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**Great Barrier Reef
Marine Park Authority**

The rapid assessment workshop to elicit expert consensus to inform the development of the

Great Barrier Reef
Outlook Report
2019

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Acknowledgements

We acknowledge the Traditional Owners of the Great Barrier Reef and pay our respects to their elders, past, present and emerging.

We also gratefully acknowledge the time and effort given by workshop participants, including for preparation, attendance and post-workshop follow up.

Summary

The Outlook consensus workshop was organised and convened by the Great Barrier Reef Marine Park Authority (GBRMPA) in Townsville on 28 May to 1 June 2018. The objective of the workshop and surrounding process was to secure an independent set of expert judgements about condition, trends and risks in the Great Barrier Reef Region[1] that could be used to inform GBRMPA's preparation of the 2019 Great Barrier Reef Outlook Report.

The workshop involved 45 experts from the 107 invited (40 attended the workshop and an additional five submitted their opinion as a set of score sheets prior to the workshop), selected because of expertise across a range of the types of issues that assessed and graded, their long-standing experience of field work in the Region and their independence from GBRMPA. The workshop outcomes reflect the combined and consensus judgement of these experts. The workshop was conducted and moderated by Terry Harper, an external facilitator independent of GBRMPA with extensive experience in management of the Great Barrier Reef and facilitation of performance assessment processes.

The five-day workshop process (four days for natural heritage values and risks, and one day for cultural and historic heritage values and risks) involved anonymous voting on the condition, trends and risks relating to the Great Barrier Reef Region. The voting procedures were conducted using a pre-set decision structure derived from the Great Barrier Reef Outlook Report 2009, and within a specified set of assumptions and guidance. This report has been prepared to summarise the outcomes and to document the process, constraints and guidance provided to workshop participants within which the findings should be interpreted. For continuity, this report followed the same process and has updated the findings previously prepared and reported by Trevor Ward, who facilitated the consensus workshop for the 2014 Outlook Report.

Condition and trend scores based on the assessment of 'Most' for each individual natural heritage and cultural heritage component have been aggregated into nine 'summary components'. The metric 'Most' represents the full distribution of the assessed component i.e. including the Best 10% and the Worst 10% but leaving out the absolute best or worst outlying examples. Results for each summary component are outlined in the report including a list of the individual components, a brief statement of results and graphs for condition and trend. Additional information on condition, trend and confidence scores are provided in the report and the complete set of scores has been placed into a spreadsheet format for analysis in this report, and for archiving by GBRMPA.

The workshop outcomes confirm the extent and breadth of opinion held in the scientific community about a number of issues in the Region. A key outcome is confirmation that the condition of a substantial number of natural and cultural heritage values of the Region were considered to be substantially degraded compared to their expected condition if there had been no human influence. Human influence and hence impacts are continuing and are considered to be resulting in a broad trend of continuing but variable declines in biodiversity, heritage values and ecosystem health in the Region. The trend of decline since 2014 is evidenced by the greater number of components considered to be deteriorated compared to the number that are stable or improved. This deterioration relates to the dominant risks—impacts of climate change, coastal development, land-based run-off, and some direct extraction of resources, including fishing.

The findings provide a strong basis for the development of evidence-based grades to inform a robust 2019 Outlook Report, which is the intended use of the outcomes of this workshop. For sessions where few experts were available to attend, the Outlook team will actively seek out additional expert input to strengthen confidence in the final assessment scores for those components used in Outlook 2019.

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[1] The Great Barrier Reef Region encompasses the Great Barrier Reef Marine Park as well as the areas around major ports.

This workshop considered several improvements recommended by the 2014 Outlook consensus workshop including:

- Providing the option of an expert briefing at the start of each session (agreed to trial for 2018 workshop).
- Changing the smoothing process inferred by a single grade at the regional scale (established assessment methods to be retained (no change).
- Introducing confidence scores for risk assessment (established assessment methods to be retained (no change).
- Providing additional time for assessments (workshop extended from 3 days to 5 days and included heritage component).

Workshop participants provided important feedback about the process and offered a number of constructive comments about any future such workshops. Participants were keen to qualify many of their responses by acknowledging the high degree of variability across the region and lack of concrete data on which to base an accurate assessment/ professional judgement.

There was considerable discussion about the relative merit of maintaining consistency of methods with previous Outlook workshops. Given the high variability in participant representation for each consensus workshop (2009, 2014, 2019 etc.), the prevailing view was that the potential for improved rigour through continuous refinement of workshop methods probably outweighed the benefits of apparent consistency of methods between workshops.

The risk analysis process involved considerable discussion to clarify the parameters and thought processes that needed to be considered. As in 2014, there was a suggestion that an assessment of confidence for each risk score would be beneficial and several participants asked that a caveat be placed on the results to recognise the high level of uncertainty involved in their assessment.

Three new risks relevant to Indigenous heritage values were proposed by experts to be considered for inclusion.

Overall, the participants were highly supportive of the workshop process and the outcomes, with more than 70 per cent of votes assigned to scores of 6 or more (agreement to strong agreement with all the statements posed) for the 8 post-workshop evaluation questions. This provides a strong basis for GBRMPA to utilise the outcomes of this workshop to support development of the 2019 Outlook Report.

Contents

Background

The Great Barrier Reef Outlook Report is focused on the Great Barrier Reef Region (Region) as defined in the *Great Barrier Reef Marine Park Act 1975*. The Region's boundaries match those of the Great Barrier Reef Marine Park (Marine Park), except that the Region also includes designated areas around major ports. The [*Great Barrier Reef Outlook Report 2009*](#) and [Great Barrier Reef Outlook Report 2014](#) (hereafter 2009 Outlook Report and 2014 Outlook Report) assessed all parts of the ecosystem within the Region, from mangroves and seagrass meadows to fish, coral reefs and the open ocean; these components of the natural marine system are collectively referred to as the Great Barrier Reef ecosystem. Where relevant, the report also looked beyond the boundaries of the Region and included information about adjacent islands (irrespective of tenure), the Catchment adjacent to the Region to the extent that it is connected to, supports and influences the values in the Region.

The Outlook Report is structured around nine assessments required by the *Great Barrier Reef Marine Park Act 1975* and *Regulations 1983* (section 116A(2) heritage values), with each forming a chapter of the report:

Extract from the *Great Barrier Reef Marine Park Act 1975*:

> *Content of report*
>
> (3) The report must contain the following matters:
>   (a) an assessment of the current health of the ecosystem within the Great Barrier Reef Region and of the ecosystem outside that region to the extent it affects that region;
>   (b) an assessment of the current biodiversity within that region;
>   (c) an assessment of the commercial and non-commercial use of that region;
>   (d) an assessment of the risks to the ecosystem within that region;
>   (e) an assessment of the current resilience of the ecosystem within that region;
>   (f) an assessment of the existing measures to protect and manage the ecosystem within that region;
>   (g) an assessment of the factors influencing the current and projected future environmental, economic and social values of that region;
>   (h) an assessment of the long-term outlook for the ecosystem within that region;
>   (i) any other matter prescribed by the regulations for the purposes of this paragraph.
>
> Extract from the Great Barrier Reef Marine Park Regulations 1983 – amended in 2013
> (2) An assessment of the heritage values, of the Great Barrier Reef Region, includes the following:
>   (a) an assessment of the current heritage values of the region;
>   (b) an assessment of the risks to the heritage values of the region;
>   (c) an assessment of the current resilience of the heritage values of the region;
>   (d) an assessment of the existing measures to protect and manage the heritage values of the region;
>   (e) an assessment of the factors influencing the current and projected future heritage values of the region;
>   (f) an assessment of the long‑term outlook for the heritage values of the region.

Following legislative amendment (specified above) the 2014 Outlook Report included an assessment of heritage values, which was not within scope of the assessment in 2009. Given the late stage of the amendment the assessment was conducted internally by GBRMPA and not considered by the 2014 Outlook consensus workshop. The 2019 Outlook consensus workshop was extended from 3 days to five and included a full day for consideration of heritage values

(Day 5). As in 2014, the 2019 Outlook Report will include a standalone chapter assessing heritage values within the Region, recognising that natural heritage values discussed in Chapters 2 and 3 also form part of overarching heritage values for the Region. In particular many cultural practices include plants, animals and the environment, making culture inseparable from natural values and cultural identity.

For each assessment in the 2009 Outlook Report and 2014 Outlook Report a set of assessment criteria (comprising one or more components) were considered, allowing an ordered analysis of the available evidence. For each criterion, grading statements guided the allocation of a 'grade of best fit'. A qualitative grading system was considered appropriate as it allowed a wide range of evidence and knowledge to be collectively assessed when assigning each grade. More quantitative approaches were impractical given the scope of the assessment area (the entire Region), the time available, the amount of evidence available, the lack of analytical resources and the variety of components to be assessed. Four grading options (Very Good, Good, Poor, Very Poor) precluded the natural tendency to 'sit on the fence' and allocate an intermediate or neutral grade. The 2009 Outlook Report and 2014 Outlook Report included a summary of each assessment at the end of each chapter together with the grades allocated. Essentially the same process will be used to develop the 2019 Outlook Report.

The Australia State of the Environment 2011 used a refinement of the 2009 Outlook Report method and, in addition, included trend information and confidence in scores information for each assessment component. This method was in turn adapted for use in the Great Barrier Reef Region Strategic Assessment undertaken by GBRMPA in 2012–13. The 2019 Outlook Report must be submitted to the Minister for the Environment and Energy by 30 June 2019.

The expert consensus workshop

This workshop was designed as an expert elicitation to consult a range of scientific experts and establish a consensus on the conditions, trends and risks in the Region. The consultation and workshop process has been adapted from the approach and decision model established for the assessment and reporting of Australia's national marine environment (Australia State of the Environment 2011) and applied internationally for aspects of the United Nations Environment Program (UNEP) World Ocean Assessment). The focus of this workshop is on achieving a consensus of independent scientific experts on the biodiversity, ecosystem health, heritage values and potential risks in the Region.

Consensus was defined for workshop participants as "a generally accepted opinion or decision among a group of people". This working definition does not require all people to agree to a single proposition, instead it represents the prevailing or 'generally accepted views' of the group. Divergent views were recorded as part of the assessment process and will be reflected in the commentary included in the 2019 Outlook Report.

Great care was taken to maintain consistency in methods between Outlook 2009, 2014 and 2019. Accordingly, a principle of 'minimum change' (no wordsmithing) and a willingness to accept the inherent limitations of the initial methodology was promoted by the facilitator at the workshop. Suggested improvements to the methodology are discussed at the end of this report.

Over 100 experts were invited by GBRMPA to attend the workshop and participate in the elicitation process based primarily on their discipline expertise and their direct experience with, and conduct of, scientific research and monitoring in the Region. Experts were selected to provide discipline expertise to cover the breadth of the issues expected to be addressed by the workshop and elicitation process. Due to availability of experts, 45 participants were able to participate in at least one session of the workshop (either in person, by phone or remotely).

The outcomes from the workshop will be used to inform the development of the Great Barrier Reef Outlook Report 2019 and will contribute to a broader understanding of the issues and risks to the Region.

To assist the experts attending the workshop, GBRMPA provided a draft assessment summary of the condition, trends and risks developed from the 2009 and 2014 Outlook Reports and updates to reflect the most recent knowledge (based on a preliminary review of available literature and data) of the Region and activities that occur within or adjacent to the Region. Workshop participants were provided this draft material for their information; it was not intended that this should influence their assessments at the workshop other than to provide a starting point for discussion and prompt additional background information they may wish to draw upon in forming their independent conclusions and consensus.

The workshop was managed by an independent facilitator (Terry Harper, TerraFormDesign) with oversight and control of the process, to ensure that independence and robustness of the outcomes were maintained. The consensus workshop focused on four assessments that were considered in two parts. Part one (days 1-4) dealt with biodiversity, ecosystem health and risks to the Region while Part two (day 5) dealt with heritage values and risks.

Several GBRMPA staff from the Outlook Report team attended each day of the workshop. Their role was to:
- Observe the process (to ensure independence and transparency).
- Support data capture including use of the scoring software package and recording of participant comments.
- Provide technical clarifications about the Outlook Report or background information provided to participants
- Assist with workshop logistics

GBRMPA staff did not participate in any assessment of the conditions, trends and risks in the Region during the workshop and did not attempt to influence experts' views on grades. They did participate in discussions about the most recent scientific information and sought advice from participants on additional data, useful case studies or vignettes for potential inclusion in the Outlook Report narrative.

Prior to the workshop, the idea of combining input from external and internal experts at the heritage values (part two) sessions of the workshop was considered due to the lower overall numbers of attendees of heritage experts. However, in the interests of consistency it was decided to limit participation for all workshop components to external participants only.

Where the 2009 version of the Outlook Report had no precedent for the Great Barrier Reef Region, the 2014 Outlook Report and 2019 Outlook Report incrementally build on the processes and outputs from preceding assessments. Grading statements and the assessment structure largely followed those used for the Strategic Assessment and Outlook Report 2014 which were, in turn, adapted from the 2009 Outlook Report and the national State of Environment process. Following development of Outlook 2019 there may be value in reviewing the methodology (including the components assessed) to ensure it remains contemporary.

Workshop approach

Real-time assessment

Scores and grades were assigned to the assessment components using a system of real-time anonymous voting by the individual experts, facilitated by the [Turning Point](#) software, with near real-time feedback. Each scoring question was posed to the workshop as a group after a brief statement about the question to bound the matters being addressed, and to identify the major elements of relevant knowledge/experience. An opportunity was provided for subject experts in attendance to make brief remarks about the state of scientific knowledge and other critical considerations for each component.

After some discussion it was agreed that workshop participants should focus first on ensuring that the summary statement provided by GBRMPA was a fair reflection of the issues and current state of knowledge about the component (based on the professional knowledge of workshop participants). Where there was disagreement on the draft summary, or additional information that should be incorporated this was raised and recorded. Participants were encouraged to speak up and share their views on individual grading statements prior to opening the polling process using the appropriate grading statement for that component. The decision to allow content experts to provide introductory remarks and provide examples of the 'best 10%', 'worst 10%' and 'most' against each component was introduced based on the recommendation from Outlook 2014 and widely considered by participants to be an improvement.

