft versions of the online surveys for each region were reviewed using multiple devices (PC, tablet, mobile phone), resulting in numerous edits in order to improve the logic, efficiency, and user experience for respondents.

In the late stages of survey instrument drafting, human research ethics approval was sought and obtained from the *CSIRO Social Sciences and Human Research Ethics Committee* (CSSHREC Approval #140/21). A survey preamble, describing the ethical considerations relevant to participation, was provided at survey landing page (as shown at the front end of each survey instrument), enabling all respondents to be adequately informed about the survey purpose and terms, and indicate their consent before proceeding to the survey questions. A review of the survey instrument was also conducted by CSIRO Privacy and Legal Officers, in consideration of privacy implications of the resulting data. Advice was received prior to commencement of data collection, that due to the limited demographic information being collected and anonymity of respondents, a *Privacy Threshold Assessment* was not required in this case.

A sample of n=500 respondents for each region was set as a desirable target, that would enable sufficient statistical discrimination power for comparisons between regions to identify changes or trends in survey responses over time, and to compare potential differences between sub-groups within each region (e.g. recreational fishers vs. non-fishers, frequent vs. infrequent waterway users).

Respondent participation in the online survey was via one of two possible pathways:

1. An online panel, in which survey participants are recruited and managed by specialised market research providers, with participant cohorts that are demographically representative of defined geographic regions (where possible; noting that number of

[14] ISP details available here: https://www.reefplan.qld.gov.au/science-and-research/independent-panel

[15] ESC details here: https://www.reefplan.qld.gov.au/working-together/committees

[16] The Online Research Unit (ORU): https://www.theoru.com/index.htm

available panel participants is lower in non-metropolitan areas). Participants in these panels are volunteers, who earn credits (e.g. 'Frequent Flyer' points) to undertake market research surveys periodically. Typically, targeted subsets of a broader panel membership are selected to participate in research surveys on the basis of their geo-demographical profile. Such panel providers (including ours) are accredited members of The Australian Data and Insights Association (ADIA) (formerly AMSRO) and hold ISO 20252 'Market, opinion and social research' (ISO 20252:2019) status. At the quotation stage, our panel provider gave an estimate of the number of available panel participants in each region. This ranged from n>400 available in the Townsville region, to n=100 in the MWI region.

2. In order to supplement the samples in each region, to achieve the desired target of n=500, the regional partnerships themselves undertook to promote and recruit additional participants via local advertising and social media. A separate URL was provided by the contractor, which was then embedded in each region's advertisements. Working with their communications and social media staff, each region utilised paid advertising through Facebook™ and other media (e.g. local newspaper, mailing lists) to promote their survey link within the defined geographic region (by postcode). Each region developed its own graphical designs to help promote the survey (see Figure 3 below for example). Two regions (Fitzroy and MWI) also utilised a prize draw to attract a wider pool of respondents (see additional information in their respective survey preambles).

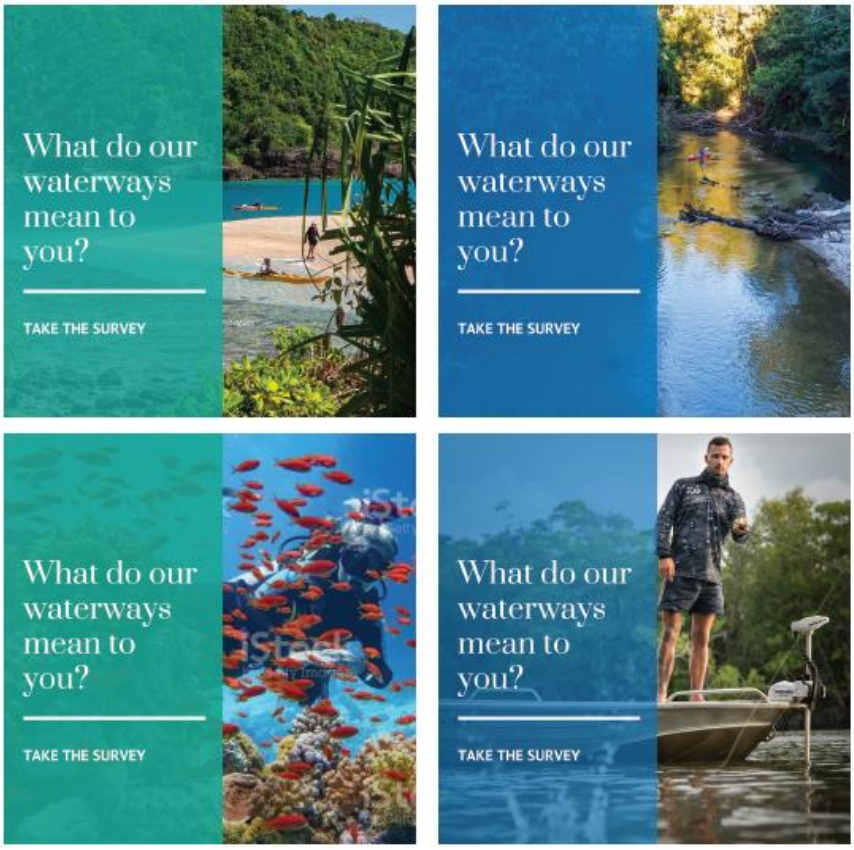



**Figure 3 Graphical advertisements designed and used by Wet Tropics Waterways in their 2021 social media survey recruitment campaign**

## 3.2 Data collection and sample sizes

Data collection for four of the RRC partnerships commenced on the 22nd of November 2021 (representing the Wet Tropics, Townsville Dry Tropics, Mackay-Whitsundays-Isaac (MWI), and Fitzroy catchment regions), and was completed on the 20th of December 2021. Due to a range of factors, the fifth partnership (Gladstone Harbour) was unable to finalise their survey instrument and opted to postpone their data collection until early/mid-2022. When available, these data should be integrated with the current dataset to enable comparative analyses.

During the data collection phase, bi-weekly updates on the number of survey completions for each region, and each recruitment pathway, were provided by the online survey company. These running totals enabled each region to monitor and assess the performance of their advertising campaigns, and increase/decrease their efforts and advertising investment accordingly.

At the end of the data collection phase, a total of n=1877 completed surveys had been collected. Totals for each region ranged between n=531 (for Townsville) and n=377 (for MWI), and this was considered a successful outcome that would enable robust statistical comparisons of the data. The final sample sizes achieved for each region and pathway are shown below (Table 9).

**Table 9 Final sample sizes for baseline Regional Report Card social surveys in Nov-Dec 2021**

| RECRUITMENT PATHWAY | WET TROPICS | TOWNSVILLE | MWI | FITZROY |
|---|---|---|---|---|
| Online panel participants | 303 | 371 | 114 | 176 |
| Regional promotion recruitment | 199 | 160 | 263 | 291 |
| **TOTAL SAMPLE ACHIEVED (n=1877); PER REGION:** | **502** | **531** | **377** | **467** |

## 3.3 Data curation

Following the conclusion of the data collection phase, the survey data was received in an email from the market research company in the form of a simple MS Excel database. This was recorded as Version 1, and was promptly backed up on a secure CSIRO server.

The Version 1 database was then examined visually for any obvious errors (none were found) before a copy was distributed to representatives from each of the participating Regional Report Cards (on 10th January 2022). The Version 1 database consisted of two Excel files: one for each recruitment pathway, with all of the responses (raw data) for each region contained within a single spreadsheet tab. Additional tabs in the database included:

- '*variable information*', which contained a list of the variable names from the raw data tab (short names: q1, q1a, q2, q3, etc.), followed by a label, which included the full text of the question wording.
- '*variable values*', which contained a list of all the numeric response categories for each question, and a corresponding label to interpret the meaning of the numeric category.

In order to improve the useability of the dataset, a Version 2 was created, in which:

- The two Excel spreadsheets were merged, bringing the online panel and social media raw data in a single spreadsheet.
- A new column was added for 'recruiting pathway' with numeric codes added to each case (1 = online panel; 2 = social media recruitment) to enable filtering or comparisons of the recruitment pathway.
- The column headings were expanded in the Raw Data tab, to enable users to more rapidly identify the question and region represented in each column. Response category descriptions were also added to the column header where deemed appropriate.
- The raw data were colour coded to assist with rapid visual recognition of the source region.
- A new spreadsheet tab was added, labelled 'Version Info' to serve as a record of changes made to the database with each version. This included a description of each change made since Version 1, and the quality control steps taken to ensure the new Version did not contain errors.

Version 2 was backed-up similarly to Version 1, with a copy distributed to representatives of the Regional Report Cards (on 14th January 2022). Subsequent cleaning of open-ended text responses (i.e. Q.4 '*first words*', Q.10 '*favourite waterways*', and Q.19 '*comments about waterway management*') over the following months involved multiple steps to correct spelling and capitalisation, as well as apply coding rules for specific analyses (e.g. for creating word clouds and for sentiment analysis). This data cleaning was done in separate files for analytical purposes, and the cleaned open-ended responses have not (yet) been reintegrated with the main data set. Version 2 was then published in a persistent, publicly accessible repository (with DOI) hosted by the CSIRO Data Access Portal[17].

## 3.4 Data analyses

For the purposes of this report, the baseline results shown in the next section are derived from simple analyses of the response distributions and the mean scores for rating scales (± standard error), using MS Excel™. Where appropriate, some statistical tests (Kruskal-Wallis analysis of variance[18]) were performed using Stata™ software to compare differences in the response distributions and mean ratings between regions.

We also present a comparison of word clouds generated from responses to Q.4 ('*What are the first words that come to mind when you think of waterways in the ___ region?*'), with their basic

[17] Version 2 dataset available at: https://doi.org/10.25919/52yr-rg31

[18] Kruskal-Wallis ANOVA was selected as the appropriate nonparametric test for ordinal (i.e. rating scale) data that does not fit a normal distribution (Kruskal & Wallis 1952).

emotional valence (either positive, negative, or neutral sentiment) coded and displayed (i.e. from a simplified *sentiment analysis*).

Data cleaning to generate the word clouds included:

- correcting word spelling
- standardising the capitalisation of words (capitals were retained for proper nouns only, e.g. place names)
- merging word variants with the same root (e.g. 'crocs' and 'crocodiles', 'pollution' and 'polluted')
- retaining word combinations only when vital meaning or context would be lost if disaggregated (e.g. 'Great Barrier Reef', 'World Heritage', 'Ross River').

Data coding for our simplified *sentiment analysis* included the application of coding rules, designed to minimise the potential for subjective (or contestable) interpretation of the word meaning (see methods and examples described in Mäntylä et al., 2018; Curnock et al., 2019). Note that this type of analysis focuses on the sentiment coding of only words, and a limited number of word combinations (as above), and not sentences or phrases.

We assigned **positive** sentiment coding to a word on the basis that:

- The word is a generic, positive adjective. For example: *good*, *fun*, *important*, *amazing*, *great*, *vital*.
- The word describes an aesthetic or other attribute of the waterways that most people would find pleasant or desirable. For example: *beautiful*, *pretty*, *fresh*, *peaceful*, *paradise*, *vast*, *lush*.
- The word indicates a human sensory experience or affective state that most people would find pleasant or desirable. For example: *tranquil*, *relaxing*, *charming*, *refreshing*.
- The word indicates an attribute of the waterways that is indicative of Outstanding Universal Value and/or iconic status. For example: *World Heritage*, *natural*, *plentiful*, *unique*, *iconic*, *precious*.
- The word indicates a healthy and/or resilient ecosystem state. For example: *healthy*, *pristine*, *clean*, *diversity, resilient*.

We assigned **negative** sentiment coding to a word on the basis that:

- The word is a generic, negative adjective. For example: *sad*, *loss*, *horrible*, *worst*.
- The word indicates a human sensory experience and/or describes an aesthetic or other attribute of the waterways that most people would find unpleasant or undesirable. For example: *dirty*, *disgusting*, *smelly*, *disgraceful*, *dangerous, noxious, concerning, unswimmable*.
- The word indicates an unhealthy, damaged, impacted and/or vulnerable ecosystem state. For example: *lifeless*, *barren*, *dead*, *choked*, *damaged*, *at risk, impacted, infested, ruined.*
- The word indicates a threat source or pressure that does/would cause or contribute to a negative impact to the ecosystem, including words suggesting poor management. For

example: *pollution*, *rubbish*, *litter*, *flood*, *drought*, *weeds*, *disaster*, *neglected, erosion, overfished, coral bleaching, misuse, corrupt.*

We assigned **neutral** sentiment coding to a word on the basis that:

- The word did not meet the above criteria for positive or negative sentiment, and/or its sentiment in the context of the waterways was considered unclear, ambiguous, and/or contestable.
- The word is a place name, habitat type, ecosystem function, waterway use type, or a name for native species/taxa.

Data cleaning and coding was performed in MS Excel, with multiple rounds of checks and revisions of the coding that involved at least two researchers, as well as representatives of the Regional Report Cards, to ensure the codes were assigned correctly in the context of regional waterways, and that the rules were applied consistently without errors. The word clouds were then produced using R script with the *wordcloud* package. Words that were mentioned twice or more are shown in the final figures (see next section).

Finally, all results presented in this report were independently cross-checked by a second researcher for potential errors in the analyses. One such error was found, and corrected.

# 4 Baseline results

The results presented in this section are intended to provide a broad, descriptive overview of the baseline dataset, with some preliminary comparisons made between regions to highlight notable differences and similarities. Further in-depth analyses will be required to address research questions as they emerge. The Regional Report Card partnerships will be able to further analyse and report on their own regional data, and are encouraged to collaborate with other researchers to investigate emerging research questions.

## 4.1 Sample demography and geographic representativeness

### Age categories

Initial analyses of the total sample (n=1877) revealed that respondents represented all age categories (from 18 years to over 75; Figure 4), with 92% of respondents aged between 25 and 74. Some regional differences were apparent in the relative proportion of respondents per age category, with the Wet Tropics region's sample having a higher proportion of older respondents (54% were aged 55 and over), and the MWI region having a higher proportion of younger respondents (70% were aged 54 and under). This age discrepancy could potentially be an influencing factor in responses to subsequent attitudinal metrics. However, due to the sufficient regional and total sample sizes achieved, this potential bias can be compensated for when applying statistical tests to understand attitudinal drivers, in follow-up studies.

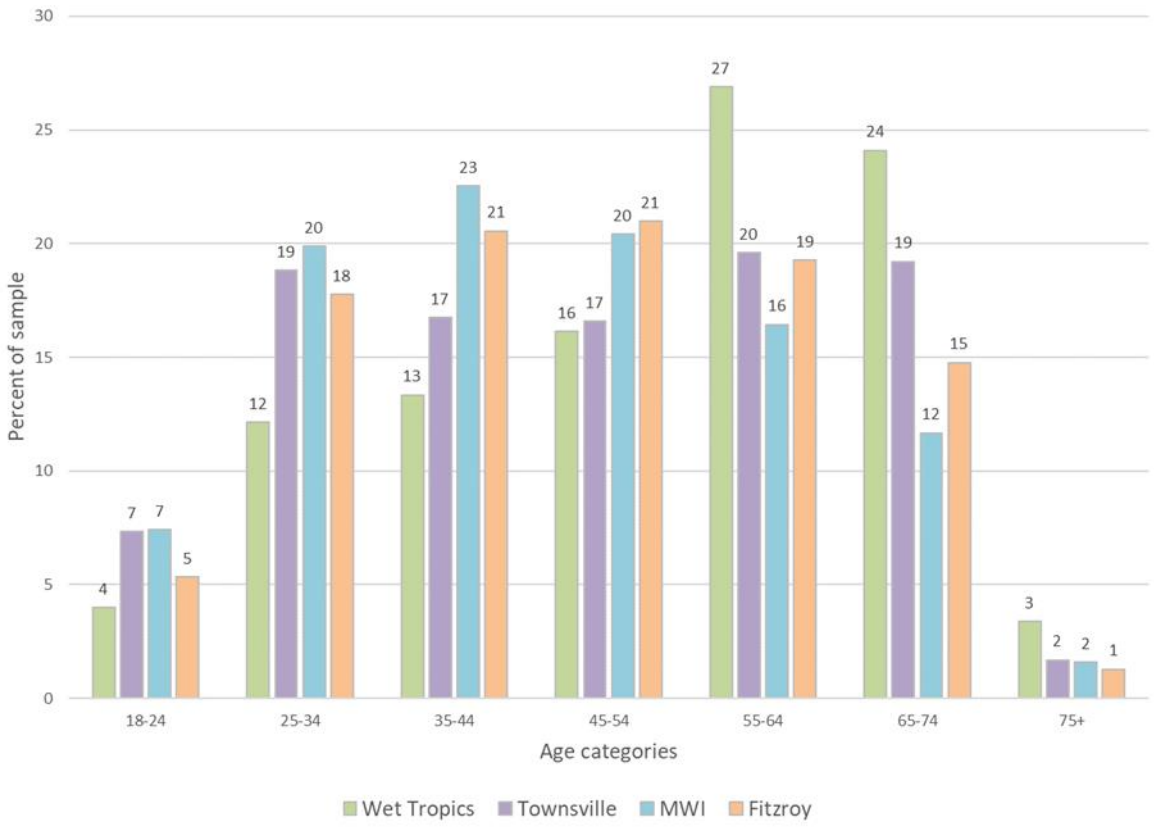



**Figure 4 Age of survey respondents in each region in categories**

## Duration of residence in the regions

The average (mean) duration of respondents' residence in each region ranged between 22 and 26 years (Table 10); however, the relatively large standard deviation (16 to 19 years) indicates a skewed distribution, with a small proportion of very long-term residents (70 years for one Townsville respondent and 83 years for a Wet Tropics respondent).

**Table 10 Respondents' duration lived in their respective region**

| | WET TROPICS (N=502) | TOWNSVILLE (N=531) | MWI (N=377) | FITZROY (N=467) |
|---|---|---|---|---|
| Mean duration (years) | 24.2 | 23.8 | 22.1 | 26.2 |
| Standard deviation (years) | 17.2 | 16.7 | 17.1 | 19.2 |
| Range (years) | (<1-83) | (<1-70) | (<1-76) | (<1-77) |

### Gender balance

The samples for each region had a slightly higher ratio of female to male respondents (Figure 5), with the highest gender imbalance in the Townsville sample (57% female).

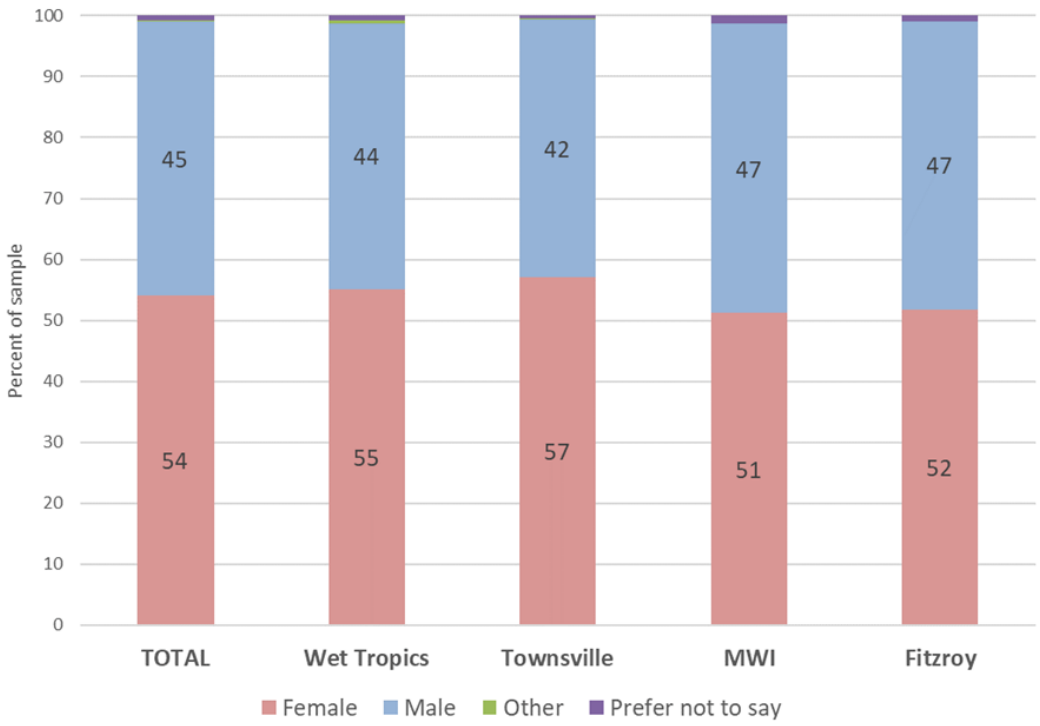



**Figure 5 Gender of survey respondents in each region**

### Indigenous heritage status

The proportion of Aboriginal and Torres Strait Islander Australians represented in the sample overall was low (4% overall), ranging from 5% in the Townsville sample to 3% in the Wet Tropics sample (Table 11). This proportion, however, is broadly consistent with that reported in the Queensland population from the Australian Bureau of Statistics 2016 Census (ABS 2017; noting that ABS Census 2021 data were not available at the time of writing).

**Table 11 Respondents' Indigenous heritage status**

| INDIGENOUS HERITAGE STATUS | WET TROPICS (N=502) | TOWNSVILLE (N=531) | MWI (N=377) | FITZROY (N=467) |
|---|---|---|---|---|
| Neither Aboriginal Australian nor Torres Strait Islander | 93% | 92% | 91% | 91% |
| Aboriginal Australian | 2% | 4% | 4% | 3% |
| Torres Strait Islander | 1% | 1% | 0% | 0% |
| Both Aboriginal Australian and Torres Strait Islander | 0% | 0% | 0% | 0% |
| Prefer not to say | 4% | 4% | 5% | 4% |

### Sectors of employment

The broad sectors within which respondents were employed are shown below (Table 12). Variation between regions in the proportion of residents employed in different sectors should be expected, for example, there was a higher proportion of respondents employed in mining in the Fitzroy region (18%), and a relatively high proportion of respondents from the health sector in Townsville (13%). Of note was an overall high proportion of respondents who were not employed at the time of the survey (22% overall, ranging from 16% in the MWI region to 28% in the Wet Tropics region). Whether these proportions are an effect of the COVID-19 pandemic (and the Wet Tropics region's high economic dependence on tourism) or the sampling method cannot be determined using the available data; however, the pandemic should be considered to have had some influence on a range of relevant social and economic factors.

**Table 12 Respondents' broad sector of employment (ABS categories)**

| EMPLOYMENT SECTOR | WET TROPICS (N=502) % | TOWNSVILLE (N=531) % | MWI (N=377) % | FITZROY (N=467) % |
|---|---|---|---|---|
| **Agricultural** | 4 | 0 | 7 | 7 |
| **Forestry** | 1 | 0 | 0 | 0 |
| **Fishing** | 0 | 1 | 1 | 0 |
| **Mining** | 2 | 3 | 12 | 18 |
| **Manufacturing** | 1 | 2 | 1 | 1 |
| **Electricity, Gas, Water and Waste Services** | 1 | 1 | 2 | 2 |
| **Construction** | 1 | 4 | 4 | 3 |
| **Wholesale Trade** | 1 | 1 | 0 | 0 |
| **Retail Trade** | 5 | 7 | 4 | 3 |
| **Accommodation and Food Services** | 3 | 3 | 2 | 3 |
| **Transport, Postal and Warehousing** | 2 | 3 | 2 | 2 |
| **Information Media and Telecommunications** | 1 | 1 | 1 | 1 |
| **Financial and Insurance Services** | 1 | 1 | 2 | 1 |
| **Rental, Hiring and Real Estate Services** | 1 | 0 | 0 | 0 |
| **Professional, Scientific and Technical Services** | 9 | 7 | 12 | 7 |
| **Administrative and Support Services** | 4 | 6 | 4 | 3 |
| **Public administration and Safety** | 2 | 4 | 2 | 2 |
| **Education and Training** | 9 | 8 | 8 | 10 |
| **Health Care and Social Assistance** | 8 | 13 | 8 | 7 |
| **Arts and Recreation Services** | 3 | 1 | 1 | 1 |
| **Other Services** | 14 | 10 | 10 | 10 |
| **None (not currently employed)** | 28 | 24 | 16 | 19 |

### Geographic representativeness

At the commencement of the survey form, respondents were asked to enter their postcode, and on the basis of their response, were directed to the appropriate region's survey. Figure 6 below shows the approximate number of respondents (in categories) per postcode for all four regions, within the GBR catchment. Zoomed-in maps showing the same data within each region are provided in Appendix B. Note that respondent eligibility to complete the survey was dependent on their residency status within the region (i.e. only residents in the defined boundary were eligible) for the northern three regions. For the Fitzroy region, due to a high proportion of Fly-In-Fly-Out workers, respondent eligibility was broadened to include people who lived and/or worked in the Fitzroy region. This resulted in some respondents in the Fitzroy sample who resided in other parts of South-East Queensland (see Apx Figure B.4).

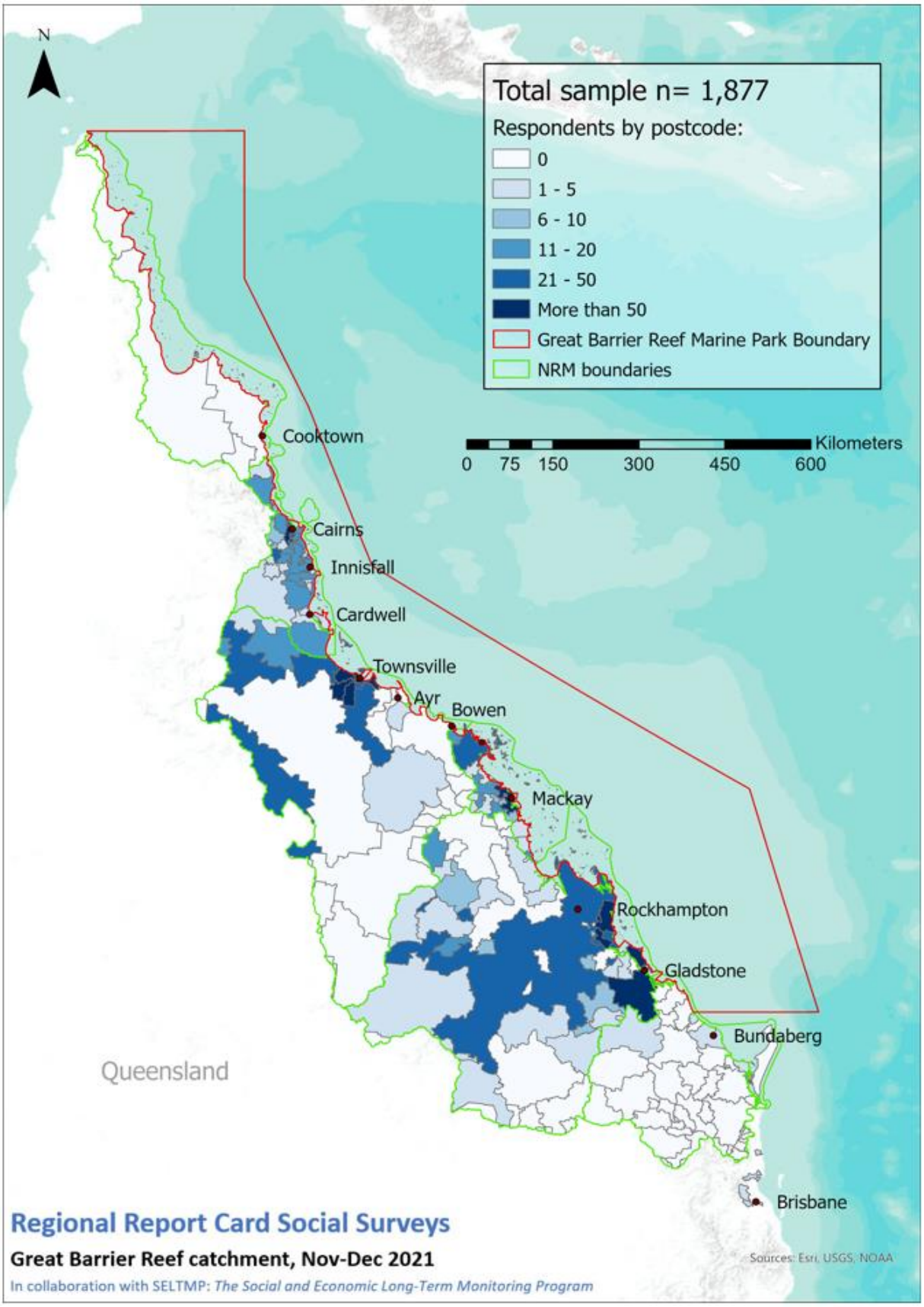



**Figure 6 Geographic distribution of survey respondents in the four Regional Report Card regions, by postcode**

### Comparison of survey recruitment pathways

As noted in the data collection methods (Section 3.1), two recruitment pathways were used in each region to achieve the total sample size (n=1877): (1) online panel participants (n=964), and (2) regional promotion recruitment (n=913). Key differences between the two recruitment pathways (cf. Table 13 below) were:

- A higher proportion of female participants in the online panel sample (63% vs 45% for the regional promotion recruits)
- A higher proportion of respondents aged 35-54 in the regional promotion sample (45% vs 28% for the online panel sample)
- A higher proportion of respondents not currently employed in the online panel sample (31% vs 14% for the regional promotion sample)

It is possible that the incentives (e.g. rewards/frequent flyer points) offered by online marketing companies influence the composition of their panel participants. For comparisons of geographic representativeness of the two sampling pathways within each region, see maps in Appendix B.

**Table 13 Comparison of two recruitment pathways' demographic representativeness**

| | ONLINE PANEL PARTICIPANTS (N=964) | REGIONAL PROMOTION RECRUITS (N=913) |
|---|---|---|
| **Respondent gender:** | % (rounded) | % (rounded) |
| • Female | 63 | 45 |
| • Male | 37 | 53 |
| • Other | 0 | 0.3 |
| • Prefer not to say | 0 | 2 |
| **Age categories:** | % (rounded) | % (rounded) |
| • 18-24 | 8 | 4 |
| • 25-34 | 20 | 14 |
| • 35-44 | 15 | 21 |
| • 45-54 | 13 | 24 |
| • 55-64 | 20 | 21 |
| • 65-74 | 23 | 12 |
| • 75+ | 1 | 3 |
| **Indigenous heritage status:** | % (rounded) | % (rounded) |
| • Neither Aboriginal Australian nor Torres Strait Islander | 94 | 90 |
| • Aboriginal Australian | 3 | 4 |
| • Torres Strait Islander | 1 | 0.1 |
| • Both Aboriginal Australian and Torres Strait Islander | 0.4 | 0.1 |
| • Prefer not to say | 2 | 7 |
| **Employment status:** | % (rounded) | % (rounded) |
| • Proportion of sample not currently employed | 31% | 14% |

## 4.2 Waterway uses, benefits and values

### 4.2.1 Relative use levels and uses of waterways

#### Respondent visitation to waterway zones and purpose of visits

As noted in the methods (Section 2.3.1 above), relative visitation to waterways in four major zones (freshwater systems, estuaries, coastal and inshore, offshore marine) were elicited. As reported in Table 14 (below), the zones with the highest proportion of respondents who had visited in the past 12 months (at least once) were coastal and inshore waterways (visited by 92% of respondents overall), followed by freshwater systems (90%). Visitation to estuaries and offshore marine areas was substantially lower (75% and 48% of total respondents, respectively). There was some variation in these visitation levels between regions (as shown in Table 14). The main purpose of respondents' visits to the different waterway zones was predominantly for recreation purposes (in all regions).

**Table 14 Respondents' visitation to regional waterways in previous 12 months and purpose of visit**

| WATERWAY ZONES VISITED IN PAST 12 MONTHS | WET TROPICS (N=502) | TOWNSVILLE (N=531) | MWI (N=377) | FITZROY (N=467) |
|---|---|---|---|---|
| **Visited freshwater system(s)**<br>*Purpose of visit below = % of visitor n shown in this row:* | **93%**<br>*(n=465)* | **87%**<br>*(n=460)* | **92%**<br>*(n=346)* | **88%**<br>*(n=411)* |
| • For recreation purposes | 92% | 94% | 94% | 84% |
| • For work purposes | 8% | 5% | 11% | 15% |
| • For cultural reasons | 3% | 2% | 2% | 3% |
| • For other reasons | 11% | 8% | 6% | 11% |
| **Visited estuaries**<br>*Purpose of visit below = % of visitor n shown in this row:* | **77%**<br>*(n=389)* | **71%**<br>*(n=376)* | **85%**<br>*(n=320)* | **70%**<br>*(n=325)* |
| • For recreation purposes | 89% | 93% | 92% | 89% |
| • For work purposes | 9% | 7% | 11% | 8% |
| • For cultural reasons | 4% | 1% | 1% | 2% |
| • For other reasons | 9% | 6% | 5% | 6% |
| **Visited coastal and/or inshore waterways**<br>*Purpose of visit below = % of visitor n shown in this row:* | **91%**<br>*(n=456)* | **89%**<br>*(n=473)* | **96%**<br>*(n=362)* | **92%**<br>*(n=429)* |
| • For recreation purposes | 94% | 96% | 94% | 95% |
| • For work purposes | 7% | 8% | 11% | 6% |
| • For cultural reasons | 2% | 1% | 1% | 1% |
| • For other reasons | 5% | 5% | 6% | 4% |
| **Visited offshore marine region**<br>*Purpose of visit below = % of visitor n shown in this row:* | **51%**<br>*(n=256)* | **39%**<br>*(n=209)* | **56%**<br>*(n=212)* | **N/A**<br>*(zone not included)* |
| • For recreation purposes | 93% | 95% | 93% | - |
| • For work purposes | 7% | 8% | 9% | - |
| • For cultural reasons | 2% | 3% | 2% | - |
| • For other reasons | 4% | 2% | 4% | - |

### Relative use levels of waterway zones

The frequency of individual respondents' visitation to waterways in the different zones was elicited (cf. Appendix A; Q.5–8), and summary results are shown below, in categories (Figure 7). A substantial proportion of respondents had visited *freshwater systems* and *coastal and inshore* waterways on at least a weekly basis (19% and 20% of respondents, respectively). A comparison of the regions for these visitation levels is provided in Appendix C, which shows the highest relative visitation to *freshwater systems* by residents in the Wet Tropics region, and the highest relative visitation to *estuaries*, *coastal and inshore,* and *offshore marine* waterways by residents in the MWI region (Apx Figure C.1–4).

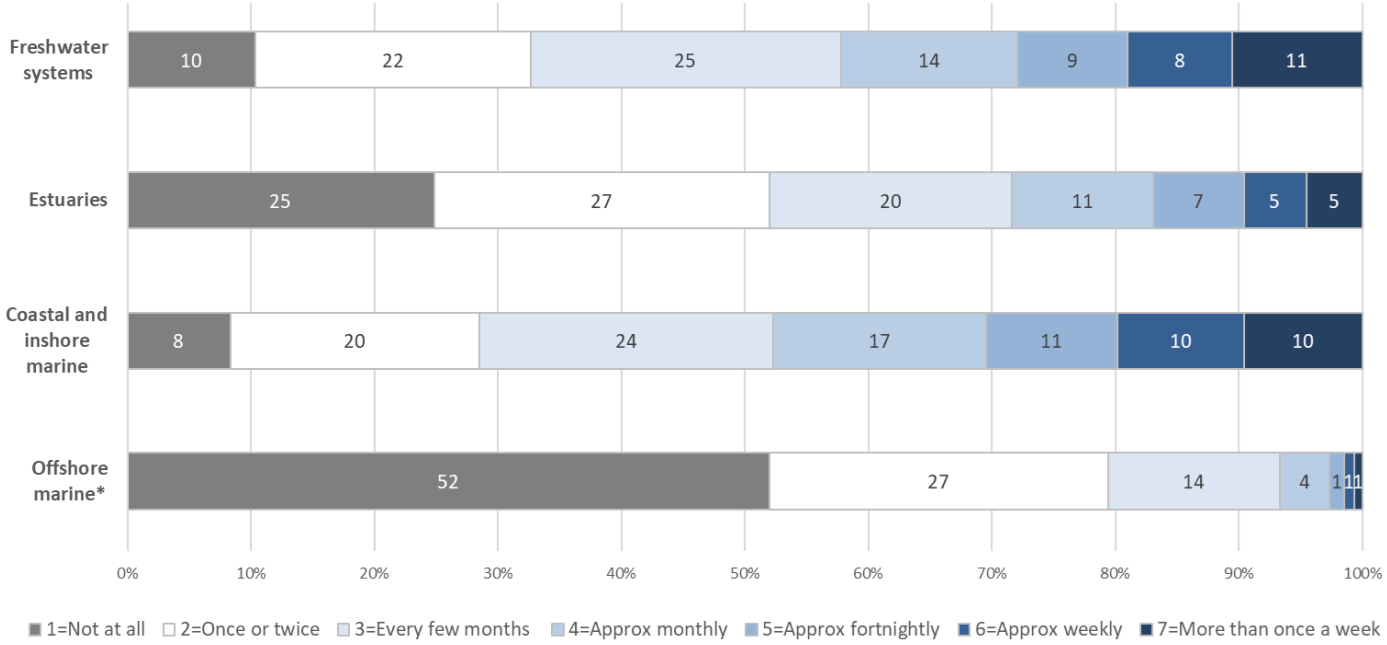



**Figure 7 Survey respondents' relative visitation to waterway zones within their region of residence [per cent of respondents in categories; n=1877 unless denoted*; *excludes Fitzroy region, n=1410]**

### Most popular recreation activities in regional waterways

Participation in a list of recreation activities in/around regional waterways was elicited (Appendix A, Q.9), and the most popular activities included *swimming*, *picnics and barbecues*, *wildlife watching and nature appreciation*, *exercising* and *fishing* (Figure 8 below). A comparison of the regions revealed some activities had highly variable participation rates. For example, in the MWI region 62% of respondents had participated in *recreational fishing*, compared with 50% or below for other regions. There was a similar higher prevalence of *swimming* and *wildlife watching and nature appreciation* in the Wet Tropics region (Figure 8).

