



METHODS FOR
THE MACKAY-WHITSUNDAY-ISAAC
2018 REPORT CARD

HUMAN DIMENSION INDICATORS



**HEALTHY RIVERS TO
REEF PARTNERSHIP**
MACKAY-WHITSUNDAY-ISAAC

Authorship statement

The Mackay-Whitsunday-Isaac Healthy Rivers to Reef Healthy Partnership (Partnership) Methods for the Mackay-Whitsunday-Isaac 2018 Report Card Human Dimension Indicators (reporting period 1st July 2017-30th June 2018) technical report was compiled by the Partnership's Technical Officers, Alysha Lee and Jessica Gillespie.

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Terms and Acronyms

ALUM	Australian Land Use and Management Classification system
Basin	An area of land where surface water runs into smaller channels, creeks or rivers and discharges into a common point and may include many sub-basins or sub-catchments (also known as river basin or catchment)
BMP	Best Management Practice
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Department of Agriculture and Fisheries Queensland
DATSIP	The Department of Aboriginal and Torres Strait Islander Partnerships
DES	Department of Environment and Science
Ecosystem	A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit
EMS	Environmental management systems
IRC	Isaac Regional Council
GBR	Great Barrier Reef
GBR report card	Great Barrier Reef Report Card
MWI	Mackay Whitsunday Isaac Region
MOU	Memorandum of Understanding
MRC	Mackay Regional Council
NRM	Natural Resource Management
NERP	National Environmental Research Programs
NQDT	North Queensland Dry Tropics Natural Resource Management Region
OGBR	Office of the Great Barrier Reef
Partnership	Mackay-Whitsunday-Isaac Healthy Rivers to Reef Partnership
P2R	Paddock to Reef
QPWS	Queensland Parks and Wildlife Service
Region (for the purposes of the report card)	Geographically, the Region covered by the Partnership in the Mackay-Whitsunday-Isaac report card is from Home Hill in the north to Flaggy Rock Creek in the south, including the freshwater and marine environment. ¹

¹ <https://healthyriverstoreef.org.au/our-region/>

RIMMReP	Reef Integrated Monitoring, Modelling and Reporting Program (RIMMReP).
SELTMP	Social and Economic Long-Term Monitoring Program for the Great Barrier Reef
Stewardship	Responsible planning and management actions
TORG	(Mackay-Whitsunday) Traditional Owner Reference Group
Waterways	Freshwater creeks and rivers, estuarine environments and wetlands within the five nominated basins in the region, and the inshore/offshore marine environment

1. Introduction

1.1. Purpose of this Document

The purpose of this document is to provide detailed information on the methods used to produce the Mackay-Whitsunday-Isaac 2018 report card. This includes condition assessments of the human dimension indicators for social and economic, stewardship and indigenous cultural heritage. Specifically, this document describes:

- The data collection methods; and,
- The scoring methods.

Cultural heritage and social and economic indicators in the 2018 report card have been updated for the first time since the release of the 2015 report card. Subsequently, the 2018 report card is the first time all human dimension indicators have aligned in their reporting cycle updates. Methods used to assess environmental indicators in the region's waterways can be found in the Methods for the Mackay-Whitsunday-Isaac 2018² environmental indicators.

1.2. Background

The Mackay-Whitsunday-Isaac Healthy Rivers to Reef Partnership (Partnership) was established in October 2014. The primary focus of the Partnership was to produce an annual report card on the health of the Region's waterways.

The report card includes assessments of the freshwater environment, the estuarine environment and the marine environment (to the eastern boundary of the Great Barrier Reef Marine Park). Different indicators are assessed to provide the overall scores for the environmental zones throughout the Mackay-Whitsunday-Isaac region. Social, cultural and economic information relevant to waterways and the marine environment is also provided, along with an assessment of stewardship in relation to waterways. Stewardship is reported for the agricultural, tourism, ports, heavy industry, aquaculture and urban sectors of the Region.

Significant review was undertaken between the release of the 2014 pilot report card and the first full 2015 report card. Further refinement of analyses and scoring methods were incorporated into the 2016 report card which helped align more methods with other report cards in the Great Barrier Reef Region. A five-year (2017-2022) program design has now been established as a framework to guide the development of the Mackay-Whitsunday-Isaac Healthy Rivers to Reef report card and its future scope and will be reviewed again after the release of the 2022 report card. The 2018 report card is the fifth and most up-to-date report card released by the Partnership. For more detail on the Mackay-Whitsunday-Isaac report card and the Partnership, refer to the 'Mackay-Whitsunday-Isaac Report Card Program Design 2017 to 2022'³ document.

² <https://healthyriverstoreef.org.au/report-card/report-card-download/>

³ <https://healthyriverstoreef.org.au/wp-content/uploads/2018/12/mackay-whitsunday-report-card-program-design-2017-2022.pdf>

2. Methods

2.1. Social and Economic

In the 2014 pilot Mackay-Whitsunday-Isaac report card Social and Economic indicators were assessed and reported based on the 2013 survey data collected during the National Environmental Research Programs (NERP) 10.1 and 10.2, which initiated the Great Barrier Reef (GBR) Social and Economic Long-Term Monitoring Program (SELTMP). Following the release of the 2014 pilot report card, the approach taken to report on social and economic indicators using this data was reviewed by technical experts and a variety of recommendations were made to improve future reporting.

Since then, a second round of SELTMP surveys were collected in 2017, incorporating a range of updated and new survey questions relevant to the assessment of human dimensions components of the Reef 2050 Plan. The data collected during the SELTMP 2017 surveys was used to assess social and economic indicators for the second time in the 2018 Mackay-Whitsunday-Isaac report card. Due to updated and expanded 2017 SELTMP survey questions and accounting, some questions no longer aligned therefore the method used by the Townsville Dry Tropics Partnership for Healthy Waters was applied. This allowed for past recommendations made by technical experts to be considered.

Where relevant, comparisons were made to previous scores achieved in the 2014 pilot report card for indicators that align with SELTMP 2017 data.

The Townsville Dry Tropics Partnership for Healthy Waters is gratefully acknowledged for their work in developing this approach and the use of their methods and results reports as templates for information for the Mackay-Whitsunday-Isaac report card.

It is noted that as part of the Reef Integrated Monitoring, Modelling and Reporting Program (RIMMReP), the approach to assessing perceived social and economic values was under consideration at the time of development of this report card. The report card is committed to aligning with the outcomes of RIMMReP where possible and acknowledge that indicators and methods used for this report card may change.

2.1.1. Data collection

Data was drawn from the SELTMP 2017 (Marshall et al. 2019). Data was collected between June and August 2017 from coastal population centres between Cooktown and Bundaberg (referred to as the GBR coastal region). Using a computer tablet, participants answered a series of digital survey questions, with the results designed to be used to describe conditions and trends of the social aspects of the GBR and adjacent waterways (Marshall et al. 2016). The results for social and economic indicators were based on questions relating to the perceived health, condition and management of waterways. Questions relating to individual capacity with respect to the GBR and associated waterways were also used. Only data from residents was used in the report card. Tourists were not included as their answers would impact consistency of longer-term monitoring of change.