A short period was then allocated for individual scoring (polling/voting), and then the group scores were tallied and displayed. Several participants contributed remote scores for some components, prior to the workshop. During the workshop a member of the Outlook team acted as proxy for these participants and submitted their scores using the electronic polling pads (the voting scores were viewed by the independent facilitator prior to the workshop).

Any unusual patterns or issues raised by the facilitator or the experts were briefly discussed, and if absolutely necessary the question was re-polled before archiving as the group consensus decision (noting that a range of scores was acceptable given the working definition of consensus used for this workshop). A repoll was conducted only where there was a technical issue (e.g. poll button not working, wrong button pressed; a change of mind was not sufficient reason to repoll). Digital photos were taken of each poll result as a secondary backup in case of software failure or operator error.

An A3 sized placemat summarising key aspects of the assessment methodology was printed and available for each participant to use as reference during the workshop. The relevant condition score indicators were highlighted at the beginning of each component to help focus participant's attention on the component and scope under consideration. This was an effective strategy that should be considered for future Outlook assessments.

During the first session of the workshop it was resolved that participants should respond to all questions relating to an individual component (i.e. participants who assessed condition and trend should also provide an assessment of confidence in the grades given). On several occasions re-polls were undertaken to maintain consistent participation across all questions for a component.

At the commencement of the workshop the potential for unweighted voting bias (i.e. where less well qualified participants have the same vote value as highly qualified participants) was raised. In response, the group agreed that if an individual participant felt unqualified to contribute (for example if this was their first professional discussion about the topic and their relatively 'uninformed vote' might undermine the integrity of Outlook 2019), then they should abstain from the polling process for that value/component being assessed.

It was agreed that a formal quorum (i.e. minimum number of votes) was not required for the assessment of each component. However, the participation rate (measured as the proportion of

workshop participants at the main table actively engaging in the polling process) would be considered when writing the narrative for Outlook 2019, especially in relation to the confidence level for the assessment of each component. While the polling participation rate was lower than in 2014, the capacity to abstain from voting was greatly appreciated by many participants where they felt unqualified to offer an expert judgement. Participant feedback suggested this increased perceived credibility for the process. It should also be noted that the polling results contribute to the final grade, trend and confidence. They are not the final result, particularly for components where data is deficient or there was limited expert input. Additional evidence will be sought following the workshop to strengthen confidence and certainty in the grades.

An attendance register was completed for each session and participants were advised that if they were sitting at the main table at any stage during the session (rather than at the quiet working table set up at the back of the room) they would be counted as actively engaged in the workshop for that session. The number of voters was recorded for each poll and is shown in the results table. There were several components for which only one or no experts were available to participate with an appropriate level of confidence. These topics included forested floodplains, heath and shrublands, grass and sedgelands, woodlands and forests, rainforests, and shoals. Low levels of polling (high levels of abstinence) will be used as a flag for the Outlook team to actively seek out additional expert input to strengthen confidence in the final assessment scores for those components. A minimum of three polls was discussed and recommended as a working threshold for seeking additional external input for an individual component. Unlike for 2014, post-workshop focused discussions and remote anonymous re-polling (by email), managed by the facilitator, was not considered necessary.

The role of each expert in this process

Background materials were distributed to help inform discussions during the workshop. Participants were invited to attend and contribute to the workshop but if they could not actually attend they were invited to provide input prior to the workshop. All participants were asked to:

Pre-workshop
- Sign a non-disclosure agreement so that background material could be sent to each participant.
- Review the draft condition and trend scores and summary statements for biodiversity and ecosystem health assessment components and heritage values.
- Review the description of risks to be assessed.
- Particularly where participants disagreed with a draft score, assemble robust information and if possible provide references for points of discussion.
- For participants that could not be at the workshop but wished to have input, they were to email this information to the independent facilitator and the Outlook team prior to the workshop for inclusion in discussions.
- Provide feedback if there were any concerns with the methodology being used including grading statements and benchmarks (see methodology).

During the workshop
- Share expert knowledge about the state of scientific knowledge and other critical considerations relevant to each assessment.
- Consider and make an informed judgement at the workshop based on the scientific and other relevant knowledge about each scoring question.
- Provide judgements that best represent professional personal opinion, not an institutional position (in the case where that may be different, and recognising that polling was anonymous).
- Provide examples that best represent the underlying data/knowledge to support the score assigned, for annotation in Outlook Report 2019.
- Contribute positively to any discussion about issues and questions that arise during the workshop.

After the workshop
- Provide additional information (e.g. emerging research papers, potential case studies or other experts who could provide useful commentary on the components being assessed).

Workshop timeframe

The timeframe considering each component, voting and achieving consensus was brief. The process was designed as a rapid assessment, for completion within 4 weeks of the workshop. The workshop itself was a full five-day event, with the assessment of biodiversity and ecosystem health and risks considered on the first four days, and heritage values and risks on the last day. The timeframes for the independent consensus process is shown in Table 1.

Table 1. Timeframe for the independent consensus process

Date	Milestone
28 May–1 June 2018	Workshops (for natural and heritage values) held
By 31 July 2018	Workshop Report prepared for GBRMPA
Second half 2018	Workshop outputs inform drafting of 2019 Outlook Report
First half 2019	Draft 2019 Outlook Report finalised and peer reviewed
By 30 June 2019	Final 2019 Outlook Report submitted to Minister for tabling in Parliament (unchanged)
Second half 2019	2019 Outlook Report and Consensus Workshop Report publicly available

Remote input

For those scientific experts who could only attend part of the workshop in person, but wished to remain as party to the outcomes, and where an expert could not attend at all, the following provisions were applied:
1. During the workshop a member of the Outlook team acted as proxy for these participants and submitted their scores using the electronic polling pads (the voting scores were viewed by the independent facilitator prior to the workshop). This facility was established prior to the workshop with each intended vote provided in writing to the facilitator prior to the workshop for anonymous contribution to the poll on that question.
2. Consistent with the approach taken in 2014, where this vote was part of a contested score, or a re-poll, it was to be removed from the re-poll at the facilitator's discretion, or at any subsequent part of the iterative process at the workshop (because the absent expert could not modify their vote based on the new information available to workshop participants). There were no circumstances where this occurred during the workshop.
3. Experts who had mainly remote input under this provision were identified and acknowledged in the attendance register separately from those who attended the full workshop process.

Decision approach

The consensus workshop (and the supporting remote process) assessed the condition and trends of 53 biodiversity and ecosystem health components of the Region (Table 2) and the risks to biodiversity (41 threats and potential impacts) (Part one of the workshop) and 8 components for heritage values and risks to those values (Part two of the workshop). The outcome is a broadly-based expert consensus on condition and trends, and an assessment of risks, to assist with the development of the 2019 Outlook Report by GBRMPA. This includes experts with a range of experience and expertise and, for many of the components considered, involved the pre-eminent regional experts, as well as scientists with long experience in the Region and scientists who are currently active in many relevant research fields.

Determining condition and trends

In this consensus workshop, the assessment of *condition* and *trend* is based on securing expert judgement on a set of components that adequately represent the biodiversity and the ecosystem health of the Region and heritage values. These components are hierarchically arranged within the values of biodiversity and ecosystem health (Table 2) and heritage values (Table 3). The assessment required scores and grades to be assigned to indicators of both condition and trend for each component, followed by an estimate of confidence in assigning those scores and grades.

Table 2. Biodiversity and ecosystem health of the Region assessed for condition, trend and confidence in the consensus workshop and remote process

Assessment	Assessment criteria	No. of components
Biodiversity	Habitats to support species	10
	Species populations or groups of species	16
Ecosystem health	Physical processes	7
	Chemical processes	3
	Ecological processes	10
	Outbreaks of disease, introduced species and pest species	4
	Terrestrial habitats that support the Great Barrier Reef	7
	Total	57

Table 3 Heritage values of the Region assessed for condition, trend and confidence in the consensus workshop and remote process

Assessment	Assessment criteria	No. of components
Heritage	Indigenous heritage values	4
	Historic heritage values	4
	Total	8

Determining risks

Risks were resolved into four grades based on the five-point grading scale of Likelihood and Consequence, as adopted in the 2009 and 2014 Outlook Reports and consistent with the widely adopted Australian Standard for Risk Assessment. Threats were assessed at both scales, region-wide and local and were grouped into one of four themes following Chapter 6 of the Outlook Report 'Factors influencing the Region's values'. The definitions for each grade of the Likelihood and Consequence, and the aggregation structure (adapted from the 2009 and 2014 Outlook Reports) were provided prior to the workshop to guide participants in their voting decisions (Appendix 2). The risks assigned were those that are current and remain in place even

though there may be a range of management measures and activities underway; hence, the risks reported here are 'residual' risks—those expected to remain after considering current management arrangements. When considering current management arrangements, participants were instructed not to consider policies, strategies and programs that are under development or not yet implemented. Issues relating to the risk assessment process are canvassed at the end of this report.

Workshop process

Indicators

For each component of natural and heritage values a condition and trend score was assigned to each of three metrics: the Best10%, Most, and Worst10% representation of the component (Figure 1). The exact meaning of each of these depends on the specific component being assessed, but broadly is used in the sense of a frequency distribution of scores across a spatial or other relevant gradient. So, for example, in assessing the habitat 'mangrove forests', for the Best10% metric, a score was assigned that reflects the expert's judgement about condition of mangrove forests in the best 10 per cent of the places (or area) where they occur across the Region—conceptually, this would be represented by the 90 per cent score on a frequency distribution of condition quality scores across individual areas/forests of the Region. Similarly, the Worst10% represents the 10 per cent score on the same distribution. 'Most' represents the modal (most frequently occurring) grade (adding the number of votes for scores within each grade) of the full distribution (i.e. including the Best 10% and the Worst 10% but leaving out the absolute best or worst outlying examples).
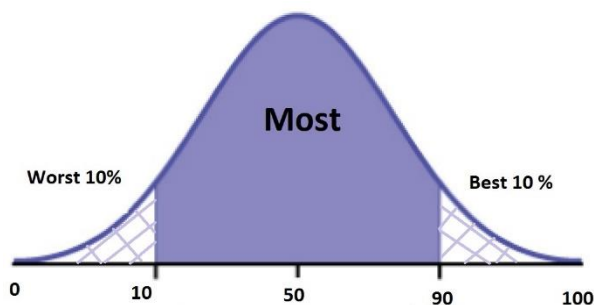
Figure 1 Distribution of Worst10%, Most and Best10% of assessed components.

The metrics therefore comprised these reporting quantities: 'Most places', 'Worst 10% places' and 'Best 10% places' for condition. For trend, the result could be one of four categories: Improved, Stable, Deteriorated, or no clear trend estimated as changes that have occurred over the last five years (since the 2014 Outlook Report). For grades and trends associated with the Most score, experts were asked to apply their judgement at the scale of the whole Region, and not be overly influenced by small areas of very good or very bad condition, or small areas where changes are very great, but always relative to the historical or potential spatial distribution of the component being assessed. So, for example, if one habitat type (say *Halimeda* beds) only occurs in a proportion of the Region, then the assessment of condition and trend applies to the area occupied (either presently, historically, or potentially), to avoid an area-bias that would otherwise apply to small but important habitat types.

For species groups, the assignment of condition and trend in the worst–best metric gradient was based on the number of species that constituted the condition quality—for example, in the sharks and rays group, the condition score assigned to the Worst10% metric represents the condition score assigned to 10 per cent of the species considered to be in the worst condition. For crocodiles and dugongs (the only species-specific groups assessed in this workshop), the assessment of condition and trend applies spatially, to populations or subgroups of these animals.

Scoring and grading

Condition

At the workshop, scores were assigned (by anonymous voting) to each indicator on a scale from 0 to 10, where 0 is consistent with the weakest level of performance or achievement of the grading criterion (Appendix 1), and 10 is the strongest or highest level of achievement. As in previous workshops, scores of zero needed to be recorded manually and inserted later into the workshop scoring record, because of a limitation in the Turning Point equipment (a zero score could not be recorded by the Turning Point hardware used here for anonymous voting because of a limit on numbers available for scoring). Participants were instructed to use zero in only extreme circumstances, for example, where a species has become extinct or the value being assessed is no longer present. There were no zero scores recorded in the workshop.

The grades are coarse levels of condition performance/achievement used for reporting purposes at the indicator level: Very Poor, Poor, Good, and Very Good. These were used in navigating towards a consensus score, constructed within the linear scale of >0 to 10 using thresholds of 2.5, 5, and 7.5 for the four categories of condition.

The voting system employed in this workshop used only whole integers, and at each of the specific thresholds, an integer score at the threshold is assigned to the lower grade (Figure 2). Scores of 5 were therefore assigned to Poor. If a score of zero was recorded it would fall below the Very Poor grade and, if it was the consensus, further consideration of how it is represented in Outlook Reports would be needed. Figure 2 was refined after the 2014 Outlook Report to more clearly show the break points between condition class scores (at 2.5, 5, 7.5, and 10) and adopt consistent colours throughout Outlook related documentation.
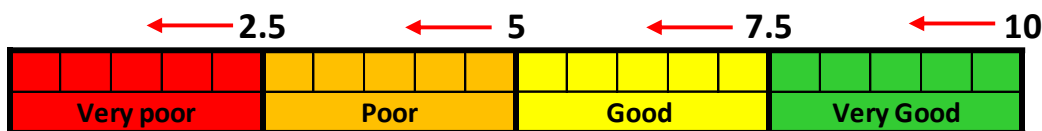
Figure 2 Scoring and grading scales for the consensus workshop

Trend

Trends related to the immediately previous five-year period, notionally the interval between the 2014 Outlook Report and the 2019 Outlook Report. The trend in each component was assigned to Best10%, Most and Worst10% within the four grades that relate to condition quality: Improved, Stable, Deteriorated, or No Clear Trend (no data/information; not enough information to determine a trend; or highly variable and/or conflicting trends across the Region or sub-components).

Because the trend score used the previous Outlook Report condition as the baseline, if workshop participants deemed this baseline to be inaccurate in retrospect (because of improved information gathered during the intervening 5-year period), they were instructed to voice their concerns for potential consideration in preparing Outlook 2019, which was recorded.