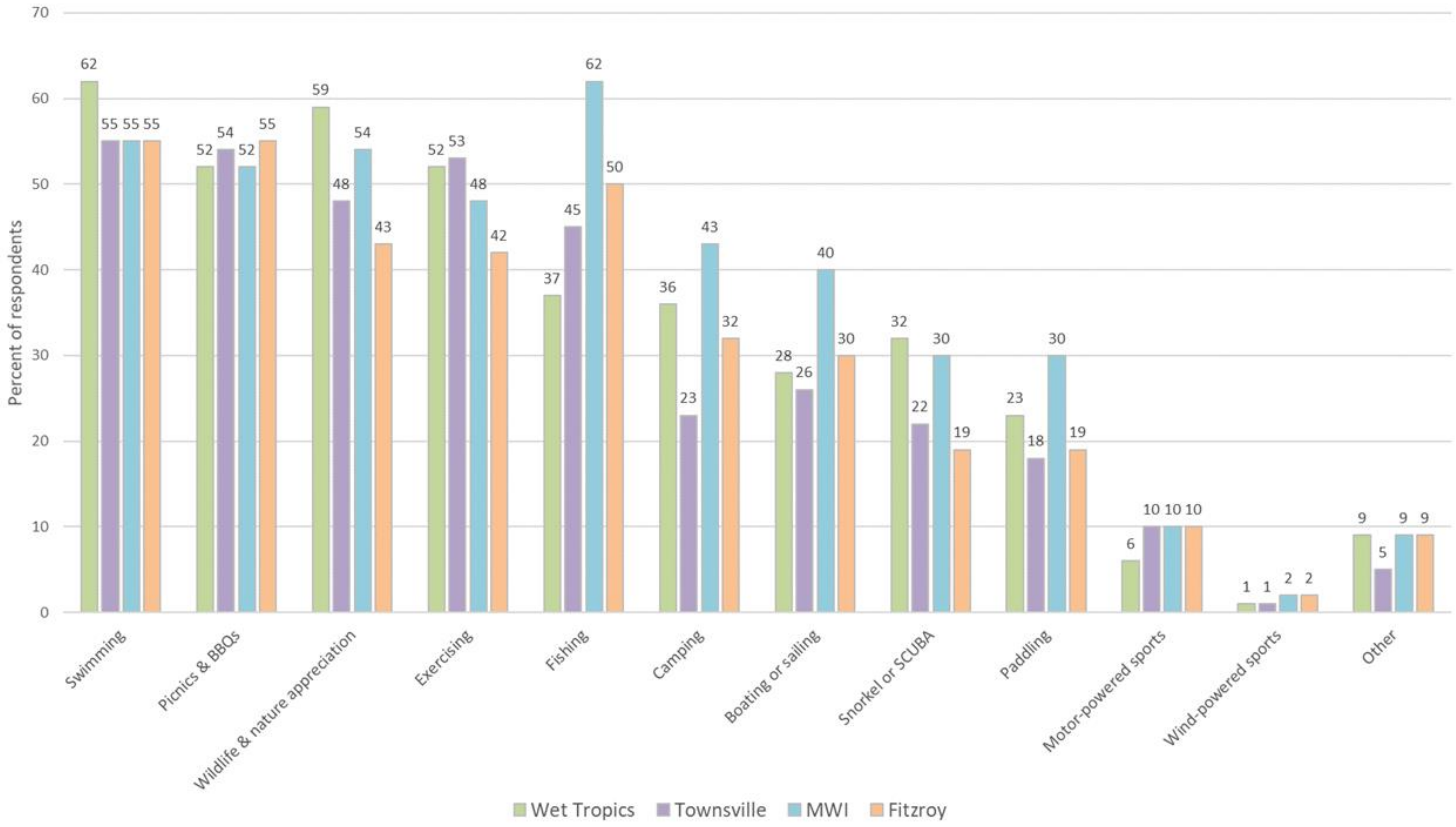



**Figure 8 Respondents' participation in recreational activities in or adjacent to waterways in their region of residence [per cent of respondents who had participated in the activity in the previous 12 months]**

### 4.2.2 Benefits derived from waterways

#### Residents' dependence of regional waterways for household income

Respondents were asked to indicate the proportion of their household income that was derived from waterways-related businesses or employment (Appendix A, Q.20). The proportion of respondents in each region who were at least partly dependent on their region's waterways for household income varied between regions, with the greatest income dependence reported in the MWI region (38%), followed by the Fitzroy region (28%), then the Wet Tropics (22%) and Townsville (16%) regions (Figure 9 below).

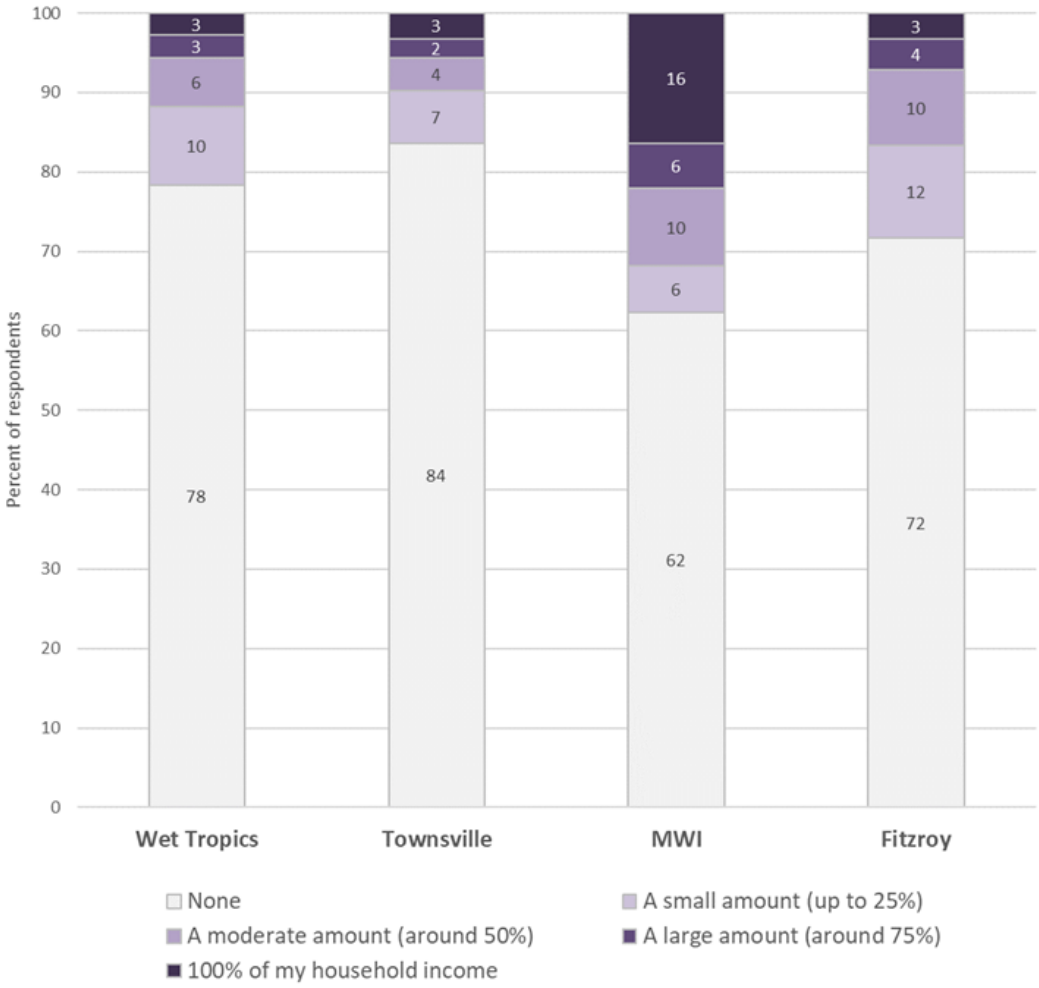



**Figure 9 Respondents' relative proportion of household income that is dependent on waterways in their region of residence, in categories [per cent of respondents per category; n=1877]**

A follow up question elicited the broad sector of employment from which those respondents above (who indicated some household income dependence) derived their household income (Appendix A, Q.21). Among those respondents, the industry sectors represented varied substantially between regions (Table 15 below).

**Table 15 Sector of employment for respondents whose household income is dependent on regional waterways**

| EMPLOYMENT SECTOR DEPENDENT ON REGIONAL WATERWAYS | WET TROPICS (N=502) | TOWNSVILLE (N=531) | MWI (N=377) | FITZROY (N=467) |
|---|---|---|---|---|
| **Proportion of respondents whose household income is dependent on regional waterways to some extent:** *Employment sector below = % of n respondents shown in this row:* | **22%** *(n=109)* | **16%** *(n=87)* | **38%** *(n=142)* | **28%** *(n=132)* |
| • Tourism | 30% (n=33) | 16% (n=14) | 15% (n=21) | 9% (n=12) |
| • Boating and retail | 5% (n=5) | 11% (n=10) | 9% (n=13) | 5% (n=6) |
| • Commercial fishing | 8% (n=9) | 15% (n=13) | 2% (n=3) | 7% (n=9) |
| • Government | 24% (n=26) | 33% (n=29) | 14% (n=20) | 10% (n=13) |
| • Science and education | 28% (n=31) | 15% (n=13) | 8% (n=12) | 13% (n=17) |
| • Agriculture | 17% (n=18) | 7% (n=6) | 19% (n=27) | 27% (n=36) |
| • Mining | 4% (n=4) | 13% (n=11) | 18% (n=142) | 30% (n=40) |
| • Aquaculture | 1% (n=1) | 2% (n=2) | 11% (n=16) | 2% (n=2) |
| • Ports and shipping | 6% (n=7) | 13% (n=11) | 15% (n=22) | 3% (n=4) |
| • Non-government organisation | 15% (n=16) | 10% (n=9) | 18% (n=26) | 17% (n=23) |
| • Other sector(s) | 7% (n=8) | 10% (n=9) | 4% (n=6) | 9% (n=12) |

### Non-monetary benefits derived from regional waterways

A series of 10-point rating scale items (1 = very strongly disagree, 10 = very strongly agree) were used to gauge the relative importance attributed by respondents to a series of personal benefits they derived from waterways in their local region (Appendix A, Q.11). The highest mean ratings were received for *experiencing nature* ('the waterways are important for allowing me to experience, appreciate and interact with the natural environment'), *social opportunities* ('waterways in the region provide an important place for me to spend time with family and friends', and *lifestyle and recreation* ('waterways in the region support my lifestyle and recreational interests'; Figure 10 below).

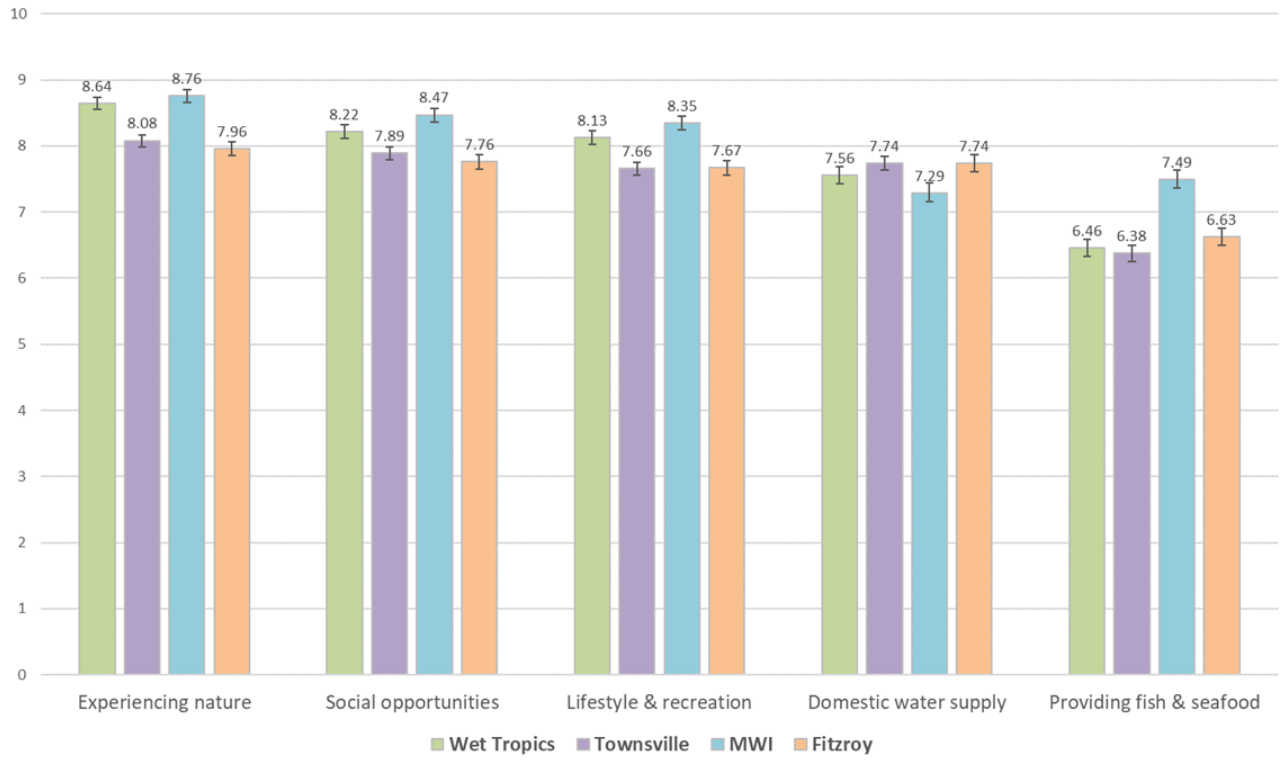



**Figure 10 Respondents' ratings of the relative importance of personal benefits derived from waterways in their region of residence [mean ratings ±SE on 1-10 scale of agreement]**

Using a Kruskal-Wallis analysis of variance test, statistically significant differences were found between the regions for most of these variables (test results in Table 16 below). One difference of note was a significantly higher importance attributed to *providing fish and seafood* ('waterways in the region are important for providing fish and seafood for me to eat') among MWI respondents (cf. Figure 10). This is consistent with the previous result (Figure 8) that shows substantially higher participation in recreational fishing among residents in the MWI region.

**Table 16 Kruskal-Wallis analysis of variance test results comparing four regions for five variables indicating residents' non-monetary benefits derived from regional waterways**

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Experiencing nature** ('*Waterways in the region are important for allowing me to experience, appreciate and interact with the natural environment*') | 55.598 (3) | 0.0001* | 61.778 (3) | 0.0001* |
| **Social opportunities** ('*Waterways in the region provide an important place for me to spend time with family and friends*') | 30.235 (3) | 0.0001* | 32.468 (3) | 0.0001* |
| **Lifestyle and recreation** ('*Waterways in the region support my lifestyle and recreational interests*') | 35.806 (3) | 0.0001* | 38.084 (3) | 0.0001* |
| **Domestic water supply** ('*The waterways are an important source of my water supply for drinking and household use*') | 5.384 (3) | 0.1458 | 5.783 (3) | 0.12226 |
| **Providing fish and seafood** ('*Waterways in the region are important for providing fresh fish and seafood for me to eat*') | 42.764 (3) | 0.0001* | 43.762 (3) | 0.0001* |

**Indicates a statistically significant difference at $p \leq 0.05$*

### Residents' dependence and attachment to regional waterways

Using the same 10-point agreement/disagreement rating scale as above, a series of statements/items were presented to elicit respondents' relative dependence and attachment to waterways in their local region (Appendix A, Q.11). Mean ratings indicated overall strong agreement for the waterways' *importance to quality of life and wellbeing* ('visiting waterways in the region is important for my quality of life and wellbeing'), and that respondents *would be personally affected if waterway health declined* ('If the health of waterways in my region declined, I would be personally affected'); however, some variability between regions was apparent, with higher mean ratings observed in the Wet Tropics and MWI regions. Ratings indicating residents' *pride in local waterways* ('I am proud of the local waterways in my region'), the *influence of regional waterways on their decision to live in the region* ('The waterways in my region are an important part of why I choose to live here'), and the importance of local waterways for their *contribution to the culture* of local residents were even more strongly varied between the regions (Figure 11 below).

The differences between the regions for each of these variables were statistically significant (Table 17 below). A comparison of the response distributions shows a substantially higher proportion of residents in the MWI and Wet Tropics region feel a strong dependence and attachment to waterways in their region (e.g. 59% of Wet Tropics respondents and 51% of MWI respondents agreed strongly that the *waterways in their region are an important part of why I choose to live there*; compared with 35% and 31% of respondents from Townsville and Fitzroy regions, respectively; Table 18 below).

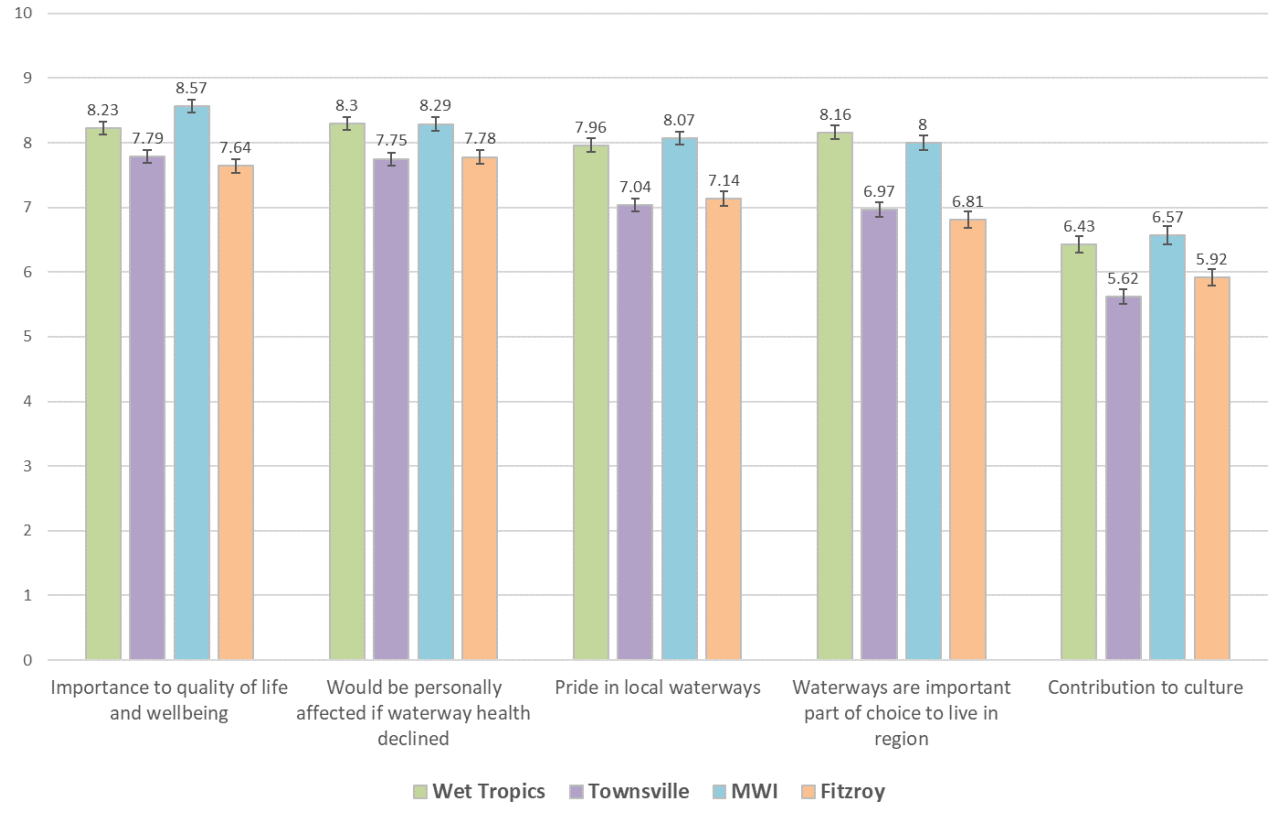



**Figure 11 Respondents' relative dependence and attachment to waterways in their region of residence [mean ratings ±SE on 1-10 scale of agreement]**

**Table 17 Kruskal-Wallis analysis of variance test results comparing four regions for five variables indicating residents' dependence and attachment to regional waterways**

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Importance to quality of life and wellbeing** ('*Visiting waterways in the region is important for my quality of life and wellbeing'*) | 53.257 (3) | 0.0001* | 57.322 (3) | 0.0001* |
| **Would be personally affected if waterway health declined** ('*If the health of waterways in my region declined, I would be personally affected*') | 29.157 (3) | 0.0001* | 31.623 (3) | 0.0001* |
| **Pride in local waterways** ('*I am proud of the local waterways in my region*') | 87.888 (3) | 0.0001* | 90.889 (3) | 0.0001* |
| **Waterways influenced choice to live here** ('*The waterways in my region are an important part of why I choose to live here*') | 109.890 (3) | 0.0001* | 115.261 (3) | 0.0001* |
| **Contribution to culture** ('*Waterways in my region are an important part of my culture*') | 36.707 (3) | 0.0001* | 37.470 (3) | 0.0001* |

**Indicates a statistically significant difference at p ≤ 0.05*

**Table 18 Respondents' agreement or disagreement with statements indicating their dependence and attachment to regional waterways [10-point scale; ratings of 1 and 2 indicate strong disagreement, 3–5 indicate disagreement; 6–8 indicate agreement; 9 and 10 indicate strong agreement; n=1877]**

| | DISAGREE STRONGLY (RATING 1-2) | DISAGREE (RATING 3-5) | AGREE (RATING 6-8) | AGREE STRONGLY (RATING 9-10) |
|---|---|---|---|---|
| ***Visiting waterways in the region is important for my quality of life and wellbeing*** | | | | |
| Total proportion (all regions, % of n=1877): | **3** | **12** | **34** | **50** |
| • Wet Tropics (n=502) | 4 | 11 | 27 | 58 |
| • Townsville (n=531) | 4 | 13 | 39 | 45 |
| • MWI (n=377) | 2 | 8 | 29 | 61 |
| • Fitzroy (n=467) | 3 | 15 | 42 | 40 |
| ***If the health of waterways in my region declined, I would be personally affected*** | | | | |
| Total proportion (all regions, % of n=1877): | **3** | **13** | **32** | **52** |
| • Wet Tropics (% of n=502) | 3 | 10 | 27 | 59 |
| • Townsville (% of n=531) | 3 | 15 | 36 | 46 |
| • MWI (% of n=377) | 2 | 11 | 32 | 56 |
| • Fitzroy (% of n=467) | 3 | 17 | 33 | 47 |
| ***I am proud of the local waterways in my region*** | | | | |
| Total proportion (all regions, % of n=1877): | **4** | **16** | **40** | **39** |
| • Wet Tropics (% of n=502) | 5 | 11 | 32 | 52 |
| • Townsville (% of n=531) | 5 | 22 | 45 | 29 |
| • MWI (% of n=377) | 2 | 11 | 40 | 48 |
| • Fitzroy (% of n=467) | 6 | 19 | 44 | 31 |
| ***The waterways in my region are an important part of why I choose to live here*** | | | | |
| Total proportion (all regions, % of n=1877): | **6** | **20** | **31** | **44** |
| • Wet Tropics (% of n=502) | 4 | 13 | 24 | 59 |
| • Townsville (% of n=531) | 7 | 24 | 34 | 35 |
| • MWI (% of n=377) | 3 | 14 | 32 | 51 |
| • Fitzroy (% of n=467) | 8 | 26 | 34 | 31 |
| ***Waterways in the region are an important part of my culture*** | | | | |
| Total proportion (all regions, % of n=1877): | 13 | **33** | **31** | **23** |
| • Wet Tropics (% of n=502) | 11 | 31 | 29 | 29 |
| • Townsville (% of n=531) | 16 | 36 | 31 | 16 |
| • MWI (% of n=377) | 12 | 25 | 33 | 30 |
| • Fitzroy (% of n=467) | 12 | 37 | 32 | 18 |

### 4.2.3 Values associated with waterways

#### Relative importance of non-monetary values

Survey respondents were asked to rate a series of statements on a 10-point scale indicating the extent to which each was personally valued by them (1 = 'I don't value this at all', 10 = 'I value this extremely highly'). Below we present a ranking of eight items representing non-monetary values associated with regional waterways, based on their mean rating (Figure 12). The ranked items for all regions included: (1st) *supporting biodiversity* ('the waterways support a variety of native habitats, plants and wildlife'), (2nd) *local recreation opportunities* ('the waterways offer a place for local residents to enjoy recreation activities'), (3rd) *existence value* ('the fact that the waterways exist, even if I don't use or directly benefit from them'), (4th) *scientific heritage value* ('the waterways provide a place where people can study and learn about the natural environment'), (5th) *supporting the local economy* ('the waterways support our local economy'), (6th) *iconic status* ('our waterways are recognised nationally and internationally for their iconic status, e.g. World Heritage, Ramsar sites'), (7th) knowledge and tradition bequest value ('the waterways provide a place where people can pass down knowledge, traditions, and a way of life'), and (8th) Traditional Owner heritage value ('the waterways have rich Traditional Owner Heritage' or 'the waterways have rich heritage to First Nations people'). The differences between the regions for all nine items were statistically significant (Table 19).

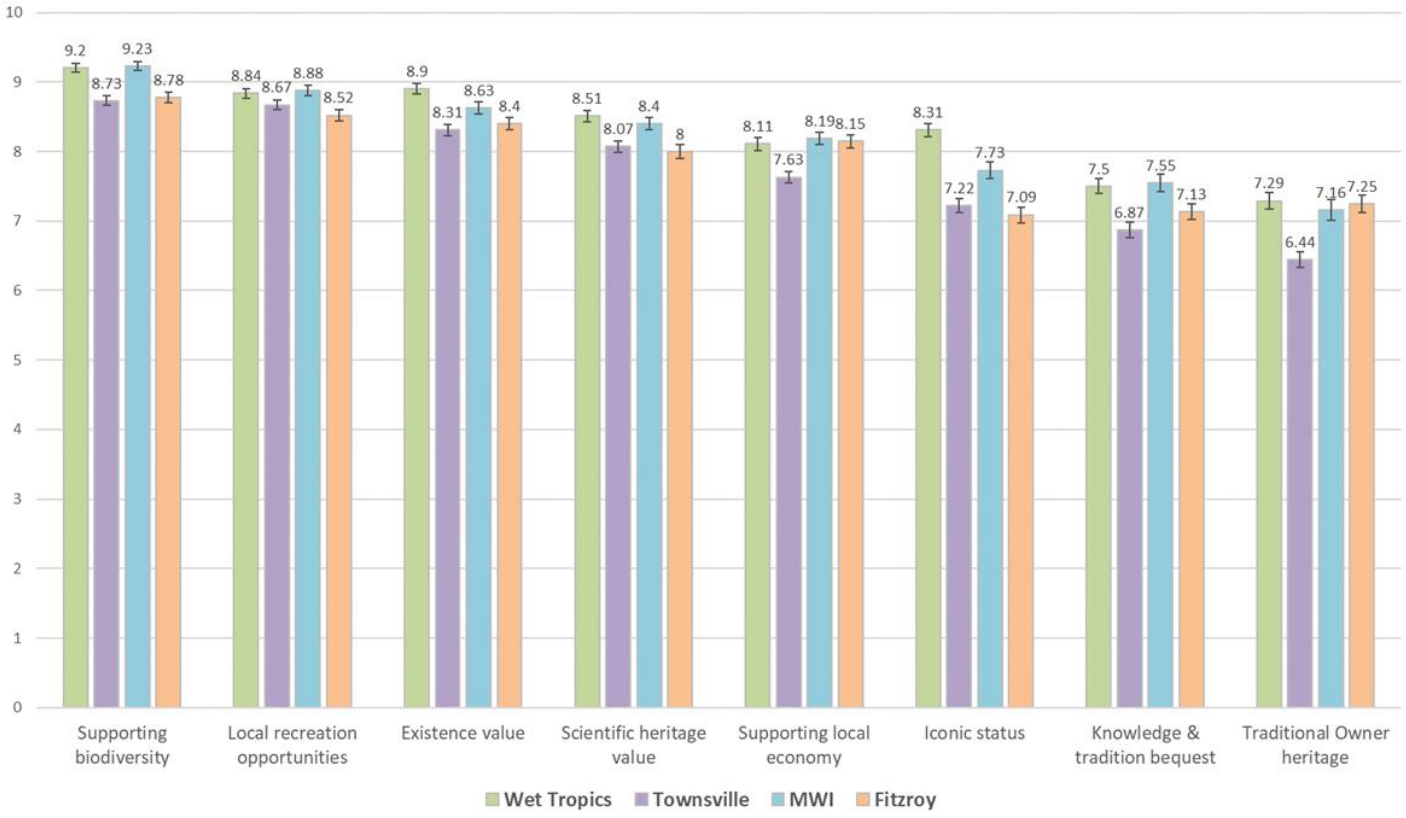



**Figure 12 Respondents' relative ratings of importance of non-monetary values associated with waterways in their region of residence [mean ratings ±SE on 1-10 scale representing extent of personal value]**

**Table 19 Kruskal-Wallis analysis of variance test results comparing four regions for eight variables indicating residents' relative importance assigned to regional waterways' non-monetary values**

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Supporting biodiversity** ('*The waterways support a variety of native habitats, plants and wildlife'*) | 40.830 (3) | 0.0001* | 49.759 (3) | 0.0001* |
| **Local recreation opportunities** ('*The waterways offer a place for local residents to enjoy recreation activities'*) | 13.126 (3) | 0.0044* | 14.820 (3) | 0.0020* |
| **Existence value** ('*The fact that the waterways exist, even if I don't use or directly benefit from them'*) | 34.717 (3) | 0.0001* | 39.273 (3) | 0.0001* |
| **Scientific heritage value** ('*The waterways provide a place where people can study and learn about the natural environment'*) | 27.163 (3) | 0.0001* | 29.073 (3) | 0.0001* |
| **Supporting local economy** ('*The waterways support our local economy"*) | 32.000 (3) | 0.0001* | 33.642 (3) | 0.0001* |
| **Iconic status** ('*Our waterways are recognised nationally and internationally for their iconic status (e.g. World Heritage, Ramsar sites)*') | 91.387 (3) | 0.0001* | 95.132 (3) | 0.0001* |
| **Knowledge and tradition bequest** ('*The waterways provide a place where people can pass down knowledge, traditions, and a way of life'*) | 27.388 (3) | 0.0001* | 28.215 (3) | 0.0001* |
| **Traditional Owner heritage** ('*The waterways have rich Traditional Owner Heritage*' or '*The waterways have rich heritage to First Nations people*') | 33.705 (3) | 0.0001* | 34.727 (3) | 0.0001* |

**Indicates a statistically significant difference at $p \leq 0.05$*

### Relative importance of recreation and industry uses of regional waterways

The extent to which respondents valued direct uses of waterways in their region, including uses by different industry sectors, were elicited using a series of items and the same 10-point rating scale (1 = 'I don't value this at all', 10 = 'I value this extremely highly'). The five ranked items (by mean rating) included: (1st) waterways' value as a *tourist attraction* ('the waterways are an important attraction for tourists visiting the region'), (2nd) waterways' value for *supporting recreational fishing* ('the waterways support recreational fishing'), (3rd) *supporting agriculture* ('the waterways support local agriculture'), (4th) *supporting aquaculture* ('the waterways support local aquaculture'; *NB. this item was not included in the Fitzroy region survey*), (5th) *supporting mining, ports and shipping* ('the waterways support mining, ports and shipping in our region'), and (6th) *supporting commercial fisheries* ('the waterways support commercial fisheries'; *NB. this item also not included in the Fitzroy survey;* Figure 13 below).

Statistically significant differences were found between regions for all of the above items, except *supporting commercial fisheries* (Table 20 below).

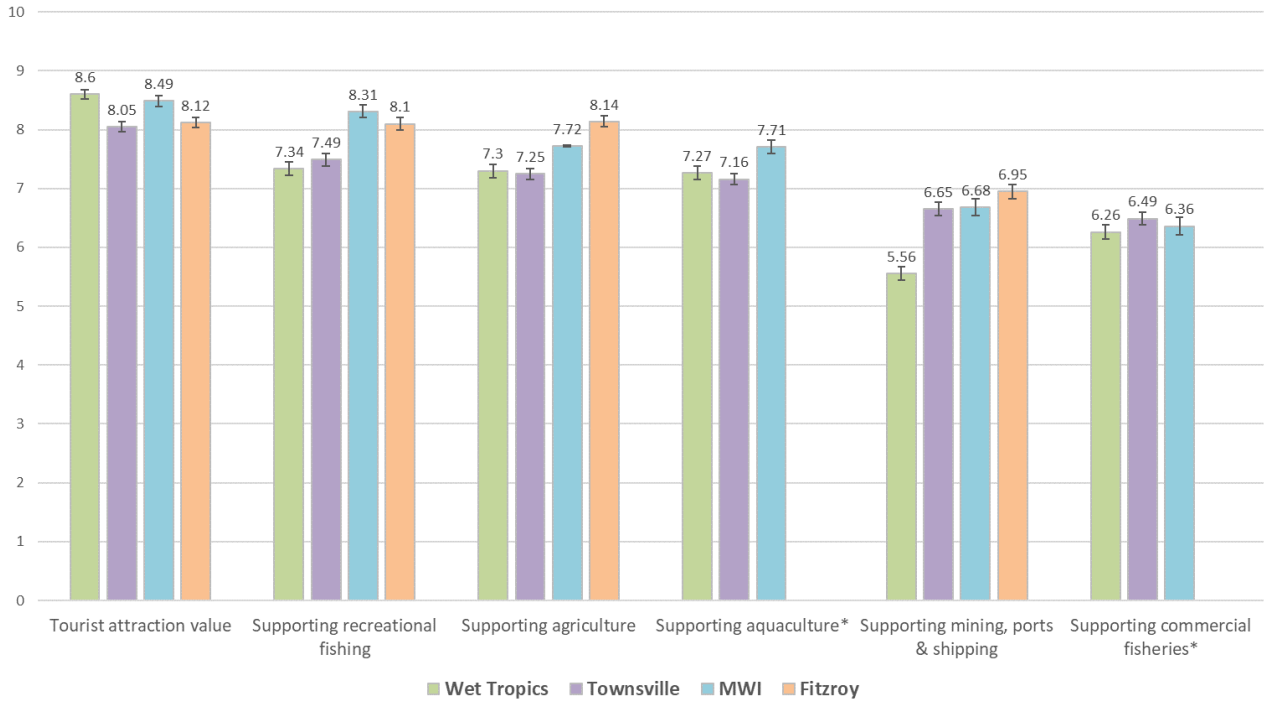



**Figure 13 Respondents' relative ratings of importance of recreation and industry uses of waterways in their region of residence [mean ratings ±SE on 1-10 scale representing extent of personal value; n=1877 unless denoted*]**

**Table 20 Kruskal-Wallis analysis of variance test results comparing the regions for six variables indicating residents' relative importance assigned to recreation and industry uses of regional waterways**

| SURVEY QUESTION (N=1877 unless denoted[a]) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Tourist attraction value** (*'The waterways are an important attraction for tourists visiting the region'*) | 39.005 (3) | 0.0001* | 41.865 (3) | 0.0001* |
| **Supporting recreational fishing** (*'The waterways support recreational fishing'*) | 47.122 (3) | 0.0001* | 49.353 (3) | 0.0001* |
| **Supporting agriculture** (*'The waterways support local agriculture'*) | 53.430 (3) | 0.0001* | 55.408 (3) | 0.0001* |
| [a] **Supporting aquaculture** (*'The waterways support local aquaculture*) | 15.245 (2) | 0.0005* | 15.692 (2) | 0.0004* |
| **Supporting mining, ports & shipping** (*'The waterways support mining, ports and shipping in our region'*) | 62.122 (3) | 0.0001* | 63.127 (3) | 0.0001* |
| [a] **Supporting commercial fisheries** (*'The waterways support commercial fisheries'*) | 1.408 (2) | 0.4946 | 1.431 (2) | 0.4890 |

**Indicates a statistically significant difference at p ≤ 0.05*

*[a] Sample size n = 1410; only three regions utilised this survey question.*

## 4.3 Waterway perceptions

### 4.3.1 Words associated with regional waterways

At the beginning of the survey (Q.4, Appendix A) occurring just after the infographic map and description of the waterway zones of interest, respondents were asked 'what are the first words that come to mind when you think of waterways in the ___ region?' Word clouds with coding of basic sentiment (positive, neutral, or negative emotional valence) of words mentioned two or more times for each region are shown below (Figure 14). In total, 6,075 word occurrences were coded, among which 1,111 were coded with positive sentiment, 4,298 were coded with neutral sentiment, and 666 were coded with negative sentiment. Differences between regions were apparent, with a higher proportion of positive word occurrences observed for the Wet Tropics and MWI regions, and a higher proportion of negative word occurrences observed for the Townsville and Fitzroy regions (Table 21 below).