2.1.2. Survey questions and responses

Survey questions acted as the indicators, with similar themed questions forming indicator categories (where relevant) or indices. Survey respondents ranked each question from 1 (lowest/strongly

disagree) to 10 (highest/strongly agree). In accordance with the sampling design, survey responses between 1 and 5 represented the inclination to disagree at varying levels and responses between 6 and 10 represented the inclination to agree at varying levels. No response was treated as neutral.

The survey questions (within their respective indicator categories and indices) that were used to generate the scores for social and economic values are listed in Table 1 and Table 2, respectively.

2.1.3. Positively worded survey questions

Some survey questions were positively worded, whilst others were negatively worded to minimise systematic bias in the survey responses. For the 2018 report card, the scores for all negative questions were inverted (e.g. a score of 1 for a negatively worded question is inverted to a 10 to represent the equivalent positively worded question).

2.1.4. Reporting water types and local government areas

SELTMP survey data contain postcodes and basic demographic details of respondents. This meant the survey responses could be filtered based on postcodes within the Mackay-Whitsunday-Isaac reporting zones. Notably, due to the limited number of responses received from Isaac Regional Council (IRC) residents, the sample size was non-representative, and data were not included within the assessment. As such, we refer only to the Mackay-Whitsunday region. The answers from all survey respondents within the reporting postcodes were averaged to generate the score for each indicator. A total of 283 local residents in the Mackay and Whitsunday region participated in the survey from a total population of approximately 139,040 (based on 2016 census data).

The SELTMP survey was primarily designed to provide long-term monitoring of a range of human dimension indicators relevant to management of the GBR Marine Park. In 2017 new questions were added to address other monitoring requirements of the Reef 2050 Plan and upon the request of the Partnership (as end-users of the data), the addition of some questions relating to freshwater, estuarine/coastal and marine waters. These questions were framed towards regional freshwater and estuarine/coastal areas, and the entire GBR region, rather than any specific waterways within the Natural Resource Management regions. The approach taken in our analysis of such questions differed from that taken by the Townsville Dry Tropics Partnership for Healthy Waters, who assessed a number of questions separately based on postcodes to associate responses with specific watercourses. For the Mackay-Whitsunday Region, the approach taken instead was to provide aggregated results of social indicators reflecting regional waterways as a whole. This approach was developed after practical limitations with associating respondent's scores to a specific waterway were identified. For example, selected suburbs are bound by two tributaries, rivers or catchments. Based on postcode alone, the probability a respondent would utilise one specific waterway over the other was unknown. Further the Mackay-Whitsunday Region has a large number of waterways relative to the catchment area when compared to the Townsville region. Aggregating results via water type also had the benefit of aligning with the reporting of bio-physical condition of waterways, which assesses health indicators for freshwater, estuarine and marine (inshore and offshore) systems.

Questions were grouped together as they related to different water types to give an indicator category. Similar themed indicator categories were grouped to provide an overall index. Where similar themed questions were not targeted to explore different water types, these questions were grouped

into an index representing the broader GBR region; this is a key difference between the approach taken by the Townsville Dry Tropics Partnership for Healthy Waters report card⁴.

It is acknowledged that some survey questions grouped within the estuarine indicator category may be influenced by perceptions of estuarine and marine environments, depending on the user's experiences and understanding of aquatic environments. This limitation should be acknowledged and carefully considered in any further analysis and caution should be taken when interpreting the results. However, these methods are adopted based on the assumption that this would not significantly confound the results.

Survey questions were scored by Local Government Area (LGA) as well as at a regional scale. The LGA's that were scored were the Mackay Regional Council (MRC) and the Whitsunday Regional Council (WRC). As discussed, there were not enough responses (n=4) received from residents within the IRC to conduct a representative assessment, therefore, this data was not included in the reporting.

2.1.5. Scoring of Social and Economic values

The key difference between the approach taken by the Townsville Dry Tropics Partnership for Healthy Waters to report on freshwater and estuaries/beaches has meant that terminology for indicator category and index does not align, however the questions that make up the indicator categories and indices for social values match those used by the Townsville Dry Tropics and the groupings applied are also the same.

The Mackay-Whitsunday-Isaac report card uses the same questions to report on economic values that were used by the Townsville Dry Tropics Partnership for Healthy Waters report card to report on their economy section. A key difference in the approach taken by the Mackay-Whitsunday-Isaac report card is that the indicators are not grouped together into any indicator categories or indices but are used collectively to report on perceived 'Economic Opportunity'.

To create the score for social and economic values, the following approach was undertaken:

1. Indicators were assessed at a regional scale and at the scale of the LGA.
2. If relevant, the LGA or regional score for each question/indicator was averaged into an indicator category (water types); and
3. Indicators or indicator categories (where relevant) were then averaged to generate a score for each index for the LGA or region

Indices for social indicators were not averaged to produce an overall score for social values due to variability in the water types assessed across individual indicator categories. For example, results for the perception of non-monetary values and wellbeing derived from the GBR were sourced from questions which only incorporated marine (GBR) water types. Instead, social values were scored at the index level as outlined in Table 1.

⁴ <https://drytropicshealthywaters.org/pilot-report-card>

In accordance with the current scoring process for biophysical indicators, all survey questions and water types contributed equally to the average indicator category and indices. All indicators and indicator categories were weighted equally when aggregated.

Table 1. Indicators used to determine the score for Social perceptions of waterways and values of the GBR, split into freshwater, estuarine/coastal and marine indicator categories where relevant. An asterisk (*) indicates the scores were inverted due to negative wording. Where questions were included in the pilot report card, the pilot indicator that this contributed to is identified and further information on this can be found in Attachment I. NB frequency of reporting is based on the past approach and this may change in the future.

Index	Indicator category (if relevant)	Indicator	Frequency of reporting	Included in Pilot Report Card	SELTMP question
Perception of waterway condition	Freshwater condition	I <i>am</i> worried about the status of freshwater fish in my region*	4 years	No	50
		The freshwater areas (e.g. rivers, creeks) in my region are <i>not</i> in good condition*	4 years	No	55
	Estuaries and beaches condition	There is <i>too</i> much rubbish (plastics and bottles) on the beaches in my region*	4 years	Yes (waterway health)	49
		The mangroves in my region are in good health	4 years	Yes (waterway health)	53
		The estuarine and marine fish in my region are in good condition	4 years	Yes (waterway health)	54
		I like the colour/clarity of the water along the beaches in my region	4 years	Yes (waterway health)	52
	Marine condition	The coral reefs in my region are in good condition	4 years	Yes (waterway health)	51
Perception of waterway management	Freshwater management	I feel confident that the freshwater areas in my region are well managed	4 years	No	19
		I support the current rules and regulations that affect access and use of freshwater areas (rivers and creeks) in my region	4 years	No	48
	GBR management	I do <i>not</i> have fair access to the GBR compared to other user groups*	4 years	Yes (access)	14
		I feel confident that the GBR is well managed	4 years	Yes (management)	16
		I support the current rules and regulations that affect access and use of the GBR	4 years	Yes (management)	23
		I feel like I can contribute to GBR management	4 years	No	33
		I think enough is being done to effectively manage the GBR	4 years	No	36
Perception of non-monetary Values derived from the GBR	N/A	I value the GBR because it supports a desirable and active way of life	4 years	Yes (values)	17
		I value the GBR because we can learn about the environment through scientific discoveries	4 years	Yes (values)	18
		The aesthetic beauty of the GBR is outstanding	4 years	Yes (values)	13
		I value the GBR because it inspires me in artistic or thoughtful ways	4 years	No	41
		I value the GBR because it is an important part of my culture	4 years	No	47
Wellbeing derived from the GBR	N/A	I love that I live beside the GBR	4 years	No	40
		Thinking about coral bleaching makes me feel depressed*	4 years	No	30
		I value the GBR because it makes me feel better physically and/or mentally	4 years	No	43
		I feel proud that the GBR is a World Heritage Area	4 years	No	9
		The GBR is part of my identity	4 years	No	11
		The GBR contributes to my quality of life and well-being	4 years	Yes (values)	12
Individual Capacity to act	N/A	I have the necessary knowledge and skills to reduce any impact that I might have on the GBR	4 years	Yes (decision making)	37
		I <i>cannot</i> make a personal difference in improving the health of the great barrier reef*	4 years	No	32
		I make every effort to use energy efficiently in my home and workplace	4 years	No	58