Confidence

There were only limited data available for many components, but the condition scores and trend grades were assigned using best judgement of the scientific experts. The confidence assigned to the condition and trend grades was represented by one of the four confidence grades: High, Medium, Low or Unknown/No Score.

A *High* confidence grade was assigned when the score was considered to be based on information/evidence that was of an adequately high quality for assigning condition and trends at the level of resolution required by the grading statements (i.e. the four grades). Evidence was considered adequate for this purpose if it was sufficiently accurate and precise that, even if considerable further data/information became available (such as from a major program of

research focused on the specific question of condition quality), then the expert's personal judgement was that it would be unlikely that the true score would lie outside the range of a single grade, with about 95 per cent confidence.

So, for example, condition of mangrove forests across the Region was estimated to be Good by a consensus of the experts contributing to the workshop using the grading statements for habitats and was assigned with a confidence of *Medium* (limited evidence is available or there is a limited scientific consensus). This infers that it was considered by the experts that even if considerably better knowledge was to be developed about the conditions of mangrove forests, the true score would be highly unlikely to change by more than one grade (a confidence band of two grades) from the assigned grade of Good.

Similarly, the band of uncertainty for *High* confidence is one grade, inferring that the true value of the score is highly unlikely to fall outside the grade assigned to the nominated score; and for *Low* the uncertainty band is three grades. Confidence less than this level (i.e. a score cannot be assigned within confidence of three grades or better) is too low to score, and in these circumstances no score for condition and no confidence grades were assigned.

Risks

Risks were assessed for the current situation and as are expected to apply in the immediate future (notionally within the next five years). The consequences of a factor that may affect the environment during this period were estimated by comparison with the current condition of the environment (notionally estimated as the condition prevailing over the past five years). The frequency and timeframe of factors contributing to an assigned risk grade is embedded in the definitions for the classes of likelihood. The classes of consequence are established based on the effects of the risk factors on ecological and ecosystem receptors, such as those described in the grading statements for condition and trend of habitats and species, combined with their spatial and temporal impacts relative to the current condition. Voting for categories of likelihood and consequence was conducted in the same manner as for condition and trend. As in 2014, confidence was not recorded for risk scores.

Aggregation of scores

Individual components

Condition: for each component indicator, the highest number of votes (mode) in each of the four grades (from the final poll if a re-poll was taken) was used to assign a grade to the three metrics for each indicator (i.e. 'Most places', 'Worst 10% places' and 'Best 10% places'). While there are only two integer numeric scores (6, 7) available for 'Good' in this scoring system, and three for each of the other grades, this potential bias was minimised by ensuring that participants navigated to a score by first identifying a grade (Very Poor, Poor, Good, Very Good), then assigning a score (from 0 to 10) within that grade for polling. The consensus outcome (i.e. the most commonly voted grade) for the 'Most' metric will be used to inform the 2019 Outlook Report condition grade for the component. The Best10% and Worst10% consensus grades determined here are used to identify specific examples of performance issues and provide context for descriptions of the spatial distribution of condition (for potential discussion in 2019 Outlook Report).

Trend: for each component indicator, the highest number of votes (mode) (from the final re-poll when that was needed) was used to assign a trend grade to that indicator. As for condition, the trend in the 'Most' metric will inform the overall grade for the component in the 2019 Outlook Report, with the Best10% and Worst10% grades used to identify specific examples of performance issues and provide context for descriptions of the spatial distribution of trend.

Confidence: for each component, the highest number of votes (mode) was used to identify the level of confidence assigned to both condition and trend grades. GBRMPA will use this

information when considering the final confidence assigned to the grades for each component in the 2019 Outlook Report.

Risk: Likelihood and Consequence (definitions provided in Appendix 1) were assigned using the highest number of votes. Where this resulted in a tie and more than a single grade was assigned in Likelihood or Consequence and more than a single risk grade resulted, this was preserved and carried through to the final risk assignment.

Aggregation of components

Condition, Trend, Confidence: the condition grade for an aggregated parameter (for example, the components of habitats of the Region all combined into a single set of estimates for the aggregate condition of habitats to support species) was determined by the highest number of votes for a grade across the individual components. Ties were not resolved, and the range was carried through to the outcomes.

Grading criteria statements

The grading statements (Appendix 1) were uniquely derived for each group of the assessment components to represent and best meet the requirements of the Act for maintaining the structure and function of the Region's ecosystems. The grading statements provided experts with the specific criteria and guidance about the thresholds to use in determining first a grade and then a score that is consistent with their knowledge of the data and information, and best represents their judgement at the indicator level of the decision model.

Benchmarks

The score/grade assigned to an indicator is formed by the experts based on relativity to a benchmark or point of reference. For this assessment, and to best meet the requirements of the Act, experts were asked to form their judgement about current condition and trends relative to the condition that would have been expected to prevail if there had been no influence of post-European settlement human activity. This broadly represents the condition in the absence of human uses or exploitation and can be considered to best represent a relatively natural set of conditions perhaps only slightly impacted by pre-European settlement human activities.

The use of a 'natural conditions' benchmark here should not be confused with the setting of a target or an objective for current management systems to achieve. The benchmark is used here for 'anchoring' the scoring and grading system to a common point of reference that relates to all components that are assessed across the Region.

The use of the 'natural conditions' benchmark is a critical aspect of condition assessment, as it is only in this way that actual 'distance' of the current system from a natural and 'undisturbed' system can be estimated. Estimates of this distance provide a point of reference that is common across the condition of all components and enables a consistent form of evaluation of the different components within a single assessment framework. Such evaluations are central to the design of efficient and effective management to maintain or recover natural ecosystem structure and function, to avoid sliding baselines in long-term management systems, and to enable robust prioritisation of investment strategies for management systems that address these issues.

Using pre-European disturbance as the natural condition base line was considered by workshop participants to be most useful for species and habitats but problematic when considering ecosystem processes such as nutrient cycling, sedimentation, ocean acidification, and competition. This concern was especially strong where a large number of factors needed to be considered under a single component (i.e. 'other invertebrates' required an assessment of an estimated 8000 species). Several ethical and philosophical concerns were raised during the heritage session (Part two) of the workshop and are addressed at the end of this report.

Elicitation bias

The assessment process used in this workshop is potentially subject to a number of sources of bias. These include such matters as a limited representation of the extant knowledge base at the workshop (including insufficient experts in attendance), and the other forms of bias always inherent in a Delphi-style rapid assessment process. The most important aspect of this matter is recognising the type and extent of bias that may apply, and where any aspect may be important (taking account of the coarse resolution of the overall process), the existence of such bias should be addressed in the workshop and documented in the workshop outcome.

The preamble to the workshop process briefly discussed the main types of individual and group bias that could affect the process. The main bias thought to potentially influence the workshop outcomes was the advance provision of the GBRMPA assessment of the same components that were being assessed in the workshop. The attention of all participants was drawn to this potential for 'anchoring' bias, so that it could be avoided. The workshop was advised that if any other forms of bias were suspected, they should be brought to the attention of the facilitator as soon as possible for corrective action. Several other potential sources of bias are addressed at the end of this report.

Recognition and use of information

GBRMPA acknowledges and recognises the substantial contribution that participating experts made to this workshop process, drawing on their time and their expertise. This workshop report identifies each expert and their institutional affiliation, and their role in contributing to the workshop (Appendix 2).

Information gathered through the consensus workshop is to inform development of the 2019 Outlook Report only. All information provided prior to and derived from the workshop is confidential unless already publicly available. Consistent with Australian Government requirements, all participants signed a non-disclosure agreement. The full workshop report (this report) and all workshop outcomes will become public domain when published by GBRMPA after the 2019 Outlook Report is tabled in Parliament by the Minister of the Environment (expected mid-2019).

Workshop outcomes

Summary and overview

A summary of the raw data collected by the elicitation process is shown below in Table 4 (condition and trends), Table 5 and Table 6 (residual risks).

A number of consistent patterns are evident in the judgements of the experts, but the dominant pattern demonstrated in the condition outcome is that, in the category Most (representing a notional 80-95 per cent of the component being assessed), there are 32 grades of uniquely Good condition (ignoring mixed grades) from the total of 57 natural values components assessed and scored (up from 27 of 53 values in 2014). While in one sense this is a slight improvement in the assessed condition of components since 2014, the results infer that, for nearly half of the components assessed, the judgement of the experts involved in this workshop was that the current condition is substantially degraded than would be the case if there had been no significant human impacts in the Region. Also, the equivalent statistic for the trend assessment is that 19 of the 57 natural values components assessed are (uniquely) continuing to deteriorate (up from 16 of the 53 values in 2014). Nonetheless, a substantive number of these assessments were assigned with a low to medium level of confidence, identifying the need for further knowledge and perhaps more detailed clarification of the gradings based on more detailed scientific data/knowledge.

In contrast, only four of the 57 natural values components were assessed as being in Very Good condition, with a medium level of confidence, inferring only slight and minor changes for these

components since European colonisation of the Region. Two of these (mangrove forests and heath and shrubland habitats) were considered to be Stable, and hence not showing any significant signs of current deterioration trend and the other two (continental slope and currents) are not showing any clear trend across the Region. While all of these habitat types were recognised as having been impacted in some areas, this was considered to be constrained to less than 10 per cent of the natural area of each habitat type.

A second feature of the overview is that, amongst the areas in best condition, the condition of the vast majority of the Best10% areas were considered to be Very Good. None of the components assessed as being in the Best10% areas were considered to be in Very Poor condition although one component (sea temperature) was considered to be in Poor condition (even in the Best10% of cases) and continuing to deteriorate with a high degree of confidence. This infers that the natural condition of sea temperature is considered to have been significantly altered by modern human activity and is having a widespread influence over the Region.

A third feature of the workshop findings on condition is that almost all the components assessed in the Worst10% areas (51 of the 55 natural values components assessed) were considered to be substantially degraded, meeting the criteria for either Poor or Very Poor condition. This infers that major impacts have occurred as a result of human development across at least some parts of nearly all components of the Region's natural values.

For the eight heritage values components assessed, only one (historic light stations) was considered to be in Very Good condition; and this assessment was considered appropriate for the Best10%, Worst10% and Most circumstances. Half of the assessed heritage values (four of eight) were considered to be in Poor condition across Most of their occurrences with a Medium level of confidence.

As in 2014, the spatial differences in condition, identified by a number of participants across a number of components, applied mainly to the north–south and inshore–offshore gradients. However, whereas in 2014 the far northern third of the Region was considered to be generally in better health than the southern two thirds (especially in relation to coral reef related habitats), this relationship has essentially inverted following the recent back to back mass bleaching events that resulted in high level of coral mortality in the far north of the Region. The overall assignment of condition scores was considered by some participants to be an inadequate representation of the heterogeneity of condition of the Region and may convey a sense of comfort which is misplaced. Nonetheless, even a score of 6, while representing 'Good' condition, also represents some loss and degradation of habitat, species, processes, and heritage integrity as defined in the grading statements (Appendix 1) compared to the condition that would have been expected in the absence of human impacts, approximating the level and type of impact since European settlement of the Region. Combined with a finding of a present-day trend of substantial levels of deterioration and with very few detectable improvements (Table 4), the overall signal for condition from the workshop is one of substantial and continuing decline of values across the Region as a whole, although the patterns of change are variable from place to place in the Region.

The self-assessed confidence estimates surrounding the condition and trend assignments provided a relative measure of certainty for the subsequently aggregated individual outcomes. This can infer a measure of relative precision in the final outcomes, but it does not necessarily confer estimates of accuracy. Therefore, the outcomes of this workshop should be interpreted with due caution—neither a finding assigned with a high level of confidence nor a low level of confidence infers high or low accuracy.

The finding of a specific condition or trend for a component should not be discounted because of its confidence—the condition may be accurately reflected in the outcomes even though confidence (which is based on a number of different uncertainties) may be expressed as low. The workshop outcomes can be confidently considered to represent a consensus of opinion (the

prevailing view) from a broad base of extensive experience and capability independent of GBRMPA and, within the bounds of a rapid assessment process, will make a strong contribution to the development of the 2019 Outlook Report.

Overview of summary components

Condition and trend scores based on the assessment of 'Most' for each individual component have been aggregated into nine 'summary components' ('Most' represents the full distribution of the component i.e. including the Best 10% and the Worst 10% but leaving out the absolute best or worst outlying examples). Results for each summary component are summarised below including a list of the individual components, brief statement of results and a graph for condition and trend. Additional information on condition, trend and confidence scores are provided in (Table 4). Raw results for all assessments have been archived by GBRMPA.

Habitats to support species

This summary component includes:
- Islands
- Mainland Beaches and coastlines
- Mangrove forests
- Seagrass meadows
- Coral reefs
- Lagoon floor
- Shoals
- Halimeda banks
- Continental slope
- Open waters

Overall, the aggregated condition of 'habitats to support species' (hereafter habitats) components was considered to be Good (Figure 3). Exceptions include coral reefs, which were considered to be in Poor condition and continental slope, which was considered to be in Very Good condition (Table 4). The aggregated trend for habitats was considered to have either deteriorated or stabilised since 2014 (Figure 4)). None of the assessed habitats components were considered to be improved. The judgements of the experts at the workshop about the condition of habitats components were mainly assigned with a medium level of confidence. This infers that the experts collectively considered that a true estimate of condition for the majority of components assessed would be within the bounds of two grades. The condition of coral reefs was estimated with a high level of confidence, inferring that the true condition is highly unlikely to fall outside the grade assigned, Poor. Confidence in trend was medium-low (5 and 4 respectively), and of those rated low confidence for trend the votes were unanimous.