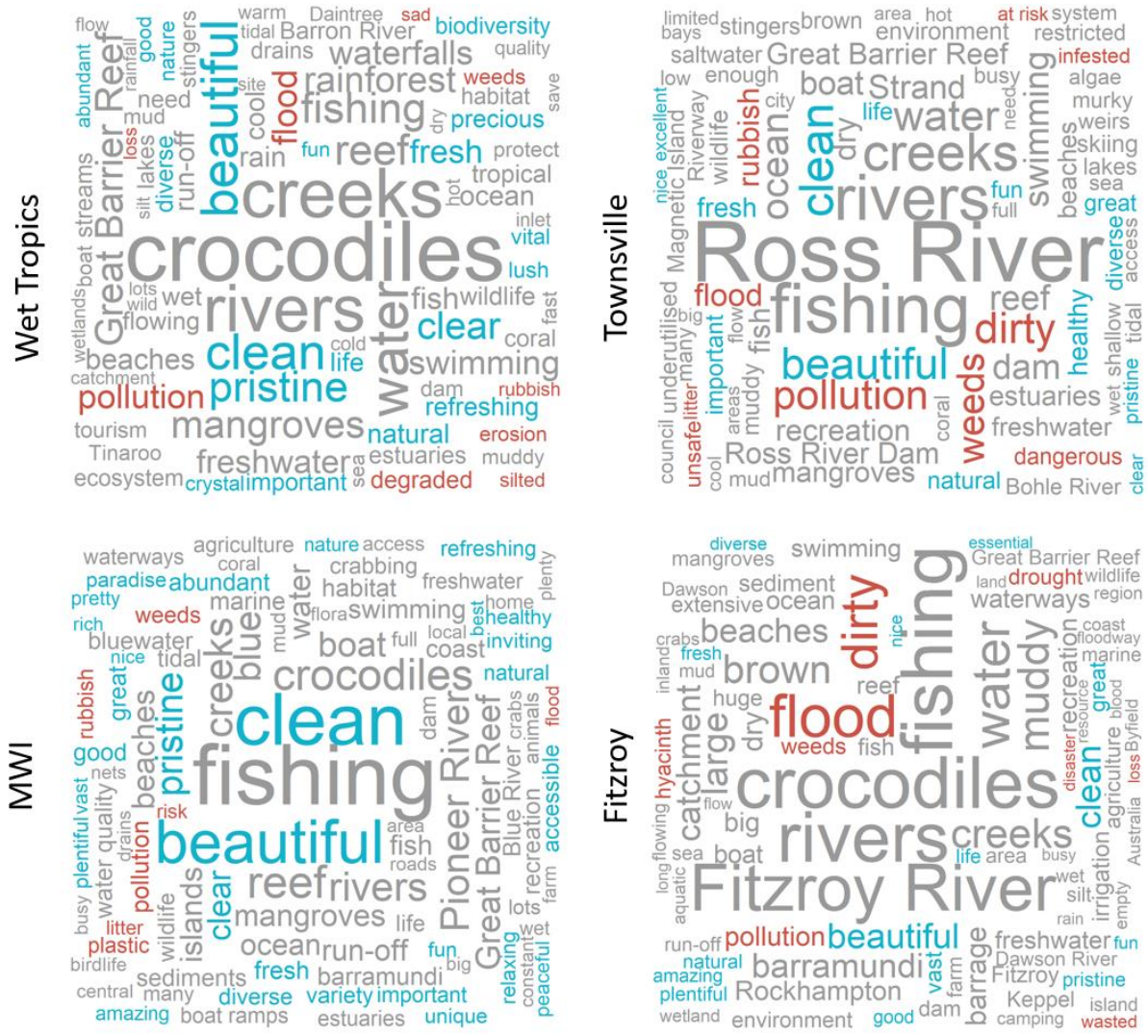



**Figure 14 Word clouds produced from analysis of respondents' first words associated with waterways in their region of residence [blue text = positive sentiment, red = negative sentiment, grey = neutral sentiment; word size indicated relative frequency of occurrence, i.e. larger = more occurrences]**

Table 21 Frequency of word occurrences coded with positive, neutral, or negative sentiment, comparing four regions [responses to the open-ended question 'what are the first words that come to mind when you think of waterways in the region'; n=1877]

| WORD OCCURRENCES AND PROPORTION OF RESPONSES PER REGION | POSITIVE | NEUTRAL | NEGATIVE | TOTAL (100%) |
|---|---|---|---|---|
| ***What are the first words that come to mind when you think of waterways in the ___ region?*** Total occurrences all regions (% of occurrences): | **1,111** (18%) | **4,298** (71%) | **666** (11%) | **6,075** |
| • Wet Tropics (n=502) | 389 (23%) | 1,180 (67%) | 151 (9%) | 1,720 |
| • Townsville (n=531) | 225 (14%) | 1,190 (72%) | 238 (14%) | 1,653 |
| • MWI (n=377) | 314 (25%) | 843 (67%) | 97 (8%) | 1,254 |
| • Fitzroy (n=467) | 183 (13%) | 1,085 (75%) | 180 (12%) | 1,448 |

### 4.3.2 Aesthetic perceptions of regional waterways

Using a 10-point agreement rating scale (1 = 'very strongly disagree', 10 = 'very strongly agree'), respondents were asked to provide a rating for the statement 'the natural beauty of waterways in the ___ region is outstanding'. Mean ratings are shown below (Figure 15), and a Kruskal-Wallis test revealed a significant difference between the regions' scores (Table 22 below).

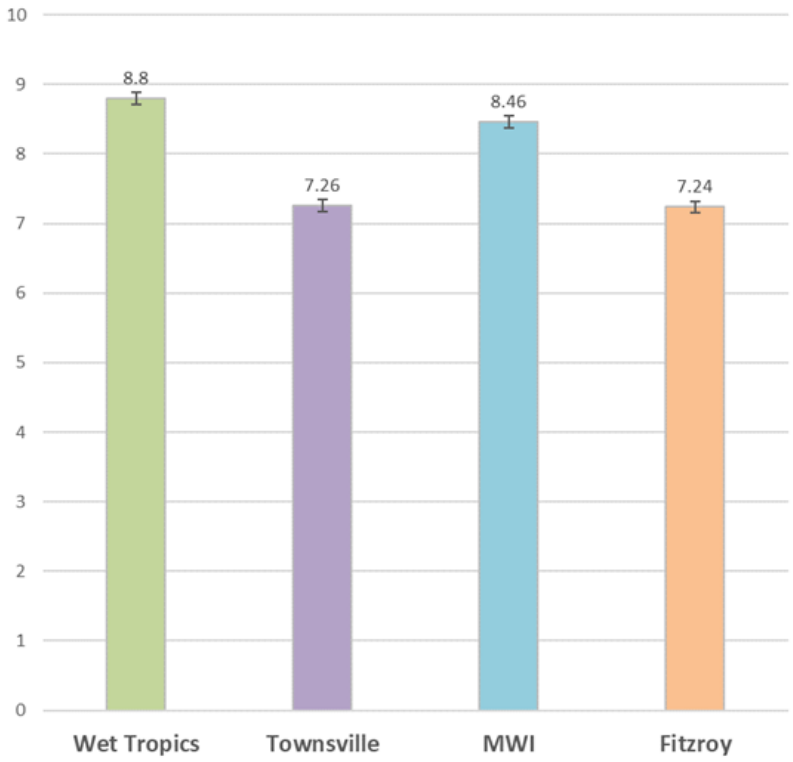



Figure 15 Respondents' mean ratings of agreement with the statement 'The natural beauty of waterways in the ___ region is outstanding' [mean ratings ±SE on 1-10 agreement scale; n=1877]

Table 22 Kruskal-Wallis analysis of variance test results comparing the four regions for residents' ratings of agreement with the statement 'The natural beauty of waterways in the ___ region is outstanding'

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Perceived aesthetic value** (*'The natural beauty of waterways in the region is outstanding'*) | 229.357 (3) | 0.0001* | 242.159 (3) | 0.0001* |

**Indicates a statistically significant difference at p ≤ 0.05*

### 4.3.3 Perceptions of waterway health

Using five categorical response options for a series of waterway habitat types, respondents were asked: 'of the places you have visited in the ___ region, how would you rate the health of the…' (see items shown in Q.13, Appendix A). Response categories included: 1 = 'in poor health', 2 = 'in fair health', 3 = 'in good health', 4 = 'not applicable (have not visited)', and 5 = 'I don't know'. Ranked items are shown below, reflecting a decreasing proportion of respondents who perceived the habitat type to be in *good* or *fair* health, for all regions combined (Figure 16). Figures comparing these perceptions between regions for each habitat type are provided in Appendix C. Overall, the waterway habitats perceived to be in the best health (relative to the list) were *beaches and the coast*, *freshwater creeks and rivers*, *ocean and sea*, *estuaries*, and *freshwater lakes, dams and wetlands*. The habitats perceived to be in the worst health were *inshore coral reefs*, *seagrass*, and *offshore coral reefs* (Figure 16).

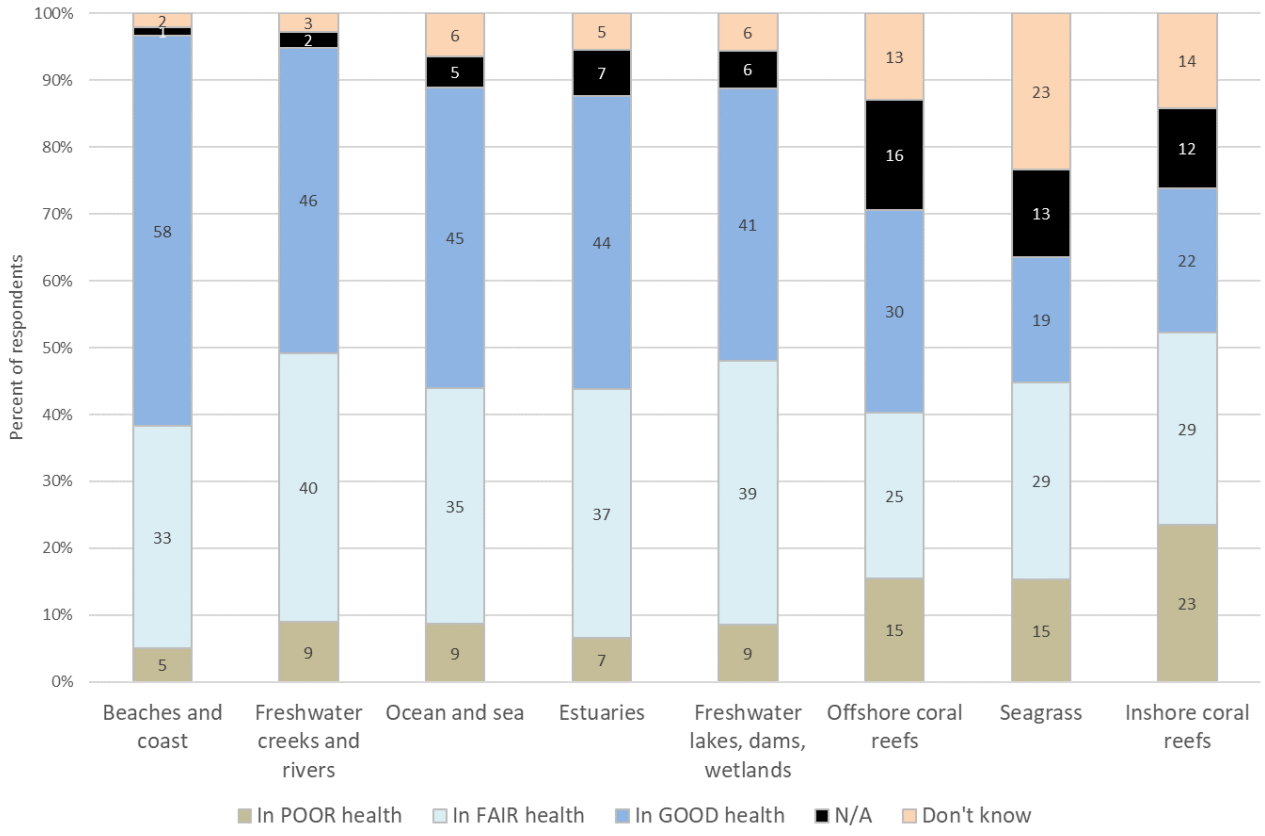



Figure 16 Respondents' perception of the relative health of major waterway habitat types in their region, in categories [all regions combined; % of respondents per category; n=1877]

### 4.3.4 Perceptions of waterway problems

Using a five-point rating scale (with a sixth "I don't know" option) as the response option, for a list of waterway-associated issues, respondents were asked: 'from your experience, how problematic do you think each of the following issues are for waterways in the ___ region' (see items shown in Q.14, Appendix A). Response options included: 1 = 'not a problem at all', 2 = 'a small problem', 3 = 'a moderate problem', 4 = 'a big problem', 5 = 'a very big problem', and 6 = 'I don't know'. Ranked items, in order of decreasing proportion of respondents who indicated 'not a problem at all', are shown below for all regions combined (Figure 17; NB. the items 'bushfire', decline in waterbirds and shorebirds', and 'decline in marine megafauna' were not included in all regional surveys – only those in which they were deemed relevant). Figures comparing these perceptions associated with each issue, between regions, are provided in Appendix C.

Overall, the issue perceived to be most problematic for regional waterways was *litter and debris* (88% of respondents gave a rating of 3–5). However, *all* of the listed issues were perceived as a moderate to very big problem by the majority of respondents (e.g. 52% gave ratings of 3–5 for *bushfire*, and this proportion was greater for the remaining items; Figure 17).

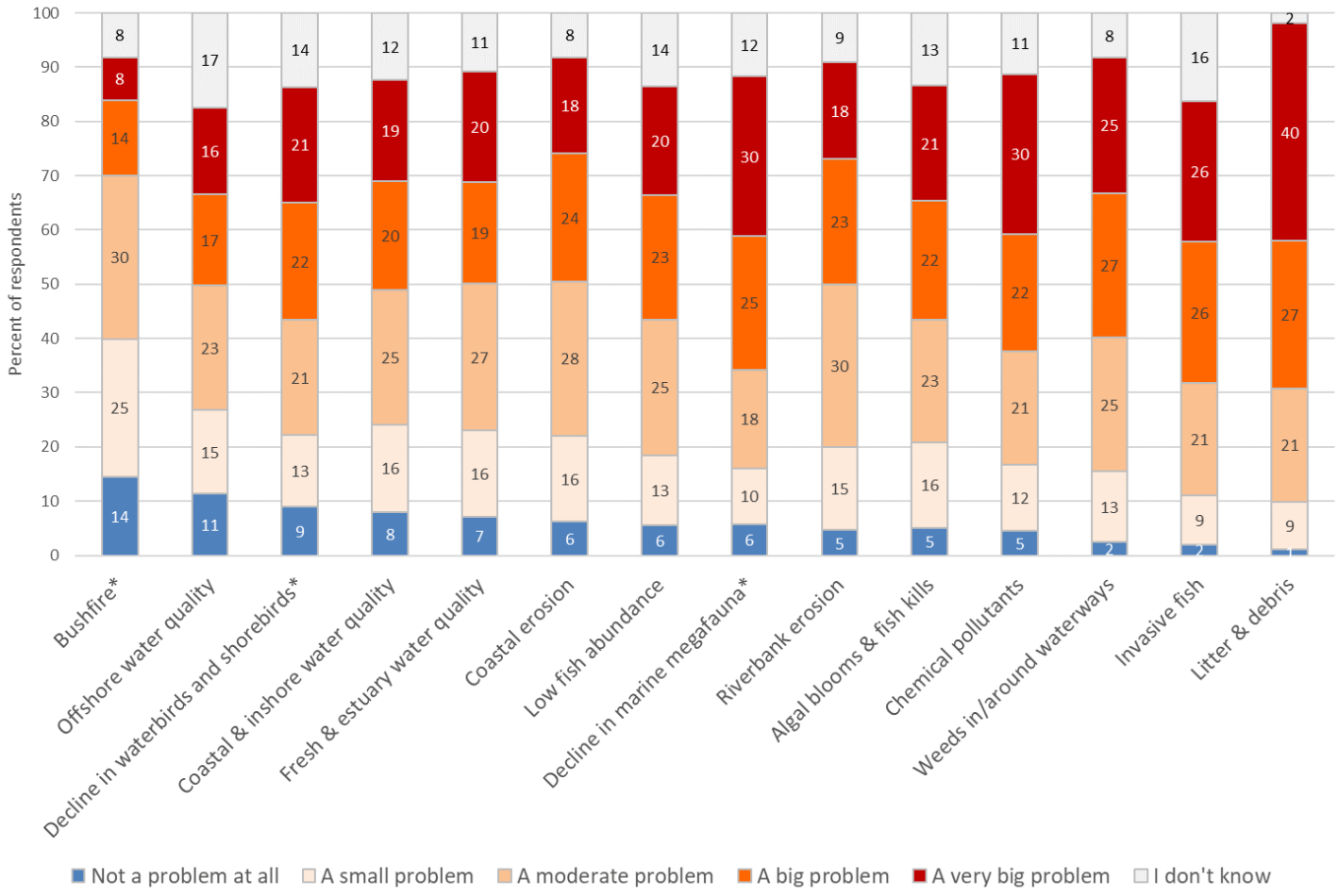



**Figure 17 Respondents' perceptions of the extent to which particular issues represent a problem for waterways in their region, in categories [all regions combined; % of respondents per category; n=1877 unless denoted*]**

### 4.3.5 Perceptions of waterway threats

Using a five-point rating scale (with a sixth "I don't know" option) as the response option, for a list of issues that potentially affect regional waterways, respondents were asked: 'for the following list of issues – please rate the extent to which you think they represent a current threat to ___ waterways' (see items shown in Q.15, Appendix A). Response options included: 1 = 'does not represent a threat at all', 2 = 'a minor threat', 3 = 'a moderate threat', 4 = 'a serious threat', 5 = 'represents an extremely serious threat', and 6 = 'I don't know'. Ranked items, in order of increasing proportion of respondents who indicated 'an extremely serious threat', are shown below for all regions combined (Figure 18). Figures comparing the ranking of these perceptions within each region are provided in Appendix C.

Overall, *climate change* was perceived as the most serious threat to regional waterways, however the proportion of respondents rating it in the higher categories (and its relative ranking) varied between regions (see Appendix C). Other threats generally perceived as among the most serious were *mining activities*, *land clearing*, *land-based runoff*, *illegal fishing practices*, and *over-fishing* (Figure 18).

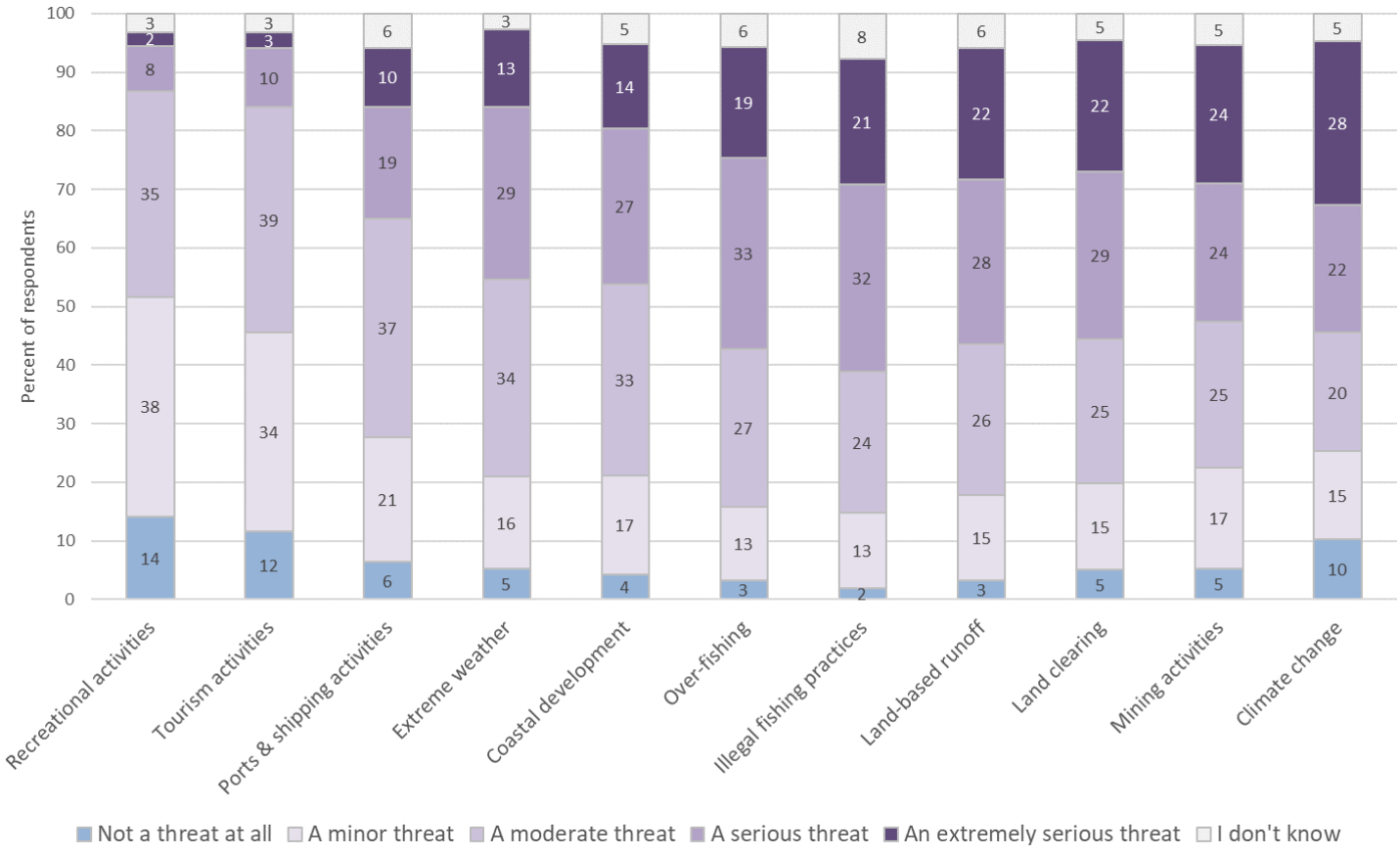



**Figure 18 Respondents' perceptions of the extent to which particular issues represent a threat to waterways in their region, in categories [all regions combined; % of respondents per category; n=1877]**

## 4.4 Waterway stewardship

### 4.4.1 Self-reported waterway stewardship actions

A list of activities associated with waterway stewardship (i.e. actions considered to mitigate human impacts and/or improve waterway health) was presented to respondents, with a five-item categorical response option. Respondents were asked: 'for the following questions, we would like to ask you about several personal actions that are intended to improve waterway health. Which of the following do you personally do?' (See items shown in Q.16, Appendix A.) Response options included: 1 = 'I do this', 2 = 'I don't do this – I was not aware of this action', 3 = 'I don't do this – I don't think this action is effective', 4 = 'I don't do this – other reasons (e.g. no opportunities, time, etc.)', and 5 = 'this is not applicable to me'. Ranked items, in order of decreasing proportion of respondents who indicated 'I do this', are shown below for all regions combined (Figure 19). Figures comparing respondents' reported level of participation in these activities within each region are provided in Appendix C.

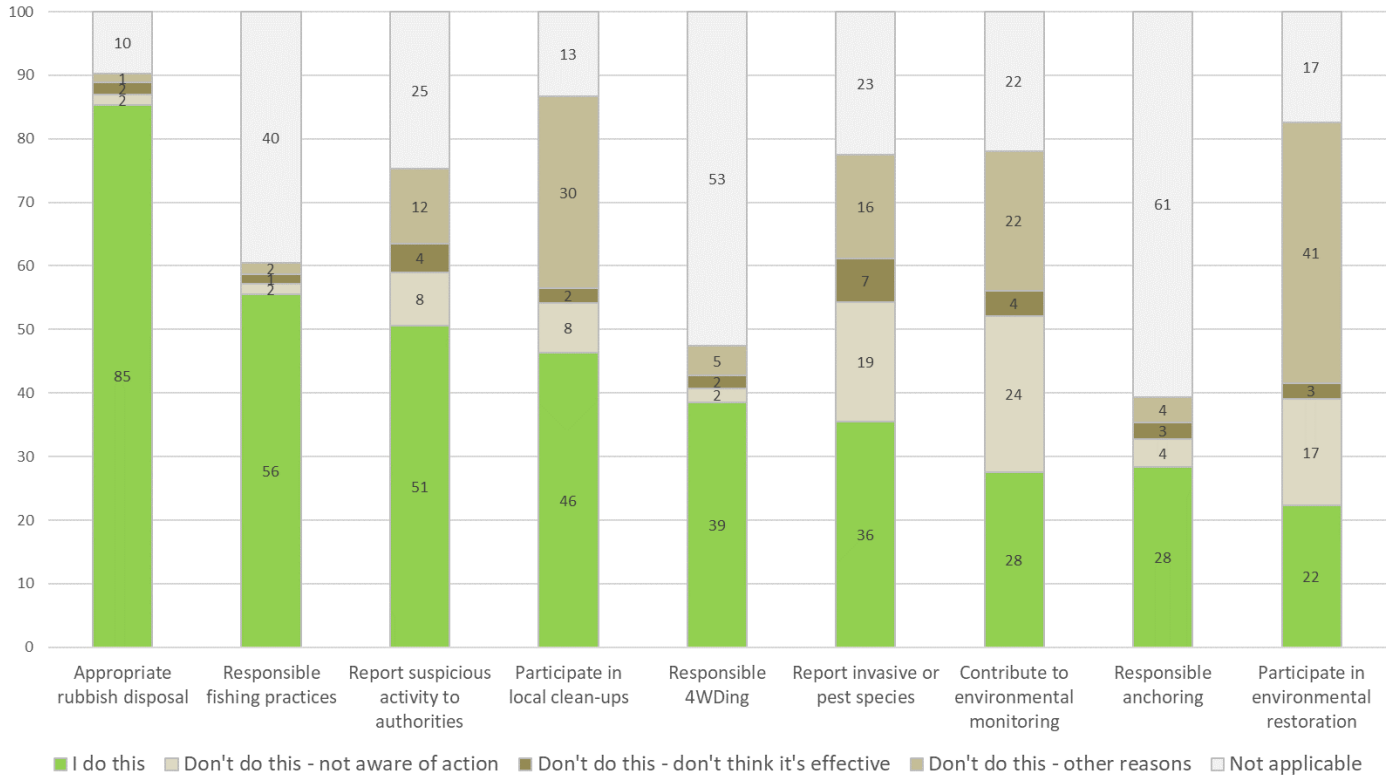



**Figure 19 Respondents' self-reported participation in specified waterway stewardship activities, in categories [all regions combined; % of respondents per category; n=1877]**

As noted in Section 1.3, survey questions such as this are prone to social desirability bias (i.e. the tendency for individuals to over-report behaviours that are considered socially desirable; Nederhof 1985), and thus the proportions reported above (Figure 19) should be interpreted with caution, and compared with objective data wherever available (e.g. participation levels in organised monitoring, clean-up and/or restoration programs).

### 4.4.2 Motivations and capacity to contribute to waterway stewardship

Regional residents' motivations and capacity to contribute to waterway stewardship were measured using six first-person attitudinal/belief statements, and two normative statements (i.e. beliefs about other people in the local community), for which survey respondents were asked to provide an indicative rating of their level of agreement on a 10-point scale (1 = 'very strongly disagree', 10 = 'very strongly agree'; Q.17, Appendix A). The eight items (ranked by mean rating) are shown below (Figure 20), and statistically significant differences were found between regions for six (Table 23 below).

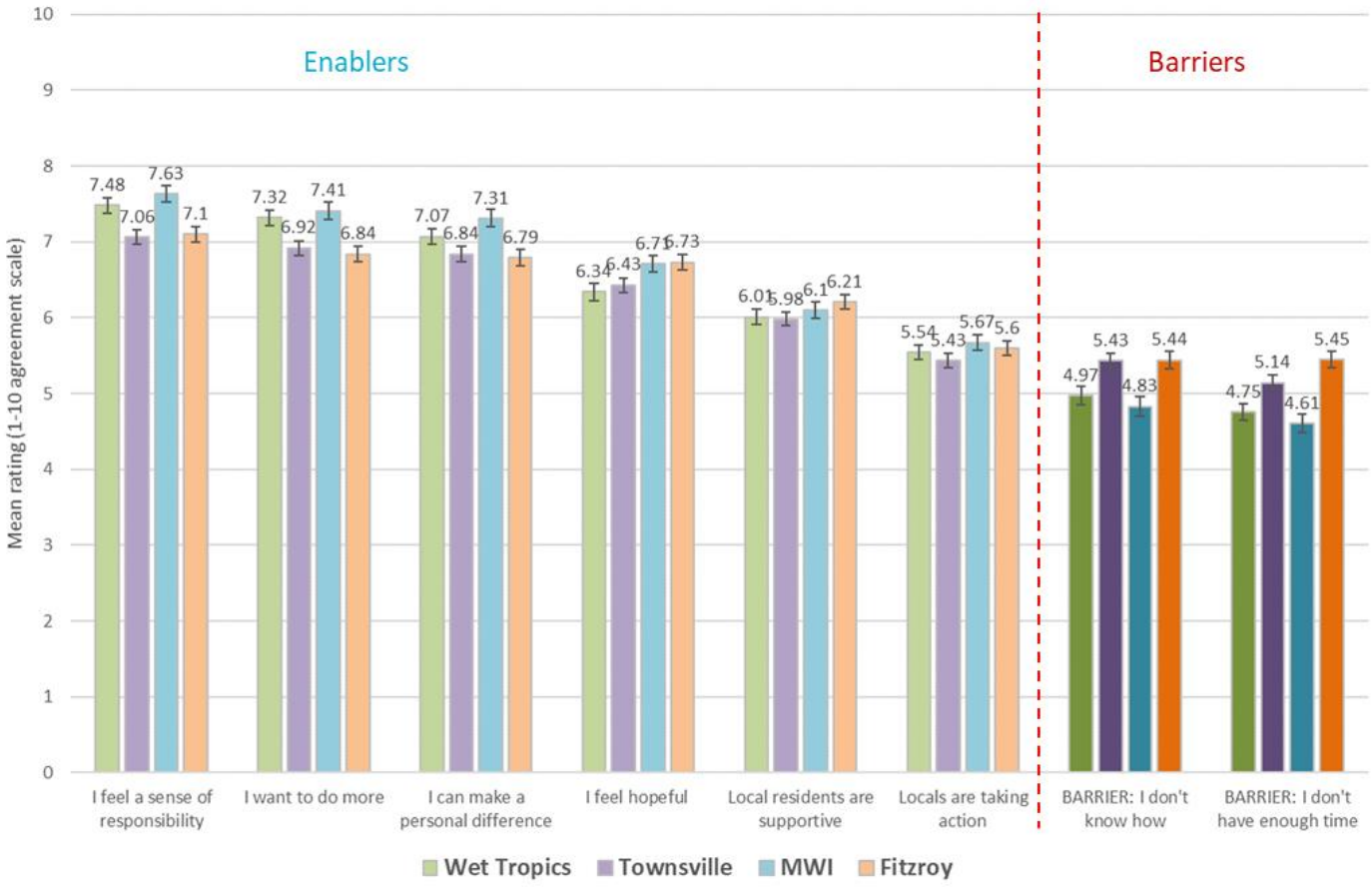



**Figure 20 Respondents' relative ratings of agreement with statements reflecting their motivations and capacity to contribute to waterway stewardship [mean ratings ±SE on 1-10 agreement scale; n=1877; the dotted red line distinguishes different question types/framing]**

**Table 23 Kruskal-Wallis analysis of variance test results comparing four regions for eight variables indicating residents' motivations and capacity to contribute to waterway stewardship**

| SURVEY QUESTION (N=1877 unless denoted[a]) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **I feel a sense of responsibility** ('*I feel a sense of responsibility to help to improve waterway health in my region'*) | 26.003 (3) | 0.0001* | 26.740 (3) | 0.0001* |
| **I want to do more** ('*I want to do more to help improve waterway health in my region'*) | 25.664 (3) | 0.0001* | 26.326 (3) | 0.0001* |
| **I can make a personal difference** ('*I can make a personal difference to improving waterway health in my region*) | 14.493 (3) | 0.0023* | 14.840 (3) | 0.0020* |
| **I feel hopeful** ('*I feel hopeful about the future health of waterways in my region*') | 8.670 (3) | 0.0340* | 8.859 (3) | 0.0312* |
| **Local residents are supportive** ('*Local residents in my region are supportive of taking action to improve waterway health'*) | 3.084 (3) | 0.3788 | 3.169 (3) | 0.3663 |
| **Locals are taking action** ('*Many local residents in my region are taking action to improve waterway health'*) | 2.836 (3) | 0.4176 | 2.924 (3) | 0.4035 |
| **BARRIER: I don't know how** ('*I don't know how I could contribute to improving waterway health in my region'*) | 20.374 (3) | 0.0001* | 20.681 (3) | 0.0001* |
| **BARRIER: I don't have enough time** ('*I don't have enough time to contribute to improving waterway health in my region'*) | 34.189 (3) | 0.0001* | 34.933 (3) | 0.0001* |

**Indicates a statistically significant difference at $p \leq 0.05$*

## 4.5 Waterway governance

### 4.5.1 Satisfaction and perceptions of waterway management for different sectoral uses

Regional residents' overall satisfaction with local waterway management and their perceptions of the management of different sectoral uses of the waterways were measured using a series of statements alongside a 10-point agreement rating scale (1 = 'very strongly disagree', 10 = 'very strongly agree'; Q.18, Appendix A). The mean ratings for each region are compared below (Figure 21), noting that 'mining uses' was a listed item in the Fitzroy survey only. Statistically significant differences were found between the regions for three of these variables: (i) '*I think that ports and shipping in our region are well managed*', (ii) '*I think that aquaculture uses of waterways in our region are well managed*', and (iii) '*I think that fisheries in our region are well managed*' (Table 24 below), with the lowest mean scores for these variables in the Wet Tropics region (indicating lowest satisfaction), and the highest in the Fitzroy region. Despite these significant differences, the relative ranking of these variables across the different sectors was consistent between regions (cf. Figure 21).