Table 1. continued

	I <i>rarely</i> consider the environmental impact of the production process for goods and services that I purchase*	4 years	No	59
	I <i>don't</i> usually make any extra effort to reduce the waste I generate*	4 years	No	60
	I re-use or recycle most goods and waste	4 years	No	61
	I would like to learn more about the condition of the GBR	4 years	No	29
	I would like to do more to help protect the GBR	4 years	No	26
	I would like to do more to improve water quality in my waterways (including rivers, creeks)	4 years	No	27

Table 2. Indicators used to determine the score for perceived Economic Opportunity were based on economic values presented by the GBR. An asterisk (*) indicates the question and scores were inverted in order to convert it so it is positively worded. Where questions were included in the pilot report card, the pilot indicator that this contributed to is identified and further information on this can be found in Attachment I.

Index	Water type (if relevant)	Indicator	Frequency of reporting	Included in Pilot Report Card	SELTMP question
Perceived Economic Opportunity	N/A	I value the GBR because it attracts people from all over the world	4 years	Yes (values)	20
		I value the GBR because we can learn about the environment through scientific discoveries	4 years	Yes (values)	18
		I value the GBR for the fresh seafood it provides	4 years	Yes (values)	21
		The GBR is a great asset for the economy of this region	4 years	No	10

2.1.6. Grading social and economic data

Similar to the grading methods used for the environmental condition assessments, the social and economic values were graded using a five-point scale ranging from A to E (Table 3). The distribution of rating scores from each survey question were visually assessed for normality. Whilst the responses to some survey questions were normally distributed, most were positively skewed to some degree. For the individual capacity category only, the positively skewed responses replicated what was found in the Townsville Dry Tropics Partnership for Healthy Waters report card, which reflects the majority of respondents self-rating their individual behaviour at the top end of the scale.

To maximise comparability between report cards, the Townsville Dry Tropics Partnership for Healthy Waters scoring approach was adopted exactly. Therefore, the A to E scoring range was shifted upwards, so that a higher mean score is required to achieve a more positive, A, grading to account for the positivity (or virtue) bias. Scaling intervals (<5 and <6, respectively) were selected qualitatively, based on the level of bias identified and to elicit sensitivity to change within the assessment process. No quantitative assessment or statistical analysis has been undertaken to test this approach. Further validation of this approach is recommended through regional comparisons and review of trends over time.

A limitation of this approach is that a significant portion of responses rated at the lower end of the scale are lost through reporting the mean. This approach had very little sensitivity, at the report card scale, to communicate changes in perceptions for index's which rate very poor. Ideally, multiple lines of evidence would be employed to validate the results and improve the approach for grading. In future, the intent is to refine this method through more comprehensive statistical analysis, employing analogous data sets for validation, or, to inform the indicator score.

In contrast to the environmental condition assessments, a "C" grade does not necessarily indicate passing or failing a guideline. Instead it indicates that the community derives moderate wellbeing from waterways.

Table 3. Scoring range and corresponding grade for Social and Economic indicator categories and indices and for the Individual Capacity indicator category.

Scoring range for Social and Economic values (excluding stewardship index)	Scoring range for stewardship index	Grade and colour code
8 to 10	9 to 10	Very Good (A)
7 to <8	8 to <9	Good (B)
6 to <7	7 to <8	Moderate (C)
5 to <6	6 to <7	Poor (D)
<5	<6	Very Poor (E)

2.2. Stewardship

Stewardship is defined as ‘actions taken by individuals, groups or networks, with various motivations and levels of capacity, to protect, care for or responsibly use the environment in pursuit of environmental and/or social outcomes in diverse socio-ecological contexts’. Stewardship is represented as the level of effective environmental management practice implemented across the region in relation to waterways and the marine environment. Stewardship is an important aspect to include in the report card, as it provides information on the voluntary action’s landholders and organisations in the region are implementing (such as improved land management practices) to provide benefits to ecosystems. Stewardship activities have a direct link to the water quality in the region and can be used to demonstrate how on-ground activities (*responses* undertaken by landholders/organisations in the region) impact water quality (the *state* of the natural environment).

Stewardship reporting assists in meeting various Partnership and report card objectives. In particular, the stewardship information aids the Partnership to achieve its objective on reporting on the *pressures* acting upon the water quality and ecosystem health in the region’s waterways. Additionally, reporting on stewardship assists the Partnership in effectively communicating relevant information which may support decision making for management activities and interventions.

The level of stewardship implemented by the different sectors is reported on in the Mackay-Whitsunday-Isaac report card in terms of the amount of each sector operating under each management practice level. Stewardship reporting is presented for the major industries in the Mackay-Whitsunday-Isaacs Region and is based on suitable frameworks (Table 4).

Table 4. Frameworks and stewardship reporting of the major industries in the Mackay-Whitsunday-Isaac (MWI) region.

Sector	Framework used to assess stewardship
Horticulture	Reef Plan Water Quality Risk Framework.
Grazing	Reef Plan Water Quality Risk Framework.
Sugarcane	Reef Plan Water Quality Risk Framework.
Ports	Developed for the MW report card
Industry Heavy industry – mining, mills, ERA/licenced activities, etc.	Developed for the MW report cards
Tourism	Developed for the MW report card with alignment to ECO Tourism certification.
Aquaculture	Developed for the MW report card
Urban Construction and operational activities under councils, i.e. STPs, developments, etc.	Reef Catchments’ ABCD framework for MWI (included in the Mackay-Whitsunday-Isaac Water Quality Improvement Plan). An urban framework indicator is currently under development, led by the Office of the Great Barrier Reef.
TBC- Fishing	To be developed through the MW Fisheries Regional Working Group, in conjunction with consultants and Reef Catchments.
TBC - Community	To be developed by Partnership staff in conjunction with Partners.