Figure 3 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of all habitats to support species combined (islands, mainland beaches and coastlines,

Figure 4 Distribution of votes for each trend category (as a proportion of all votes) for all habitats to support species combined (islands, mainland beaches and coastlines, mangrove forests, seagrass meadows, corals reefs, lagoon floor, shoals, halimeda banks, continental slope and open waters)

Populations of species and groups of species

This summary component includes:

- Mangroves
- Seagrasses
- Benthic algae
- Corals
- Other invertebrates
- Plankton and microbes
- Bony fishes
- Sharks and rays
- Sea snakes
- Marine turtles
- Estuarine crocodiles
- Seabirds
- Shorebirds
- Whales
- Dolphins
- Dugongs

Overall, the aggregated condition of 'populations of species and groups of species' (hereafter species) components was considered to be Good (Figure 5), although coral species, other invertebrates, marine turtles, dolphins and dugongs were considered to be in Poor condition while mangrove species were considered to be in Very Good condition (Table 4). The trend for species was highly variable (Figure 7) with mangroves, seagrasses, bony fish, sea snakes, and dugong considered stable; coral species, other invertebrates, and dolphins deteriorated; and crocodiles, whales and benthic algae improved (Table 4). The judgements of the experts at the workshop about species components were mainly assigned with a medium level of confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of two grades. The trend of coral species was estimated with a high level of confidence, inferring that the true trend is highly unlikely to fall outside the grade assigned, deteriorated.
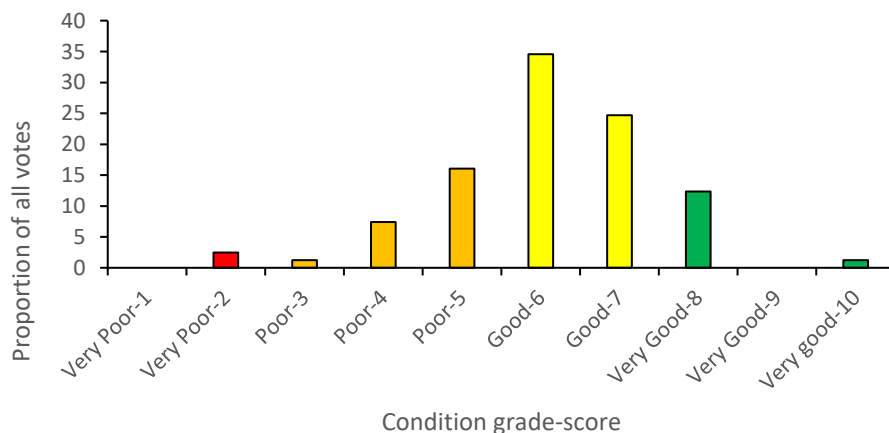
Figure 5 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'populations of species and groups of species' combined (Mangroves, Seagrasses, Benthic algae, Corals, Other invertebrates, Plankton and microbes, Bony fishes, Sharks and rays, Sea snakes, Marine turtles, Estuarine crocodiles, Seabirds, Shorebirds, Whales, Dolphins, and Dugongs).
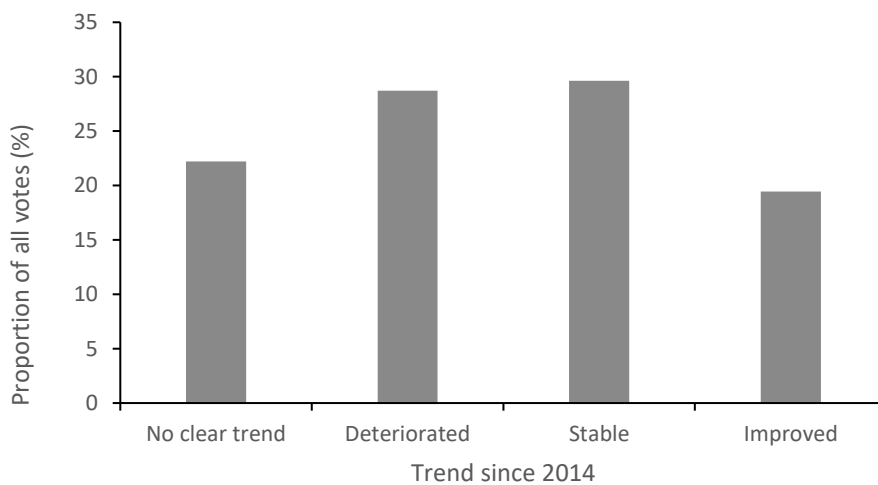
Figure 6 Distribution of votes for each trend category (as a proportion of all votes) for 'populations of species and groups of species' combined (Mangroves, Seagrasses, Benthic algae, Corals, Other invertebrates, Plankton and microbes, Bony fishes, Sharks and rays, Sea snakes, Marine turtles, Estuarine crocodiles, Seabirds, Shorebirds, Whales, Dolphins, and Dugongs).

Physical processes

This summary component includes:

- Currents
- Cyclones and wind
- Freshwater inflow
- Sediment exposure
- Sea level
- Sea temperature
- Light

Overall, the aggregated condition of 'physical processes' was Good (Figure 7), although cyclones and wind, sea temperature and sediment exposure were in Poor condition and ocean currents were in Very Good condition (Table 4). The trend for 'physical processes' components was deteriorated or no clear trend (Figure 8). The judgements of the experts at the workshop about 'physical processes' components were mainly assigned with a medium level of

confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of two grades. However, the condition and trend scores for sea level and sea temperature were estimated with a high level of confidence, inferring that the true condition is highly unlikely to fall outside the grades to which each has been assigned.

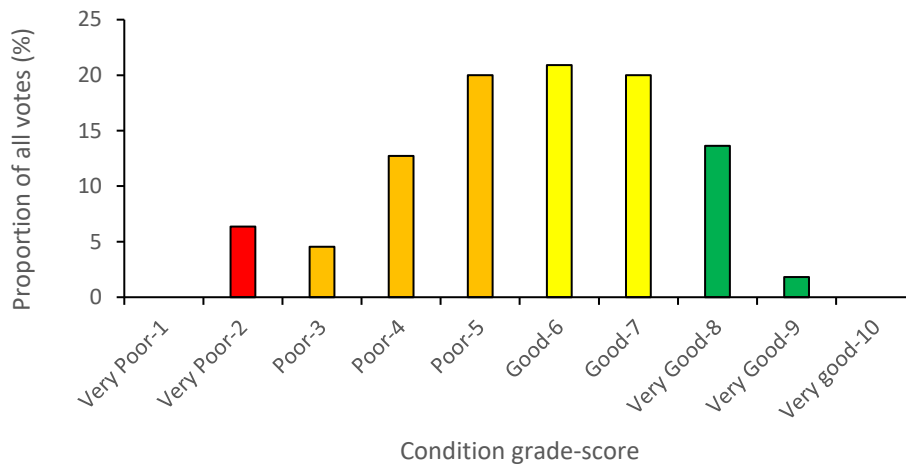**Figure 7 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'physical processes' combined (Currents, Cyclones and wind, Freshwater inflow, Sediment exposure, Sea level, Sea temperature, and Light).**
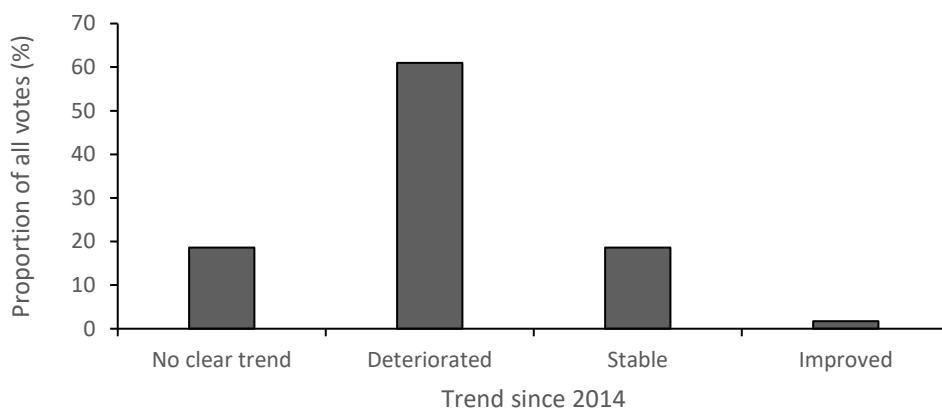
Figure 8 Distribution of votes for each trend category (as a proportion of all votes) for 'physical processes' combined (Currents, Cyclones and wind, Freshwater inflow, Sediment exposure, Sea level, Sea temperature, and Light).

Chemical processes

This summary component includes:
- Nutrient cycling
- Ocean pH
- Ocean salinity

Overall, the aggregated condition of 'chemical processes' components was Good (Figure 9) and the aggregated trend was deteriorated or stable (Figure 11). Two out of three components were considered to be in Good condition, with the exception being nutrient cycling, which was considered to be in Poor condition. The trend for ocean pH was considered to be deteriorated (Table 4). No chemical processes were considered to be improved. The judgements of the

experts at the workshop about 'chemical processes' components were nearly all assigned with a high or medium level of confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of one to two grades.
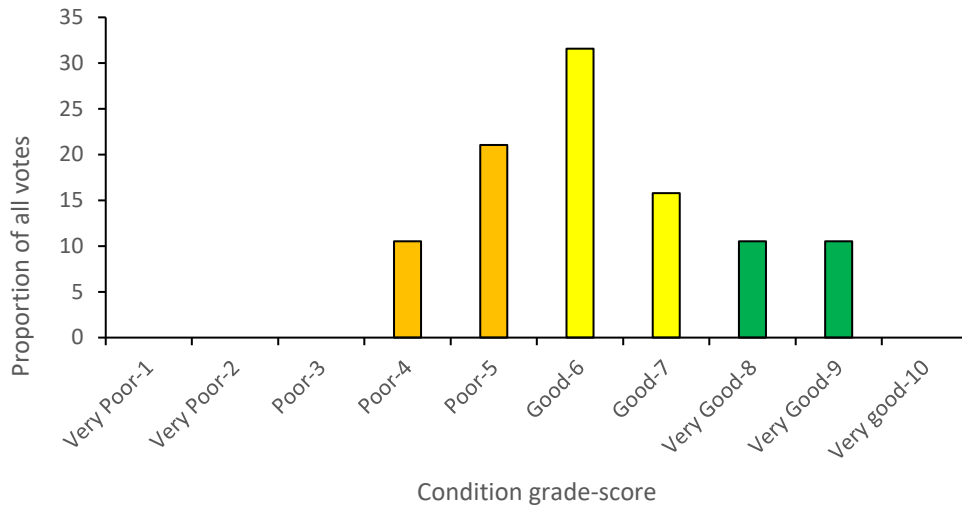
Figure 9 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'chemical processes' combined (Nutrient cycling, Ocean pH, and Ocean salinity).
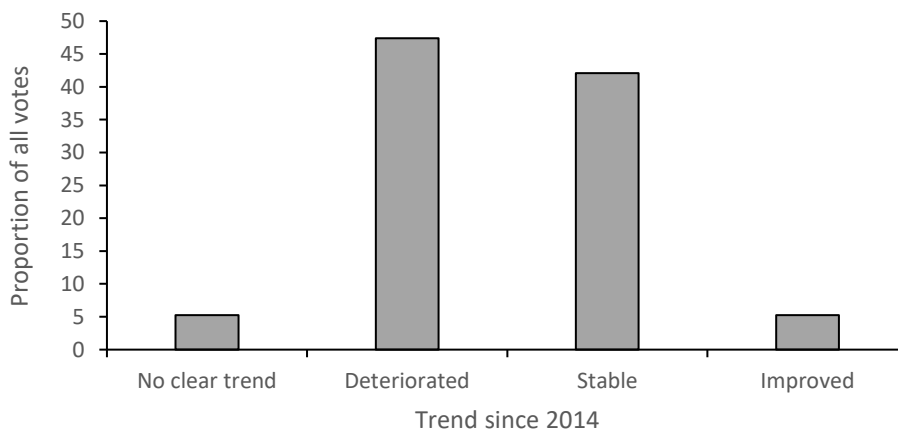
Figure 10 Distribution of votes for each trend category (as a proportion of all votes) for 'chemical processes' combined (Nutrient cycling, Ocean pH, and Ocean salinity).

Ecological processes

This summary component includes:
- Microbial processes
- Particle feeding
- Primary production
- Herbivory
- Predation
- Symbiosis
- Recruitment
- Reef building
- Competition
- Connectivity

Overall, the aggregated condition of 'ecological processes' components was considered to be Good (Figure 11), although symbiosis and reef building processes were considered to be in Poor condition, and no ecological processes were considered to be in Very Good or Very Poor condition (Table 4). The aggregated trend for 'ecological processes' was deteriorated (Figure 13) with individual components considered to have deteriorated, remained stable or shown no clear trend (Table 4). No ecological processes were considered to be improved. The judgements of the experts at the workshop about the components of 'ecological processes' components mainly assigned with a medium or low level of confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of two, or in some cases, three grades.
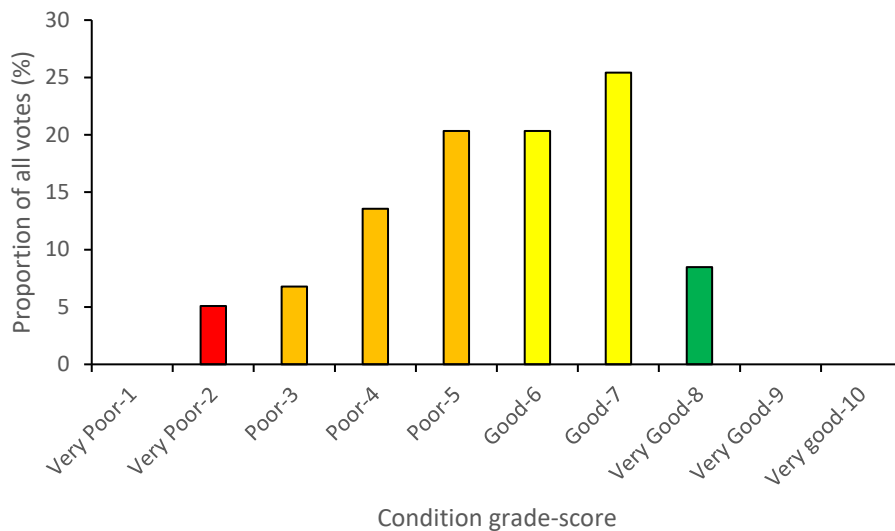

Figure 11 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'ecological processes' combined (Microbial processes, Particle feeding, Primary production, Herbivory, Predation, Symbiosis, Recruitment, Reef building, Competition, and Connectivity).
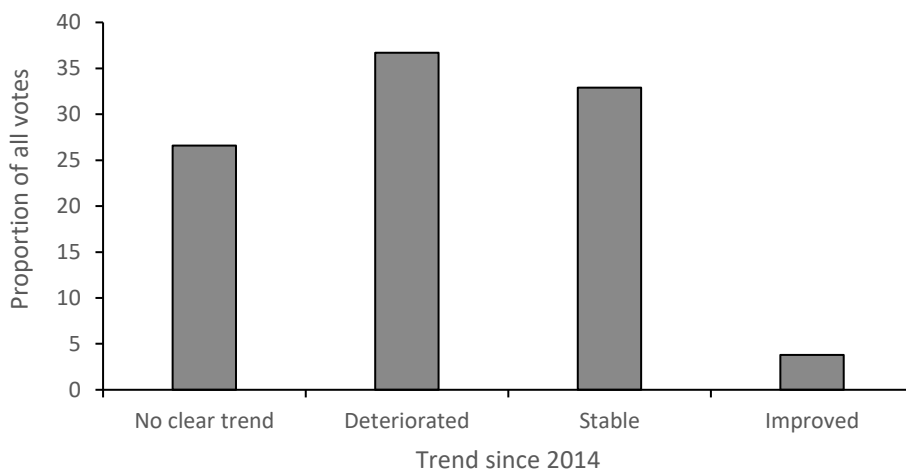
Figure 12 Distribution of votes for each trend category (as a proportion of all votes) for 'ecological processes' combined (Microbial processes, Particle feeding, Primary production, Herbivory, Predation, Symbiosis, Recruitment, Reef building, Competition, and Connectivity).