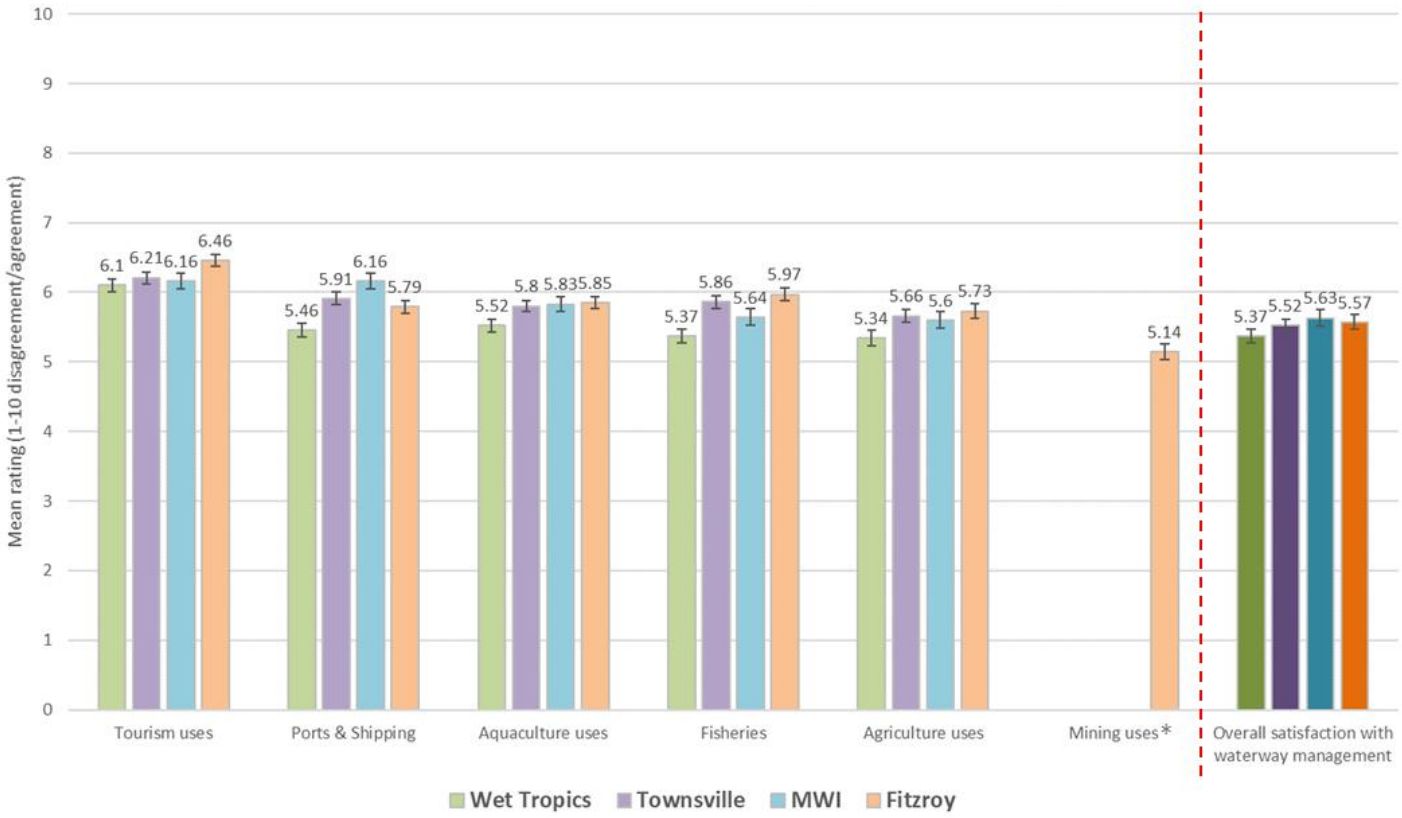



**Figure 21 Respondents' relative ratings of agreement with statements reflecting their satisfaction with waterway management overall, and for specific sectoral uses [mean ratings ±SE on 1-10 agreement scale; n=1877 unless denoted*; the dotted red line distinguishes different question types]**

**Table 24 Kruskal-Wallis analysis of variance test results comparing four regions for six variables indicating residents' satisfaction and perceptions of waterway management, encompassing different sectoral uses of waterways**

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Tourism uses** (*'I think that tourism uses of waterways in our region are well managed'*) | 6.710 (3) | 0.0817 | 6.885 (3) | 0.0757 |
| **Ports & Shipping** (*'I think that ports and shipping in our region are well managed'*) | 23.795 (3) | 0.0001* | 24.409 (3) | 0.0001* |
| **Aquaculture uses** (*'I think that aquaculture uses of waterways in our region are well managed'*) | 8.886 (3) | 0.0308* | 9.282 (3) | 0.0258* |
| **Fisheries** (*'I think that fisheries in our region are well managed'*) | 22.033 (3) | 0.0001* | 22.642 (3) | 0.0001* |
| **Agriculture uses** (*'I think that agriculture uses of waterways in our region are well managed'*) | 6.916 (3) | 0.0746 | 7.068 (3) | 0.0698 |
| **Overall satisfaction with waterway management** (*'Overall, I feel satisfied with how local waterways are managed'*) | 2.417 (3) | 0.4905 | 2.470 (3) | 0.4807 |

**Indicates a statistically significant difference at $p \leq 0.05$*

### 4.5.2 Participation, perceived fairness and trust in waterway governance

Using the same agreement rating scale (Q.18, Appendix A), additional items were presented to respondents for their ratings, to indicate their level of participation, perceived fairness, and trust in waterway governance. Mean ratings for each region are shown below (Figure 22), and statistically significant differences were found between the regions for four of the listed items (Table 25 below).

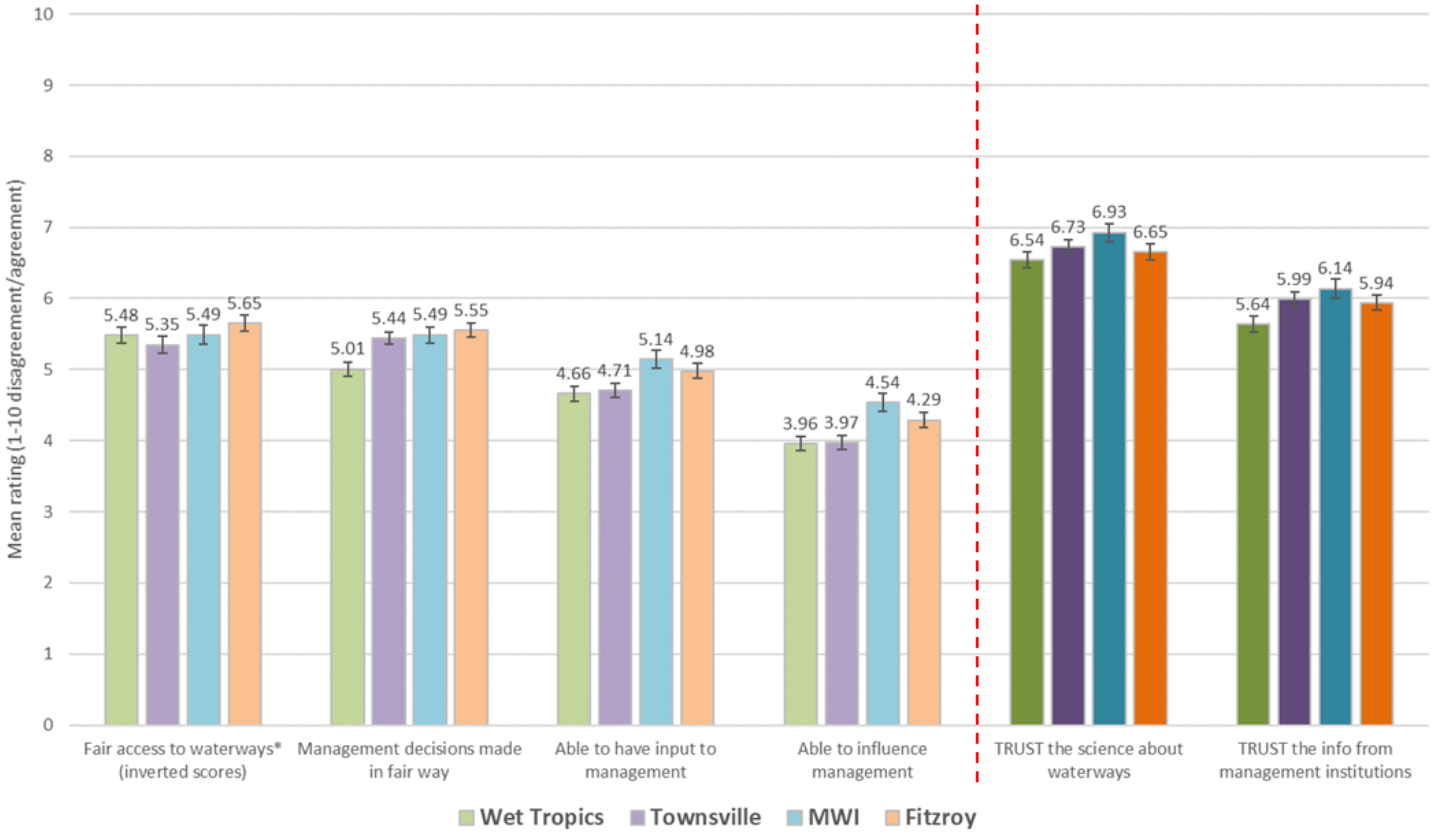



**Figure 22 Respondents' relative ratings of agreement with statements reflecting their participation, perceived fairness, and trust in waterway governance [mean ratings ±SE on 1-10 agreement scale; n=1877; *indicates inverted scores due to negative question wording; the dotted red line distinguishes different (non-comparable) question types]**

**Table 25 Kruskal-Wallis analysis of variance test results comparing four regions for six variables indicating residents' self-reported participation, perceived fairness, and trust, in waterway governance**

| SURVEY QUESTION (N=1877) | $X^2$ (d.f.) | p | $X^2$ with ties (d.f.) | p |
|---|---|---|---|---|
| **Fair access to waterways** ('*I do not have fair access to all the waterways in my region that I would like to use*') | 3.227 (3) | 0.3580 | 3.289 (3) | 0.3492 |
| **Management decisions made in fair way** ('*I think that decisions about managing local waterways are made in a fair way*') | 16.032 (3) | 0.0011* | 16.533 (3) | 0.0009* |
| **Able to have input to management** ('*I feel able to have input into the management of waterways in my region if I choose to*') | 11.007 (3) | 0.0117* | 11.216 (3) | 0.0106* |
| **Able to influence management** ('*I feel I personally have some influence over how local waterways are managed*') | 16.332 (3) | 0.0010* | 16.648 (3) | 0.0008* |
| **TRUST the science about waterways** ('*I trust the science about waterway health and management*') | 6.259 (3) | 0.0997 | 6.380 (3) | 0.0945 |
| **TRUST the info from management institutions** ('*I trust the information I receive from institutions that manage our waterways (e.g. local council, QLD Government, GBRMPA)*') | 7.908 (3) | 0.0480* | 8.043 (3) | 0.0451* |

**Indicates a statistically significant difference at $p \leq 0.05$*

### 4.5.3 Awareness of regional report cards

The final two questions in the survey utilised a simple yes/no response, and asked: (i) 'prior to completing this survey, were you aware of the ___ Regional Report Card?' and (ii) 'prior to completing this survey, were you aware of the ___ Regional Partnership?'. The proportion of respondents in each region who indicated 'yes' is shown below (Figure 23). In this baseline survey, the MWI region achieved the highest level of community awareness, with 40% of their respondents indicating prior awareness of the report card, and 44% indicating a prior awareness of the regional partnership. The lowest level of community awareness was in the Townsville region (with 23% and 16% respectively).

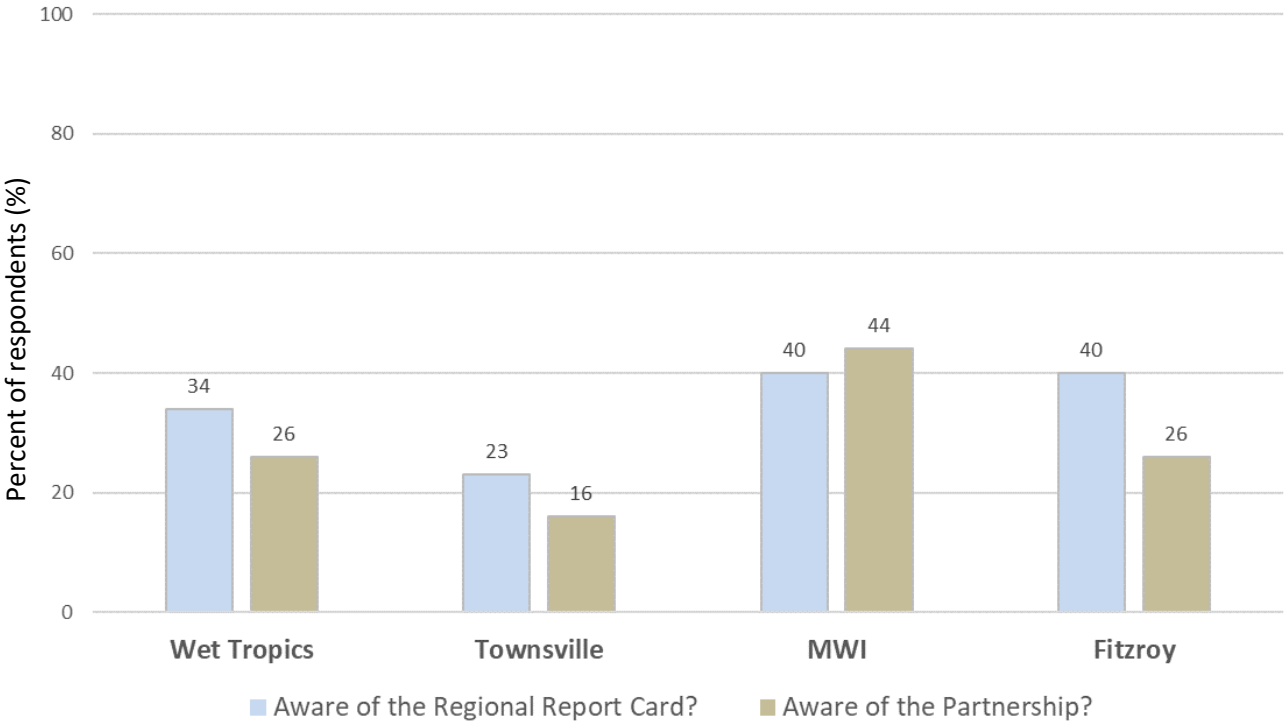



**Figure 23 Proportion of respondents in each region who indicated 'yes', that they were (i) previously aware of the existence of their Regional Report Card, and (ii) previously aware of their Regional Report Card Partnership [per cent of respondents; n=1877]**

# 5 Discussion

## 5.1 Achievement of project objectives

The three main objectives of this project (Section 1.2) were achieved, with evidence and supporting materials documented in this report:

1. Regionally appropriate metrics and survey instruments were co-designed with the Regional Report Card partnerships (August to October 2021). As reported in Sections 2.3–2.5, the survey metrics:
    a. address relevant Reef 2050 human dimension indicators (Tables 3–7)
    b. address relevant indicators prioritised in the 2020-2021 workshops led by Alluvium (Table 8)
    c. are fit-for-purpose, robust, and consistent with relevant scientific theories and frameworks (Section 2.3)
    d. include a subset of 'common core metrics' that enable benchmarking between regions, and comparisons with other GBR human dimension monitoring programs (e.g. SELTMP Great Barrier Reef survey, Paddock to Reef).
2. A baseline dataset was collected using the above survey instruments (November to December 2021) that can be replicated in a long-term monitoring program. Data collection procedures and data governance processes are documented in this report (Section 3) to facilitate reliable ongoing use and confidence in the data and results
3. The Regional Report Card partnerships' capacity to continue the long-term data collection and reporting on regionally relevant human dimensions indicators has been enhanced, with methods and protocols for replication documented in this report.

Additional capacity building activities associated with this project have included the development of a pilot online data visualisation dashboard[19] for the baseline dataset, and ongoing advice and support provided to regional partnerships in the analysis, interpretation and presentation of their region's data (e.g. presentations to partnership members, advice on development of communications messaging, co-authored conference presentations).

While the publication of this report marks the completion of this project, the authors are committed to building on the outcomes, continuing the successful collaboration with the Regional Report Card partnerships, and supporting future monitoring and evaluation. This is expected to include further contributions to the development of report card grades from human dimension indicators, as well as advancing the scientific understanding of processes within the wider social-ecological system.

[19] Available via https://research.csiro.au/seltmp/

## 5.2 Baseline dataset and regional samples

### Effectiveness of sampling methods

Based on the statistical tests shown in the results section (e.g. the standard error of most mean ratings was approximately 0.1 scale points, and statistically significant differences were detected across a range of metrics), we consider the overall sample size and the regional samples achieved (Table 9, Section 3.2) to be adequate to enable reliable comparisons between regions.

The use of two recruitment pathways (online panel + regional promotion recruitment) was considered necessary for data collection at an early stage of the project, based on the online survey provider's quoted number of available online panel participants in each region, and recent prior experience with sampling for the SELTMP GBR survey in June-July 2021. To attain comparable samples in future iterations, the continued use of both recruitment pathways is considered an ongoing necessity. The regional promotion recruitment led by each of the regional partnerships was also considered to generate an additional benefit of raising public awareness of the Regional Report Cards and the partnerships.

### Representativeness of samples

A comparison of demographic variables between the two recruitment methods revealed some differences between the subsamples (e.g. potential over-representation of female respondents in some regions, and of unemployed respondents among the online panel participants; Table 13), further suggesting a need to continue both recruitment methods in future, to ensure an overall sample that reflects the demography of the regional populations. Note that 2021 ABS Census data will become available later in 2022, which can be used for benchmarking the demographic makeup of the survey samples within each region.

Despite differences in the age distribution of respondents from the Wet Tropics and MWI regions (i.e. high proportions of older respondents in the Wet Tropics region and younger respondents in the MWI region; Figure 4), there were many similarities in the results from these two regions, across a wide range of attitudinal variables. Demographic variables such as age, gender, income and education are often shown to correlate with environmental attitudes (McMillan et al., 1997; Gifford & Sussman, 2012), and further analyses of demographic correlates within these data are warranted.

The geographic distribution of respondents (Figure 6 above, and Appendix B below) appears to show adequate participation by residents in remote areas (postcodes), as well as by those in the regional population centres.

Regional variability in the proportion of respondents from different employment sectors (Table 12 above) is likely reflective of the dominant industries in each region, and no particular employment sector was over-represented to an extent that would raise concerns of sampling bias; however, the relatively high proportion of unemployed respondents should be considered in future time-series comparisons.

## 5.3 Key findings from baseline results

As noted at the beginning of Section 4, the results presented in this report provide a high-level, descriptive account of the baseline dataset, with some comparisons made between regions to highlight key similarities and differences. Further in-depth analyses are expected, and will be necessary to extract the full value from the data, including within regions (to be initiated and/or led by the Regional Report Card partnerships) and between-regions (e.g. to address research questions, ideally with the consent and/or involvement of the Regional Report Card partnerships).

We note that the dataset has been made publicly available in a persistent online repository[20], accompanied by a non-commercial licensing agreement and an attribution statement acknowledging the intellectual contributions by participants in the co-design process.

We encourage the Regional Report Card partnerships to continue to engage with the research community, and to utilise the available data to address emerging research questions that can help to improve regional waterway management.

Below we provide a brief discussion of key findings from the results, presented under the four major categories of metrics (Section 2.3).

### 5.3.1 Waterway uses, benefits, and values

#### Use levels

The baseline survey results provide a useful indication of relative use levels of major waterway zones in each region, noting that social surveys of this type cannot provide an objective measure of actual use in any particular area. While there was some between-region variability in relative use levels, overall the waterways with the highest reported levels of use were *coastal and inshore*, followed by *freshwater systems,* and recreation was the predominant purpose of respondents' visitation to these and other waterways (Table 14).

A relatively small proportion of respondents could be considered 'frequent users' of the different waterway types (i.e. those who visit at least weekly), while a much larger proportion could be categorised as 'infrequent' or occasional users (i.e. visiting at most monthly; Figure 7). Comparisons of these 'use-frequency' groups across a range of variables within the survey dataset may reveal valuable insights about differing perceptions of waterway health, problems, threats, and management, as well as user values and benefits, noting that such analyses were beyond the scope of this report.

[20] Available at: https://doi.org/10.25919/52yr-rg31

### Predominant uses and recreation activities

A comparison between the regions of the popularity of different waterway recreation activities revealed distinct differences that may reflect predominant regional lifestyles. For example, a substantially higher proportion of respondents from the MWI region reported participation in recreational fishing, camping, boating and sailing, compared to other regions (Figure 8). This regional distinctiveness is again reflected in respondents' perceptions of regional waterways, in which the most frequently recalled word by MWI respondents was 'fishing', when asked '*what are the first words that come to mind when you think of waterways in the region?*' (Figure 14).

### Dependence and attachment

When comparing residents' dependence on regional waterways, the MWI region also had the highest proportion of respondents who indicated household income dependence (NB. 22% could be considered 'heavily dependent' by relying on regional waterways for an equivalent or greater proportion of 50% of their household income; Figure 9). The region with lowest reported income dependence on waterways was the Townsville region, with just 16% of respondents indicating some household income dependence (and 9% considered 'heavily dependent').

Dominant sectors of employment linked to income dependency on regional waterways (i.e. represented by the proportion of respondents) included agriculture, mining, tourism, government, and science & education. As reported for other results, there were clear differences in the representation of these (and other) employment sectors among respondents from different regions (Table 15).

A statistical comparison of other metrics indicating individual/personal (not necessarily financial) dependence and attachment to waterways revealed significant differences between the regions (Table 18). Substantially higher mean ratings were observed for the Wet Tropics and MWI regions for waterways' *importance to quality of life and wellbeing*, respondents being *personally affected if waterway health declined*, pride in local waterways, the influence of regional waterways in respondents' *choice to live in the region*, and the waterways' *contribution to culture* for respondents (Figure 11).

### Derived benefits

The ranking of importance for a list of personal benefits derived from regional waterways was similar between regions (Figure 10), despite the regional mean scores for most items being significantly different (Table 16). The highest rated benefit derived from waterways (or attribute associated with waterways) in all regions was their *importance for allowing people to experience, appreciate and interact with the natural environment*, and this was closely followed by *providing an important place for people to spend time with family and friends*, and then *supporting residents' lifestyle and recreational interests*.

#### Non-monetary values

Results for this group of metrics, as for those above, showed the high importance of natural and biodiverse waterways, and their role in providing a setting for local recreation to residents in all four regions. Similar to the findings described above, the relative ranking of importance for a range of economic and non-monetary values (or ecosystem services) associated with waterways was consistent between regions, although many of the regional mean ratings were significantly different, with higher ratings for most of the items observed in the Wet Tropics and MWI regions (Figure 12, Table 19). The waterway values/services with the highest mean ratings overall were *supporting biodiversity*, the *provision of recreation opportunities*, and waterways' *existence values*. The relative importance of waterways' direct use values, by recreational users and different industry sectors, was more varied between the regions, and most items were again significantly different (Figure 13, Table 20). Overall, however, the value of waterways as a *tourism attraction*, for *supporting recreational fishing*, and for *supporting agriculture* were rated highest overall.

The variability in mean scores between regions for the above range of waterway values and services suggests that such values are not static, and should not be assumed to be homogeneous within the communities of residents. Studies of similar values associated with the Great Barrier Reef have reported changes in such scores, which have been attributed to significant disturbance events (e.g. mass coral bleaching), and accompanied by shifts in community sentiment and emotional responses to a threatened iconic ecosystem (Marshall et al., 2019a; Curnock et al., 2019).

### 5.3.2 Waterway perceptions

#### General perceptions and sentiment

The word clouds generated from respondents' *first words that come to mind when thinking about waterways* in their region (Figure 14) provide a rich snapshot of residents' general (and diverse) sentiments, and indicate regionally distinctive themes associated with local lifestyles, values, and perceptions of waterways. Changes in the composition and prevalence of recalled words are considered likely over time, and will potentially be influenced by a range of emergent environmental and social issues and events.

#### Aesthetic perceptions

As noted in the results section, ratings indicating perceptions of the natural beauty of regional waterways were significantly different between regions (Figure 15, Table 22). It is important to recognise that such perceptions at an individual level are influenced by a range of subjective personal experiences, including memories of in situ interactions with environmental settings, as well as social and media representations of the environment in the region (Pocock 2002; Brady 2016). While broadly indicative of residents' perceptions of the state of aesthetics values in the region, it is important to note that these data are not linked to any specific places or habitats.

#### Perceived waterway health, problems and threats

Public perceptions of regional waterway health, problems and threats, too, are strongly influenced by social and media representations, as well as the timing and proximity of disturbance events (Lankester et al., 2015; Thiault et al., 2021). In these baseline results, we found that the *inshore coral reefs* were perceived to in *poor health* by the highest proportion of respondents, while *beaches and the coast* were perceived to be in *good health* by the majority of respondents (Figure 16). For most of the habitats listed in the survey, the proportion of respondents in each response category varied (Appendix C.2), however, the relative ranking of the listed habitats was similar across the regions.

*Litter and debris* was the highest ranked problem affecting regional waterways (Figure 17), and while the proportion of respondents who categorised the issue as 'a very big problem' varied between regions, the overall ranking was consistent (Appendix C.3).

*Climate change* was ranked as the most serious current threat to regional waterways overall (Figure 18); however, this ranking was not consistent for all regions (Appendix C.4), and a relatively large proportion (between 9% and 11%) of respondents in each region indicated that they did not consider climate change to be a threat at all to their region's waterways.

Further analyses of the perceptions of different demographic groups and 'use frequency' groups (as mentioned above in Section 5.3.1) may reveal useful insights about social factors associated with different waterway perceptions, in particular those perceptions that diverge from scientific assessments of the relative health and problems affecting different waterway habitats.

### 5.3.3 Waterway stewardship

#### Self-reported participation

As noted in Section 1.3, self-reported participation in waterway stewardship activities is likely to be subject to social desirability bias (Nederhof 1985), and as such these results should not be considered as an objective measure of actual participation levels in the listed activities. Nonetheless, these data and results can be compared or benchmarked with objective data, where available, and can serve as a useful indicator of trends in relative participation over time.

Overall, self-reported participation was highest for activities that appear to require relatively little effort, including *appropriate rubbish disposal*, and *responsible fishing practices* (for relevant respondents; Figure 19). The response categories indicating reasons *why people don't participate* in the listed behaviours may be more enlightening and the underlying reasons or predictive variables are worthy of further investigation. For example, the relatively high proportion of respondents (7%) who perceived *reporting of invasive or pest species* to be an ineffective action may be indicative of their (or persons' known) previous attempts to do so, and a dissatisfying outcome and/or lack of feedback (Mankad et al., 2019; Curnock et al., 2017). The response category '*I don't do this – I was not aware of this action*' is similarly insightful, revealing a lower awareness of those activities, or of the ability to participate, and/or of the associated benefits from the activity (e.g. environmental restoration, environmental monitoring, among other actions listed; Figure 19).

#### Motivations and capacity

Relatively high mean ratings were observed for survey items indicating residents' motivation to support and/or participate in waterway stewardship, noting some significant differences between regions (Figure 20). Recent research has suggested that people who hold strong place values are more likely to *support* or *accept* environmental stewardship initiatives, however, such values and attitudes do not necessarily result in 'behavioural engagement', or participation in stewardship action (Le et al., 2022).

While the statistical differences between regions for most of these variables are of interest for further investigation, equally interesting are those variables that *weren't* statistically different (Table 23), including: (i) '*Local residents in my region are supportive of taking action to improve waterway health*' (a descriptive norm) and (ii) '*Many local residents in my region are taking action to improve waterway health*' (an injunctive norm). The similarity between regions for these normative beliefs contrasts with the strong (and significant) regional differences in beliefs about personal capacity for stewardship action (i.e. *I don't know how I could contribute to improving waterway health*, and *I don't have enough time to contribute to improving waterway health*; Figure 20). Questions that could be addressed in follow-up research may include: what factors are associated with (or potentially influencing) such personal beliefs, and why do such factors vary regionally?

The relationship between motivational, capacity and contextual factors and the adoption of stewardship behaviour remains an active area of scientific research (Bennett et al., 2018), and efforts to improve our understanding of the enablers and barriers of community stewardship in the GBR catchment contribute to a key objective of the Reef 2050 Plan (see Table 5). The empirical data provided by these social surveys can therefore make a significant contribution to this understanding, in particular as time-series data are accumulated, enabling the assessment of trends in these variables and potential causal relationships.

### 5.3.4 Waterway governance

#### Satisfaction with waterway management

Mean ratings of governance metrics in the survey were generally lower than ratings for other types of metrics (e.g. values, benefits), indicating more varied, and more negative perceptions in the communities of all four regions. A comparison of these results with similar metrics (using the same measurement scale) from the SELTMP 2021 Great Barrier Reef survey reveals slightly higher ratings given for satisfaction with the management of regional waterways, when compared with resident satisfaction with management of the GBR (regional ratings from 5.37 to 5.63 out of 10 in this survey; Figure 21), compared with an overall mean rating of 5.08 for the GBR (in Hobman et al., 2022).

There was some regional variation in ratings of satisfaction with the management of different industry sectors' uses of waterways, but the generally low scores overall (the highest mean rating was 6.46 out of 10) suggest there is scope for improvement of management, and/or the communication of management policy and progress towards shared objectives (e.g. those stated

in the Reef 2050 Plan). Further analyses of correlates and/or predictors of satisfaction with waterway management should be enlightening.

### Participation, perceived fairness and trust

Similar to those metrics described above, the placement of mean scores for these variables around or below the mid-point of the 10-point agreement scale suggests that there is room for improvement in the management of regional waterways, and in the involvement of local residents in governance processes. These results were very similar to those found in the SELTMP 2021 GBR survey, for which Hobman et al. (2022) reported a mean score of 5.13 for GBR residents' perceived *procedural justice* (i.e. *management decisions made in a fair way*), a mean score of 4.6 for *opportunities for participation in decision making* (i.e. *able to have input to management*) and a mean score of 3.78 for *influence* (i.e. *able to influence management*; cf. Figure 22), suggesting a large proportion of the catchment community is disengaged and/or disempowered in the governance of waterways and the GBR.

The mean ratings for the two trust variables (in waterway science, and in management institutions) are also lower than the SELTMP 2021 trust ratings reported for science and management of the GBR. Hobman et al. (2022) reported a mean of 7.55 (on a similar 10-point scale) for trust in information about the GBR from scientific institutions (cf. mean scores of 6.93 and below for *trust in the science* about regional waterways; Figure 22), and a mean of 7.15 for residents' trust in the Great Barrier Reef Marine Park Authority (cf. mean scores of 6.14 and below for *trust in information from waterway management institutions*; Figure 22). As noted above, further analyses of both the Regional Report Card survey data and SELTMP GBR survey data may elucidate factors associated with residents' level of engagement and empowerment in waterway and GBR governance.

# 6 Conclusion and recommendations

This report presents summary results of the baseline dataset for Regional Report Card social surveys, that contribute to relevant human dimension indicators in the Reef 2050 Plan. While further analyses of the current dataset will help to answer a number of research questions (e.g. those articulated in the discussion above), the accumulation of time-series data will be critical for evaluating progress towards management objectives, and to understand changes associated with global, regional, and local-scale trends and disruptive events in the social-ecological system.

Important contextual considerations at the time of this baseline survey include the substantial social and economic disruptions caused by the COVID-19 pandemic, a series of cumulative pressures and impacts affecting the marine and terrestrial environment, and rapidly changing technological and socio-political dynamics at a global scale. Determining the extent to which such external factors influence regional community values, attitudes and perceptions towards the natural environment can be challenging; however, causal or predictive factors can be attributed with consistent monitoring over time (e.g. as reported in Thiault et al., 2021; Marshall et al., 2019a; Curnock et al., 2019).

Based on the outcomes of this project, and findings reported above from the baseline survey dataset, we offer the following recommendations for ongoing monitoring of human dimension indicators by the Regional Report Card partnerships:

1. **Surveys should be repeated biennially, at approximately the same time of year (i.e. Nov–Dec 2023, 2025, etc.)**, to enable the effective evaluation of progress towards management objectives, and to improve the potential of the data to attribute changes and trends to the social-ecological context (e.g. significant disturbance events).
2. **The core metrics should be reviewed periodically; however, changes should only be made on the basis of compelling evidence.** Retention of core metrics is the basis of long-term monitoring. The removal or alteration of a metric may result in the inability to compare changes over time.
3. **The current survey length is about right.** During the piloting phase the average completion time for the survey was estimated at 15 minutes. We anticipate that the regional partnerships and stakeholders will want to add new metrics in future iterations to address emergent information needs. This is fine; however, trade-offs should be considered, with a potential reduction in survey completions to be expected if the survey becomes excessively long.
4. **Retain the dual pathways for survey recruitment at least in the short to medium-term**. Comparability of the survey results over time depends not only on the consistency of the metrics, but a consistent method of data collection, to minimise the potential for sampling bias. For regions in which low numbers of online panel participants are available (i.e. MWI and Fitzroy), the use of promotional incentives (e.g. a prize draw) has been shown to be effective for increasing the sample size.

5. **Each region should continue to aim for a sample size of n=500.** As shown in the results, the sample size for each region was sufficient to enable the detection of significant differences between regions for many of the core metrics. Such discrimination power will be particularly valuable for time-series analyses. The ability to compare different user groups within a region will depend on the size of subsamples.
6. **Survey results should be compared with objective data from other sources for triangulation/benchmarking.** This is particularly relevant for comparisons and benchmarking of self-reported waterway use levels, participation in activities, and self-reported stewardship actions. A variety of different data sources may be useful for such comparisons, including program and event records, observational surveys, and/or remote sensing data which is being deployed increasingly in Marine Park management.
7. **Continuation of data curation and data governance processes.** This includes continued publication of time series data in a publicly accessible and persistent online repository, and ensuring that Data Management Standards are met to enable ongoing use in the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP).
8. **Reporting and communication of social survey results by the Regional Partnerships within their region.** The social survey data here offers great potential to engage with regional residents and build community awareness and interest in waterway management issues. Communication of public perceptions, and statistics thereof, often arouses a high level of public interest.

It is our hope that the outcomes of this project, and this technical report, provide the Regional Report Card partnerships with a useful template and necessary contextual/explanatory information to enable them to confidently report and communicate their own survey results within their communities. Driving social change to improve waterway health is an overarching goal of the Regional Report Cards, and human dimension monitoring can potentially make a significant contribution towards the achievement of this goal.

# Appendix A  Template of 2021 survey with common core survey questions

## *[Region] Waterways Survey 2021*

[insert RRC partnership logo here]

### Introduction and purpose:

In this survey, as a local resident of [insert region here], you will be asked about what it is like to live in the region, your perceptions of regional waterways (from the catchment to the Reef) and your thoughts on how these waterways are managed.

**The purpose of this survey is to help inform and improve waterway management, for the benefit of all local residents in the region.**

The survey is being conducted by [RRC partnership name] in collaboration with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and with funding and support provided by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation, the Queensland Government's Reef Water Quality Program, and the Great Barrier Reef Marine Park Authority.

**Your participation in this survey is voluntary and you will remain anonymous**.

Summary results from this survey will contribute to the [Region] Report Card, publicly available at [insert RRC URL], and regional monitoring for the Reef 2050 Long-Term Sustainability Plan.

### What does participation involve?

Completing the survey should take about 10 to 15 minutes. **You will remain anonymous, and your participation is completely voluntary.** You are free to withdraw from the survey by stopping at any time and closing the browser window. If you decide to withdraw from the survey, any responses you have provided up to that point will be deleted. You may also skip any questions you do not wish to answer.

### Risk and benefits (click link to reveal paragraph below)

Aside from giving up your time, **there are no foreseeable risks associated with participating in this survey**. While your participation in this survey may not benefit you directly, your responses will help to inform local and state management agencies responsible for regional waterways, and will help to evaluate progress towards management objectives.

### Optional prize draw (click link to reveal paragraph below)

As an incentive to participate, the [RRC partnership name] is offering an optional prize draw for survey respondents in the [Region name] (see their website for details). If you wish to participate in the optional prize draw, you will be prompted to follow a link at the end of the survey to the [RRC partnership name] website, where you can enter your contact details to enter the prize draw. Note that if you choose to enter your personal contact details for the prize draw, these details will be stored separately, and will not be linked to your survey responses.

If you opt to participate in the prize draw and provide your contact details to the [RRC partnership name], they will only retain your personal contact details for the purpose of the prize draw, and this information will be destroyed after the prize draw has taken place. The [RRC partnership name] also has a separate list of contacts for their mailing list, which you may opt to join via their website.

## Confidentiality (click link to reveal hidden paragraph below)

All information provided by you in this survey will be treated confidentially. All survey data will be de-identified, and you will remain anonymous. All results from this survey will be analysed and presented in an aggregate form. All data collected as part of this study will be handled in accordance with the *Privacy Act 1988 (Cth)* and the NH&MRC National Statement on Ethical Conduct in Human Research (2007). Your data will be securely stored in accordance with CSIRO's Recordkeeping Procedure, and the de-identified aggregated data will be made available to researchers and managers from a range of institutions, for long-term data set analyses, reporting and scientific publications.

If you would like to read CSIRO's privacy statement, please click here. (click link to see Privacy section below)

## How will my information be used? (click link to reveal paragraph below)

It is anticipated that the de-identified survey findings will be published and/or presented in a variety of forums. This includes the production of the [Region] Report Card, other technical reports, scientific journal publications, conference presentations, and potentially a range of other targeted communications and news stories. De-identified data collected from the survey will be made publicly available via a persistent online repository, and will be used for long-term evaluations of regional changes. [RRC partnership name] will endeavour to communicate key findings to all residents in the region, as well as to relevant government agencies and supporting institutions.