2.2.1. Management frameworks

Available environmental management practice frameworks are used to provide the basis for stewardship reporting. In agriculture, frameworks that have been developed, reviewed, and endorsed by industry are currently available for grazing, sugarcane, and horticulture and are based on Paddock to Reef (P2R) reporting that uses “Water Quality Risk frameworks” (previously “ABCD Frameworks”) (Australian and Queensland Governments 2019a). Outside of agriculture, industry specific management frameworks have been developed. An updated urban stewardship framework is currently under development, led by the Office of the Great Barrier Reef, and expected to be incorporated into regional report cards in the future. For the purposes of this report and the Mackay-Whitsunday-Isaac report card, the term “Management frameworks” will be used, noting that different sectors use slightly different terminology.

2.2.2. Data collection and reporting

Data on stewardship is currently collected and reported in the Mackay-Whitsunday-Isaac report card annually, with the exception of the 2017 report card, due to trialling an earlier release of the 2018 report card. The stewardship reporting is not broken down to the reporting zones used in the environmental assessment nor the local government areas that exist within the region.

The displays for stewardship reporting in the report card vary depending on the sector being reported. The agricultural sectors of grazing, sugarcane, and horticulture adopt the same display style as used in the GBR report card, since the data and structure of assessment is identical. The stewardship result displays for the other sectors (ports, tourism, heavy industry, urban and aquaculture) are reported in the report card using ‘fire rating’ style diagram shown in Figure 1, with the arrow indicating the average operational level of the industry in the region

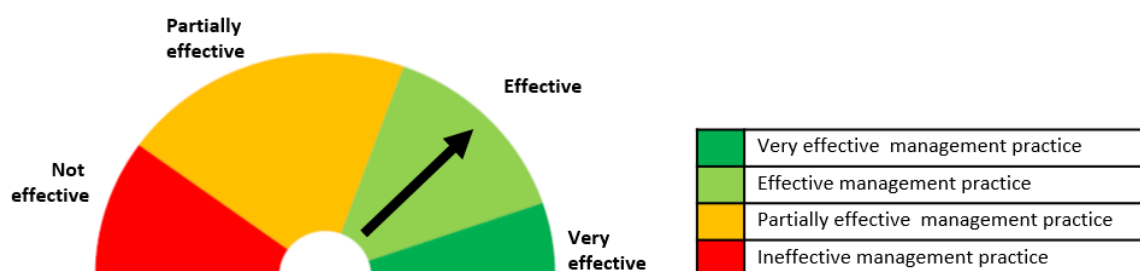


Figure 1. Example of stewardship displays for ports, tourism, heavy industry, urban and aquaculture sectors.

All stewardship reporting covers the Mackay-Whitsunday-Isaac natural resource management region, with the addition of the Don Basin. The agricultural stewardship reporting incorporates data from the Don Basin and therefore the results may vary slightly from those presented in the GBR report card, where the Don is incorporated in the assessment of the Burdekin region.

2.2.3. Agricultural industry

The Mackay-Whitsunday-Isaac report card aligns its agricultural stewardship reporting with the GBR report card, which are reported through the Paddock to Reef (P2R) program¹. Each year, significant investment from Government is directed towards adoption of best practice farm management systems with the aim to achieve the Reef 2050 Water Quality Improvement Plan's outcomes and targets and improve the quality of water flowing into the Great Barrier Reef (Australian and Queensland governments 2019b).

Farm management practice adoption benchmarks were revised for each agricultural industry practice for the GBR report card. These benchmarks are reviewed and revised every 5 years and annual change is based on data reported each year. As the Mackay-Whitsunday-Isaac report card aligns its agricultural stewardship reporting baselines with the GBR report card, the revised agricultural management practice baselines were utilised. The 2016-17 year is set as the benchmark from which to show improvements. P2R program management practice and management system benchmarks were developed for each agricultural industry sector, and in each of the five major river basins within each region. Best management practices for water quality outcomes are defined in the Paddock to Reef program water quality risk frameworks² for each major agricultural industry. Grazing, sugarcane and horticulture are the major agricultural industries in the Mackay-Whitsunday-Isaac Region. For grazing systems, the water quality risk frameworks describe practices impacting upon land condition, soil erosion (pasture-hillslope, streambank and gully) and water quality. For sugarcane and horticulture, nutrients, pesticides and soil are reported against the framework.

Best management practice is defined as the summed area managed under Low and Moderate-Low risk (or 'A and B' practice) levels in each catchment (Australian and Queensland Governments 2019c). The breakdown of practice standards, across all agricultural industries, are outlined further in Table 5 below.

Table 5. Water Quality Risk Frameworks for the Reef 2050 Water Quality Improvement Plan and alignment with the 'ABCD' terminology and industry best management practice (BMP) programs (generalised).

Terminology	Practice Standard			
Water Quality Risk Framework	Lowest risk, commercial feasibility may be unproven	Moderate-low risk	Moderate risk	Moderate-High risk
	Innovative	Best practice	Minimum Standard	Superseded
ABCD	A	B	C	D
Industry BMP (generalised)	Above industry standard (typically aligns with Moderate-Low risk but in some instances aligns with Lowest risk state)		Industry Standard	Below Industry Standard

¹ <https://www.reefplan.qld.gov.au/tracking-progress/reef-report-card/2017-2018>

² <https://www.reefplan.qld.gov.au/tracking-progress/paddock-to-reef/management-practices>

A summary of the data sources and levels of uncertainty around management system baselines for agricultural stewardship related to the Mackay-Whitsunday-Isaac (aligning with the GBR report card) Region is included in Table 6 below.

Table 6. Summary of the data sources and uncertainty around management system baselines developed for the Reef 2050 WQIP agricultural management practice adoption benchmarks.

Industry	Primary data sources	Confidence in benchmarks	Sources of uncertainty
Grazing	<ul style="list-style-type: none"> Grazier 1:1 surveys 2013-16 Previous reporting to P2R Grazing BMP (aggregated, anonymous) 	Moderate – low	<p>Relatively small proportion of the overall large population is represented in the datasets.</p> <p>Inability to describe land condition (as a consequence of management) across the landscape.</p>
Horticulture	<ul style="list-style-type: none"> Hort360 BMP Industry experts 	Moderate	Very good industry representation, however lack of alternative lines of evidence for cross checking.
Sugarcane	<ul style="list-style-type: none"> Previous reporting to P2R Compliance reporting (reef protection legislation) Smartcane BMP (anonymous, aggregated) Industry surveys Soil analyses trends Industry experts Confidential commercial data 	Moderate – High	<p>Several different large and representative datasets providing evidence for most practices in most catchments.</p> <p>However, benchmarks for some practices are based on expert opinion (as no data sources exist).</p>

A detailed outline of the methods for assessing agricultural stewardship can be found within the GBR Report Card, on the Reef 2050 Water Quality Improvement Plan website¹.

At the regional reporting level, assessed best practice management progress for each basin do not align fully with those outlined in the GBR Report Card. The Mackay-Whitsunday-Isaac report card incorporates assessment of the Don Basin, which extends from South of Ayr to the north east of Airlie Beach, spanning the Burdekin and Mackay-Whitsunday-Isaac Natural Resource Management (NRM) regions. Although the Don Basin is principally managed by the North Queensland Dry Tropics (NQDT) NRM body, its condition is hydrologically relevant to the Mackay-Whitsunday-Isaac region due to upgradient inputs being captured within local catchments. As a result, stewardship results for the Don Basin are included within the calculations for stewardship within the Mackay-Whitsunday-Isaac report card. This results in a slight disparity between scores presented in the Mackay-Whitsunday-Isaac region and the Great Barrier Reef report card.