Outbreaks of disease, introduced species and pest species

This summary component includes:

- Outbreaks of disease
- Outbreaks of crown-of-thorns starfish
- Introduced species
- Other outbreaks

Overall, the aggregated condition of 'outbreaks of disease, introduced species and pest species' components was Good (Figure 13), with all components considered to be Good except crown-of-thorns outbreaks, which were considered to be in Poor condition, (Table 4). The aggregated trend for 'outbreaks of disease, introduced species and pest species' was deteriorated (Figure 14). Overall, no 'outbreaks of disease, introduced species and pest species' components were considered to be improved (Table 4). The judgements of the experts at the workshop about 'outbreaks of disease, introduced species and pest species' components were mainly assigned with a medium or low level of confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of two or three grades. However, the condition and trend scores for crown-of-thorns outbreaks were estimated with a higher level of confidence (medium/high).

Figure 13 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'outbreaks of disease, introduced species and pest species' combined (Outbreaks of disease, Outbreaks of crown-of-thorns starfish, Introduced species, and other outbreaks).
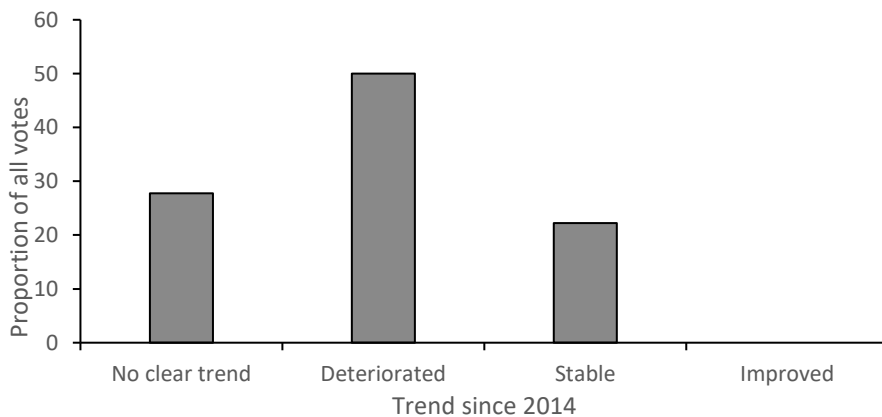
Figure 14 Distribution of votes for each trend category (as a proportion of all votes) for 'outbreaks of disease, introduced species and pest species' combined (Outbreaks of disease, Outbreaks of crown-of-thorns starfish, Introduced species, and Other outbreaks).

Coastal ecosystems that support the Great Barrier Reef

This summary component includes:

- Saltmarshes
- Freshwater wetlands
- Forested floodplains
- Heath and shrublands
- Grass and sedgelands
- Woodlands and forests
- Rainforests

Overall, very few workshop participants voted on the condition of 'coastal ecosystems that support the Great Barrier Reef'. Woodlands and forests, and rainforests were not assessed and are not represented in the aggregated result of Good condition (Figure 16) with a trend of stable (Figure 17). Saltmarshes (the only component to receive more than two votes) was considered to be Good condition with a Stable trend (Table 4). It is recommended that additional expert input be sought for this component to better inform drafting of Outlook 2019.
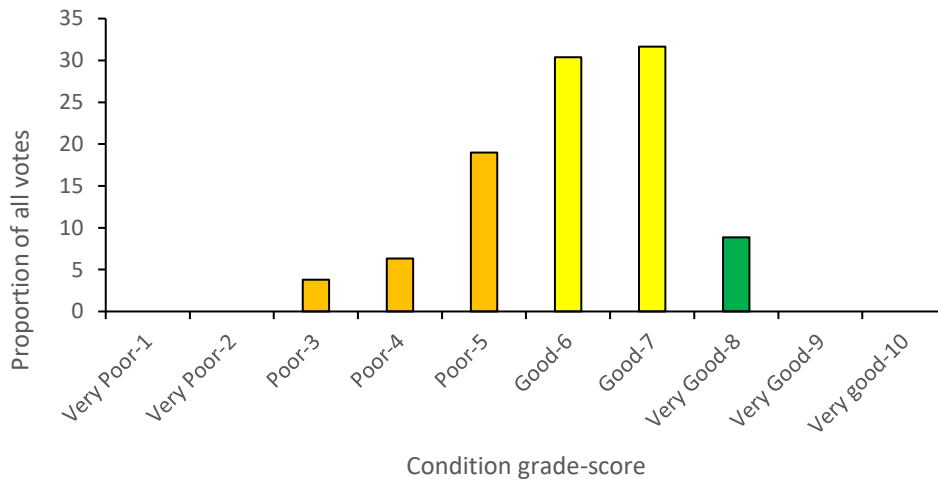

Figure 15 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'coastal ecosystems that support the Great Barrier Reef' combined (Saltmarshes, Freshwater wetlands, Forested floodplains, and Heath and shrublands).
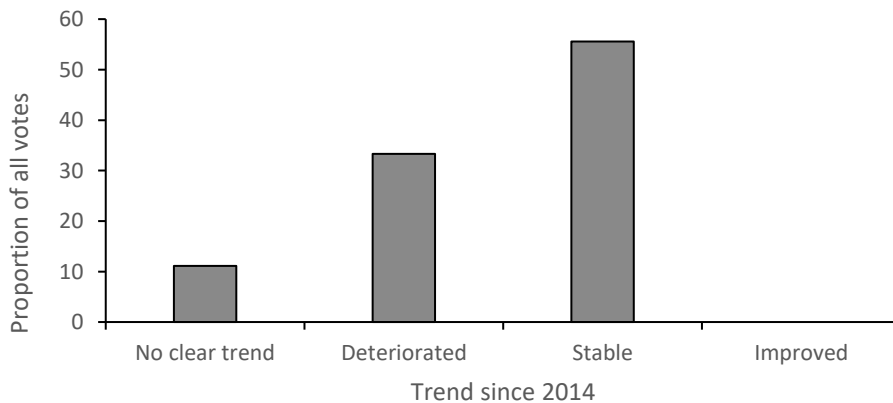
Figure 16 Distribution of votes for each trend category (as a proportion of all votes) for 'coastal ecosystems that support the Great Barrier Reef' combined (Saltmarshes, Freshwater wetlands, Forested floodplains, and Heath and shrublands).

Indigenous heritage

This summary component includes:
- Cultural practices, observances, customs and lore
- Sacred sites, sites of particular significance, places important for cultural tradition
- Stories, songlines, totems and language
- Indigenous structures, technology, tools and archaeology

Please note: Because few experts were available to attend the heritage components workshop (Day 5), the Outlook team will actively seek out additional expert input to strengthen confidence in the final assessment scores for the Indigenous heritage and historic heritage components.

Overall, the aggregated condition of 'Indigenous heritage' components was Poor (Figure 17). Cultural practices, observances, customs and lore were considered to be Good (Table 4). Sacred sites, sites of particular significance, places important for cultural tradition were considered to be Good/Poor, with both the stories, songlines, totems and language and the Indigenous structures, technology, tools and archaeology components considered to be in Poor condition. The trend for 'Indigenous heritage' components was considered to be deteriorated since 2014 (Figure 18), except for cultural practices, observances, customs and lore which had a mixed trend of Deteriorated/Stable (Table 4). None of the assessed 'Indigenous heritage' components were considered to be improved. The judgements of the experts at the workshop about 'Indigenous heritage' components were assigned with a medium level of confidence. This infers that the experts collectively considered that a true estimate of both condition and trend for each of the components assessed would be within the bounds of two grades.
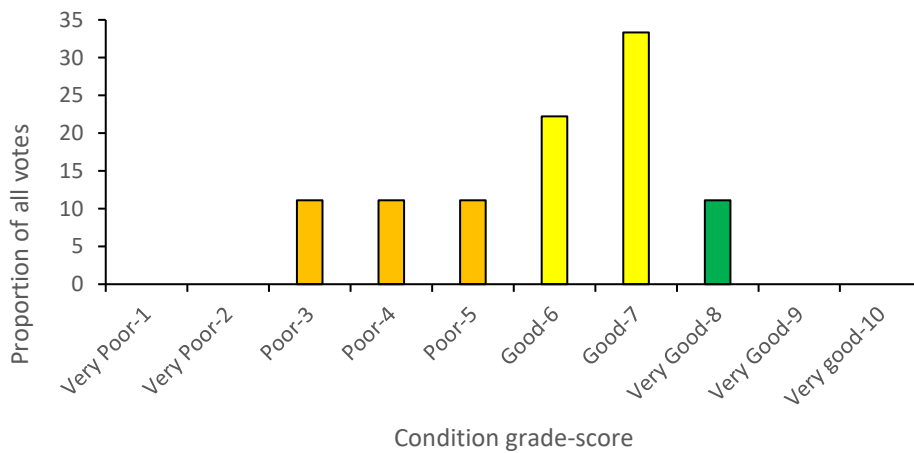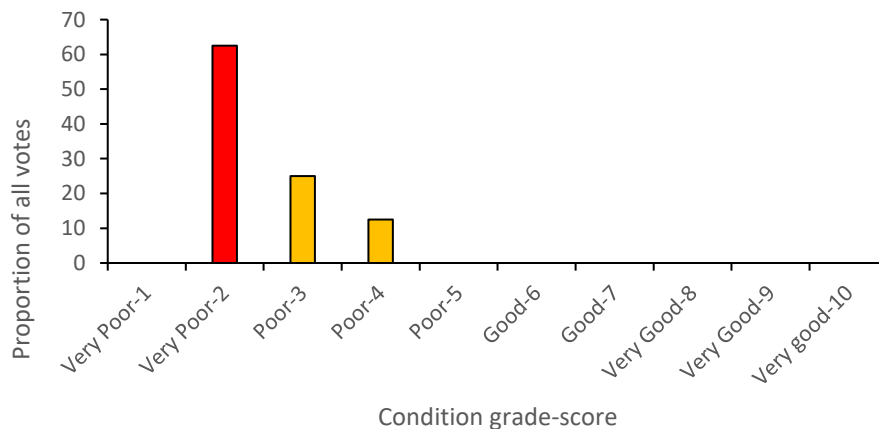

Figure 17 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'Indigenous heritage' combined (Cultural practices, observances, customs and lore; Sacred sites, sites of particular significance, places important for cultural tradition; Stories, songlines, totems and language; and Indigenous structures, technology, tools and archaeology).
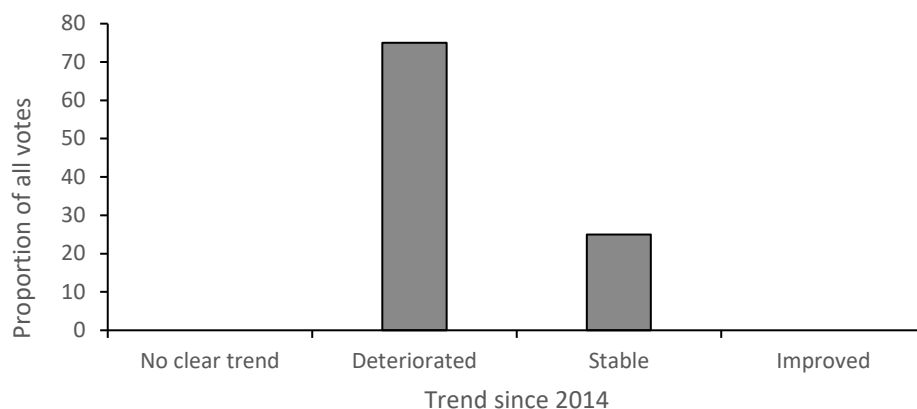
Figure 18 Distribution of votes for each trend category (as a proportion of all votes) for 'Indigenous heritage' combined (Cultural practices, observances, customs and lore; Sacred sites, sites of particular significance, places important for cultural tradition; Stories, songlines, totems and language; and Indigenous structures, technology, tools and archaeology).

Historic heritage

This summary component includes:
- Historic voyages and shipwrecks
- Historic lightstations
- World War II features and sites
- Other places of historic significance

Please note: Because few experts were available to attend the heritage components workshop (Day 5), the Outlook team will actively seek out additional expert input to strengthen confidence in the final assessment scores for the Indigenous heritage and historic heritage components.