## Ethical clearance and contacts (click link to reveal paragraph below)

This study has been reviewed and approved by CSIRO's Social Science Human Research Ethics Committee in accordance with the *National Statement on Ethical Conduct in Human Research (2007); Approval number [insert CSSHREC Approval Number].* If you have any questions concerning your participation in the study, please contact the researchers via their contact details below. Alternatively, any concerns or complaints about the conduct of this study can be raised with the CSIRO Manager of Social Responsibility and Ethics on (07) 3833 5693 or by email at csshrec@csiro.au.

## For further information you can contact: (click link to reveal contact details below)

[insert contact details for RRC partnership + CSIRO researchers]

## **Privacy Statement** (on separate page via link above)

Your personal information is protected by the *Privacy Act 1988* (Cth). [RRC partnership name] and CSIRO will handle your personal information in accordance with this Act and the NH&MRC National Statement on Ethical Conduct in Human Research (2007) as amended from time to time.

Some personal information (e.g. your postcode, gender, employment sector) and answers to the survey questions are being collected for the purpose of ensuring the survey sample is representative of the regional population. While the collection of your information is not intended to identify you, it is possible, however unlikely, that some of the information may have the potential to re-identify you once collated.

The information you provide will be de-identified and/or aggregated before it is made available for analyses by researchers, and subsequently published/presented in a variety of forums. This will include the [Region] Report Card, other technical reports, scientific papers, conference/seminar presentations, as well as news media and social media posts.

For information about how the **[online survey provider company name]** handles personal information, please see their Privacy Policy at: [online survey provider URL]

The CSIRO Privacy Policy available at https://www.csiro.au/en/About/Access-to-information/Privacy outlines how your personal information will be handled, including details about how you can seek access or correction of the personal information we hold about you and how you can complain about a breach of the Australian Privacy Principles (APPs) and how CSIRO will deal with the complaint. If you require further information on how your personal information will be handled, please contact privacy@csiro.au.

## Do you consent to take part in the survey?

❑ Yes, I agree to participate in the survey (continue to Q1)

❑ No, I do not agree to participate in the survey …. (Thanks and exit link to Regional Report Card website)

1. **What is your current residential / home postcode?**
   Postcode: _____
   City / Township / Suburb: _____

   *If outside the [region name] region – EXIT NOTE: thank you, but this survey is just for people living in the [region name] region. Please keep an eye out for surveys about waterways in other regions nearby.*

## SECTION ONE: A little bit about you, and your uses of waterways in the [insert region name] region

2. **What is your age?**

❑18-24 ❑25-34 ❑35-44 ❑45-54 ❑55-64 ❑65-74 ❑75+

*(*Note survey respondents must be 18 years or older)*

3. **How do you describe your gender?** (tick one box only)

   ❑ Female

   ❑ Male

   ❑ Other / non-binary

   ❑ Prefer not to say

Throughout this survey, the term ”waterways” refers to all aquatic environments within the [region name] region, as shown in the map below.

[insert region waterways map]

**Waterways in the [region name] region include:**

- **Freshwater systems**: Includes all rivers, creeks, freshwater wetlands, and dams in the region.
- **Estuaries**: Includes lower reaches of creeks and rivers that are tidal, where salt and freshwater mix, including mangroves and saltmarshes.
- **Coast and Inshore Marine:** Inshore marine areas, including the coasts, and inner GBR waters and islands.
- **Offshore Marine**: Offshore marine areas, beyond the inner islands to the outer boundary of the Great Barrier Reef Marine Park.

1. **What are the first words that come to mind when you think of waterways in the [region name] region?**
   - _____
   - _____
   - _____

2. **In the previous 12 months, how often did you visit a freshwater system in the [region name] region?** (e.*g. as shown in the above map and description*) (tick one box only)

❑ Not at all (go to Q.6)
❑ Once or twice
❑ Every few months (i.e., 3-6 times)
❑ Approximately monthly (i.e., 7-12 times)
❑ Approximately fortnightly (i.e., 13-24 times)
❑ Approximately weekly (i.e., 25-50 times)
❑ More than once a week (i.e., more than 50 times)

**5a. Were these freshwater visits mostly for** (please tick one or more reasons below):

❑ Recreation, *OR* ❑ Work, *OR* ❑ Cultural reasons, *OR* ❑ Other reason(s)?

6. **In the previous 12 months, how often did you visit an estuary in the [region name] region?** (e.*g. as shown in the above map and description*)

❑ Not at all (go to Q.7)
❑ Once or twice
❑ Every few months (i.e., 3-6 times)
❑ Approximately monthly (i.e., 7-12 times)
❑ Approximately fortnightly (i.e., 13-24 times)
❑ Approximately weekly (i.e., 25-50 times)
❑ More than once a week (i.e., more than 50 times)

**6a. Were these estuary visits mostly for** (please tick one or more reasons below):

❑ Recreation, *OR* ❑ Work, *OR* ❑ Cultural reasons, *OR* ❑ Other reason(s)?

7. **In the previous 12 months, how often did you visit a coastal or inshore marine waterway in the [region name] region?** (e.*g. as shown in the above map and description*)

❑ Not at all (go to Q.9)
❑ Once or twice
❑ Every few months (i.e., 3-6 times)
❑ Approximately monthly (i.e., 7-12 times)
❑ Approximately fortnightly (i.e., 13-24 times)
❑ Approximately weekly (i.e., 25-50 times)
❑ More than once a week (i.e., more than 50 times)

**7a. Were these coastal or inshore visits mostly for** (please tick one or more reasons below)**:**

❑ Recreation, *OR* ❑ Work, *OR* ❑ Cultural reasons, *OR* ❑ Other reason(s)?

**8. In the previous 12 months, how often did you visit the offshore marine area in the [region name] region?** (*as shown in the above map and description*) (tick one box only)

❑ Not at all (go to Q7)
❑ Once or twice
❑ Every few months (i.e., 3-6 times)
❑ Approximately monthly (i.e., 7-12 times)
❑ Approximately fortnightly (i.e., 13-24 times)
❑ Approximately weekly (i.e., 25-50 times)
❑ More than once a week (i.e., more than 50 times)

**8a. Were these offshore visits mostly for:** (please tick one or more reasons below)

❑ Recreation, OR ❑ Work, OR ❑ Cultural reasons, OR ❑ Other reason(s)?

**9.** When visiting **all the different waterways** in the [region name] region, in the past 12 months, what recreational activities have you participated in? (please select all that apply)

| **Activity** | **Select all that apply** |
|---|---|
| Fishing | ❑ |
| Boating or sailing | ❑ |
| Snorkelling, freediving, SCUBA diving | ❑ |
| Motor-powered water sports (e.g. water skiing, jet skiing) | ❑ |
| Wind-powered water sports (e.g. kite surfing) | ❑ |
| Paddling/canoeing/kayaking | ❑ |
| Swimming | ❑ |
| Picnics and barbeques | ❑ |
| Camping | ❑ |
| Wildlife watching & appreciating nature | ❑ |
| Exercising/hiking/biking/running | ❑ |
| Other (please specify): _____ | ❑ |

**10. What is your favourite waterway to visit in the [region name] region for recreation?**

_____

**11. Thinking about your visits and uses of waterways in the [region name] region in general, please rate your level of agreement with the following statements.**

| | **Very strongly disagree** | **Very strongly agree** |
|---|---|---|
| Visiting waterways in the [region name] region is important for my quality of life and wellbeing | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Waterways in the [region name] region support my lifestyle and recreational interests | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Waterways in the region provide an important place for me to spend time with family and friends | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Waterways in the region are important for providing fresh fish and seafood for me to eat | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Waterways in the region are an important part of my culture | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Waterways in the region are important for allowing me to experience, appreciate and interact with the natural environment | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways are an important source of my water supply for drinking and household use | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I am proud of the local waterways in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways in my region are an important part of why I choose to live here | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The natural beauty of waterways in the [region name] region is outstanding | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| If the health of waterways in my region declined, I would be personally affected | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |

**12. How much do you value the following aspects of waterways in the [region name] region?** (please select one number on the rating scale for each item)

| | **I don't value this at all** | **I value this extremely highly** |
|---|---|---|
| The waterways support a variety of native habitats, plants and wildlife | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The fact that the waterways exist, even if I don't use or directly benefit from them | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways offer a place for local residents to enjoy recreation activities | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways provide a place where people can pass down knowledge, traditions, and a way of life | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways have rich Traditional Owner Heritage | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways are an important attraction for tourists visiting the region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support our local economy | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways provide a place where people can study and learn about the natural environment | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support recreational fishing | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Our waterways are recognised nationally and internationally for their iconic status (e.g. World Heritage, Ramsar sites) | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support mining, ports and shipping in our region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support local agriculture | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support commercial fisheries | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| The waterways support local aquaculture | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |

**SECTION TWO: For the next few questions, we would like you to tell us about your perceptions of waterways in the [region name] region, including their health, and any problems or threats the waterways currently face.**

**13. Of the places you have visited in the [region name] region, how would you rate the health of the…**

| | In poor health | In fair health | In good health | Not applicable *(have not visited)* | I don't know |
|---|---|---|---|---|---|
| Freshwater creeks and rivers | ❑ | ❑ | ❑ | ❑ | ❑ |
| Freshwater lakes, dams and wetlands | ❑ | ❑ | ❑ | ❑ | ❑ |
| Estuaries (including mangroves and saltmarshes) | ❑ | ❑ | ❑ | ❑ | ❑ |
| Beaches and the coast | ❑ | ❑ | ❑ | ❑ | ❑ |
| Seagrass | ❑ | ❑ | ❑ | ❑ | ❑ |
| Inshore coral reefs | ❑ | ❑ | ❑ | ❑ | ❑ |
| Offshore coral reefs | ❑ | ❑ | ❑ | ❑ | ❑ |
| Ocean and sea | ❑ | ❑ | ❑ | ❑ | ❑ |
| Groundwater | ❑ | ❑ | ❑ | ❑ | ❑ |

**14. From your experience, how problematic do you think each of the following issues are for waterways in the [region name] region?**

| | 1 = Not a problem at all | 2 = A small problem | 3 = A moderate problem | 4 = A big problem | 5 = A very big problem | I don't know |
|---|---|---|---|---|---|---|
| Poor water quality in freshwaters and estuaries | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Poor coastal and inshore water quality | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Poor offshore marine water quality | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Riverbank erosion | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Coastal erosion | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Bushfire | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Weeds in and around waterways | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Litter and debris (e.g. plastics) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Chemical pollutants (e.g. pesticides, PFAS) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Invasive fish (e.g., Tilapia) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Low abundance of fish | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Decline in waterbirds and shorebirds | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Algal blooms and fish kills | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Decline in numbers of marine megafauna (e.g. turtles, dugongs, dolphins) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |

**15. For the following list of issues – please rate the extent to which you think they represent a current threat to [region name] waterways?**

| | 1 = Does not represent a threat at all | 2 = A minor threat | 3 = A moderate threat | 4 = A serious threat | 5 = Represents an extremely serious threat | I don't know |
|---|---|---|---|---|---|---|
| Illegal fishing practices (e.g., poaching in no-take zones) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Over-fishing | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Sediments, nutrients and pesticides from land-based runoff | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Climate change | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Tourism activities | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Land clearing | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Ports and shipping activities | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Mining activities (e.g. water extraction, releases) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Coastal development | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Extreme weather (e.g. cyclones, droughts, floods) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |
| Recreation activities (e.g. boats, fishers, water sports) | 1 - - - - - - - - - - 2 - - - - - - - - - - 3 - - - - - - - - - - 4 - - - - - - - - - - 5 | | | | | ❑ |

## SECTION THREE: The next few questions are about efforts to reduce negative impacts on waterways and improve waterway health

**16.** For the following questions, we would like to ask you about several personal actions that are intended to improve waterway health. **Which of the following do you personally do?** (select one response category per item)

| | I do this | I **don't** do this – I was not aware of this action | I **don't** do this – I don't think this action is effective | I **don't** do this – Other reasons (e.g. no opportunities, time, etc.) | This is not applicable to me |
|---|---|---|---|---|---|
| ***For people who have or use a boat...***<br>**Responsible anchoring** (e.g. by using a geo-spot electric motor, or anchoring only in sandy areas away from corals/seagrass) | ❑ | ❑ | ❑ | ❑ | ❑ |
| ***For people who go fishing…***<br>**Responsible fishing** (e.g. take only the fish you intend to eat; quickly release undersize or unidentified fish; using barbless or circle hooks) | ❑ | ❑ | ❑ | ❑ | ❑ |
| ***On and around waterways…***<br>**Dispose of food scraps and rubbish appropriately** (i.e. ashore, in a rubbish bin provided by council, or at home) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Report suspicious activity to relevant authorities** (e.g. illegal dumping, illegal fishing practices, chemical or oil spills) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Report invasive or pest species to relevant authorities** (e.g. weeds, feral animals; to council, or Biosecurity QLD) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Contribute to environmental monitoring programs** (e.g. by participating in data collection, or reporting wildlife sightings) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Participate in local environmental clean-ups** (e.g. picking up rubbish, or marine debris) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Participate in local environmental restoration** (e.g. weed removal, tree planting, coral restoration) | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Responsible four-wheel driving** (e.g. avoiding river banks to minimise erosion, sand dunes during turtle nesting season) | ❑ | ❑ | ❑ | ❑ | ❑ |

**17. Please rate your level of agreement with the following statements:**

| | **Very strongly disagree** | **Very strongly agree** |
|---|---|---|
| I **can** make a personal difference to improving waterway health in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I feel a sense of responsibility to help to improve waterway health | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I want to do more to help improve waterway health in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I feel hopeful about the future health of waterways in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I don't have enough time to contribute to improving waterway health in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I don't know how I could contribute to improving waterway health in my region | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Local residents in my region are supportive of taking action to improve waterway health | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| Many local residents in my region are taking action to improve waterway health | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |

## SECTION FOUR: For the next few questions, we would like you to share your views on how our waterways are managed.

**18. Please rate your level of agreement with the following statements:**

| | **Very strongly disagree** | **Very strongly agree** |
|---|---|---|
| Overall, I feel satisfied with how local waterways are managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that tourism uses of waterways in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that agricultural uses of waterways in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that the fisheries in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that aquaculture uses of waterways in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that ports and shipping in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that mining uses of waterways in our region are well managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I think that decisions about managing local waterways are made in a fair way | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I ***do not*** have fair access to all the waterways in my region that I would like to use | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I feel I personally have some influence over how local waterways are managed | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I feel able to have input into the management of waterways in my region if I choose to | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I trust the information I receive from institutions that manage our waterways (e.g. local council, QLD Government, GBRMPA) | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |
| I trust the science about waterway health and management | 1 - - - 2 - - - 3 - - - 4 - - - 5- - | 6 - - - 7 - - - 8 - - - 9 - - - 10 |

**19. Any additional comments about waterway management?**

_____

## SECTION FIVE (final section): A little bit more about you, to help us better understand waterway users in the [region name] region

**20. What proportion of your household income is from [region name] waterways-related businesses or employment?** (select one category that fits your household best)

- ❑ None – *go to question 22*
- ❑ A small amount (less than 25%)
- ❑ A moderate amount (around 50%)
- ❑ A large amount (around 75%)
- ❑ All my household income (100%)

**21. Which broad sector of waterway-dependent business or employment does this household income come from?** (select one or more categories)

- ❑ Agriculture
- ❑ Aquaculture
- ❑ Boating and retail
- ❑ Fishing
- ❑ Government
- ❑ Mining
- ❑ Non-government organisation
- ❑ Ports or shipping
- ❑ Science and Education
- ❑ Tourism (including hospitality)
- ❑ Other

**22. For how many years have you lived in the [region name] region?** _____ (years)

**23. Do you identify as an Aboriginal Australian, or Torres Strait Islander?**

- ❑ No
- ❑ First Nation of the Fitzroy Region
- ❑ Aboriginal Australian
- ❑ Torres Strait Islander
- ❑ Both Aboriginal Australian and Torres Strait Islander
- ❑ Prefer not to say

**24. What sector do you mainly work in?** (select one)

- ❑ None (*not currently employed*)
- ❑Agricultural
- ❑ Forestry
- ❑ Fishing
- ❑ Mining
- ❑ Manufacturing
- ❑ Electricity, Gas, Water and Waste Services
- ❑ Construction
- ❑ Wholesale Trade
- ❑ Retail Trade
- ❑ Accommodation and Food Services
- ❑ Transport, Postal and Warehousing
- ❑ Information Media and Telecommunications
- ❑ Financial and Insurance Services
- ❑ Rental, Hiring and Real Estate Services
- ❑ Professional, Scientific and Technical Services
- ❑ Administrative and Support Services
- ❑ Public administration and Safety
- ❑ Education and Training
- ❑ Health Care and Social Assistance
- ❑ Arts and Recreation Services
- ❑ Other Services

**25.** Prior to completing this survey, were you aware of the **[RRC name]** **Report Card**?

- ❑ No
- ❑ Yes

**26.** Prior to completing this survey, were you aware of the **[RRC partnership name]** regional partnership? Note: This organisation is a separate entity to the [regional NRM entity].

- ❑ No
- ❑ Yes

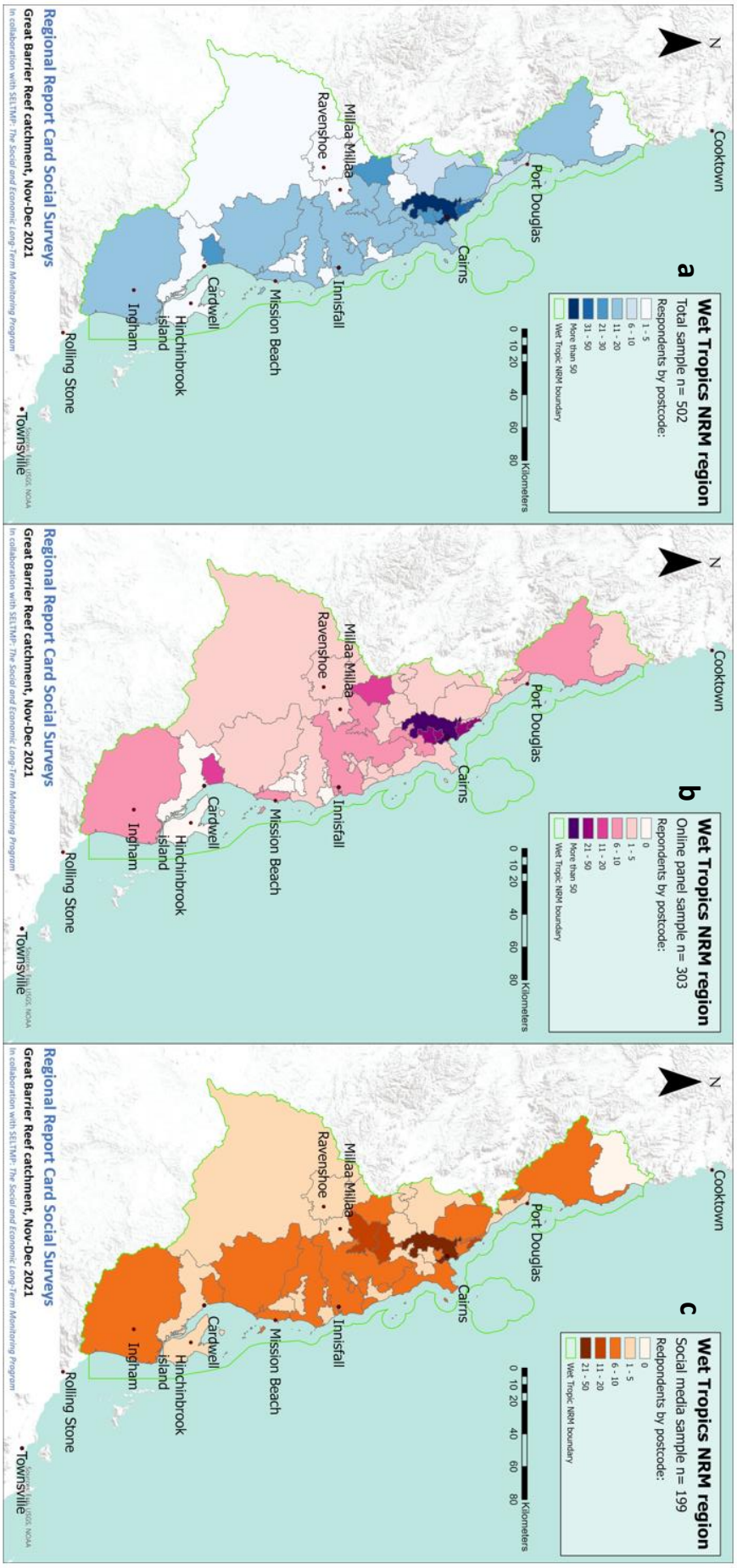
**Survey End.**

Thank you for your time and responses to this survey. A summary of the results will be made available on the **[RRC partnership name]** website in the coming months. Individual survey respondents will remain anonymous.

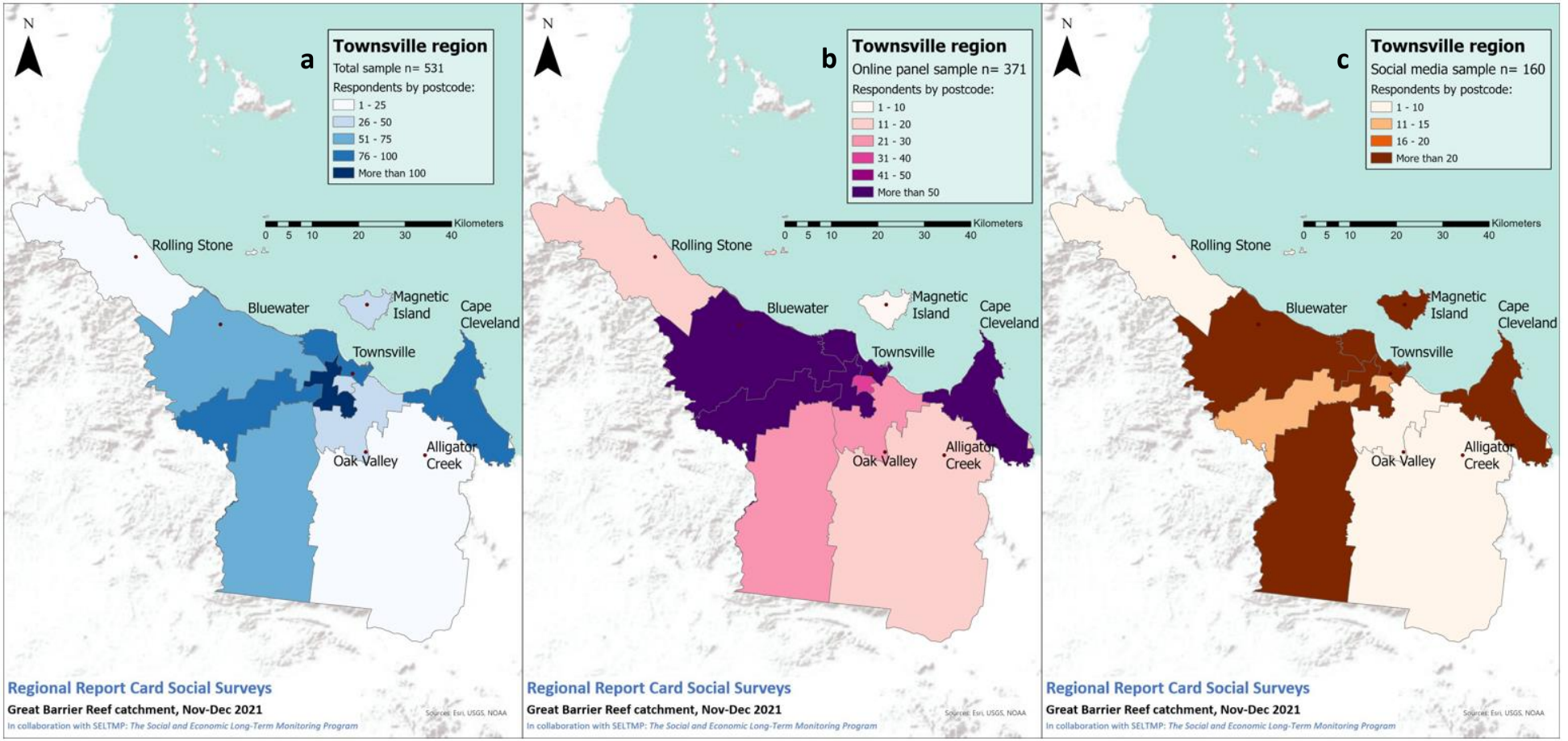
If you would like to know more about the **[RRC partnership name]**, or if you would like to enter the optional prize draw, please visit: [insert URL]

Have a great day!

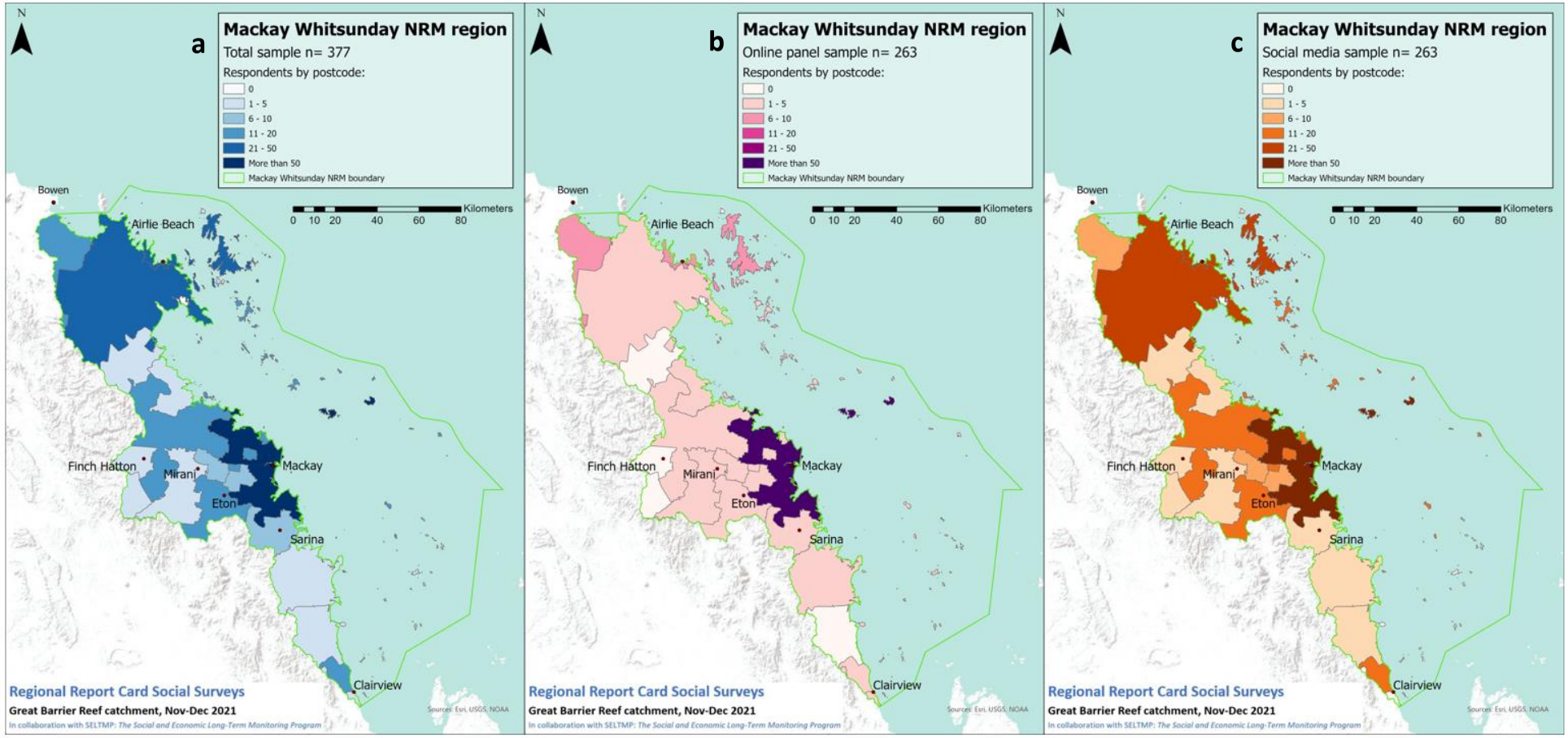
# Appendix B Regional sampling outcomes (maps)



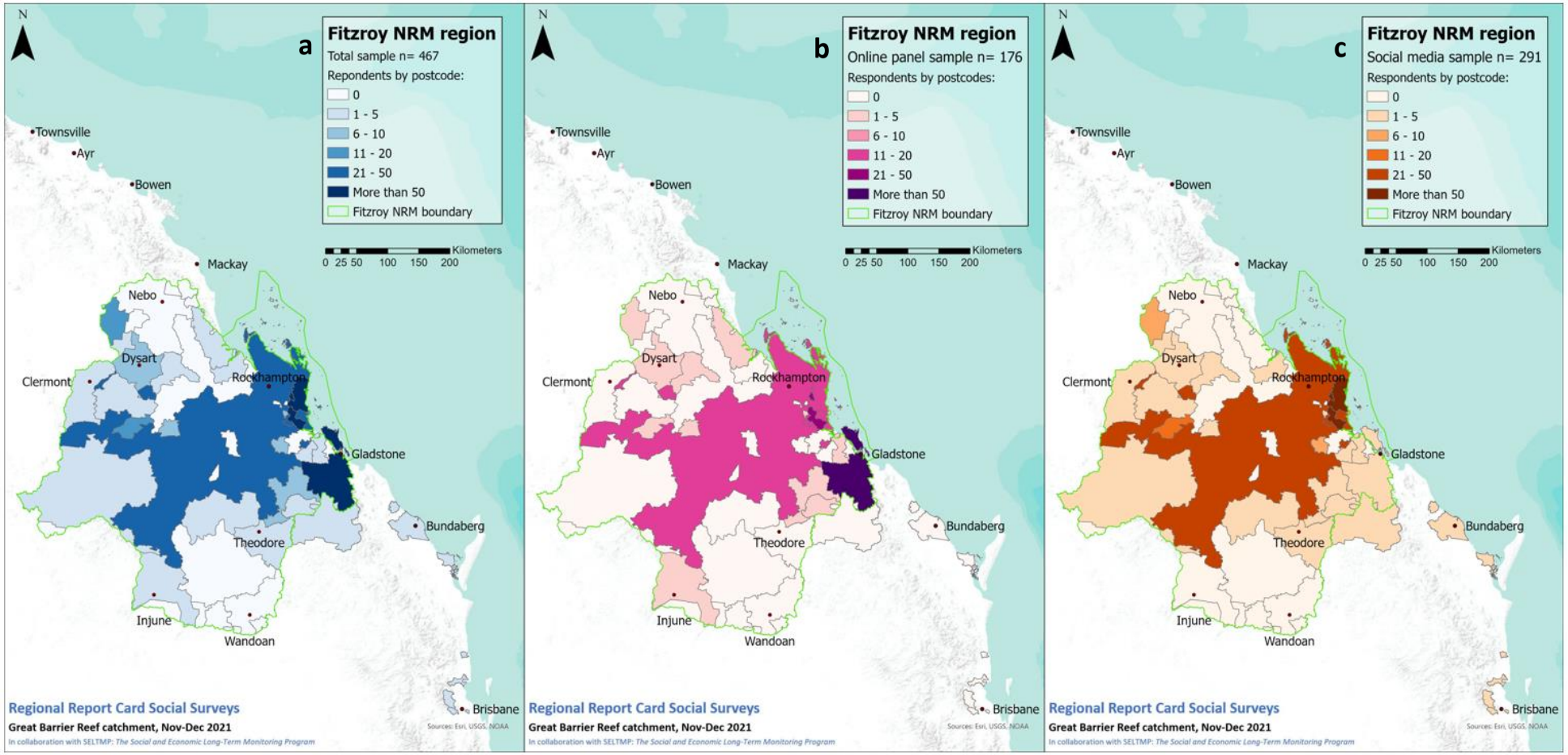

**Apx Figure A.1 Geographic distribution of survey respondents in the Wet Tropics region, by postcode [a = total sample; b = online panel sample; c = regional recruitment sample]**




**Apx Figure B.2 Geographic distribution of survey respondents in the Townsville region, by postcode [a = total sample; b = regional recruitment sample; c = social media sample]**




**Apx Figure B.3 Geographic distribution of survey respondents in the MWI region, by postcode [a = total sample; b = online panel sample; c = regional recruitment sample]**

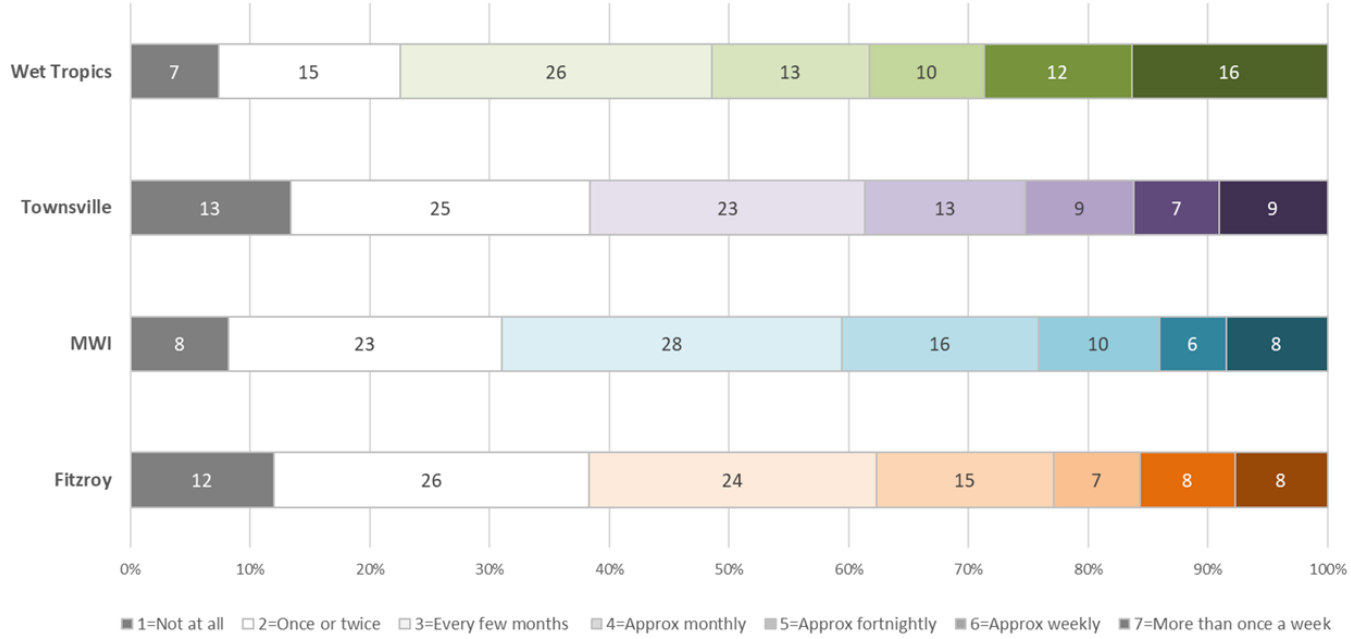



Apx Figure B.4 Geographic distribution of survey respondents in the Fitzroy region, by postcode [a = total sample; b = online panel sample; c = regional recruitment

# Appendix C Results comparison between regions

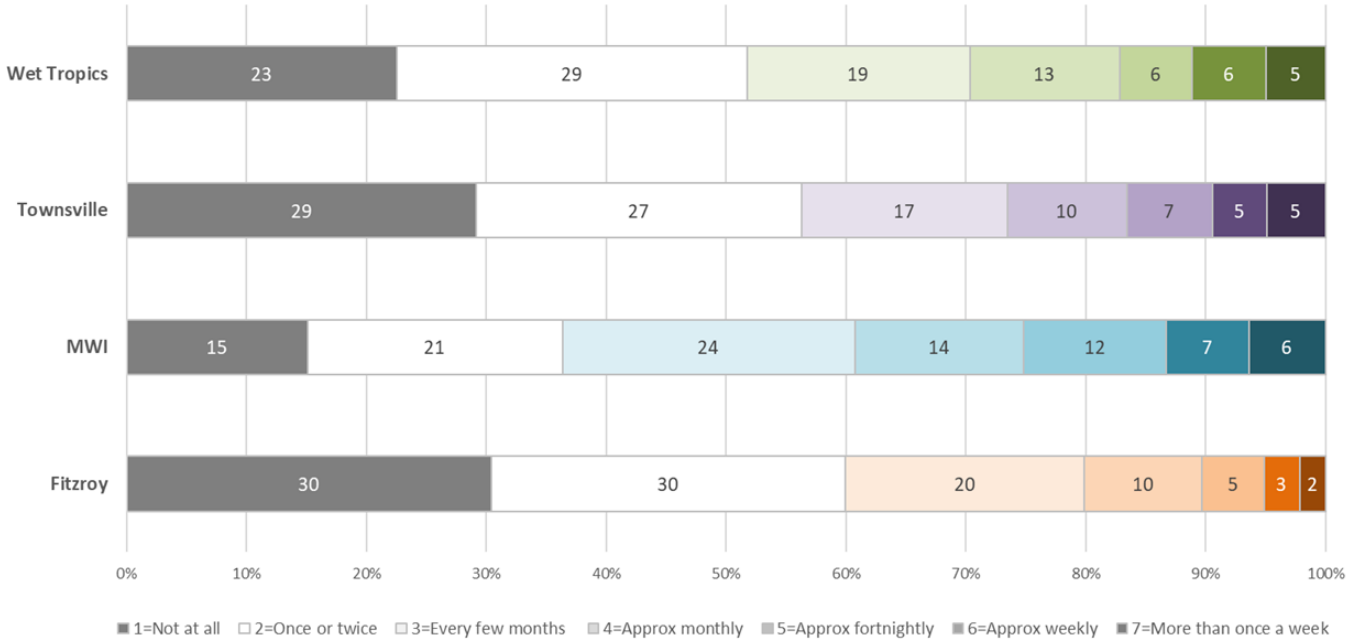
## C.1 Waterway visitation in previous 12 months