¹ <https://www.reefplan.qld.gov.au/tracking-progress/reef-report-card/methods-to-create-report-card>

2.2.4. Non-agricultural industries

The methods for assessing stewardship across non-agricultural industries is summarised below. This information is based on a review of reports prepared by Eco Logical Australia and Adaptive Strategies (2015) and Ecological Australia and Adaptive Strategies (2016). Reporting for non-agricultural industries in the 2018 report card is broadly consistent with reporting undertaken in fulfilment of previous report cards. Further information on the methods for assessing stewardship across non-agricultural industries can be requested at info@healthyriverstoreef.org.

An urban stewardship framework is currently under development through the Queensland Reef Water Quality Program, led by the Office of the Great Barrier Reef (OGBR), with a pilot study program set to be undertaken in 2019. Following the pilot, it is expected the refined framework will be applied to regional report cards and improve the urban stewardship method currently used in the Mackay-Whitsunday-Isaac report card. Reporting on non-agricultural industries is a priority for the Partnership, and due to the updates being developed for the urban sector, a decision was made to undertake a review of the current non-agricultural stewardship assessment methods for the remaining sectors. This work is anticipated to be undertaken once the findings of the urban stewardship pilot study are available for review, which is expected to be available in 2020.

2.2.4.1. Data collection and reporting

To assess environmental stewardship, an implementation plan was first developed with the Partnership, which identified key stakeholders within the sectors being assessed. Relevant contacts (e.g. Environmental Manager) at each company, industry representative body or organisation were then contacted and invited to participate in the stewardship assessment.

Participation occurred through the completion of a confidential survey on the environmental management practices and the provision of supporting information relevant to the organisation. The responses provided in completed surveys were assessed and scored in accordance with stewardship frameworks developed for each industry (Eco Logical Australia and Adaptive Strategies, 2015).

A disadvantage of this self-reporting approach is the potential perception of bias in the results. That is, companies may shape their responses to 'make themselves look good'. This was countered by specifically tailoring questions to target issues for which 'supporting evidence' would be readily available (e.g. EMS ISO14001 accreditation; number of environmental incidents). This made the data largely objective rather than being merely the unsubstantiated opinion of companies (or individuals within companies) (Eco Logical Australia and Adaptive Strategies, 2015).

Further rigour was introduced into the data collection process by including information in the public domain where relevant to the assessment of environmental stewardship (e.g. annual reports of companies or regulatory agencies) and by assessing compliance data (Eco Logical Australia and Adaptive Strategies, 2015).

Compliance data (with confidential information removed) was provided by the Department of Environment and Science (DES), noting the number of inspections completed for each industry and the level of compliance with legislation or approval conditions (i.e., the results of the inspection). A

compliance rate for each industry was calculated. The Department of Agriculture and Fisheries (DAF) also provided compliance data for the Aquaculture industry, which was assessed in a similar manner (Eco Logical Australia and Adaptive Strategies, 2015).

Stewardship scores were generated for management themes and activity groups in accordance with the relevant industry framework method. Stewardship was assessed on a scale comprising four levels: Very Effective, Effective, Partially Effective and Ineffective. The lowest of the three management theme scores was adopted as the overall stewardship rating for the sector (Eco Logical Australia and Adaptive Strategies, 2015).

2.2.4.2. Ports

A Port Management framework was developed for the Gladstone Healthy Harbour Partnership to evaluate stewardship within the ports industry (Eco Logical Australia and Adaptive Strategies, 2015). This framework and associated questionnaire was reviewed and adapted as required to be appropriate to operations and activities within the Mackay-Whitsunday-Isaac region. A series of activities were identified which formed the basis for the development of criteria against which the management effectiveness (stewardship) could be evaluated:

- Administration
 - Extension and research projects;
 - Compliance approach;
 - Environmental management systems (EMS);
 - Training, knowledge and staff awareness;
 - Community engagement; and
 - Tenancy management.
- Operations
 - Operation and ancillary services (including all operational elements that may affect ecosystem health, such as landside waste, hazardous substance storage, refueling vehicles, quarries, loading and unloading, spill management, stock pile management); and
 - Maintenance dredging.
- Development
 - New capital development and/or significant upgrades; and
 - Capital dredging.
- Shipping
 - Movement;
 - Anchorage;
 - Discharges; and
 - Biosecurity.

The questionnaire for the Ports sector was developed to specifically address each activity listed above as well as theme (planning, implementation and outcome) (see Eco Logical Australia and Adaptive Strategies, 2015).

There are three ports in the region (Abbot Point, Port of Mackay, and Hay Point) and one port authority, North Queensland Bulk Ports Corporation Limited, who manage the ports. However, there are other companies in the region that are port tenants and undertake activities that could be classified as “port” activities, such as dredging and shipping. Thus, all activities undertaken by the port authority, and all dredging and shipping activities undertaken by any other company, were included in the port stewardship framework (Eco Logical Australia and Adaptive Strategies, 2015). For all other activities (not dredging and shipping) port tenants were included in the heavy industry framework (Eco Logical Australia and Adaptive Strategies, 2015).

For the 2018 report card, a response rate of 100% was achieved from the companies and agencies invited to provide information to inform the Port stewardship assessment (Eco Logical Australia and Adaptive Strategies, 2015).

2.2.4.3. Heavy industry

A heavy industry framework was developed specifically for the Mackay-Whitsunday-Isaac region as a component of the 2014 pilot report card (Eco Logical Australia and Adaptive Strategies, 2015) and was utilised again this reporting year (2017/18). For the purposes of the Mackay-Whitsunday-Isaac report card, “heavy industry” is defined as large industrial facilities such as coal terminals, sugar mills, meat processing facilities and mineral processing and storage facilities (Eco Logical Australia and Adaptive Strategies, 2016). The stewardship assessment covered the following criteria across three management themes, being planning, implementation and outcome:

- Involvement in extension and research projects related to ecosystem health;
- Compliance with environmental approvals/licences, legislation and level of engagement with regulators;
- Development and implementation of an Environmental Management System;
- Training, qualifications, knowledge and awareness of environmental management issues for key staff;
- Community engagement on programs related to ecosystem health;
- Environmental standards are in place for tenants through lease conditions (if applicable);
- Biosecurity plans and protocols are in place and well established;
- Long term strategies are in place to manage activities that may cause environmental harm, like maintenance dredging or stormwater; and
- Further development or expansion is undertaken in line with a master plan and takes into account environmental issues.

The stewardship results for the 2018 report card were generated from four companies across the sugar milling, meat processing and coal handling industries. Compliance data from the DES and a range of relevant studies and publications were also utilised, including annual reports of companies and industry bodies. A response rate of 57% was achieved from the companies and agencies invited to provide information to inform the assessment.