The aggregated condition and trend of 'historic heritage' components was Good and deteriorated (Figure 19 and 21). Historic lightstations were considered to be Very Good condition, World War II features and sites were considered to be Good, and both Historic voyages and shipwrecks and other places of historic significance were considered to be in Poor condition (Table 4). The trend for World War II features and sites and other places of historic significance was considered to be deteriorated since 2014 (Table 4). None of the assessed 'historic heritage' components were considered to be improved. The judgements of the experts at the workshop about 'historic heritage' components were assigned with a medium level of confidence (apart from historic lightstations which were assigned with a high level of confidence). This infers that the experts collectively considered that a true estimate of both condition and trend for the majority of components assessed would be within the bounds of two grades.
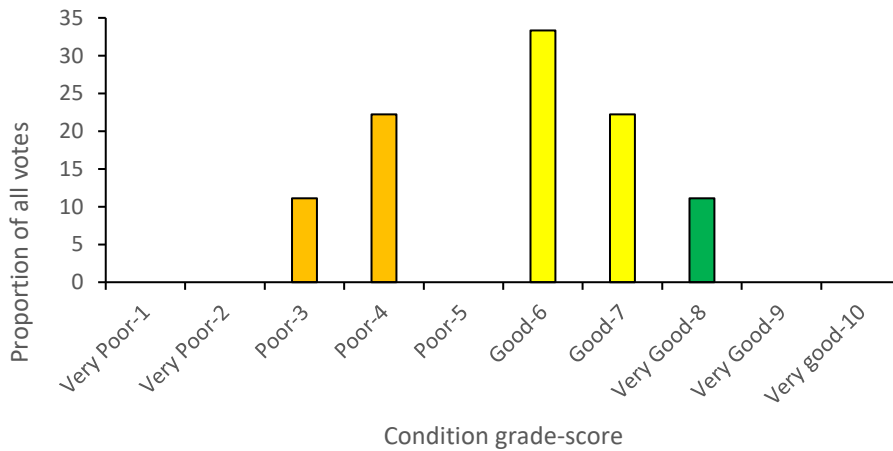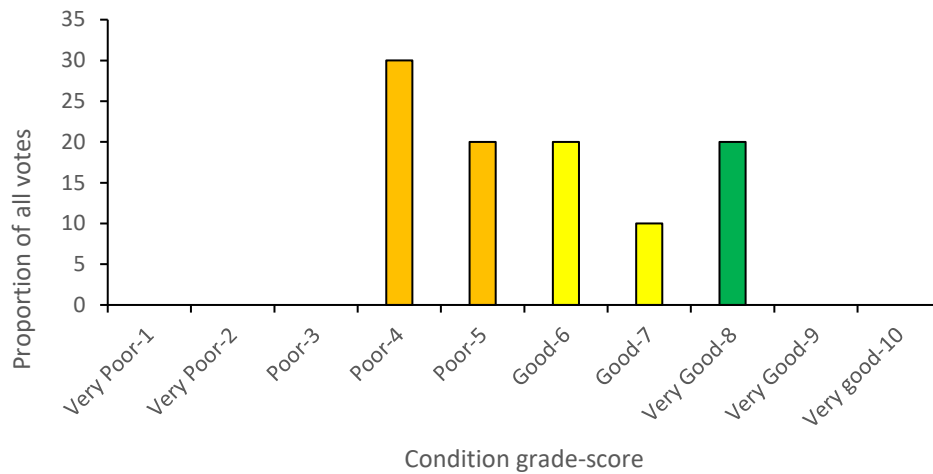
Figure 19 Distribution of scores and corresponding grade (as a proportion of all votes for each score between 1-10) on the condition of 'historic heritage' combined (Historic voyages and shipwrecks; Historic lightstations; World War II features and sites; and Other places of historic significance).
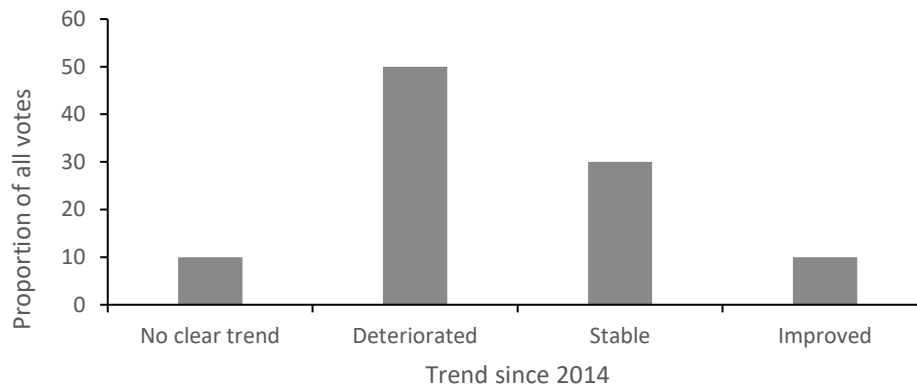
Figure 20 Distribution of votes for each trend category (as a proportion of all votes) for 'historic heritage' combined (Historic voyages and shipwrecks; Historic lightstations; World War II features and sites; and Other places of historic significance).

Table 4. Summary of workshop outcomes for all natural and heritage components—Condition, Trend and Confidence

COMPONENT		# voters	CONDITION				TREND			
			Worst 10%	Best 10%	Most	Confidence	Worst 10%	Best 10%	Most	Confidence
Habitats to support species	islands	13	Poor (10)	Very Good (9)	Good (10)	medium (10)	deteriorated (10)	stable (8)	deteriorated (8)	medium (9)
	mainland beaches and coastline	9	Very Poor (6)	Very Good (8)	Good (6)	medium (7)	deteriorated (7)	stable (9)	deteriorated (4) stable (4)	medium (8)
	mangrove forests	10	Poor (5)	Very Good (8)	Good (6)	medium (7)	deteriorated (5)	stable (9)	stable (9)	medium (10)
	seagrass meadows	11	Very Poor (6)	Very Good (9)	Good (8)	medium (11)	deteriorated (4) stable (4)	stable (7)	stable (6)	medium (8)
	coral reefs	17	Very Poor (15)	Very Good (10)	Poor (13)	high (9)	deteriorated (15)	stable (11)	deteriorated (15)	medium (9)
	Lagoon floor	5	Poor (4)	Very Good (4)	Good (3)	medium (3)	no clear trend (2) Deteriorated (2)	stable (5)	stable (4)	low (5)
	shoals	1	Poor (1)	Good (1)	Good (1)	low (1)	stable (1)	improved (1)	stable (1)	low (1)
	Halimeda banks	3	Poor (2)	Good (2)	Good (3)	low (3)	deteriorated (2)	stable (3)	no clear trend (1) deteriorated (1) stable (1)	low (3)
	continental slope	2	Poor (2)	Very Good (2)	Very Good (2)	low (1) medium (1)	no clear trend (2)	no clear trend (1) stable (1)	no clear trend (2)	low (2)
	open waters	10	Very Poor (7)	Very Good (6)	Good (8)	medium (5)	deteriorated (8)	deteriorated (5)	deteriorated (9)	medium (7)
Populations of species and groups of species	mangroves	7	Good (5)	Very Good (7)	Very Good (7)	medium (5)	stable (4)	stable (7)	stable (7)	Medium (5)
	seagrasses	8	Poor (5)	Very Good (6)	Good (7)	medium (9)	deteriorated (5)	improved (6)	stable (5)	medium (8)
	benthic algae	7	Poor (5)	Very Good (7)	Good (4)	medium (4)	no clear trend (3)	improved (4)	improved (3)	medium (6)
	corals	15	Very Poor (12)	Good (6)	Poor (10)	medium (8)	deteriorated (12)	stable (9)	deteriorated (13)	high (9)
	other invertebrates	8	Very Poor (4) Poor (4)	Very Good (6)	Poor (5)	low (5)	deteriorated (6)	stable (5)	deteriorated (5)	low (5)
	plankton and microbes	4	Poor (3)	Very Good (4)	Good (2)	low (2) medium (2)	deteriorated (3)	stable (3)	no clear trend (2) stable (2)	Low (3)
	bony fish	9	Very Poor (5)	Very Good (8)	Good (7)	medium (5)	deteriorated (9)	stable (7)	stable (5)	medium (6)
	sharks and rays	8	Very Poor (5)	Very Good (4)	Poor (4) Good (4)	medium (7)	deteriorated (7)	stable (4)	no clear trend (3) deteriorated (3)	medium (8)

COMPONENT		# voters	CONDITION				TREND			
			Worst 10%	Best 10%	Most	Confidence	Worst 10%	Best 10%	Most	Confidence
	sea snakes	2	Very Poor (2)	Poor (1) Very Good (1)	Very Poor (1) Good (1)	low (2)	deteriorated (2)	Deteriorated (1) stable (1)	Deteriorated (1) stable (1)	Medium (1) High (1)
	marine turtles	9	Very Poor (6)	Very Good (4)	Poor (6)	medium (7)	no clear trend (5)	Improved (5)	no clear trend (4)	Medium (5)
	crocodiles	6	Poor (3)	Very Good (4)	Good (5)	medium (4)	improved (3)	improved (4)	improved (5)	medium (4)
	sea birds	4	Poor (4)	Very Good (2)	Good (2)	medium (4)	deteriorated (3)	stable (4)	no clear trend (3)	medium (3)
	shorebirds	2	Very Poor (2)	Very Good (2)	Good (2)	low (1) medium (1)	stable (2)	stable (2)	no clear trend (1) deteriorated (1)	Low (1) medium (1)
	whales	6	Good (5)	Very Good (5)	Good (3) Poor (3)	medium (5)	no clear trend (2) stable (2) improved (2)	improved (6)	improved (5)	medium (6)
	dolphins	3	Very Poor (2)	Very Good (1) Good (1) Poor (1)	Poor (2)	low (3)	deteriorated (3)	no clear trend (1) stable (1) deteriorated (1)	deteriorated (2)	low (3)
	dugongs	8	Very Poor (5)	Good (6)	Poor (7)	medium (7)	deteriorated (5)	improved (5)	Stable (3) improved (3)	medium (7)
Physical processes	currents	5	Good (3)	Very Good (4)	Very Good (4)	medium (3)	no clear trend (4)	no clear trend (3)	no clear trend (3)	Low (2) medium (2)
	cyclones and wind	7	Poor (5)	Very Good (4)	Poor (4)	medium (5)	deteriorated (4)	no clear trend (3)	no clear trend (3) deteriorated (3)	Low (3) medium (3)
	freshwater inflow	8	Very Poor (4)	Very Good (5)	Good (4)	medium (5)	deteriorated (5)	stable (3)	deteriorated (4)	medium (4)
	sediment exposure	11	Very Poor (7)	Very Good (9)	Poor (6)	medium (7)	deteriorated (6)	stable (5)	deteriorated (8)	medium (6)
	sea level	5	Poor (3)	Good (3)	Good (5)	high (4)	deteriorated (5)	deteriorated (4)	deteriorated (5)	High (4)
	sea temperature	10	Very Poor (8)	Poor (6)	Poor (7)	high (9)	deteriorated (10)	deteriorated (9)	deteriorated (10)	high (10)
	light	13	Very Poor (6) Poor (6)	Very Good (11)	Good (9)	medium (9)	deteriorated (8)	stable (9)	deteriorated (6) stable (6)	medium (11)
Chemical processes	nutrient cycling	7	Poor (4)	Very Good (4)	Poor (4)	low (4)	deteriorated (5)	stable (5)	stable (4)	medium (4)
	ocean pH	7	Poor (4)	Good (6)	Good (4)	high (4)	deteriorated (7)	deteriorated (6)	deteriorated (7)	High (6)
	Ocean salinity	5	Poor (4)	Very Good (4)	Good (3)	high (3)	no clear trend (4)	stable (4)	stable (4)	medium (4)
Ecological processes	microbial processes	4	Very Poor (2) Poor (2)	Very Good (3)	Good (4)	low (3)	deteriorated (3)	stable (3)	no clear trend (2) stable (2)	Low (4)

	particle feeding	7	Very Poor (4)	Very Good (5)	Good (5)	medium (6)	deteriorated (5)	stable (5)	stable (4)	medium (4)
	primary productions	9	Very Poor (5)	Very Good (8)	Good (8)	medium (7)	deteriorated (7)	stable (6)	deteriorated (4)	medium (6)
	herbivory	8	Poor (4)	Very Good (6)	Good (5)	medium (7)	deteriorated (4)	stable (6)	stable (5)	medium (7)
	predation	9	Poor (7)	Very Good (9)	Good (5)	medium (6)	no clear trend (5)	stable (7)	stable (4)	medium (5)
	symbiosis	4	Very Poor (4)	Good (3)	Poor (4)	medium (3)	deteriorated (4)	stable (2)	deteriorated (4)	high (2)
	recruitment	12	Poor (7)	Very Good (10)	Good (7)	medium (7)	deteriorated (10)	stable (10)	no clear trend (5) deteriorated (5)	low (7)
	reef building	9	Very Poor (6)	Good (4)	Poor (6)	medium (6)	deteriorated (7)	stable (4)	deteriorated (4)	medium (7)
	competition	7	Very Poor (5)	Very Good (5)	Good (4)	low (6)	deteriorated (4)	stable (7)	deteriorated (3)	Low (7)
	connectivity	10	Poor (7)	Very Good (8)	Good (9)	low (5) medium (5)	deteriorated (6)	stable (5)	deteriorated (5)	low (8)
Coastal ecosystems that support the Great Barrier Reef	Saltmarshes	4	Very Poor (2)	Very Good (4)	Good (4)	medium (4)	deteriorated (3)	stable (4)	stable (3)	medium (3)
	freshwater wetlands	2	Very Poor (2)	Very Good (1) Good (1)	Poor (1) Good (1)	medium (2)	deteriorated (2)	Deteriorated (1) stable (1)	Deteriorated (1) stable (1)	Low (1) medium (1)
	forested floodplains	1	Very Poor (1)	Very Good (1)	Poor (1)	medium (1)	deteriorated (1)	no clear trend (1)	deteriorated (1)	medium (1)
	heath and shrublands	1	Very Poor (1)	Very Good (1)	Very Good (1)	medium (1)	no clear trend (1)	stable (1)	stable (1)	medium (1)
	grass and sedgelands	1	Very Poor (1)	Good (1)	Poor (1)	medium (1)	deteriorated (1)	no clear trend (1)	no clear trend (1)	Low (1)
	woodlands and forests	0	Not scored							
	rainforests	0	Not scored							
Outbreaks of disease, introduced species and pest species	disease	5	Poor (3)	Very Good (5)	Good (5)	low (3)	no clear trend (3)	stable (4)	stable (3)	low (3)
	crown-of-thorns outbreaks	7	Very Poor (7)	Very Good (5)	Poor (5)	high (4)	deteriorated (5)	deteriorated (4)	deteriorated (6)	High (3)
	invasive species	5	Good (2)	Very Good (4)	Good (2)	low (3)	deteriorated (4)	stable (4)	deteriorated (3)	low (3)
	other outbreaks	1	Poor (1)	Very Good (1)	Good (1)	low (1)	no clear trend (1)	stable (1)	no clear trend (1)	low (1)
Indigenous heritage	cultural practices, observances, customs and lore	2	Very Poor Poor	Very Good	Good	Medium	Stable	Improved	Deteriorated Stable	Medium
	sacred sites, sites of particular significance, places important for cultural tradition	2	Very Poor Poor	Very Good	Poor Good	Medium	Deteriorated	Deteriorated Stable	Deteriorated	Medium

	stories, songlines, totems and languages	2	Very Poor Poor	Very Good	Poor	Medium	Deteriorated	Stable	Deteriorated	Medium
	indigenous structures, technology, tools and archaeology	2	Very Poor	Good Very Good	Poor	Medium	Deteriorated	Stable	Deteriorated	Medium
Historic heritage	historic voyages and shipwrecks	2	Very Poor Poor	Very Good	Poor	Medium	Deteriorated	Stable	no clear trend Deteriorated	Medium
	historic light stations	2	Very Good	Very Good	Very Good	High	Stable Improved	Stable	Stable	High
	World War II features and sites	2	Very Poor Poor	Good Very Good	Good	Medium	Deteriorated	Stable	Deteriorated	Medium
	other places of historic significance	2	Very Poor	Good Very Good	Poor	Medium	Deteriorated	Stable	Deteriorated	Medium