### Relative visitation to freshwater systems



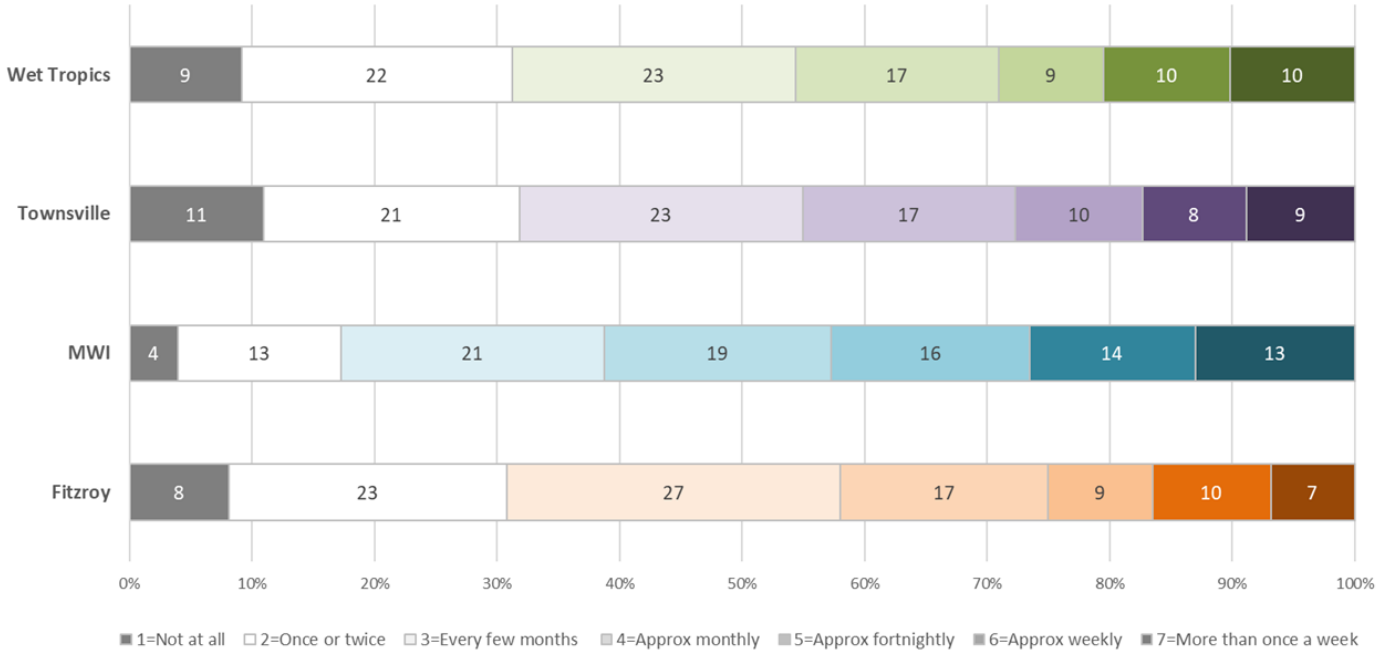

**Apx Figure C.1 Survey respondents' relative visitation to freshwater systems within their region of residence, in categories**

### Relative visitation to estuaries



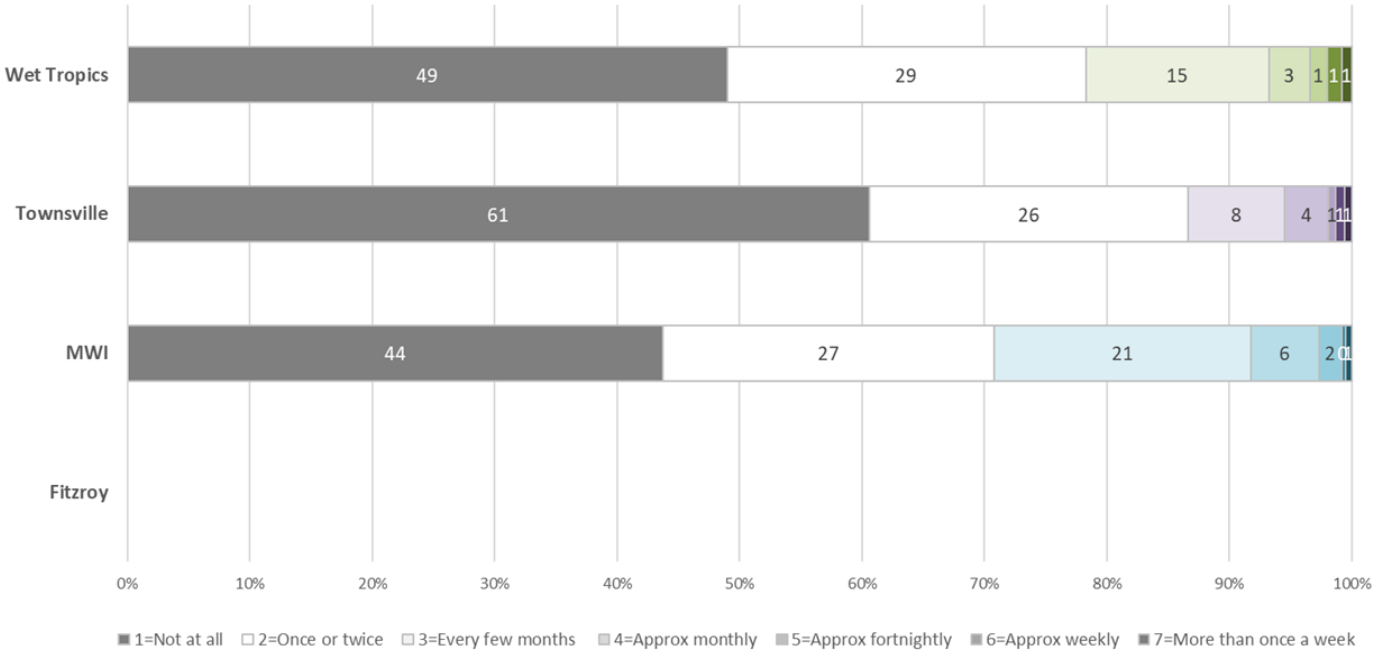

**Apx Figure C.2 Survey respondents' relative visitation to estuaries in their region of residence, in categories**

## Relative visitation to coastal and inshore waterways




**Apx Figure C.3 Survey respondents' relative visitation to coastal and inshore waterways within their region of residence, in categories**

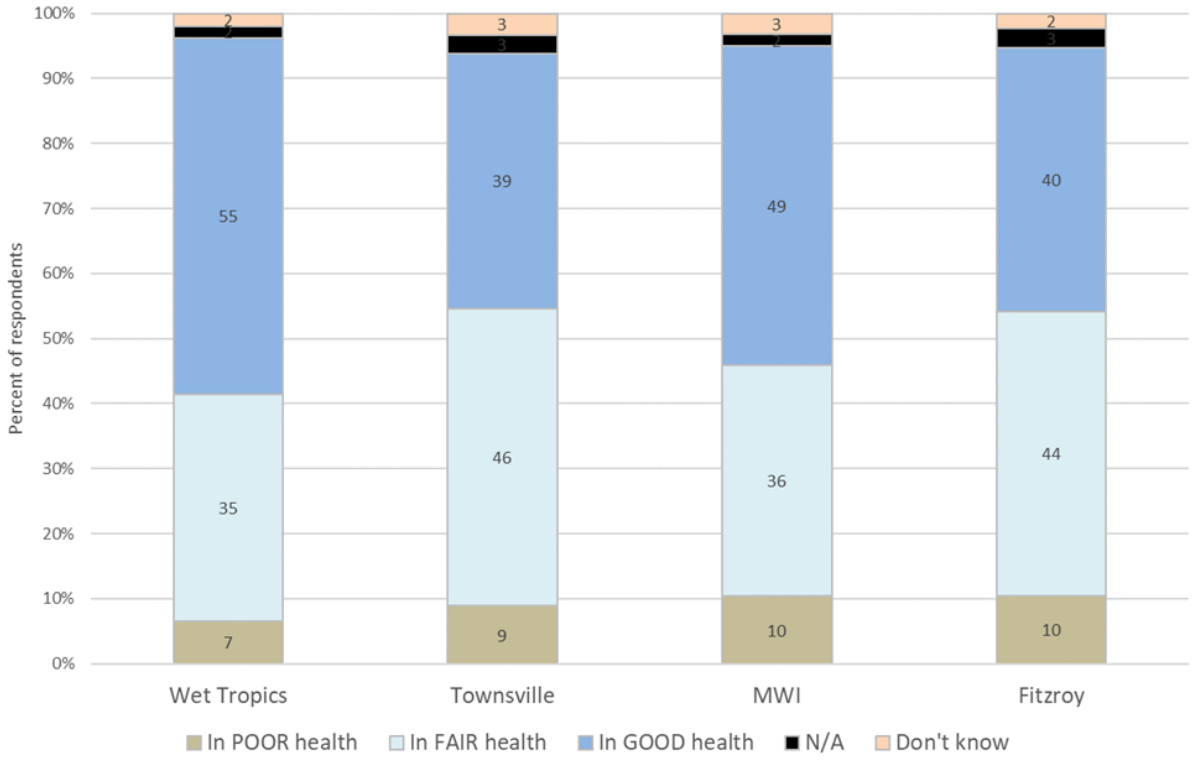
## Relative visitation to offshore marine regions




**Apx Figure C.4 Survey respondents' relative visitation to offshore marine areas adjacent to their region of residence, in categories [NB. offshore marine zone not included in Fitzroy regional survey]**

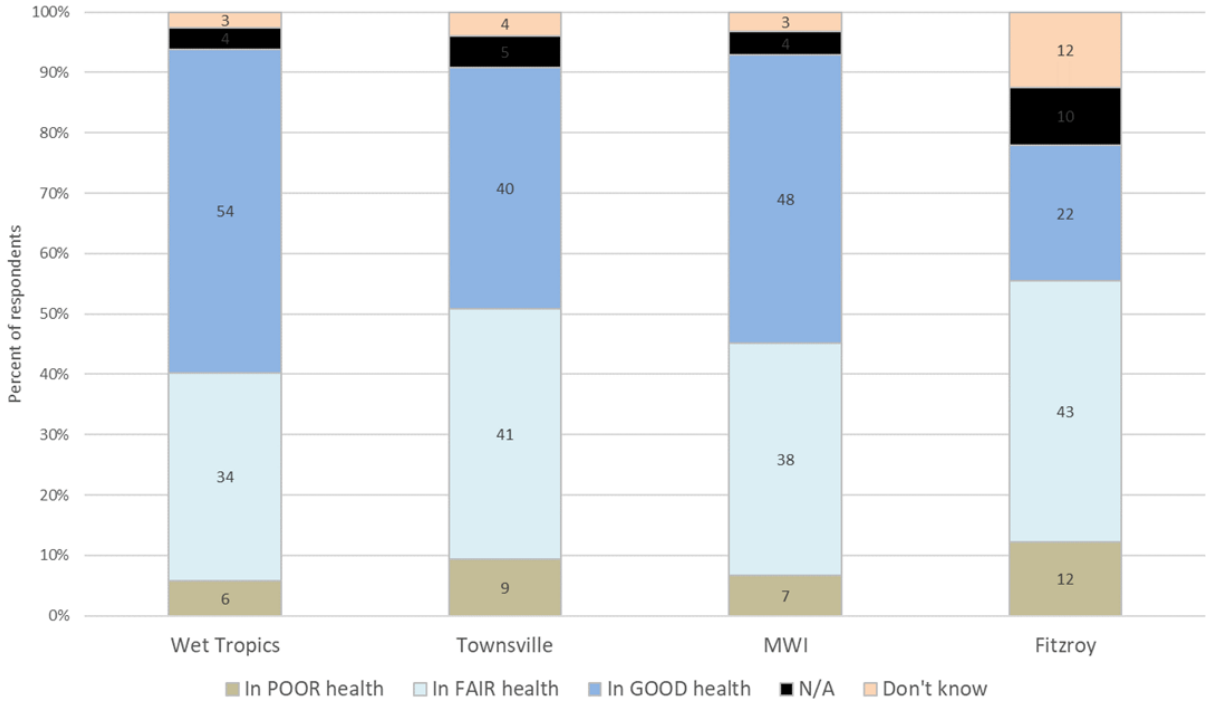
## C.2 Perceptions of waterway health

### Freshwater creeks and rivers



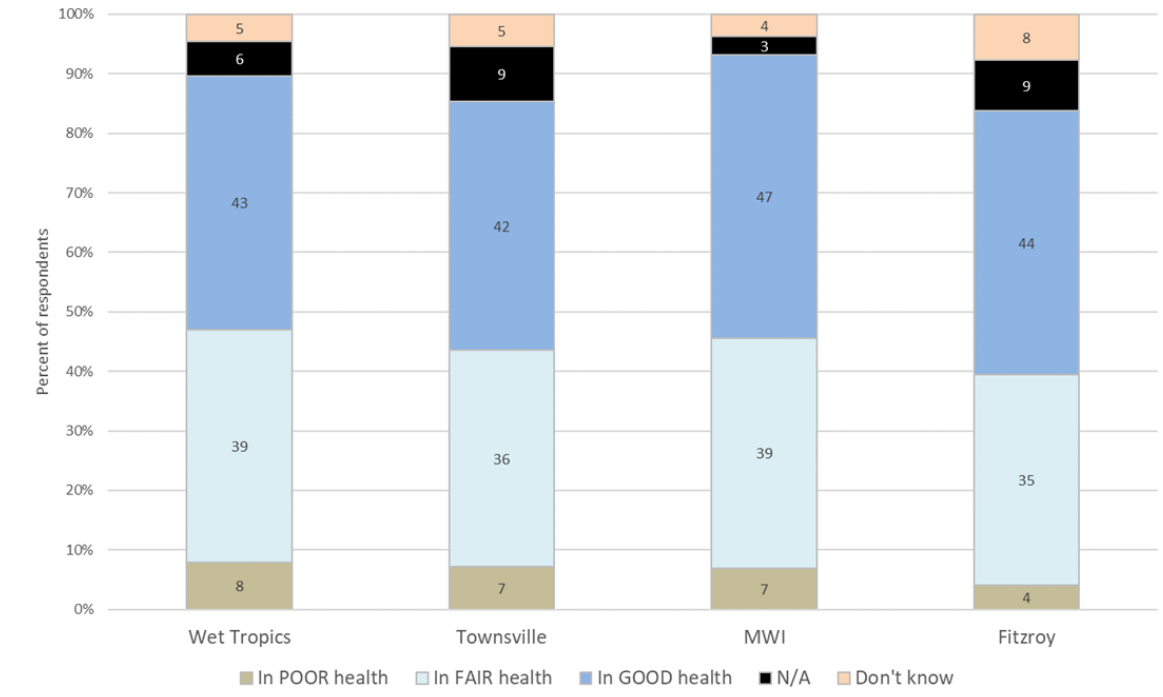

**Apx Figure C.5 Respondents' perception of the relative health of freshwater creeks and rivers in their region, in categories [per cent of respondents per category]**

### Freshwater lakes, dams and wetlands



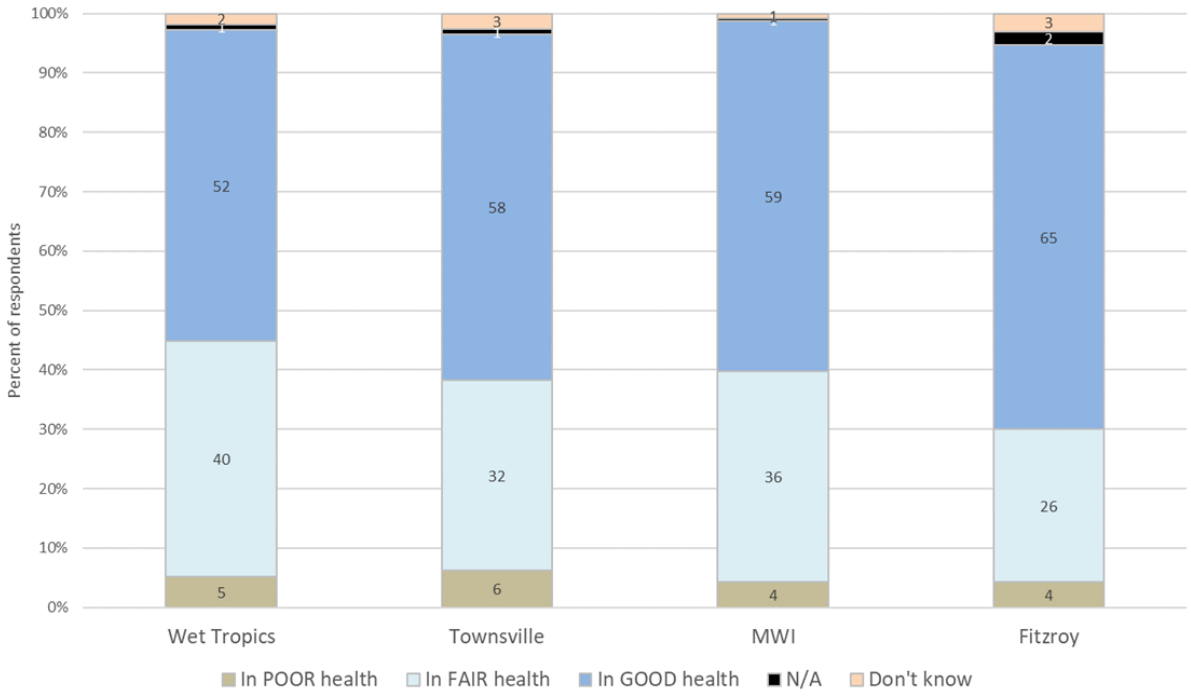

**Apx Figure C.6 Respondents' perception of the relative health of freshwater lakes, dams and wetlands in their region, in categories [per cent of respondents per category]**

## Estuaries



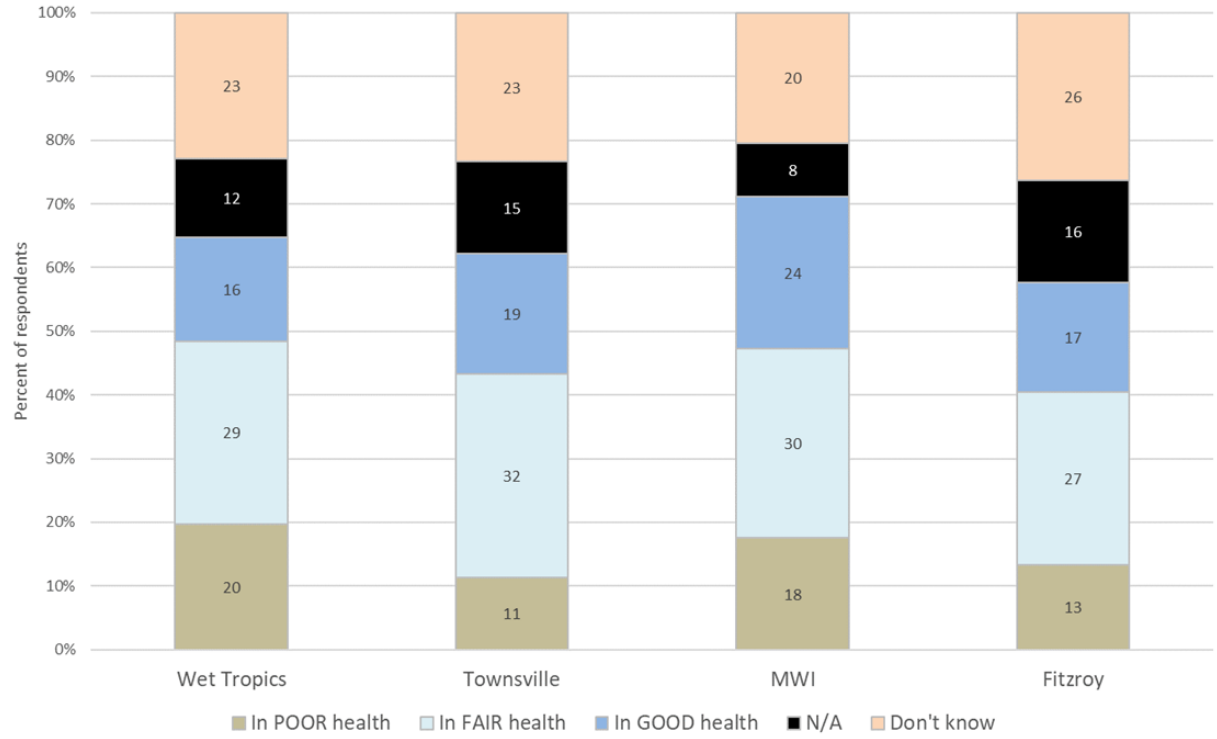

**Apx Figure C.7 Respondents' perception of the relative health of estuaries in their region, in categories [per cent of respondents per category]**

## Beaches and coastal waterways



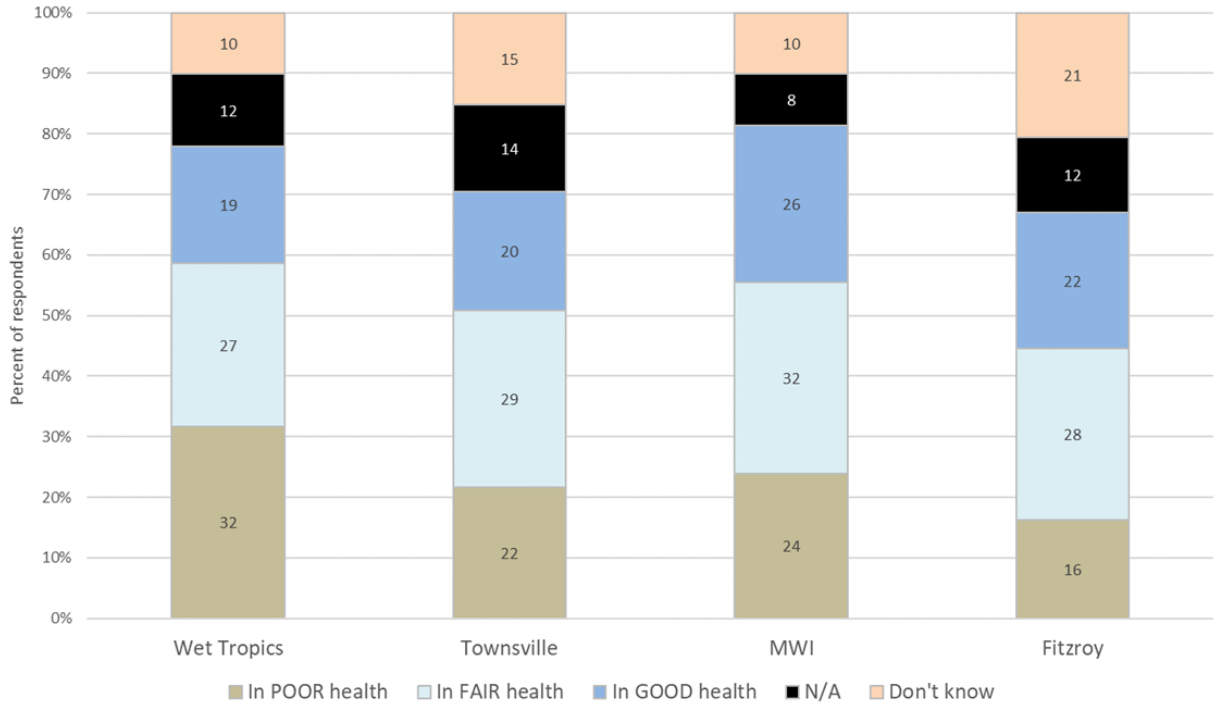

**Apx Figure C.8 Respondents' perception of the relative health of beaches and coastal waterways in their region, in categories [per cent of respondents per category]**

## Seagrass habitat



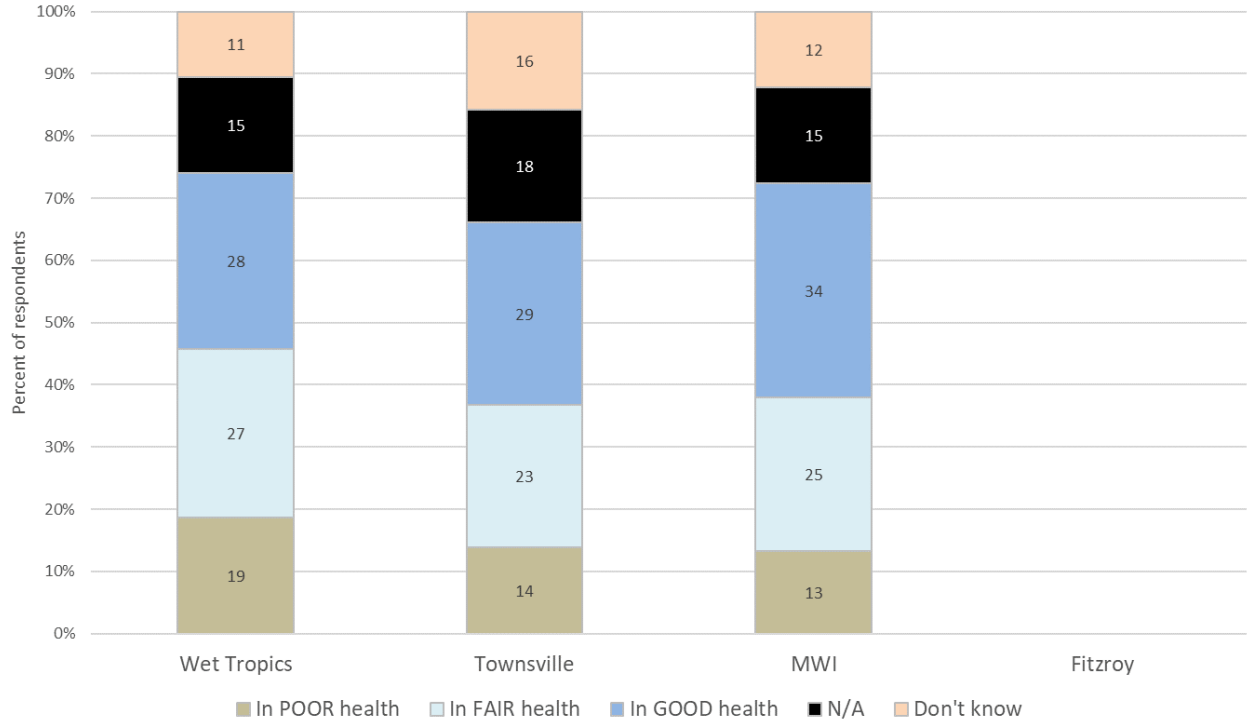

**Apx Figure C.9 Respondents' perception of the relative health of seagrass habitat in their region, in categories [per cent of respondents per category]**

## Inshore coral reefs



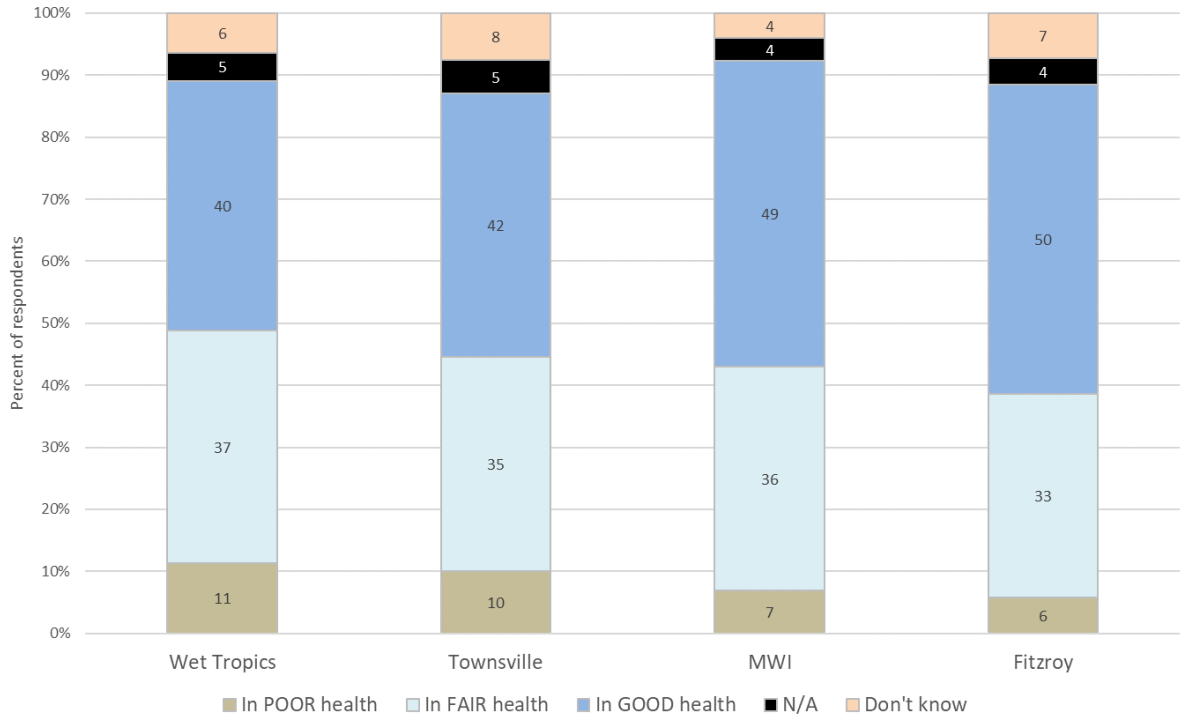

**Apx Figure C.10 Respondents' perception of the relative health of inshore coral reefs in their region, in categories [per cent of respondents per category]**

## Offshore coral reefs




**Apx Figure C.11 Respondents' perception of the relative health of offshore coral reefs in their region, in categories [per cent of respondents per category]**

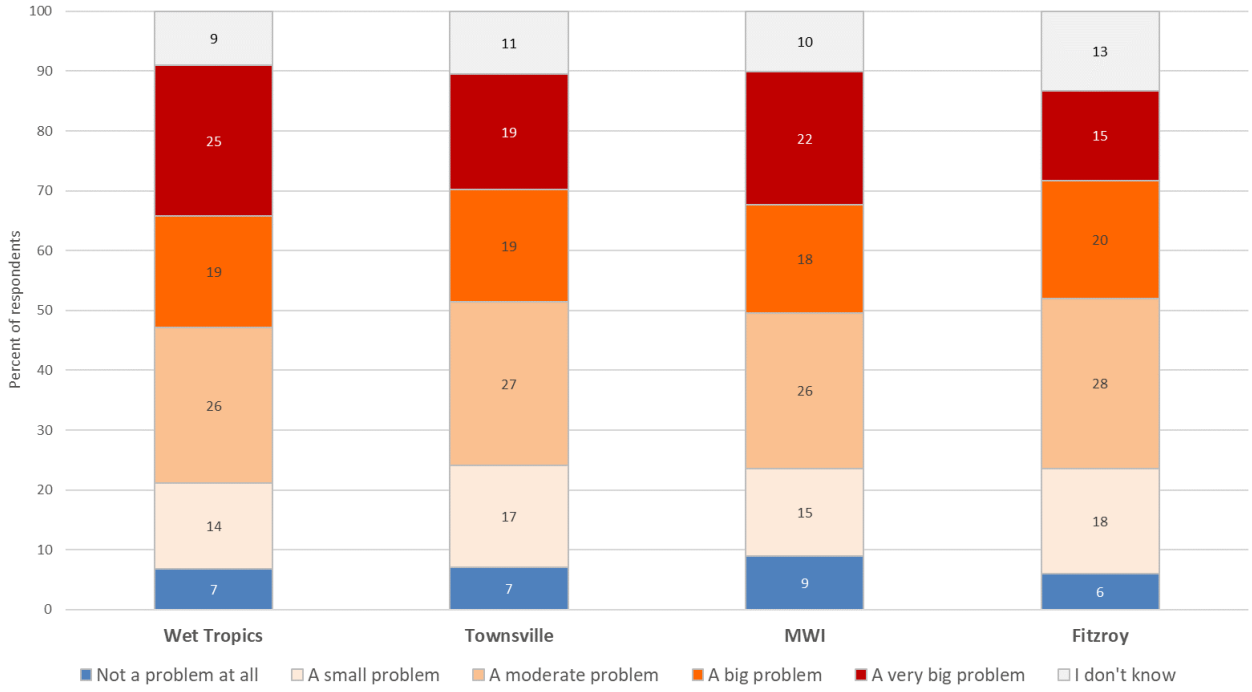
## Ocean and sea




**Apx Figure C.12 Respondents' perception of the relative health of the ocean and sea in their region, in categories [per cent of respondents per category]**

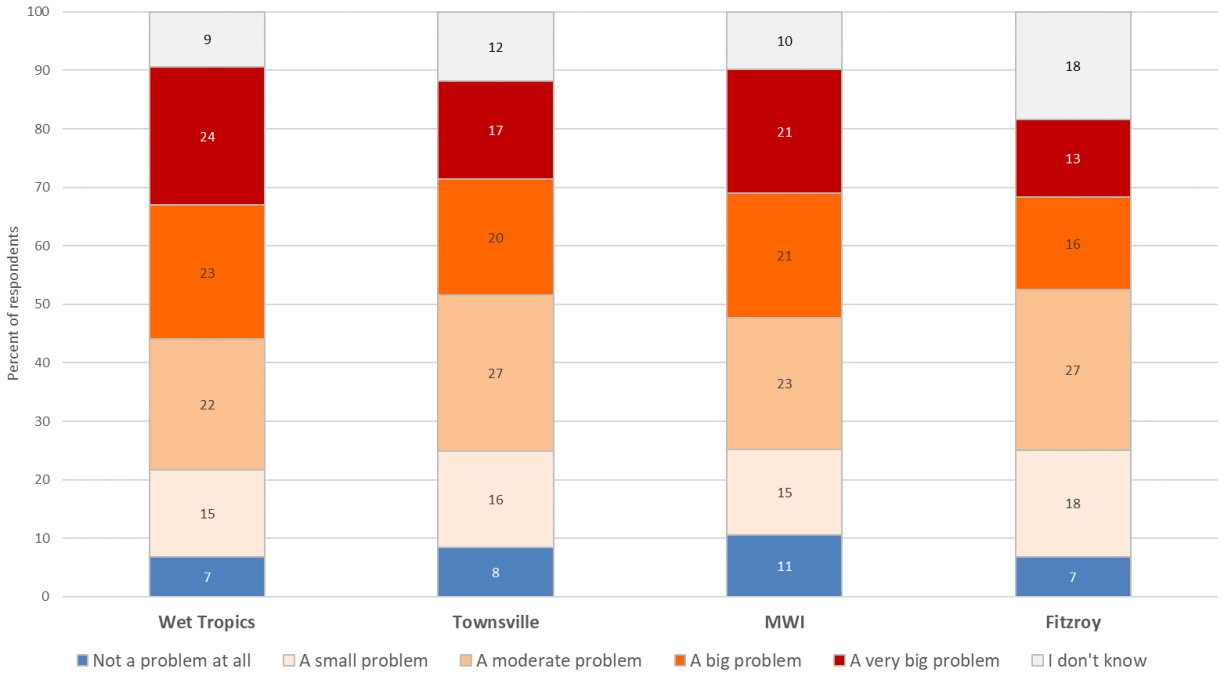
## C.3 Perceptions of waterway problems

### Water quality in fresh waters and estuaries



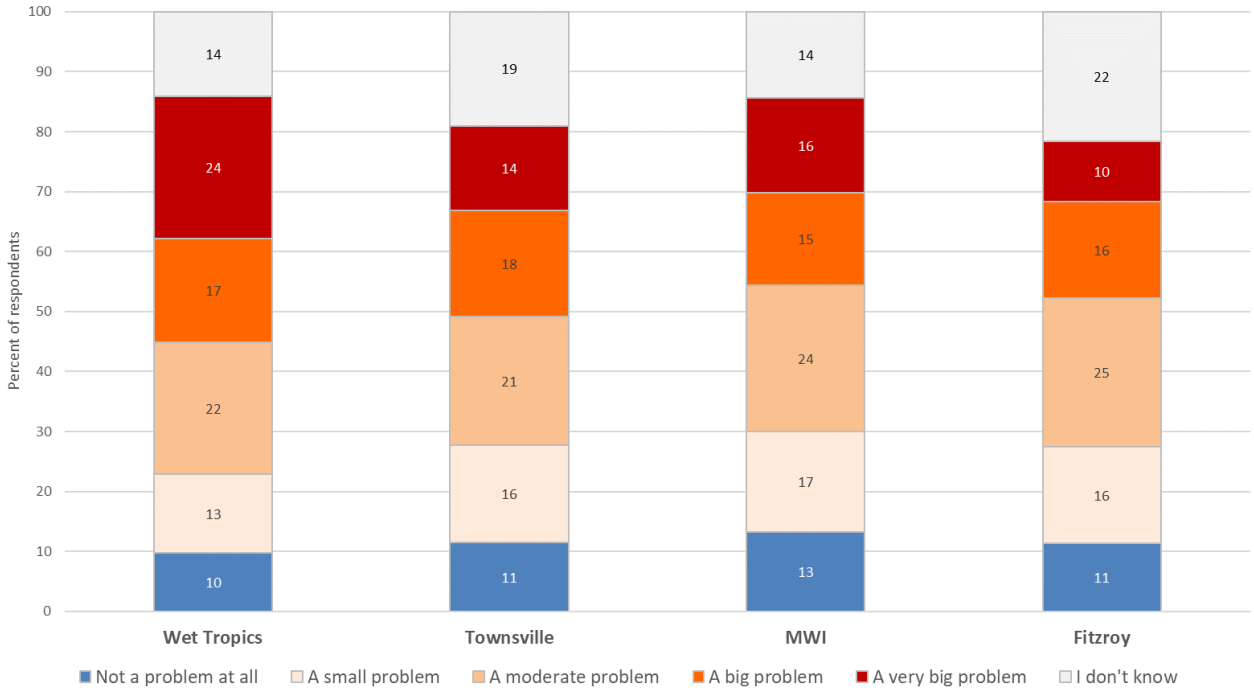

**Apx Figure C.13 Respondents' perceptions of the extent to which water quality in fresh waters and estuaries represents a problem in their region, in categories [per cent of respondents per category]**