2.2.4.4. Aquaculture

A management framework for the aquaculture industry was developed specifically for the Mackay-Whitsunday-Isaac region as a component of the 2014 pilot report card (Eco Logical Australia and Adaptive Strategies, 2015) and was utilised again this reporting year (2017/18). Guidance was taken from the Environmental Code of Practice for Australian Prawn Farmers during development of the framework. The stewardship assessment covered the following criteria across three management themes, being planning, implementation and outcome:

- Involvement in extension and research projects related to ecosystem health;
- Compliance with environmental approvals/licences, legislation and level of engagement with regulators;
- Development and implementation of an Environmental Management System;
- Training, qualifications, knowledge and awareness of environmental management issues for key staff;
- Community engagement on programs related to ecosystem health;
- Environmental standards are in place for tenants through lease conditions (if applicable);
- Biosecurity plans and protocols are in place and well established;
- Long term strategies are in place to manage activities that may cause environmental harm, like maintenance dredging or stormwater;
- Further development or expansion is undertaken in line with a master plan and takes into account environmental issues; and
- Processes are in place to monitor and manage the incidence of disease (aquaculture).

The aquaculture industry in the Mackay-Whitsunday-Isaac Region is comprised of a small number of prawn, barramundi and red-claw crayfish farms. The industry is highly regulated, primarily in relation to wastewater discharges and the management of biosecurity issues such as disease (Eco Logical Australia and Adaptive Strategies, 2015).

The stewardship results for the 2018 report card were generated from three companies and liaison with three representative bodies in the prawn, barramundi and red claw crayfish farming industries. Compliance data from the DAF, DES, and a range of relevant studies and publications were also utilised (e.g. research from CSIRO and publications from industry representative bodies). A response rate of 75% was achieved from the companies and agencies invited to provide information to inform the assessment (Eco Logical Australia and Adaptive Strategies, 2015).

2.2.4.5. Tourism

A management framework was developed to assess the level of stewardship within the marine tourism industry in the Mackay-Whitsunday-Isaac Region for the 2014 pilot report card (Eco Logical Australia and Adaptive Strategies, 2015) and was utilised again this reporting year (2017/18). Commercial marine tourism activities operating in the Mackay-Whitsunday-Isaac Region include cruises and boat tours, organised diving and snorkelling, air charters and water sport operations. The industry is closely regulated, primarily in relation to access and operations within the Great Barrier Reef Marine Park and National Park islands. For the purposes of the stewardship framework, individual recreational activities and self-hire boats/yachts have been excluded, as have resorts and hotels. This

latter group is considered to be within the urban category for the purposes of stewardship evaluation (Eco Logical Australia and Adaptive Strategies, 2015).

The framework was similar to those for port, heavy industry and aquaculture so that comparisons could be made. However, given that systems for the industry are well established and there were a much larger number of operators than for other industries, it had a greater focus on certification and training and participation rates (Eco Logical Australia and Adaptive Strategies, 2015).

The tourism industry is highly reliant on the maintenance of good water quality and ecosystem health within the region. Indeed, this is often the key experience tourists are seeking as part of their participation in tourism activities. Therefore, the stewardship assessment of the tourism industry was focused on management efforts to maintain or improve the ecosystem health of marine and coastal waters.

Data collection for the 2018 report card was generated from the survey responses of six tour companies, liaison with industry representative bodies, information provided by Ecotourism Australia and a range of relevant studies and publications.

2.2.4.6. Urban

The urban stewardship framework was designed to evaluate environmental management efforts within urban environments for a range of stakeholders including councils, commercial operators and developers who develop, operate or manage urban land. This includes activities such as residential and commercial development, airports, racecourses, golf courses and tourism resorts (Eco Logical Australia and Adaptive Strategies, 2016). A new urban stewardship framework is currently being developed by the Queensland Government (Office of the Great Barrier Reef), with a pilot being undertaken within selected regional centres.

Urban development within the Mackay-Whitsunday-Isaac region is largely concentrated along the coastal zone. Urban land uses occur predominantly within cities such as Mackay and large regional centres. Several small towns are also located inland and along the coast.

The stewardship results for the 2018 report card were generated from a range of information sources, including surveys completed by companies involved in urban development, commercial airport facilities, local governments, compliance data from the DES and a range of relevant studies and publications (e.g. Council annual reports). A response rate of 80% was achieved from the companies and agencies invited to provide information to inform the assessment.

The nation-wide State of the Environment Report management effectiveness framework was used as a basis for developing the stewardship framework (summarised in Table 7; Eco Logical Australia, 2016). It captures information on management efforts to maintain or improve ecosystem health of the Great Barrier Reef. The approach was consistent with stewardship reporting for ports, heavy industry, tourism and aquaculture.

Table 7. Guiding criteria for planning, implementation and outcome themes in the Mackay-Whitsunday-Isaac stewardship framework Effectiveness rating.

Effectiveness rating	Theme	Guiding criteria
Very effective	Planning	Understanding of environmental factors affecting waterway and ecosystem health is good. Effective plans are in place for significant activities. Plans and operational procedures clearly establish management objectives for major risks. Responsibility for managing issues is clearly and appropriately allocated and there is a clear willingness to effectively manage issues.
	Implementation	Financial and staffing resources are adequate to implement plans and this is secure over the longer term. Evidence-based biophysical and socioeconomic information is available and used to inform management decisions. Well-designed management systems are being implemented to monitor or manage activities and these are regularly reviewed. Low instance of minor administrative non-compliances; zero non-compliance resulting in potential environmental harm.
	Outcome	Management responses are progressing in accordance with planned programs and are achieving their desired objectives. Targeted threats are being monitored, reported and responded to.
Effective	Planning	Understanding of environmental factors affecting water quality and ecosystem health is generally good, but there is some variability across activity. Effective plans are in place, management responsibilities are allocated appropriately and there is a willingness to effectively manage issues. Plans and operational procedures clearly establish management objectives and priorities for addressing major risks, but may not specify implementation procedures, objectives or other key elements or be reviewed on a regular basis.
	Implementation	Financial and staffing resources are mostly adequate to implement plans, but may not be secure over the longer term. Biophysical and socioeconomic information is available to inform decisions, although there may be deficiencies in some areas. Well-designed management systems are in place or under development, but are not yet being fully implemented. Low instance of non-compliances; matters resulting in potential environmental harm are temporary and responded to immediately.
	Outcome	Management responses are mostly progressing in accordance with planned programs and are achieving their desired objectives. Targeted threats are understood and there are measures in place to monitor and report.
Partially effective	Planning	Understanding of environmental factors affecting water quality and ecosystem health is only fair. Planning systems are not comprehensive and are not regularly reviewed. There may also be a lack of clarity regarding a willingness to effectively manage issues and/or a lack of clarity associated with who has management responsibility.
	Implementation	Financial and staffing resources are unable to address issues in some important areas. Biophysical and socioeconomic information is available to inform management decisions, although there are significant deficiencies in some areas. Management systems provide some guidance, but are not consistently delivering with regards to stakeholder involvement, adaptive management or reporting. Notable non-compliances resulting in potential environmental harm that are responded to immediately and effectively.

Table 7. Continued.