Risks

Experts contributed their judgements about two aspects of each of the 41 identified threats—the likelihood of the threat occurring and, in the event that it did occur, the consequences that would arise for the values of the Region. The grading structure for Likelihood and Consequence were provided to workshop participants (Appendix 2), and the grades assigned at the workshop were converted to a risk assignment, according to the established conversion framework (Appendix 2) from the 2009 and 2014 Outlook Reports.

Of the 40 threats assessed for residual risk against natural values components, a total of 31 were considered to pose a high or very risk at the regional or local scale (the risk of incompatible uses was not assessed for natural values components as it primarily related to heritage values). The 16 threats considered to have High or Very High levels of residual risk at the regional scale included: altered weather patterns, barriers to flow, extraction of predators, illegal activities, illegal fishing and poaching, incidental catch of species of conservation concern, marine debris, noise pollution, nutrient run-off, ocean acidification, outbreak of crown-of-thorns starfish, pesticide run-off, sea temperature increase, sediment run off, spill—small, and vessel waste discharge (Table 5).

Of the 28 (of the 41) threats assessed for residual risk against heritage values components, a total of 19 were considered to pose a High or Very High risk (experts participating in the heritage component of the workshop did not feel suitably qualified to assess 13 of the identified risks). Consistent with Outlook 2014, no distinction was made between regional or local scale threats for heritage values components. The 19 threats considered to have High or Very High levels of residual risk included: altered weather patterns, barriers to flow, damage to reef structure, disposal of dredge material, dredging, extraction from spawning aggregations, extraction of predators, illegal fishing and poaching, incidental catch of species of conservation significance, incompatible uses, marine debris, modifying coastal habitats, nutrient run-off, ocean acidification, outbreak of crown-of-thorn starfish, pesticide run-off, sea level rise, sea temperature increase, and sediment run-off (Table 6).

While confidence in the expert judgements of likelihood and consequence (which are combined to assign a level of risk) were not assigned at the workshop, the distribution of individual votes was recorded and can be used to infer at least a measure of the independent agreement amongst participants.

Table 5. Summary of workshop outcomes for residual risks that were assessed (natural values components)

Outlook Report 2019 (40 threats) for NATURAL VALUES	# voters	REGION SCALE			LOCAL SCALE		
		Likelihood (votes)	Consequence (votes)	Overall risk	Likelihood (votes)	Consequence (votes)	Overall risk
Acid sulphate soils: Exposure of acid sulphate soils	8	Possible (5)	Minor (4)	Low	Possible (4)	Minor (4)	Low
Altered ocean currents: Climate change induced altered ocean currents	17	Possible (8)	Minor (8)	Low	Possible (10)	Major (6)/ Minor (6)	High/Low
Altered weather patterns: Climate change effects on weather patterns (e.g. cyclones, wind, rainfall, air temperature)	18	Likely (10)	Moderate (9)	High	Likely (10)	Major (13)	High
Artificial light: Artificial lighting including from resorts, industrial infrastructure, mainland beaches and coastlines, vessels and ships	12	Almost certain (3)/ Likely (3)/ Possible (3)	Minor (7)	Medium/ Low	Almost certain (8)	Minor (7)	Medium
Atmospheric pollution: Pollution of the atmosphere related to domestic, industrial and business activities in both the Region and adjacent areas. The contribution of gases such as carbon dioxide to climate change is not included as this is encompassed under threats such as sea temperature increase and ocean acidification.	8	Possible (3)	Moderate (3)/Minor (3)	Medium/ Low	Almost certain (3)/ Likely (3)	Moderate (4) / Minor (4)	Medium/ High
Barriers to flow: Artificial barriers to riverine and estuarine flow (e.g. dams, weirs, breakwalls and gates)	15	Almost certain (7)	Minor (5)/ Moderate (5)	Medium/ High	Almost certain (6)/ Likely (6)	Moderate (6)	High
Damage to reef structure: Physical damage to reef benthos (reef structure) through actions such as snorkelling, diving, anchoring and fishing, but not vessel grounding	8	Likely (4)	Minor (5)	Medium	Almost certain (4)/ Likely (4)	Minor (5)	Medium
Damage to seafloor: Physical damage to non-reef benthos (seafloor) through actions such as trawling and anchoring	9	Almost certain (7)	Minor (5)	Medium	Almost certain (5)	Moderate (5)	High
Discarded catch: Immediate or post-release effects (such as death, injury, reduced reproductive success) on discarded species as a result of interactions with fishing gear. Does not include species of conservation concern.	7	Almost certain (4)	Minor (6)	Medium	Almost certain (5)	Minor (4)	Medium
Disposal of dredge material: Disposal and resuspension of dredge material	19	Likely (7)	Minor (10)	Medium	Likely (9)	Moderate (8)	High
Dredging: Dredging of the seafloor	19	Likely (8)	Minor (12)	Medium	Almost certain (8)/ Likely (8)	Major (8)	Very High

Activity		Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Exotic species: Introduced exotic species from aquaculture operations, hull fouling, ballast release, and release of aquarium specimens to the Region, plus the introduction of weeds, pests and feral animals to islands	7	Possible (3)	Minor (4)	Low	Likely (3)	Moderate (3)/ Minor (3)	Medium/ High
Extraction from spawning aggregations: Retained take (extraction) of fish from unidentified or unprotected spawning aggregations	4	Possible (3)	Moderate (3)	Medium	Possible (3)	Moderate (2)	Medium
Extraction of herbivores: Retained take (extraction) of herbivores (e.g. some fishes, molluscs, dugongs, green turtles) through commercial and non-commercial uses	7	Possible (3)	Minor (4)	Medium/ Low	Possible (5)	Minor (4)	Low
Extraction of particle feeders: Retained take (extraction) of particle feeders (filter feeders, detritivores) through commercial and non-commercial uses	5	Possible (3)	Minor (4)	Medium/ Low	Almost certain (2)	Minor (3)	High/Medium
Extraction of predators: Retained take (extraction) of predators (e.g. sharks, fish) through commercial and non-commercial uses	6	Likely (3)	Moderate (4)	High	Almost certain (4)	Moderate (4)	High
Grounding large vessel: Grounding of large vessels (>50m) including physical damage and the dislodging of antifoulants	12	Possible (8)	Minor (7)	Low	Possible (9)	Minor (6)	Low
Grounding small vessel: Grounding of small vessels (<50m) including physical damage and the dislodging of antifoulants	12	Almost certain (5)/ Likely (5)	Minor (5)	Medium	Likely (8)	Moderate (6)	High
Illegal activities — other: Illegal activities such as entering a protected or restricted area, illegal release of industrial discharge, shipping outside of designated shipping areas	6	Almost certain (2)/ Likely (2)/ Possible (2)	Moderate (3)	High	Almost certain (2)/ Likely (2)/ Possible (2)	Minor (4)	Medium
Illegal fishing and poaching: Illegal fishing, collecting and poaching	9	Almost certain (5)	Moderate (5)	High	Likely (6)	Moderate (5)	High
Incidental catch of species of conservation concern: Immediate or post-release effects (such as death, injury, reduced reproductive success) of interactions of species of conservation concern with fishing gear	8	Almost certain (5)	Major (3)	Very High	Almost certain (4)/Likely (4)	Major (4)	Very high
Incompatible uses: Activities undertaken within the Region that disturb or exclude other users, such as recreational use in areas important for cultural activities		Assessed for Heritage Values only					
Marine debris: Manufactured material discarded, disposed of or abandoned in the marine and coastal environment (including discarded fishing gear and plastics)	8	Almost certain (6)	Major (3)/ Moderate (3)	Very High/ High	Almost certain (7)	Major (4)	Very High
Modifying coastal habitats: Clearing or modifying wetlands, mangroves and other coastal habitats	13	Likely (7)	Minor (5)/ Moderate (5)	Medium	Almost certain (7)	Major (7)	Very High
Noise pollution: Noise from human activities, both below and above water	12	Likely (5)	Moderate (5)	High	Almost certain (8)	Minor (7)	Medium

Activity/Threat							
Nutrient run-off: Nutrients from diffuse land-based run-off	19	Almost certain (11)	Moderate (10)	High	Almost certain (13)	Moderate (10)	High
Ocean acidification: Decreasing pH of the Region's waters	15	Almost certain (8)	Major (7)	Very High	Almost certain (7)	Major (6)/ Minor (6)	Very High/High/ Medium
Outbreak of crown-of-thorns starfish: Outbreak of crown-of-thorns starfish	18	Likely (9)	Major (8)/Moderate (8)	High	Almost certain (7)	Major (8)	Very High/ High
Outbreak of disease: Outbreak of disease, both naturally occurring and introduced	15	Possible (6)	Moderate (9)	Medium	Possible (6)	Moderate (9)	Medium
Outbreak of other species: Outbreak or bloom of naturally occurring species other than crown-of-thorns starfish	8	Possible (5)	Minor (8)	Low	Possible (5)	Minor (6)	Low
Pesticide run-off: Pesticides (including herbicides, insecticides, fungicides) from diffuse land-based run-off	19	Likely (13)	Moderate (10)	High	Likely (12)	Moderate (12)	High
Sea level rise: Rising sea level	18	Almost certain (13)	Minor (9)	Medium	Almost certain (12)	Moderate (8)	High
Sea temperature increase: Increasing sea temperature	16	Almost certain (12)	Major (10)	Very High	Almost certain (13)	Catastrophic (8)	Very High
Sediment run-off: Sediments from diffuse land-based run-off	21	Almost certain (11)	Moderate (12)	High	Almost certain (12)	Major (10)	Very High
Spill — large chemical: Chemical spill that triggers a national or regional response or is more than 10 tonnes	5	Unlikely (3)	Moderate (2)/ Minor (2)	Low	Unlikely (2)/ Rare (2)	Moderate 2)/ Catastrophic (2)	High
Spill — large oil: Oil spill that triggers a national or regional response or is more than 10 tonnes	6	Unlikely (3)	Moderate (5)	Medium/ Low	Possible (2)/ Unlikely (2)/Rare (2)	Catastrophic (2)/ Major (2)/ Moderate (2)	Very High/High/M edium/Low
Spill — small: Chemical or oil spill that does not trigger a national or regional response and is less than 10 tonnes	6	Likely (3)	Moderate (3)	High	Likely 5)	Minor (4)	Medium
Terrestrial discharge: Terrestrial point-source discharge including polluted water, sewage, wastewater and stormwater	20	Almost certain (7)	Minor (14)	Medium	Almost certain (13)	Moderate (9)	High
Vessel strike: Death or injury to wildlife as a result of being struck by a vessel of any type or size	12	Almost certain (6)	Insignificant (5)	Low	Almost certain (7)	Major (5)	Very High
Vessel waste discharge: Waste discharge from a vessel (including sewage)	5	Almost certain (4)	Moderate (2) Insignificant (2)	High/Low	Almost certain (3)	Minor (3)	Medium
Wildlife disturbance: Disturbance to wildlife including from snorkelling, diving, fish feeding, walking on islands and beaches, and the presence of boats; not including noise pollution	11	Almost certain (8)	Minor (5)	Medium	Almost certain (9)	Moderate (5)	High

Table 6. Summary of workshop outcomes for residual risks that were assessed (heritage values components)