### Coastal and inshore water quality



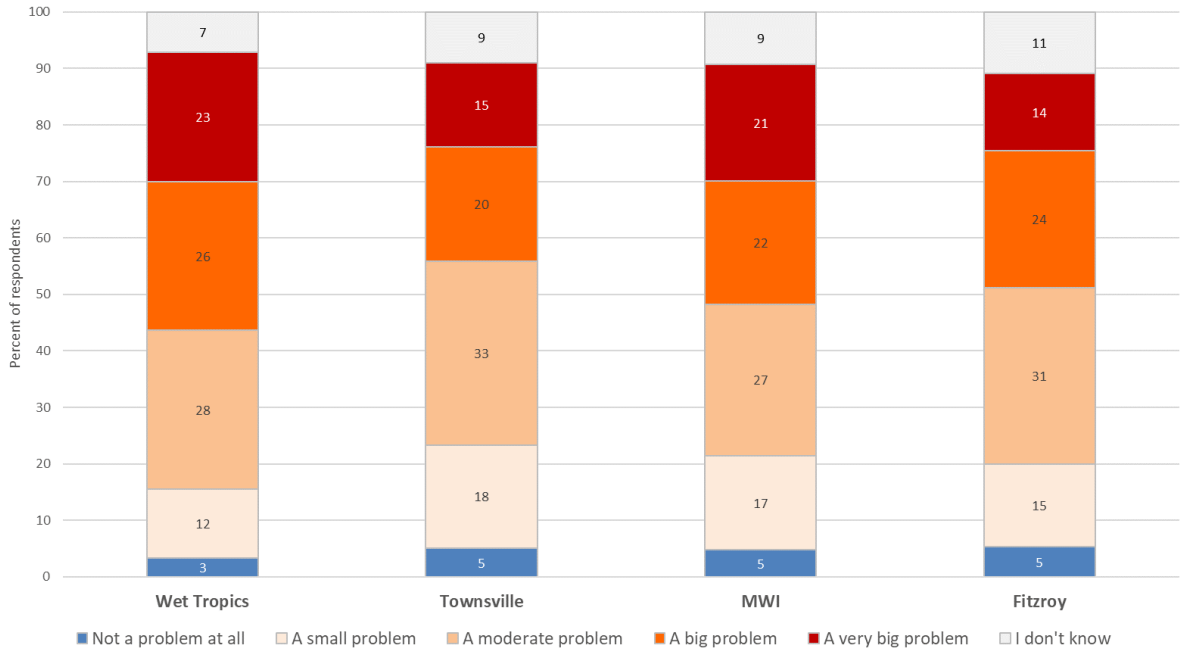

**Apx Figure C.14 Respondents' perceptions of the extent to which coastal and inshore water quality represents a problem in their region, in categories [per cent of respondents per category]**

## Offshore water quality



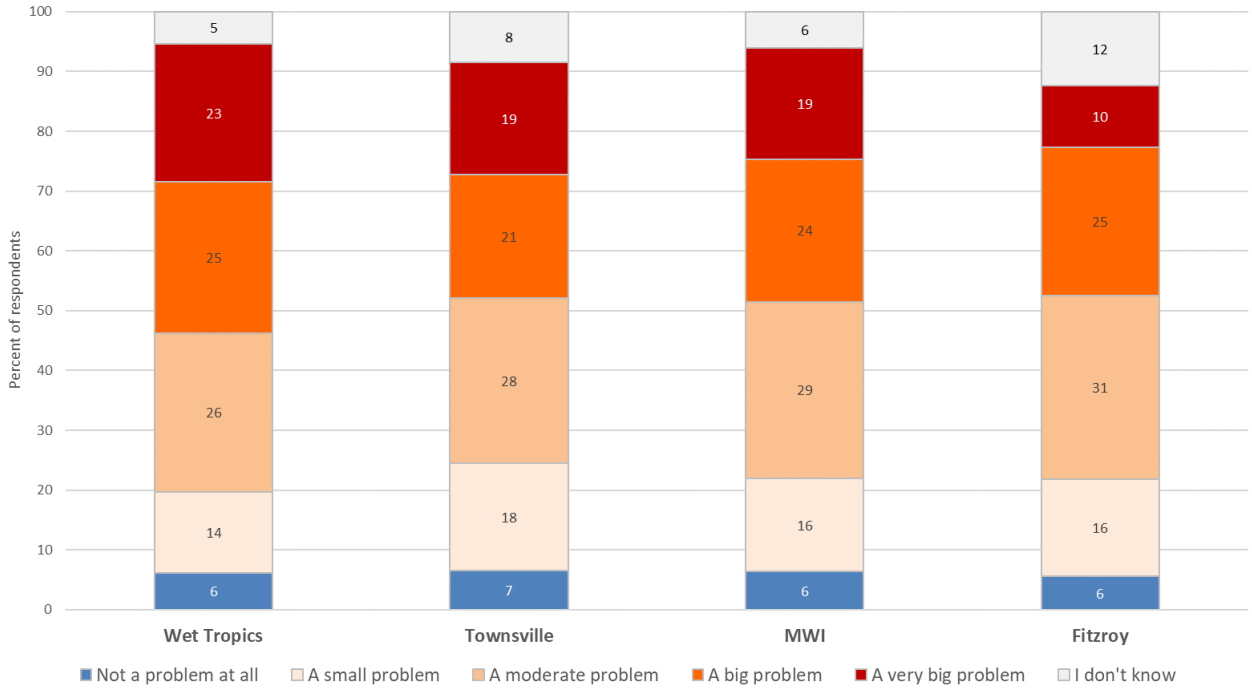

**Apx Figure C.15 Respondents' perceptions of the extent to which offshore water quality represents a problem in their region, in categories [per cent of respondents per category]**

## Riverbank erosion



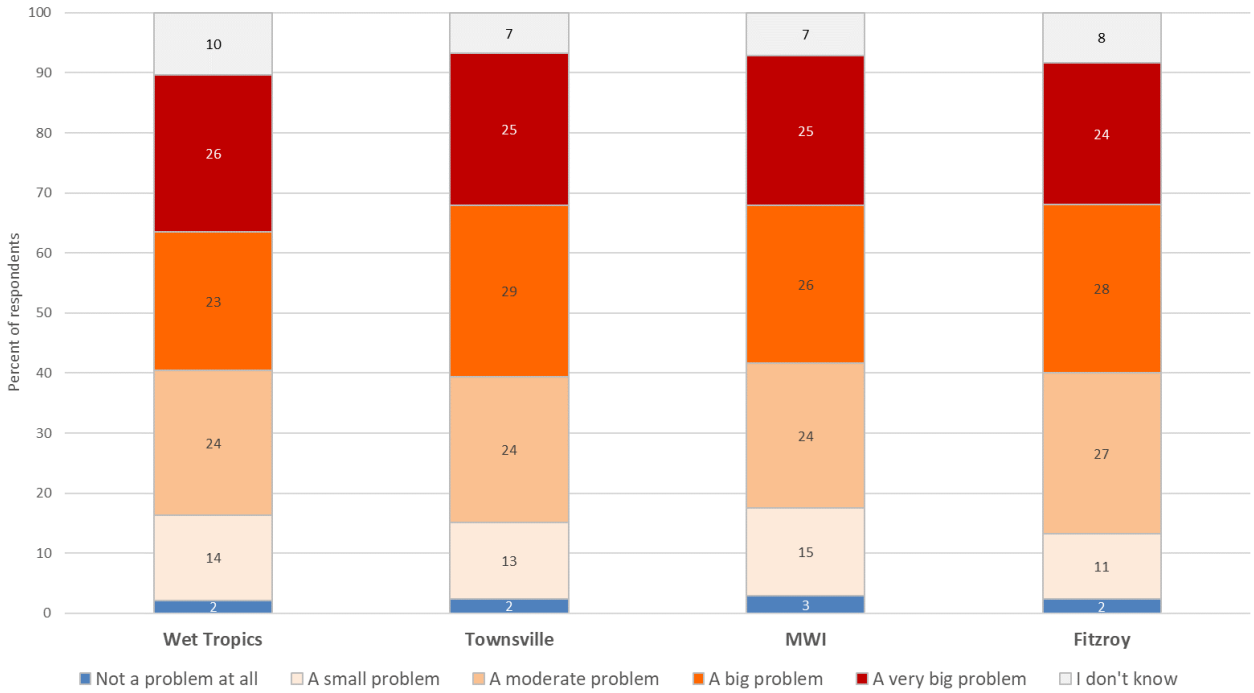

**Apx Figure C.16 Respondents' perceptions of the extent to which riverbank erosion represents a problem in their region, in categories [per cent of respondents per category]**

## Coastal erosion



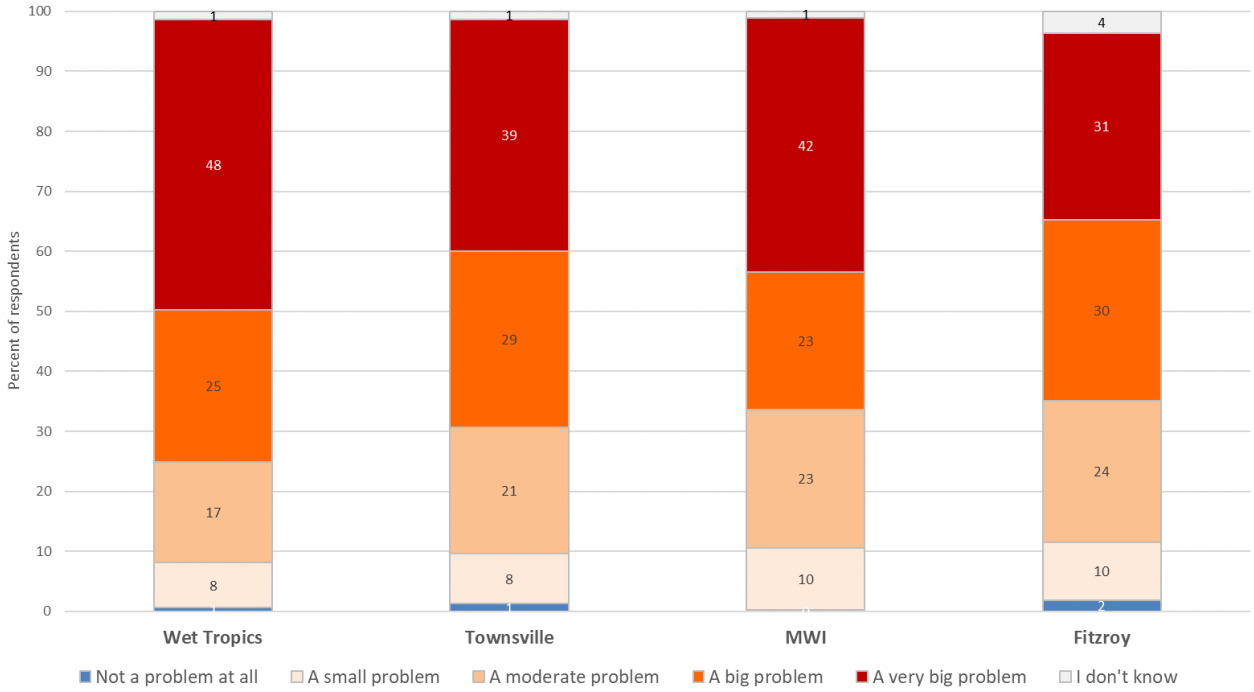

**Apx Figure C.17 Respondents' perceptions of the extent to which coastal erosion represents a problem in their region, in categories [per cent of respondents per category]**

## Weeds in and around waterways



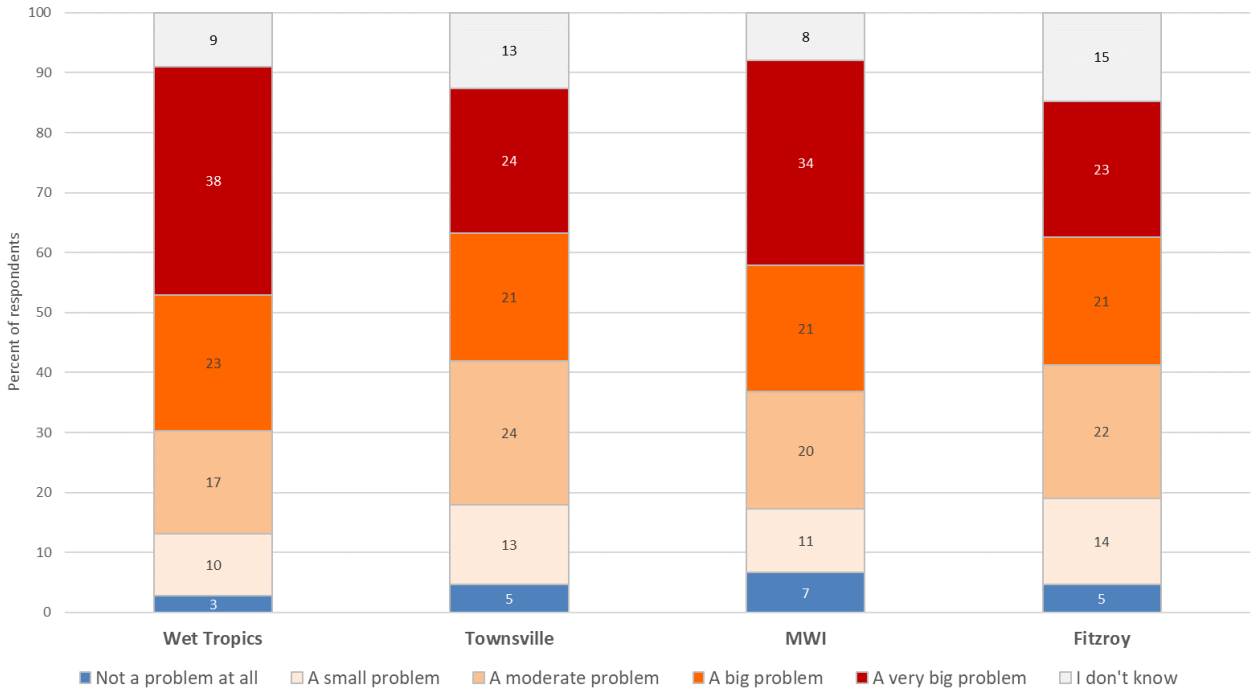

**Apx Figure C.18 Respondents' perceptions of the extent to which weeds in/around waterways represent a problem in their region, in categories [per cent of respondents per category]**

## Litter and debris



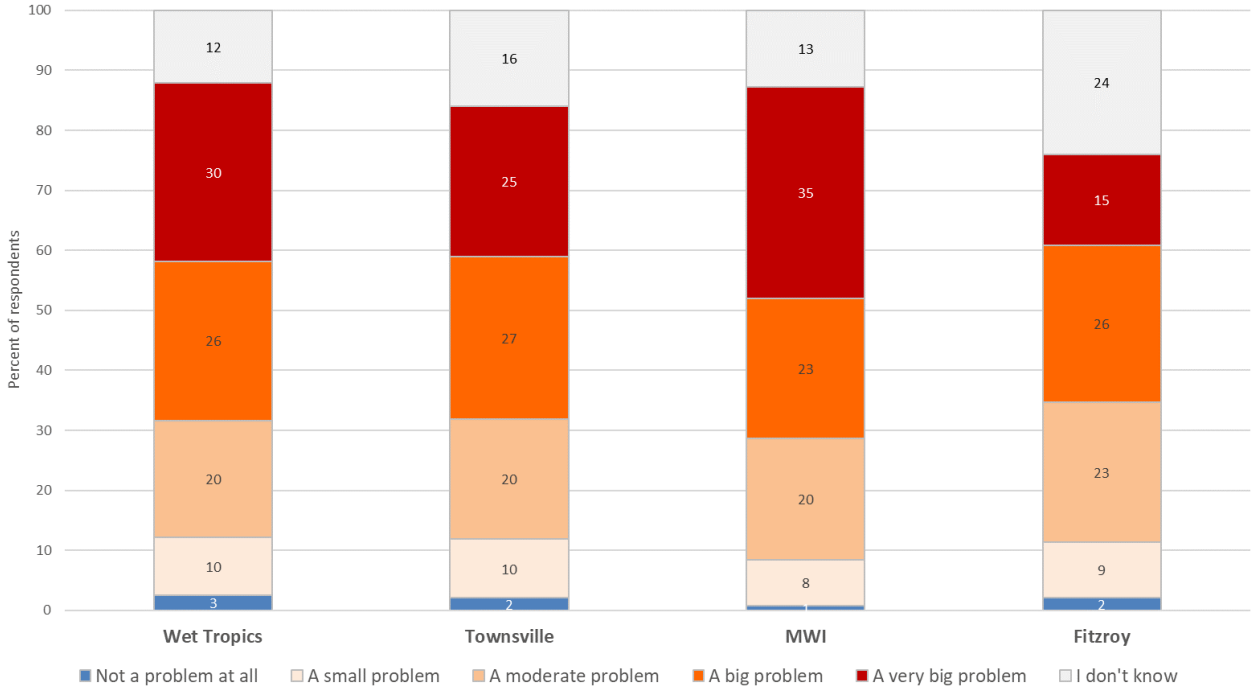

**Apx Figure C.19 Respondents' perceptions of the extent to which litter and debris represent a problem for waterways in their region, in categories [per cent of respondents per category]**

## Chemical pollutants



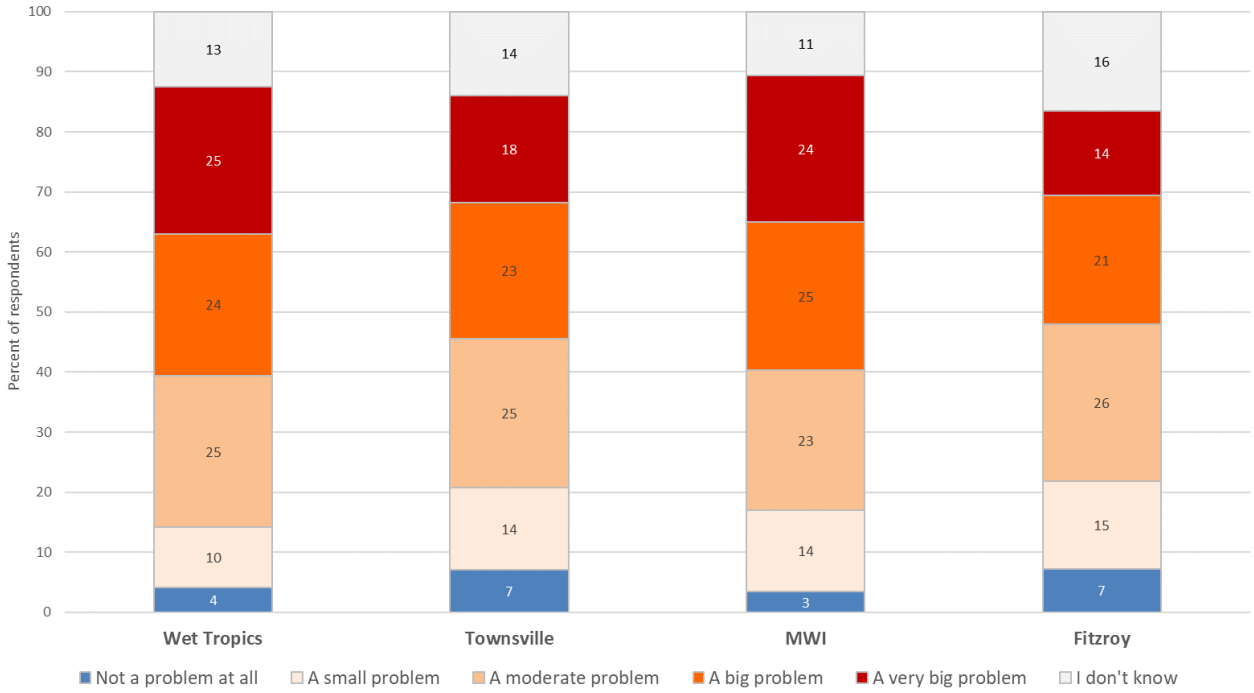

**Apx Figure C.20 Respondents' perceptions of the extent to which chemical pollutants represent a problem for waterways in their region, in categories [per cent of respondents per category]**

## Invasive fishes



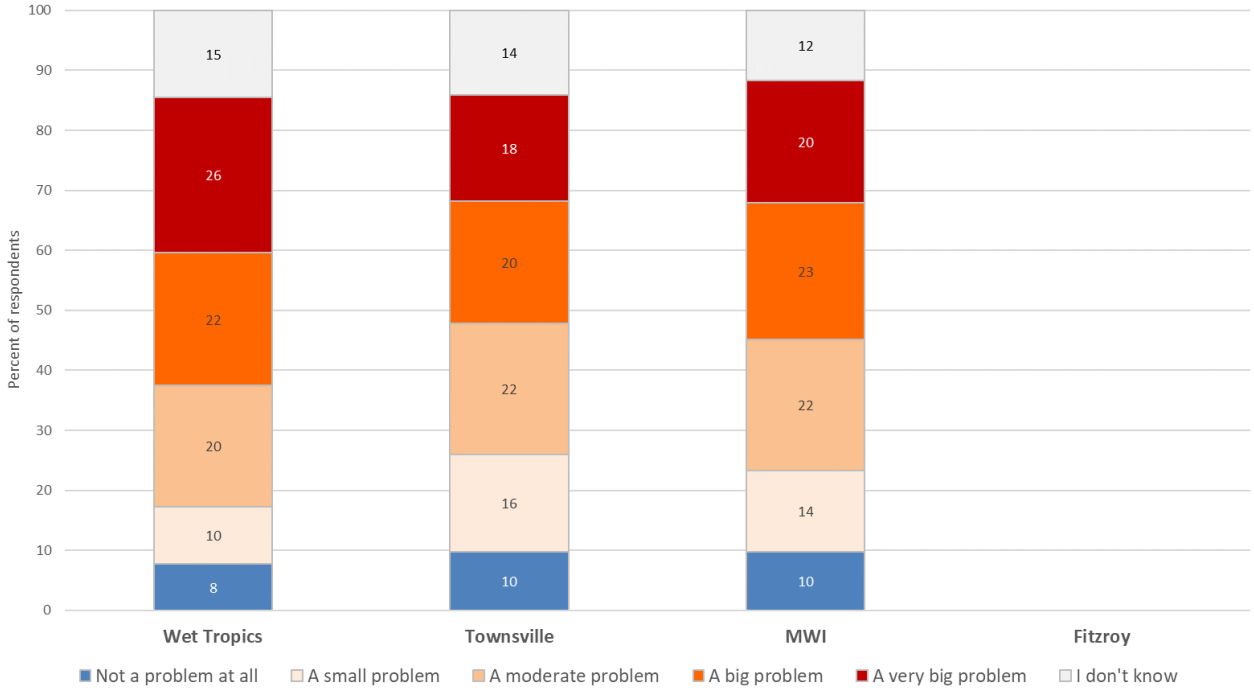

**Apx Figure C.21 Respondents' perceptions of the extent to which invasive fishes represent a problem for waterways in their region, in categories [per cent of respondents per category]**

## Low abundance of fishes



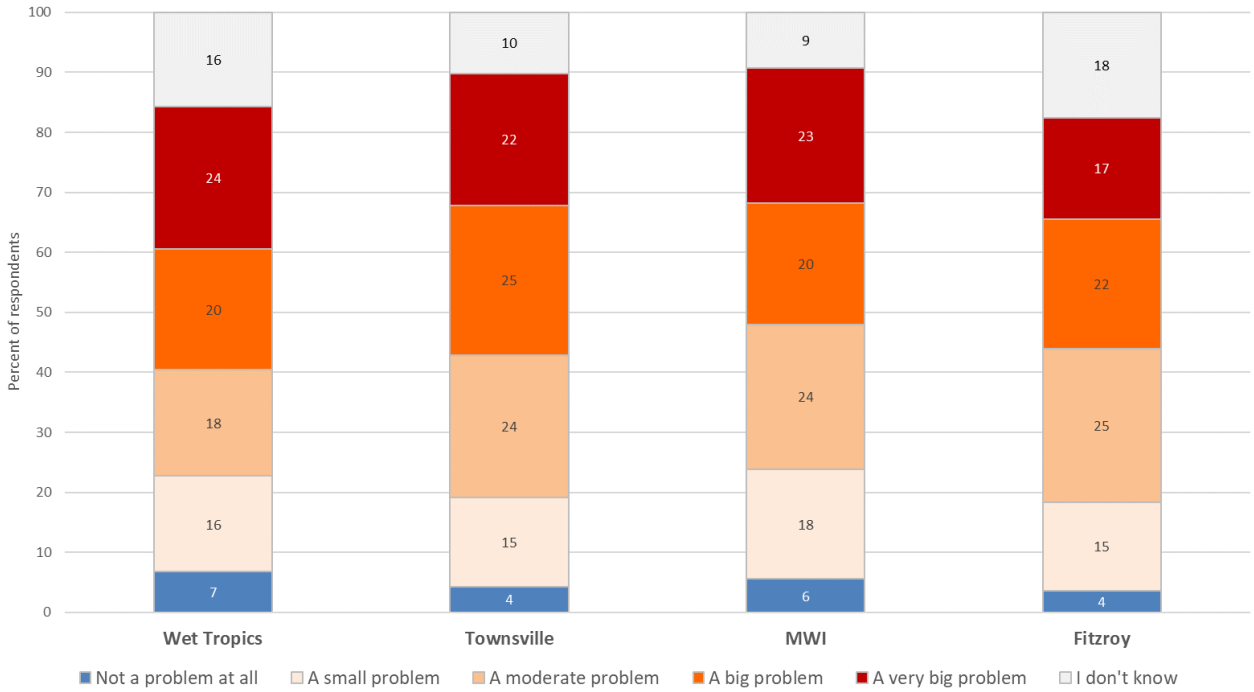

**Apx Figure C.22 Respondents' perceptions of the extent to which low abundance of fishes represents a problem for waterways in their region, in categories [per cent of respondents per category]**

## Declines in waterbirds and shorebirds



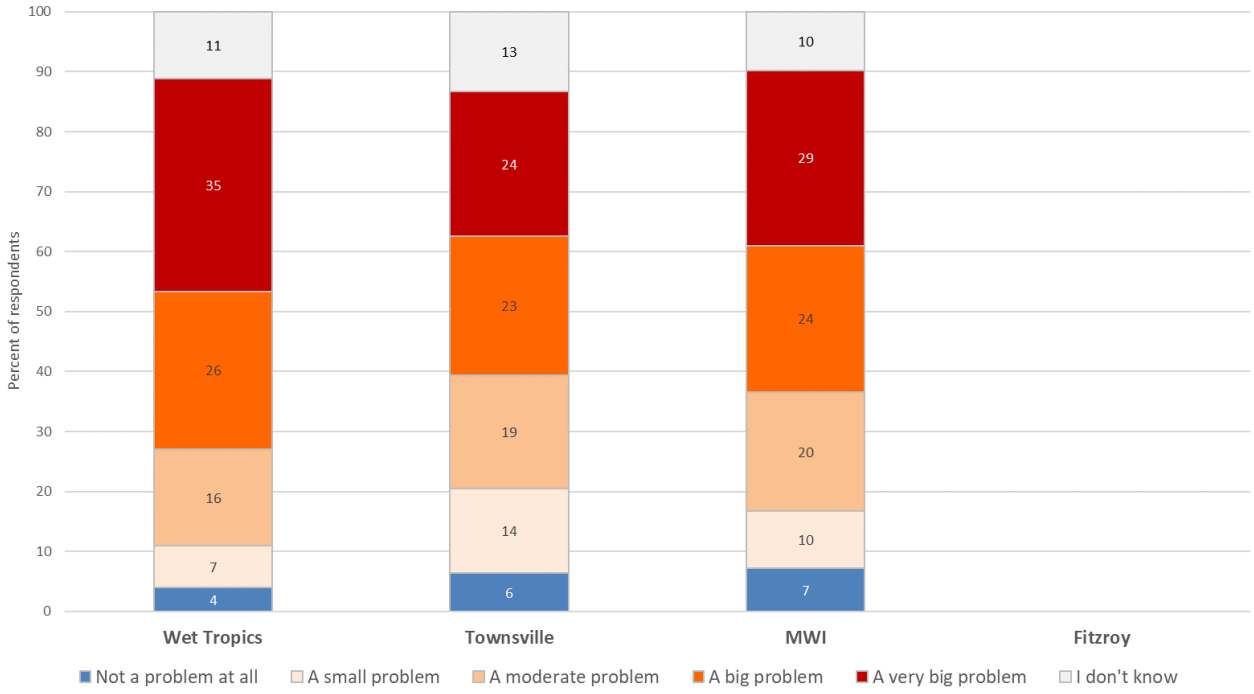

**Apx Figure C.23 Respondents' perceptions of the extent to which declines in waterbirds and/or shore birds represent a problem for waterways in their region, in categories [per cent of respondents per category]**

## Algal blooms and fish kills



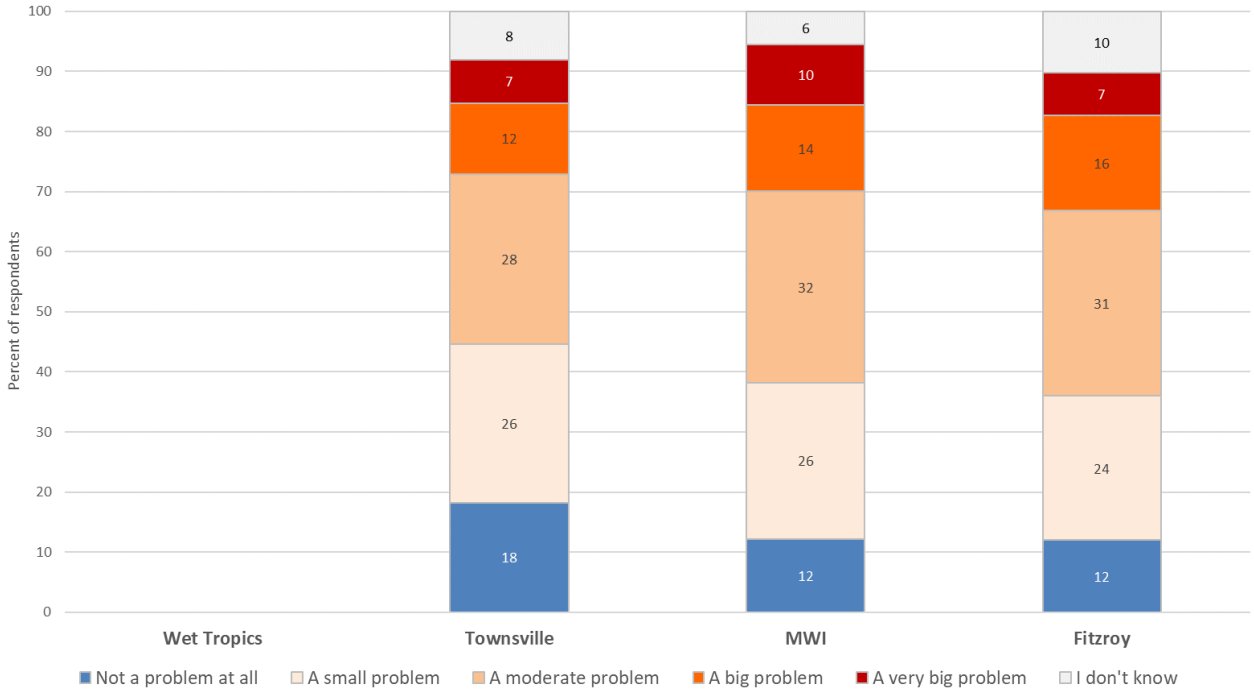

**Apx Figure C.24 Respondents' perceptions of the extent to which algal blooms and/or fish kills represent a problem for waterways in their region, in categories [per cent of respondents per category]**

## Decline in marine megafauna




**Apx Figure C.25 Respondents' perceptions of the extent to which a decline in marine megafauna represents a problem for waterways in their region, in categories [per cent of respondents per category]**

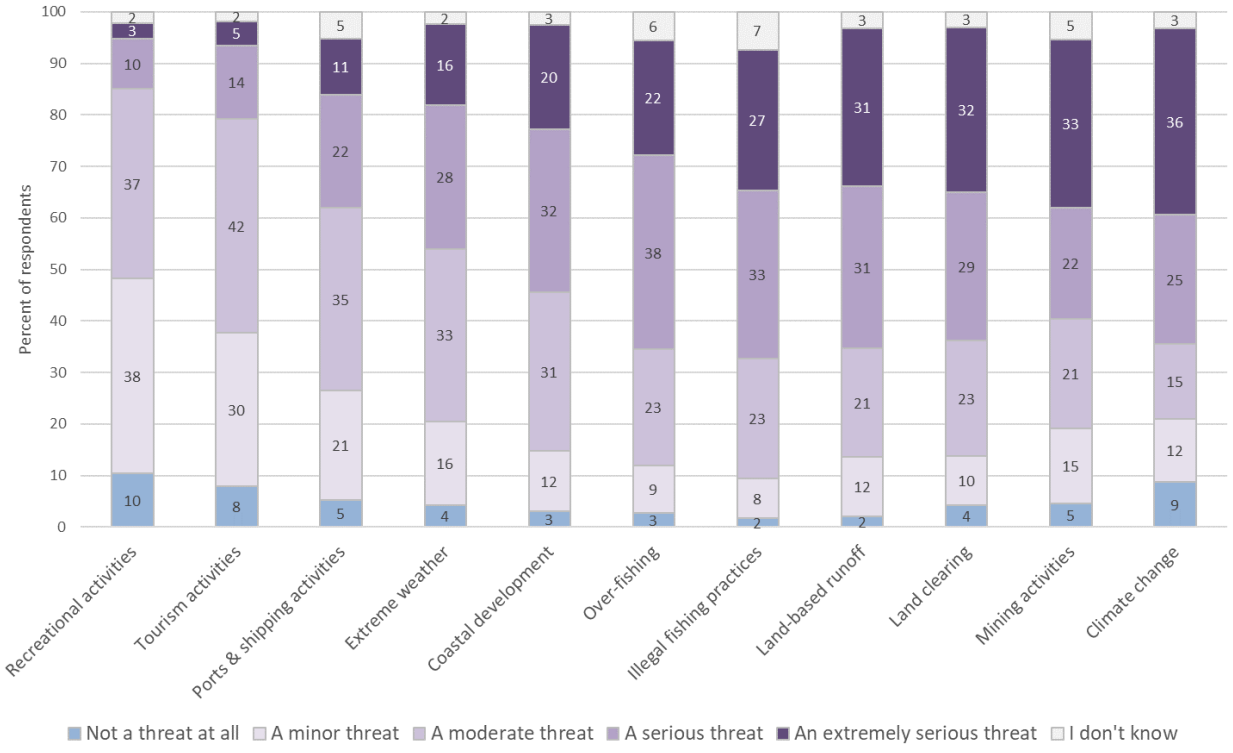
## Bushfire




**Apx Figure C.26 Respondents' perceptions of the extent to which bushfire represents a problem for waterways in their region, in categories [per cent of respondents per category]**