Effectiveness rating	Theme	Guiding criteria
Partially effective	Outcome	Management responses are progressing and showing signs of achieving some management objectives. Targeted threats are understood and measures are being developed to manage them. The expected impacts of management measures on improving resilience of environmental values are yet to be seen. Managed threats remain as significant factors influencing water quality and ecosystem health.
Not effective	Planning	Understanding of environmental factors affecting water quality and ecosystem health is poor. Planning systems have not been developed to address significant issues. Responsibilities are unclear and there is a lack of willingness to effectively manage issues.
	Implementation	Financial and staffing resources are unable to address issues in many areas. Biophysical and socioeconomic information to support decisions is deficient in many areas. Adequate management systems are not in place. Lack of consistency and integration of management across activities is a problem for many issues. Regular non-compliances; resulting in potential for environmental harm with limited response to address the issue.
	Outcome	Management responses are either not progressing in accordance with planned programs (significant delays or incomplete actions) or the actions undertaken are not achieving their objectives. Unmitigated or poorly understood threats remain as significant factors influencing water quality and ecosystem health.

A list of key activities undertaken by urban stakeholders that may influence ecosystem health and water quality was developed based on consultation with industry personnel, review of environmental authorities and industry knowledge. These activities were then a basis for the development of criteria against which the management effectiveness (i.e. stewardship) of companies or organisations could be evaluated (Eco Logical Australia and Adaptive Strategies, 2016).

2.2.4.7. Fishing

The assessment framework and methods for stewardship within the fishing industry (recreational and commercial) are being considered so that stewardship in the fishing industry can be reported in future report cards.

2.2.4.8. Community

A community stewardship assessment is being considered for stewardship. The aim of the indicator will be to measure community stewardship effort in the reporting year, possibly by local government area.

2.3. Indigenous cultural heritage

The 2018 report card presents the second assessment of the Indigenous cultural heritage indicators. Indigenous cultural heritage indicators were reported on for the first time in the 2015 report card (Golden and Chisholm 2016). Whilst the Partnership releases an annual report card on waterway health, cultural heritage assessments were identified in the Partnership's Program Design¹ to be updated every 2-3 years.

In 2018, the Partnership worked closely with the Mackay-Whitsunday-Isaac Traditional Owner Reference Group (TORG), coordinated by Reef Catchments, to undertake re-assessments of cultural heritage indicators. The findings of these assessments were ultimately reported in this year's Mackay-Whitsunday-Isaac report card. The TORG include representatives from Yuwibara, Koinjmal/Koinmerburra, Barada/Widi, and Ngara/Gia/Juru Traditional Owners of the Mackay-Whitsunday-Isaac region. Markwell and Associates were engaged as consultants to facilitate the cultural heritage report card score process.

The geographical region established for cultural heritage assessments surveys was divided into five (5) zones for the Mackay-Whitsunday-Isaac report card, which included;

Zone 1: St Helens Beach;

Zone 2: Hook Island, Whitsunday Island and South Molle Island;

Zone 3: Cape Hillsborough, incorporating Andrews Point, Wedge Island, Finlayson Point and Halliday Bay;

Zone 4: Cape Palmerston; and

Zone 5: The Mackay Region.

Four of the five zones were assessed for the 2018 report card, an improvement when compared to the 2015 report card which assessed three of the five zones. These sites included Zone 1 (2 sites), Zone 2 (4 sites), Zone 3 (9 sites) and Zone 4 (8 sites). Zone 4 (Cape Palmerston) was assessed for the first time in the 2018 report card.

2.3.1. Data collection and reporting

For the purposes of the 2018 report card, the cultural values indicators, measures and scoring system were refined, streamlined and simplified compared to the 2015 report card. The measures used in the 2018 report card provided a more balanced and culturally appropriate approach, with greater emphasis on Traditional Owner values and perspectives, than was the case during the assessment for the 2015 report card (Markwell and Associates 2019). Specifically, the methodology was amended to:

- Increase the focus of Traditional Owner perspective (stories, significance and associations) of their heritage;

¹ <https://healthyriverstoreef.org.au/report-card/program-design/>

- Apply an expanded definition of Aboriginal heritage values (sites/places/landscapes) throughout the project, which was defined and agreed by TORG members;
- Expand the quantity of sites assessed and the number of zones visited; and
- Establish “baseline” data for the sites, including GPS locations, physical condition of the site, threats to the site and management options to preserve and protect the Cultural Values of the site/location/landscape.

Whilst refinements occurred to the cultural heritage values, measures and scoring system, indicators and zoning remained the same as reported in the 2015 report card. The revised approach aligns to the emerging Indigenous Heritage program-design forming under the Reef 2050 Integrated Monitoring and Reporting Program (RIMMReP).

As representatives of the TORG, the Yuwibara Koinjmal/Koinmerburra, Barada/Widi, and Ngaro/Gia/Juru Traditional Owners had an active role in all stages of the data collection and reporting process.

For previous methods employed for cultural heritage surveys, refer to the Development of Methods for the Mackay-Whitsunday-Isaac report card Stewardship and Cultural Heritage report¹.

For the purposes of this report, the indicators for each of the zones visited were scored in the field based on the scoring system in Table 8. Broad grade/value ranges (A to E and very high to very low) in this scoring system matched those used in 2015, but attribution of + or – to letter grades was better defined in the 2018 assessments (Table 8). This did not impact reporting as the report card does not report + or – along with a letter grade.

Table 8. Scoring system for indigenous cultural heritage.

Score	Grade	Value
4.51 – 5	A	Very High
4.1 – 4.5	B+	High
3.51 – 4	B-	
3.1 – 3.5	C+	Medium
2.51 – 3	C-	
2.1 – 2.5	D+	Low
1.51 – 2	D-	
1 – 1.5	E	Very low

To arrive at each indicator score, evidence was collected from a broad range of sources, including Traditional Owner knowledge and perspectives on sites, scientific data, online resources such as the Queensland Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) register, and research.

¹ https://healthyriverstoreef.org.au/wp-content/uploads/2018/12/development-of-methods-for-the-mackay_stewardship-and-cultural-2015.pdf

2.3.2. Cultural heritage indicators

For the purposes of this assessment, indicators were developed at the zone level and enable a holistic assessment of the heritage values, sites, cultural landscape and management activities within each zone. For the purposes of this assessment, indigenous cultural heritage for each zone is assessed as a combination of five indicators:

1. Spiritual / social value of the zone;
2. Scientific/archaeological value of sites within the zone;
3. Physical condition of sites within the zone;
4. Protection of sites; and
5. Cultural maintenance activities within the zone.

Measures used for each of the indicators are presented in Table 9. For the 2018 report card, the cultural value indicators were streamlined, refined and simplified, and provided a more balanced and culturally appropriate picture, with greater emphasis on Traditional Owner values through the inclusion of a direct measure, 'Importance of site to Traditional Owners' into the Spiritual/Social value indicator (Table 9). Indicators remained the same as the 2015 report card (where cultural heritage indicators were developed and reported for the first time) with similar measures to allow for comparison across report cards.

For more information on the development of the cultural heritage indicators and methods, refer to the Development of Methods for the Mackay-Whitsunday-Isaac report card Stewardship and Cultural Heritage report¹.

¹ https://healthyriverstoreef.org.au/wp-content/uploads/2018/12/development-of-methods-for-the-mackay_stewardship-and-cultural-2015.pdf

Table 9. Cultural heritage indicators in the Mackay-Whitsunday-Isaac report card and what was measured to assess them.

Indicator	Measure
Spiritual/Social Value	Traditional Owner knowledge about the site and zone
	Importance of site to Traditional Owners
Archaeological Value	Representativeness – how well sites represent or support the story and traditional land use
	Uniqueness – how rare or distinct identified sites are
	Potential to answer research questions for Traditional Owners and archaeologists
Physical Condition	Visible impact of threats from: <ul style="list-style-type: none"> • Environment e.g. Storm surges; inundation and erosion; for art sites - fading of motifs, insect nests, water flow across art, mineral staining etc. • Animals e.g. Burrowing, trampling, animal waste • Humans e.g. Tracks, vehicles, paths, trampling, boating activities
	Impact of threats on cultural values – stability or deterioration as a result of visible impact of threats from environment, animals and humans
Protection of Sites	Registration of sites with the Queensland Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP)
	Management of threats to sites
	Control of access to sites (e.g. through boardwalks, information signage and fencing)
	No obvious threats (physical protection not needed)
Cultural Maintenance	Documented on-going management arrangements (e.g. Management Plans, Council MOUs, and QPWS MOUs etc.)
	Engaging and collaborating with stakeholders to fulfil joint cultural values aims (e.g. regular meetings, committees etc.).

2.4. Confidence associated with human dimension results

2.4.1. Social and Economic values

There is currently no method to score confidence for social and economic indices, therefore, the standard error and proportion of the population surveyed are presented with the results. The standard error was calculated for each question and then averaged for each indicator category. In the absence of a measure of accuracy for the methodology and, therefore, the results, the standard error represents the variability in survey responses. The percentage of the population surveyed was calculated based on the number of survey respondents and the number of people living within the overall reporting zone and the LGA. The population within each LGA was based on 2016 Census data (Australian Bureau of Statistics, 2016). The population, number of survey respondents within the population and calculated proportion of population surveyed are included in Table 1 of the Results for Mackay-Whitsunday-Isaac 2018 Report Card Human Dimensions Indicators.

Based on the proportion of population surveyed, the sample size was relatively small, therefore, reducing the representativeness of survey results. For example, 113 Mackay residents participated in the survey, out of a total population of 116,539 (based on 2016 Census data, Australian Bureau of Statistics). Increasing survey sizes will improve the accuracy of the data and representativeness of the results. This limitation should be acknowledged and taken into account when interpreting the results.

2.4.2. Stewardship and Indigenous cultural heritage

The results for agricultural stewardship, non-agricultural stewardship and Indigenous cultural heritage in the report card were rated in terms of the confidence based on the same methods used for other report card indicators.

For Indigenous cultural heritage reporting, the representativeness criteria was assessed by considering the number of sites recorded as part of the assessment compared to the number listed in the DATSIP register and any known but unlisted sites for the reporting zone.

2.5. Confidence methods for agricultural and non-agricultural stewardship, and Indigenous cultural heritage

A multi-criteria analysis approach was used to qualitatively score the confidence for each key indicator used in the report card. The approach enables the use of expert opinion and measured data.

A multi criteria analysis identifies the key components that contribute to a problem. These are known as criteria. Each criterion is then scored using a defined set of scoring attributes. The attributes are ranked from those that contribute weakly to the criteria to those that have a strong influence. If the criteria are seen to have different levels of importance for the problem being addressed, they can be weighted accordingly. The strengths of this approach are that it is repeatable, transparent and can include contributions from a range of sources. The weaknesses are that it can be subjective and open to manipulation.

The determination of confidence for the report card used five criteria:

- Maturity of methodology (the score is weighted half for this criterion so not to outweigh the importance of the other criteria);
- Validation;
- Representativeness;
- Directness; and
- Measured error.

Maturity of methodology

The purpose of this criterion is to show the confidence that the method/s being used are tested and accepted broadly by the scientific community. Methods must be repeatable and well documented. Maturity of methodology is not a representation of the age of the method but the stage of development. This score is weighted half for this criterion so as not to outweigh the importance of the other criteria. It is expected that all methods used would be robust, repeatable and defensible.

Validation

The purpose of this criterion is to show the proximity of the indicator being measured to the indicators reported. The use of proxies is scored lower than direct measures. The reason for this criterion is to minimise compounded error.

Representativeness

The purpose of this criterion is to show the confidence in the representativeness of monitoring/data to adequately report against relevant targets. This criterion takes into consideration the spatial and temporal resolution of the data as well as the sample size.

Directness

This criterion is similar to “validation” but instead of looking at the proximity of the indicator, the criterion looks at the confidence in the relationship between the monitoring and the indicators being reported against.

Measured error

The purpose of this criterion is to incorporate uncertainty (as defined above) into the metric and use any quantitative data where it exists.

2.6. Confidence Scoring

For all indicators where a condition score was reported, each criterion is scored 1 (lowest) to 3 (highest) as defined in Table 10.

For Indigenous cultural heritage reporting, the representativeness criteria were assessed by considering the number of sites recorded as part of the assessment, compared to the number listed in the DATSIP register and any known but unlisted sites for the reporting zone.

Once each criterion is scored, these scores are added together and an overall ranking for confidence for each indicator is provided (Table 10). How confidence is presented in the report card is provided in Table 11.

Table 10. Scoring matrix for each criteria used to assess confidence.

Maturity of methodology (weighting 0.5)	Validation	Representativeness	Directness	Measured error
Score = 1 New or experimental methodology	Score = 1 Limited Remote sensed data with no or limited ground truthing or Modelling with no ground truthing or Survey with no ground truthing	Score = 1 Low 1:1,000,000 or Less than 10% of population survey data	Score = 1 Conceptual Measurement of data that have conceptual relationship to reported indicator	Score = 1 Greater than 25% error or limited to no measurement of error or error not able to be quantified
Score = 2 Developed Peer reviewed method	Score = 2 Not comprehensive Remote sensed data with regular ground truthing (not comprehensive) or Modelling with documented validation (not comprehensive) or Survey with ground-truthing (not comprehensive)	Score = 2 Moderate 1:100,000 or 10%-30% of population survey data	Score = 2 Indirect Measurement of data that have a quantifiable relationship to reported indicators	Score = 2 Less than 25% error or some components do not have error quantified
Score = 3 Established methodology in published paper	Score = 3 Comprehensive Remote sensed data with comprehensive validation program supporting (statistical error measured) or Modelling with comprehensive validation and supporting documentation or Survey with extensive on ground validation or directly measured data	Score = 3 High 1:10,000 or 30-50% of population	Score = 3 Direct Direct measurement of reported indicator with error	Score = 3 10% error and all components have errors quantified

Table 11. Overall confidence score, associated ranking and how ranking is displayed in the report card.

2015 Confidence Score Categories	Ranking	Display
≥12 = five bars ranking	Five dots	<div>High</div> <div>●●●●●</div> <div>●●●●○</div> <div>●●●○○</div> <div>●●○○○</div> <div>Low</div> <div>●○○○○</div>
10 to 11.5 = four bars ranking	Four dots	
8.5 to 9.5 = three bars ranking	Three dots	
6.5 to 8 = two bars ranking	Two dots	
≤6 = one bar ranking	One dot	

References

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