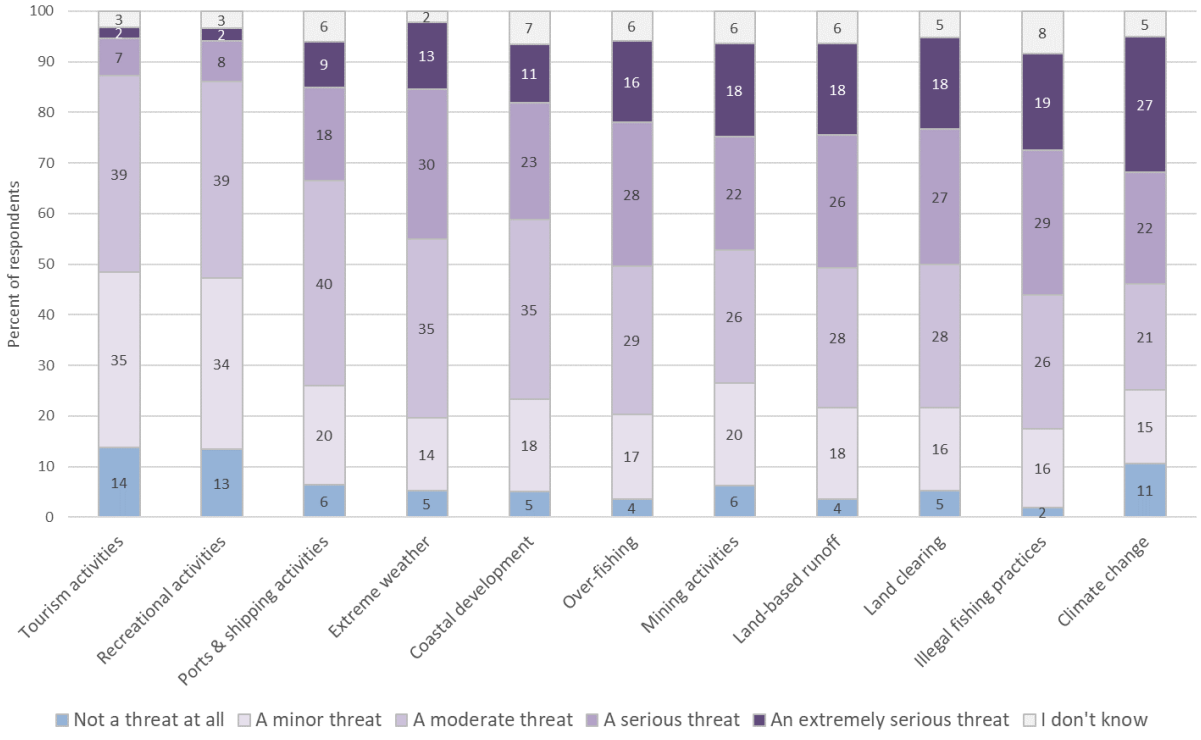
# C.4 Perceptions of waterway threats

## Wet Tropics region (n=502)



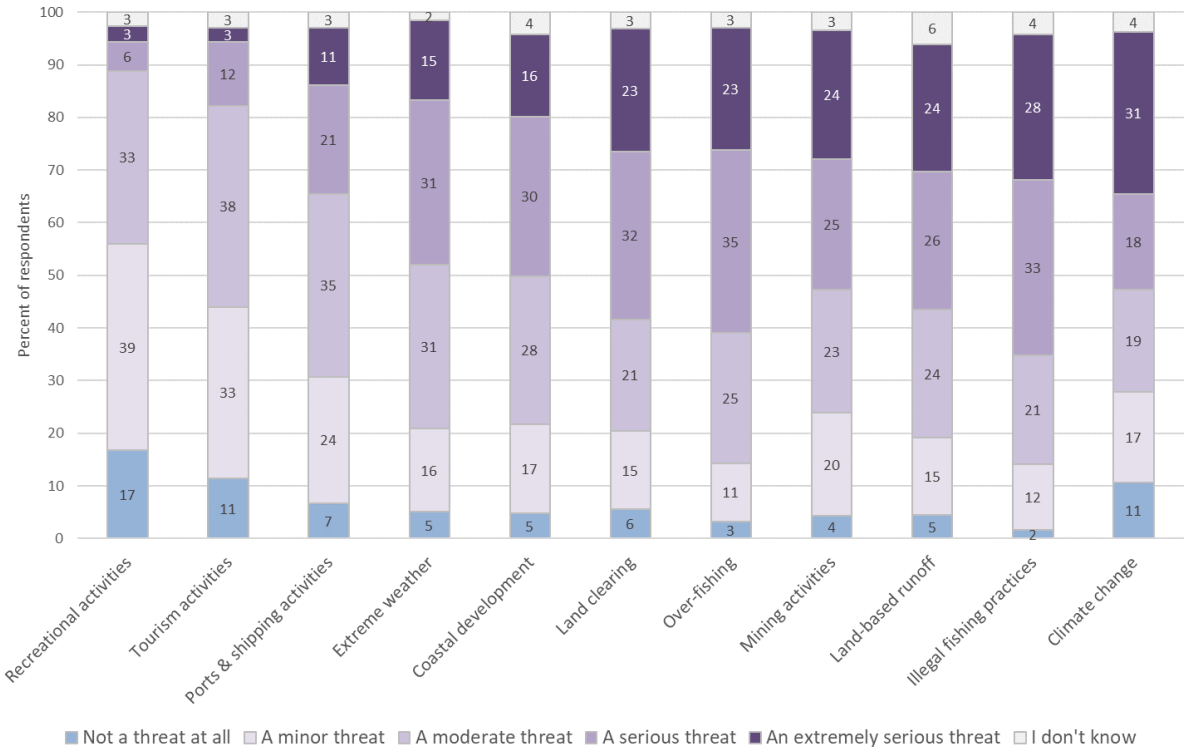

**Apx Figure C.27 Wet Tropics region residents' ratings of the extent to which issues represent a current threat to waterways in their region, in categories [per cent of respondents per category; n=502]**

## Townsville region (n=531)



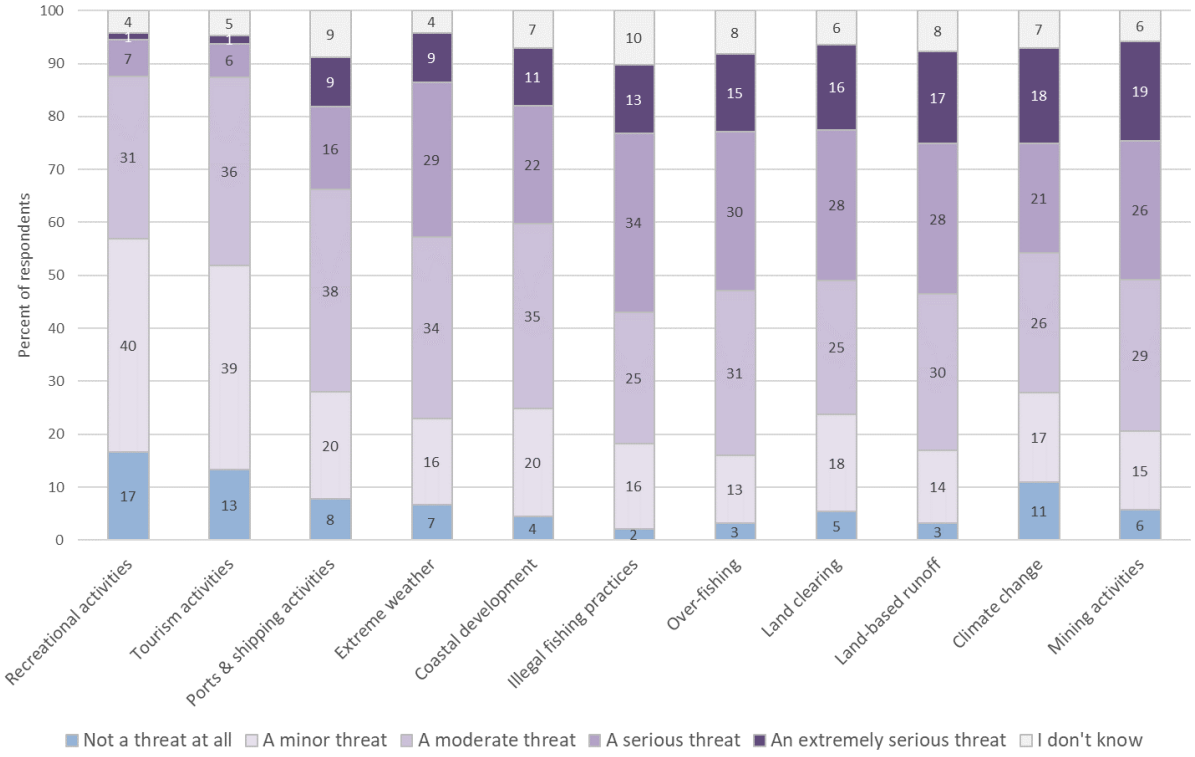

**Apx Figure C.28 Townsville region residents' ratings of the extent to which issues represent a current threat to waterways in their region, in categories [per cent of respondents per category; n=531]**

## Mackay-Whitsunday-Isaac region (n=377)




**Apx Figure C.29 MWI region residents' ratings of the extent to which issues represent a current threat to waterways in their region, in categories [per cent of respondents per category; n=377]**

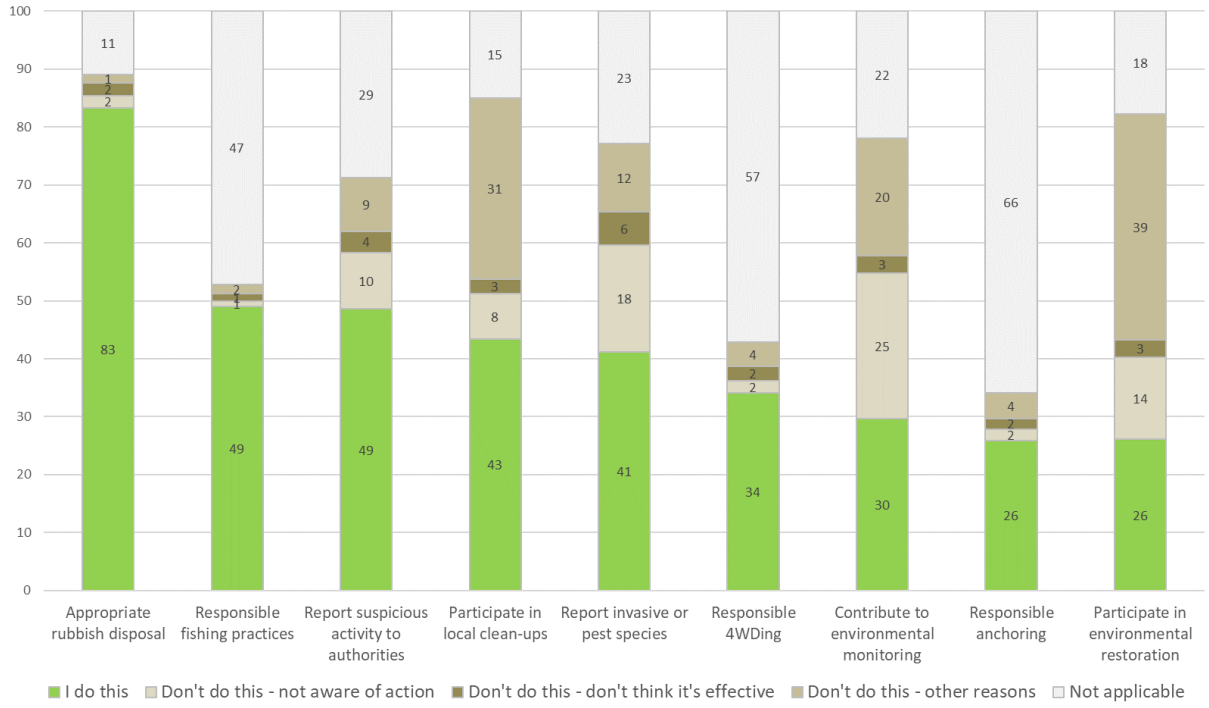
## Fitzroy region (n=467)




**Apx Figure C.30 Fitzroy region residents' ratings of the extent to which issues represent a current threat to waterways in their region, in categories [per cent of respondents per category; n=467]**

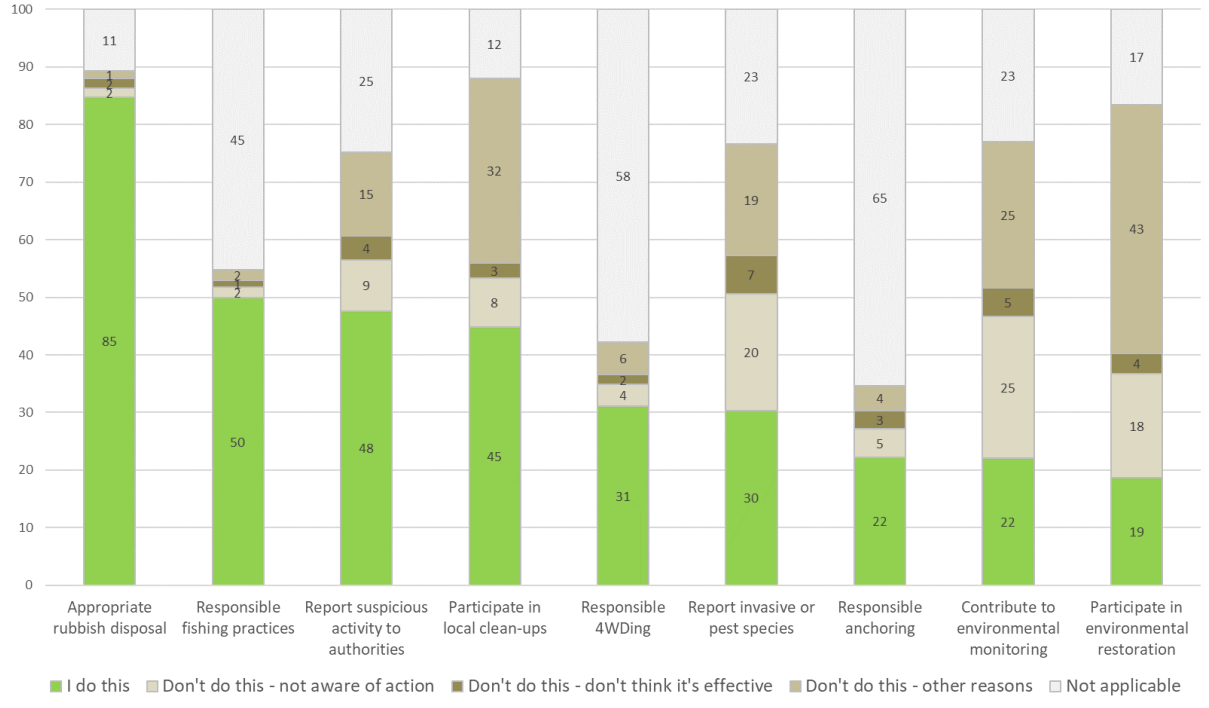
## C.5 Self-reporting of waterway stewardship practices

### Wet Tropics region (n=502)



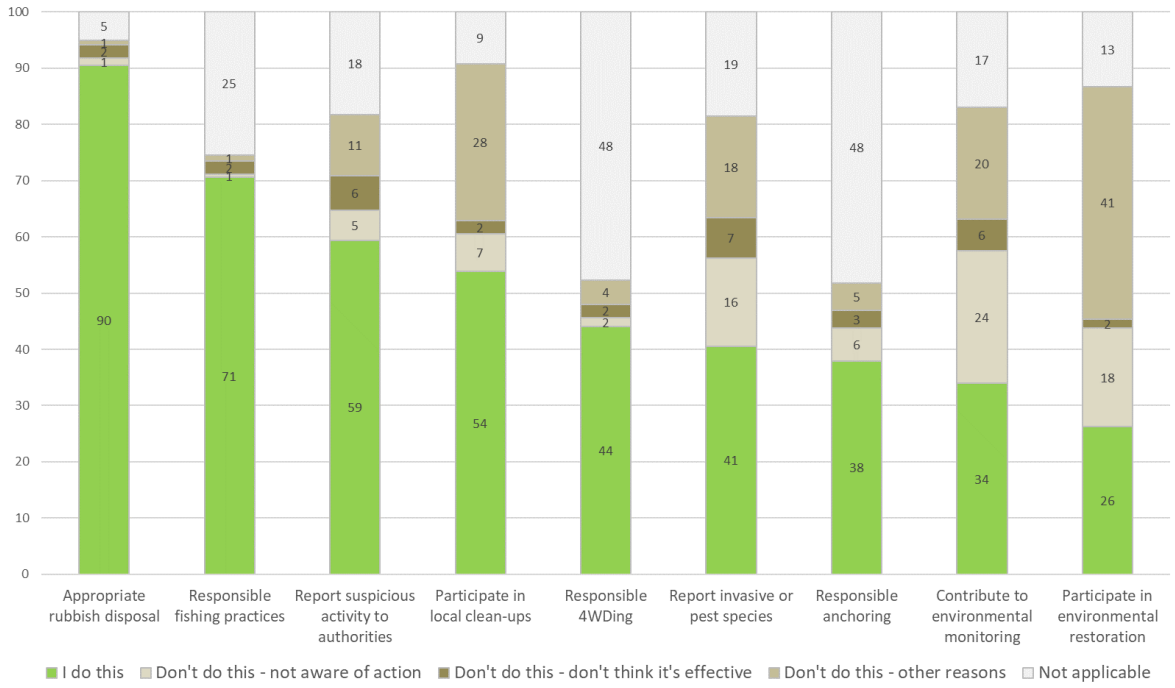

**Apx Figure C.31 Wet Tropics region residents' self-reported waterway stewardship practices, in categories [per cent of respondents per category; n=502]**

### Townsville region (n=531)



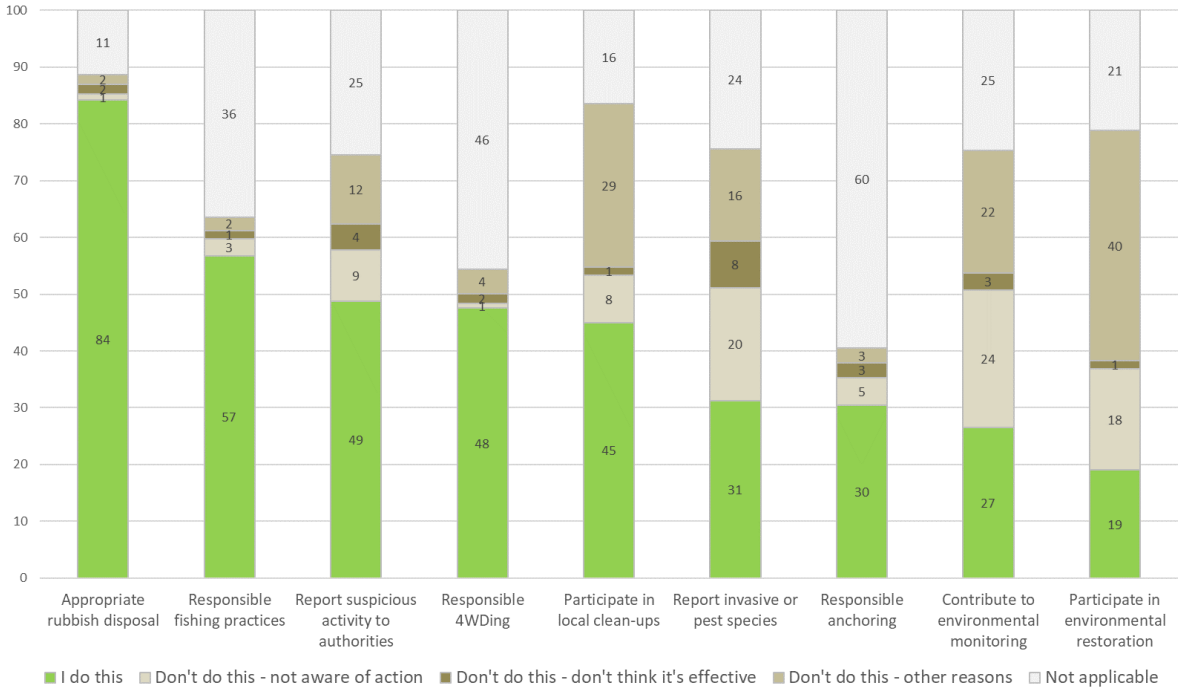

**Apx Figure C.32 Townsville region residents' self-reported waterway stewardship practices, in categories [per cent of respondents per category; n=531]**

## Mackay-Whitsunday-Isaac region (n=377)




**Apx Figure C.33 MWI region residents' self-reported waterway stewardship practices, in categories [per cent of respondents per category; n=377]**

## Fitzroy region (n=467)




**Apx Figure C.34 MWI region residents' self-reported waterway stewardship practices, in categories [per cent of respondents per category; n=467]**

# References


ABS (2017). Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians. Australian Bureau of Statistics. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/latest-release

Alluvium (2021). Human Dimension Indicators for Regional Report Cards, Final Report to the Office of the Great Barrier Reef, June 2022.

Argyris, C. & Schön, D.A. (1989). Participatory Action Research and Action Science Compared: A Commentary. *American Behavioural Scientist* 32 (5): 612-623. https://doi.org/10.1177/0002764289032005008

Australian Government (2021). Reef 2050 Long-Term Sustainability Plan 2021-25. Commonwealth Department of Agriculture, Water and Environment, Canberra. https://www.awe.gov.au/parks-heritage/great-barrier-reef/long-term-sustainability-plan

Baum, F., MacDougall, C. & Smith, D. (2006). Participatory action research. *Journal of Epidemiology and Community Health* 60: 854-857. http://dx.doi.org/10.1136/jech.2004.028662

Bell, S. & Morse, S. (1999). *Sustainability Indicators: Measuring the immeasurable*. Earthscan Publications Ltd., London.

Bell, S. & Morse, S. (2003). *Measuring Sustainability: Learning from doing*. Earthscan Publications Ltd., London.

Bennett, N.J. (2016). Using perceptions as evidence to improve conservation and environmental management. *Conservation Biology* 30(3): 582-92. https://doi.org/10.1111/cobi.12681

Bennett, N.J. & Satterfield, T. (2018). Environmental governance: A practical framework to guide design, evaluation, and analysis. *Conservation Letters* 11 (6): e12600. https://doi.org/10.1111/conl.12600

Bennett, N.J., Whitty, T.S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S. & Allison, E.H. (2018). Environmental Stewardship: A Conceptual Review and Analytical Framework. *Environmental Management* 61, 597–614. https://doi.org/10.1007/s00267-017-0993-2

Brady, E. (2016). Aesthetic Value, Nature, and Environment. In S. Gardiner, A. Thompson (Eds.), *Oxford Handbook of Environmental Ethics* (pp.186-196), Oxford University Press, New York.

Bryman, A. (2012). *Social Research Methods*, 4th Edition. Oxford University Press, London.

Carter, L., Mankad, A., Zhang, A, Curnock, M. & Pollard (2021). A multidimensional framework to inform stakeholder engagement in the science and management of invasive and pest animal species. *Biological Invasions* 23, 625–640 (2021). https://doi.org/10.1007/s10530-020-02391-6

Clark, W.C. (2007). Sustainability Science: A room of its own. *Proceedings of the National Academy of Sciences* 104 (6): 1737-1738. https://doi.org/10.1073/pnas.0611291104

Curnock, M.I., Farbotko, C., Collins, K., Robinson, C.J. & Maclean, K. (2017). Engaging with risk (or not): shared responsibility for biosecurity surveillance and the role of community gardens. *Geographical Research* 55 (4): 379-394. https://doi.org/10.1111/1745-5871.12231

Curnock, M.I., Marshall, N.A., Thiault, L., Heron, S.F., Hoey, J., Williams, G., Taylor, B., Pert, P.L., Goldberg, J. (2019). Shifts in tourists' sentiments and climate risk perceptions following mass coral bleaching of the Great Barrier Reef. *Nature Climate Change* 9: 535-541. https://www.nature.com/articles/s41558-019-0504-y

Curnock, M., Pert, P., Smith, A., Molinaro, G. and Cook, N. (2020). Designing an Aesthetics Long-Term Monitoring Program (ALTMP) for the Great Barrier Reef. Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns (82pp.). https://nesptropical.edu.au/index.php/round-5-projects/project-5-6/

Dawes, J. (2008). Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7-point and 10-point scales. *International Journal of Market Research*, 50 (1): 61-104. https://doi.org/10.1177/147078530805000106

Dolnicar, S., Grun, B., Leisch, F. and Rossiter, J. (2011). Three good reasons NOT to use five and seven point Likert items. CAUTHE 2011: 21st CAUTHE National Conference, Adelaide, Australia, 8-11 February 2011. https://www.researchgate.net/publication/268349382_Three_good_reasons_NOT_to_use_five_and_seven_point_Likert_items

Dyer, M., Newlands, M., Bradshaw, E., and Hernandez, S. (2021). Stewardship in the Great Barrier Reef: A review of concepts and definitions of stewardship in the Great Barrier Reef applied to Reef health, Great Barrier Reef Marine Park Authority, Townsville (42pp). https://elibrary.gbrmpa.gov.au/jspui/handle/11017/3781

Ford, R.M., Williams, K.J.H., Bishop, I.D. & Webb, T. (2009). A value basis for the social acceptability of clearfelling in Tasmania, Australia. *Landscape and Urban Planning*, 90 (3-4): 196-206. https://doi.org/10.1016/j.landurbplan.2008.11.006

Ford, R.M., Williams, K.J.H., Smith, E.L. & Bishop, I.D. (2014). Beauty, belief, and trust: toward a model of psychological processes in public acceptance of forest management. *Environment and Behavior* 46 (4): 476-506. https://doi.org/10.1177/0013916512456023

Gifford, R. & Sussman, R. (2012). Environmental attitudes. In S. D. Clayton (Ed.), *The Oxford handbook of environmental and conservation psychology* (pp. 65–80). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199733026.013.0004

Gobster, P.H., Floress, K., Westphal, L.M., Watkins, C.A., Vining, J. & Wali, A. (2016). Resident and user support for urban natural areas restoration practices. *Biological Conservation* 203: 216-225. https://doi.org/10.1016/j.biocon.2016.09.025

Gooch, M., Dale, A., Marshall, N., and Vella, K. (2019). Assessment and Monitoring of the Human Dimensions within the Reef 2050 Integrated Monitoring and Reporting Program: Final report of the Human Dimensions Expert Group, Great Barrier Reef Marine Park Authority, Townsville. Available at: https://elibrary.gbrmpa.gov.au/jspui/handle/11017/3534

Grimble, R. & Wellard, K. (1997). Stakeholder Methodologies in Natural Resource Management: a Review of Principles, Contexts, Experiences and Opportunities. *Agricultural Systems* 55 (2): 173-193. https://doi.org/10.1016/S0308-521X(97)00006-1

Gurney, G.G., Blythe, J., Adams, H., Adger, W.N., Curnock, M., Faulkner, L., James, T. & Marshall, N.A. (2017). Redefining community based on place attachment in a connected world. *Proceedings of the National Academy of Sciences* 114 (38): 10077-10082. https://doi.org/10.1073/pnas.1712125114

Guy, G.B. & Kilbert, C.J. (1998). Developing indicators of sustainability: US experience. *Building Research & Information* 26 (1): 39-45. https://doi.org/10.1080/096132198370092

Harger, J.R.E. & Meyer, F.M. (1996). Definition of indicators for environmentally sustainable development. *Chemosphere* 33: 1749-1775. https://doi.org/10.1016/0045-6535(96)00194-4

Healthy Rivers to Reef Partnership (2018). The Mackay-Whitsunday-Isaac 2018 Report Card. https://healthyriverstoreef.org.au/wp-content/uploads/2019/07/hr2r_2018-report-card-030719-web-view.pdf

Hobman, E.V., Mankad, A., Pert, P.L., van Putten, I., Fleming-Muñoz, D. & Curnock, M. (2022). CSIRO Social and Economic Long-Term Monitoring Program Team (2021). Monitoring social and economic

indicators among residents of the Great Barrier Reef region in 2021: A report from the Social and Economic Long-term Monitoring Program. CSIRO Land and Water, Australia. https://research.csiro.au/seltmp/publications/

Holling, C.S. (ed.) (1978). *Adaptive Environmental Assessment and Management*. John Wiley & Sons, New York.

Jarvis, D., Hill, R., Buissereth, R., Moran, C., Taibot, L., Bullio, R., Grant, C., Dale, A. P., Deshong, S., Fraser, D., Gooch, M., Hale, L., Mann, M., Singleton, G. & Wren, L. (2019). Strong peoples - Strong country Indigenous heritage monitoring framework: Summary report, Great Barrier Reef Marine Park Authority, Townsville. https://elibrary.gbrmpa.gov.au/jspui/handle/11017/3537

Kates, R.W., Clark, W.C., Corell, R., et al. (2001). Sustainability Science. *Science* 27 (292): 641-642. https://www.science.org/doi/10.1126/science.1059386

Kruskal, W.H. & Wallis, W.A. (1952). Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association* 47 (260): 583-621. https://doi.org/10.2307/2280779

Lankester, A.J., Bohensky, E. & Newlands, M. (2015). Media representations of risk: The reporting of dredge spoil disposal in the Great Barrier Reef Marine Park at Abbot Point. *Marine Policy* 60: 149-161. https://doi.org/10.1016/j.marpol.2015.06.009

Le, J.D., Becken, S. & Curnock, M. (2022). Gaining public engagement to restore coral reef ecosystems in the face of acute crisis. *Global Environmental Change* 74: 102513. https://doi.org/10.1016/j.gloenvcha.2022.102513

MacKearcher, T., Diedrich, A., Gurney, G.G. & Marshall, N.A. (2018). Who trusts whom in the Great Barrier Reef? Exploring trust and communication in natural resource management. *Environmental Science and Policy* 88: 24-31. https://doi.org/10.1016/j.envsci.2018.06.010

Mankad, A., Zhang, A. & Curnock, M. (2019). Motivational drivers of action in response to an environmental biosecurity incursion. *Journal of Environmental Management* 232: 851-857. https://doi.org/10.1016/j.jenvman.2018.11.115

Mäntylä, M.V., Graziotin, D. & Kuutila, M. (2018). The evolution of sentiment analysis—A review of research topics, venues, and top cited papers. *Computer Science Review* 27: 16-32. https://doi.org/10.1016/j.cosrev.2017.10.002

Marshall, N., Adger, W.N., Benham, C., Brown, K., Curnock, M.I., Gurney, G.G., Marshall, P., Pert, P.L., Thiault, L. (2019a). Reef Grief: Investigating the relationship between place meanings and place change

on the Great Barrier Reef, Australia. *Sustainability Science* 14: 579-587. https://doi.org/10.1007/s11625-019-00666-z

Marshall, N. A., Barnes, M., Birtles, R.A., Brown, K., Cinner, J. E., Curnock, M., Eakin, H., Goldberg, J., Gooch, M., Kittinger, J.N., Manuel-Navarrete, M.P.A., Pelling, D.M., Smit, B. & Tobin, R. (2018). Measuring what Matters in the Great Barrier Reef. *Frontiers in Ecology and the Environment* 16 (5): 271-277. https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.1808

Marshall, N.A., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Nicotra, B., Pert, P., Scherl, L.M. Stone-Jovicich, S. & Tobin, R.C. (2016). Advances in monitoring the human dimension of natural resource systems: an example from the Great Barrier Reef. *Environmental Research Letters* 11: 114020. http://iopscience.iop.org/article/10.1088/1748-9326/11/11/114020/meta

Marshall, N.A., Dunstan, P., Pert, P., Thiault, L. (2019b). How people value different ecosystems within the Great Barrier Reef. *Journal of Environmental Management* 243: 39-44, https://doi.org/10.1016/j.jenvman.2019.05.024

Marshall N.A., Thiault L., Beeden A., Beeden R., Benham C., Curnock M.I., Diedrich A., Gurney G.G., Jones L., Marshall P.A., Nakamura N., Pert P. (2019c). Our Environmental Value Orientations Influence How We Respond to Climate Change. *Frontiers in Psychology* 10: 938. https://doi.org/10.3389/fpsyg.2019.00938

McMillan, M., Hoban, T., Clifford, W. & Brant, M. (1997). Social and Demographic Influences on Environmental Attitudes. *Journal of Rural Social Sciences* 13(1): Article 5. https://egrove.olemiss.edu/jrss/vol13/iss1/5

McTaggart, R. (1991). Principles for Participatory Action Research. *Adult Education Quarterly* 41 (3): 168-187. https://doi.org/10.1177/0001848191041003003

Miller, G. & Twining-Ward, L. (2005). *Monitoring for a Sustainable Tourism Transition: The Challenge of Developing and Using Indicators*. CABI Publishing, Oxfordshire, UK.

Nederhof, A.J. (1985). Methods of coping with social desirability bias: A review. *European Journal of Social Psychology* 15(3): 263-280. https://doi.org/10.1002/ejsp.2420150303

Ostrom, E. (2007). A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences* 104 (39): 15176-15178. https://doi.org/10.1073/pnas.0702288104

Pascoe, S., Tobin, R., Windle, J., Cannard, T., Marshall, N.A., Kabir, Z. & Flint, N. (2016). Developing a social, cultural and economic report card for a regional industrial harbour. *PLOS One* 11: e0148271. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148271

Pert, P.L., Thiault, L., Curnock, M.I., Becken, S. & Claudet, J. (2020). Beauty and the reef: Evaluating the use of non-expert ratings for monitoring aesthetic values of coral reefs. *Science of the Total Environment* 730: 139156. https://doi.org/10.1016/j.scitotenv.2020.139156

Pocock, C. (2002). Sense matters: aesthetic values of the Great Barrier Reef. *International Journal of Heritage Studies*, 8 (4): 365-381. https://doi.org/10.1080/1352725022000037191g

Preston, C.C. & Colman, A.M. (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. *Acta Psychologica*, 104: 1-15. https://doi.org/10.1016/S0001-6918(99)00050-5

Rokeach, M. (1973). The nature of human values. Free Press, New York.

Shaughnessy, J., Zechmeister, E., & Jeanne, Z. (2011). *Research Methods in Psychology* (9th ed.). McGraw Hill, New York, NY.

Swart, R.J., Raskin, P. & Robinson, J. (2004). The problem of the future: sustainability science and scenario analysis. *Global Environmental Change* 14: 137-146. https://doi.org/10.1016/j.gloenvcha.2003.10.002

Taylor B., Vella K., Maclean K., Newlands M., Ritchie B., Lockie S., Lacey J., Baresi U., Barber M., Siehoyono Sie L., Martin M., Marshall N. & Koopman D. (2019). Reef Restoration and Adaptation Program: Stakeholder, Traditional Owner and Community Engagement Assessment. A report provided to the Australian Government by the Reef Restoration and Adaptation Program (95 pp). https://gbrrestoration.org/wp-content/uploads/2020/09/T1-Stakeholder-Traditional-Owner-Community-Engagement-Assessment3.pdf

Thiault, L., Curnock, M., Gurney, G.G., Heron, S.F., Marshall, N.A., Bohensky, E., Nakamura, N., Pert, P.L. & Claudet, J. (2021). Convergence of stakeholders' environmental threat perceptions following mass coral bleaching of the Great Barrier Reef. *Conservation Biology* 35 (2): 598-609. https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13591

UNESCO (2021). Operational Guidelines for the Implementation of the World Heritage Convention. UNESCO World Heritage Centre, Paris. https://whc.unesco.org/en/guidelines/

Weijters, B., Cabooter, E. & Schillewaert, N. (2010). The effect of rating scale format on response styles: The number of response categories and response category labels. *International Journal of Research in Marketing*, 27: 236-247. https://doi.org/10.1016/j.ijresmar.2010.02.004

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