Outlook Report 2019 (41 threats) for HERITAGE VALUES	Likelihood	Consequence	Overall risk
Acid sulphate soils: Exposure of acid sulphate soils	Not assessed		
Altered ocean currents: Climate change induced altered ocean currents	unlikely	major	Medium/ High
Altered weather patterns: Climate change effects on weather patterns (e.g. cyclones, wind, rainfall, air temperature)	almost certain	major	Very high
Artificial light: Artificial lighting including from resorts, industrial infrastructure, mainland beaches and coastlines, vessels and ships	not assessed		
Atmospheric pollution: Pollution of the atmosphere related to domestic, industrial and business activities in both the Region and adjacent areas. The contribution of gases such as carbon dioxide to climate change is not included as this is encompassed under threats such as sea temperature increase and ocean acidification.	not assessed		
Barriers to flow: Artificial barriers to riverine and estuarine flow (e.g. dams, weirs, break walls and gates)	almost certain	major	Very high
Damage to reef structure: Physical damage to reef benthos (reef structure) through actions such as snorkelling, diving, anchoring and fishing, but not vessel grounding	almost certain	moderate	High
Damage to seafloor: Physical damage to non-reef benthos (seafloor) through actions such as trawling and anchoring	likely	Moderate/ Major	Medium/ High
Discarded catch: Immediate or post-release effects (such as death, injury, reduced reproductive success) on discarded species as a result of interactions with fishing gear. Does not include species of conservation concern.	not assessed		
Disposal of dredge material: Disposal and resuspension of dredge material	likely	moderate	High
Dredging: Dredging of the seafloor	likely	Moderate	High
Exotic species: Introduced exotic species from aquaculture operations, hull fouling, ballast release, and release of aquarium specimens to the Region, plus the introduction of weeds, pests and feral animals to islands	likely	minor	Medium
Extraction from spawning aggregations: Retained take (extraction) of fish from unidentified or unprotected spawning aggregations	likely	Moderate	High
Extraction of herbivores: Retained take (extraction) of herbivores (e.g. some fishes, molluscs, dugongs, green turtles) through commercial and non-commercial uses	likely	Insignificant	Low
Extraction of particle feeders: Retained take (extraction) of particle feeders (filter feeders, detritivores) through commercial and non-commercial uses	almost certain	minor	Medium
Extraction of predators: Retained take (extraction) of predators (e.g. sharks, fish) through commercial and non-commercial uses	almost certain	moderate	High
Grounding large vessel: Grounding of large vessels (>50m) including physical damage and the dislodging of antifoulants	possible	Moderate	Medium

Grounding small vessel: Grounding of small vessels (<50m) including physical damage and the dislodging of antifoulants	almost certain	Minor	Medium
Illegal activities — other: Illegal activities such as entering a protected or restricted area, illegal release of industrial discharge, shipping outside of designated shipping areas	almost certain	minor	Medium
Illegal fishing and poaching: Illegal fishing, collecting and poaching	almost certain	major	Very high
Incidental catch of species of conservation concern: Immediate or post-release effects (such as death, injury, reduced reproductive success) of interactions of species of conservation concern with fishing gear	almost certain	major	Very high
Incompatible uses: Activities undertaken within the Region that disturb or exclude other users, such as recreational use in areas important for cultural activities	almost certain	moderate	High
Marine debris: Manufactured material discarded, disposed of or abandoned in the marine and coastal environment (including discarded fishing gear and plastics)	almost certain	moderate	High
Modifying coastal habitats: Clearing or modifying wetlands, mangroves and other coastal habitats, changes in water movement due to reclamation or installation of break walls, etc.	almost certain	major	Very high
Noise pollution: Noise from human activities, both below and above water	not assessed		
Nutrient run-off: Nutrients from diffuse land-based run-off	almost certain	major	Very high
Ocean acidification: Decreasing pH of the Region's waters	almost certain	catastrophic	Very high
Outbreak of crown-of-thorns starfish: Outbreak of crown-of-thorns starfish	almost certain	major	Very high
Outbreak of disease: Outbreak of disease, both naturally occurring and introduced	not assessed		
Outbreak of other species: Outbreak or bloom of naturally occurring species other than crown-of-thorns starfish	not assessed		
Pesticide run-off: Pesticides (including herbicides, insecticides, fungicides) from diffuse land-based run-off	almost certain	moderate	High
Sea level rise: Rising sea level	almost certain	major/ catastrophic	Very high
Sea temperature increase: Increasing sea temperature	almost certain	catastrophic	Very high
Sediment run-off: Sediments from diffuse land-based run-off	almost certain	major	Very high
Spill — large chemical: Chemical spill that triggers a national or regional response or is more than 10 tonnes	not assessed		
Spill — large oil: Oil spill that triggers a national or regional response or is more than 10 tonnes	not assessed		
Spill — small: Chemical or oil spill that does not trigger a national or regional response and is less than 10 tonnes	not assessed		
Terrestrial discharge: Terrestrial point-source discharge including polluted water, sewage, wastewater and stormwater	not assessed		
Vessel strike: Death or injury to wildlife as a result of being struck by a vessel of any type or size	not assessed		
Vessel waste discharge: Waste discharge from a vessel (including sewage)	not assessed		

Wildlife disturbance: Disturbance to wildlife including from snorkelling, diving, fish feeding, walking on islands and beaches, and the presence of boats; not including noise pollution	almost certain	minor	Medium

Participant observations and potential methodological improvements

Throughout the workshop, participants offered constructive comments about the workshop process, and how it might be improved for future iterations. Key suggested improvements included:

- Ensuring recognised content experts independently reviewed the preliminary grading statements for <u>all</u> components prior to being assessed at the consensus workshop;
- Ensuring key experts were present for every component and reducing the potential bias arising from less well qualified participants having the same vote value as highly qualified participants;
- Identifying example reference sites for the worst 10% and best 10% of cases prior to voting;
- Further refining grading statements to specifically suit each component being assessed, particularly for Physical, Chemical and Ecosystem Processes; and
- Clarifying the scope and potential overlap between broad and specific value components.

Suggested improvements to the risk assessment methods included:
- Recording confidence for each risk score;
- Adding a description of 'catastrophic consequence' for a local scale risk;
- Removing the requirement to consider timescales in both likelihood and consequence,
- Providing greater guidance when assessing multiple different risks in the same assessment (e.g. for climate change) and risks occurring over different temporal and geographic scales.

There was support for continuously improving the Outlook assessment methodology while maintaining sufficient consistency for core measures (rather than maintaining historic methods for the sake of apparent consistency).

In relation to the heritage values components, workshop participants recommended that future science consensus workshops should:

- Include greater participation from Indigenous people and a larger and broader range of heritage experts (noting that several Indigenous people and Traditional Owners were invited but unable to attend);
- Assess natural and cultural values together (with greater clarity around the 'natural condition' baseline used as the reference point to assess the condition of heritage values); and
- Assess heritage values in the same way as natural values in terms of their capacity to 'impact on the Region'.

Three new risks relevant to Indigenous heritage values were proposed by experts to be considered for inclusion:

- **Looting and vandalism of Indigenous Heritage sites** (specific to tangible Indigenous heritage such as scar trees, middens, fish traps, burial grounds, stone arrangements, art work).
- **Lack of Traditional Owner access to their land and sea country** (including the potential impact on the enduring connection Traditional Owners have with their land and sea country and the maintenance of culture and the transfer of knowledge to younger generations).
- **Incomplete and fragmented knowledge of tangible and intangible heritage values** (including the risk that tangible and intangible knowledge will become lost and/or fragmented as elders age, and young people leave their traditional land and sea country).

Participant workshop evaluation

A brief evaluation was undertaken (using traffic light cards and voluntary comments) as deemed necessary (e.g. at the end of the day) and a combined evaluation was held at the end of Day 4 (Natural values) using Turning Point to poll the same workshop evaluation questions asked for the 2014 Outlook workshop. Twelve participants of the 45 in total, took part in the feedback poll. Because of low attendance at the heritage sessions on Day 5 (Heritage values) the formal feedback questions were not polled however potential improvements were discussed (above).

At the conclusion of the workshop, participants were invited to vote to indicate their agreement/disagreement (anonymously, as with all earlier polling) with each of the following eight statements designed to permit their evaluation of the workshop, the process and the outcomes. Participants were also invited to contribute written or verbal comments at any stage during or after the workshop.

Voting was sought from the participants on these statements:
"Within the constraints of a rapid assessment:
- The structure of the decision problem was correctly framed to allow the key issues of risk to the reef to be appropriately addressed. (Note, because this question was considered to be confusing by several participants it was operationally defined by the facilitator to "The structure of the questions was correctly framed to allow expert opinion to be polled appropriately?") [wholly disagree1 - wholly agree10]
- My *inputs to the workshop* consensus process were able to be fully recognised and incorporated [wholly disagree1 - wholly agree10]
- The workshop process was *transparent*, and potential bias was adequately managed [wholly disagree1 - wholly agree10]
- The workshop process provided an appropriate mechanism for securing a *broad consensus of expert opinion* [wholly disagree1 - wholly agree10]
- Arrangements to resolve any *persisting disagreements* amongst the experts seem appropriate [wholly disagree1 - wholly agree10]
- The *logistics, the facilitator and the venue* arrangements were appropriate to enable an effective workshop [wholly disagree1 - wholly agree10]
- In general, I support the *process and the outcomes* [wholly disagree1 - wholly agree10]
- I expect that the outcomes provide a *robust basis for Outlook 2019* [wholly disagree1 - wholly agree10]

Participants were invited to submit any other comments or recommendations to improve the workshop process either privately or openly by email to facilitator.

Overall, the participants were highly supportive of the workshop process and the outcomes, with more than 70 per cent of votes assigned to scores of 6 or more (agreement to strong agreement with all the statements posed), and there was a substantial mode of agreement around scores of 7 and 8 (Figure 22). This infers a broadly based high level of agreement for the workshop and its outcomes. Nonetheless, for statement 1, only 25 per cent were in agreement, inferring that the structure of questions was not best framed to allow expert opinion to be polled appropriately. When probed, participants stated that their scores for this question largely reflected some ambiguity in the definitions of the grading statements, particularly for the risk assessment. Key areas of support were 100 per cent agreement with statements 2 and 6 and 90 per cent agreement with statement 7, which provides a strong basis for GBRMPA to utilise the outcomes of this workshop to support the 2019 Outlook Report.
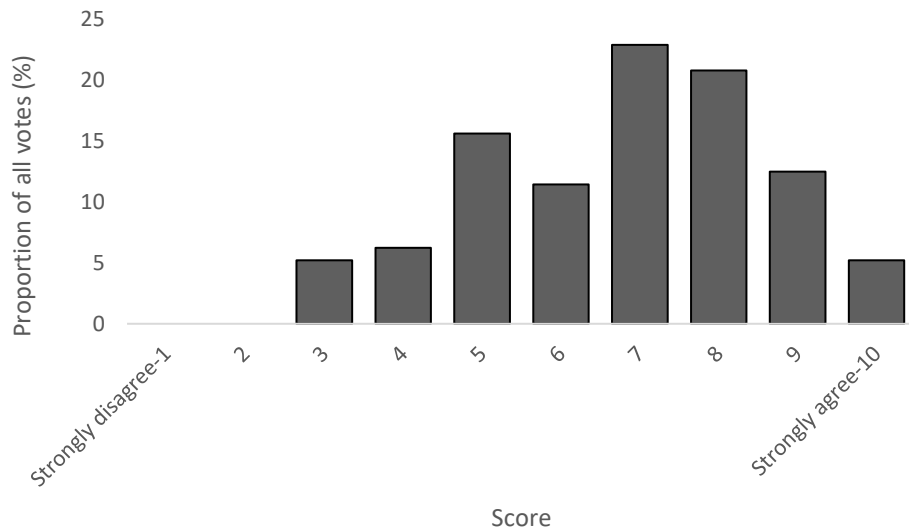
Figure 21 Distribution of scores and corresponding level of agreement (as a proportion of all votes for each score between 1-10) of all eight questions posed to participants to garner feedback on the Science Consensus Workshop process and outcomes.

Polling results of individual questions

Q1. Within the constraints of a rapid assessment, the structure of the decision problem was correctly framed to allow the key issues of risk to the reef to be appropriately addressed? (NB. operationally defined by the facilitator to "The structure of the questions was correctly framed to allow expert opinion to be polled appropriately?").
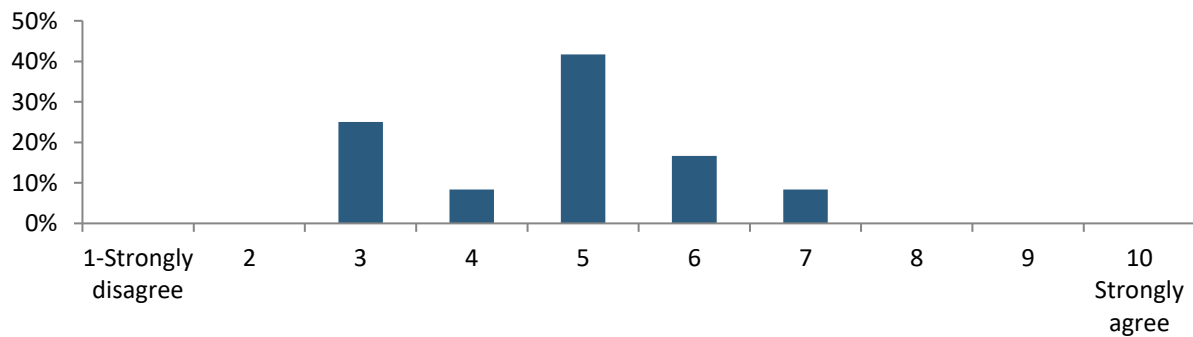
Q2. My inputs to the workshop consensus process were able to be fully recognised and incorporated.
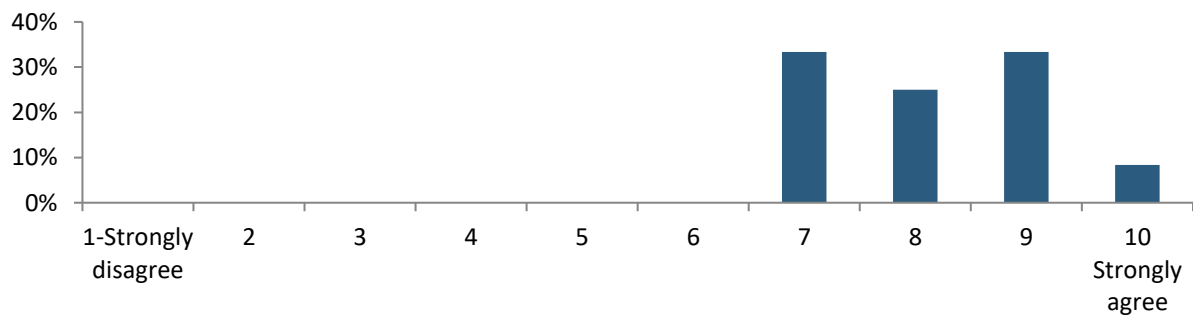
Q3. The workshop was transparent, and potential bias was adequately managed.
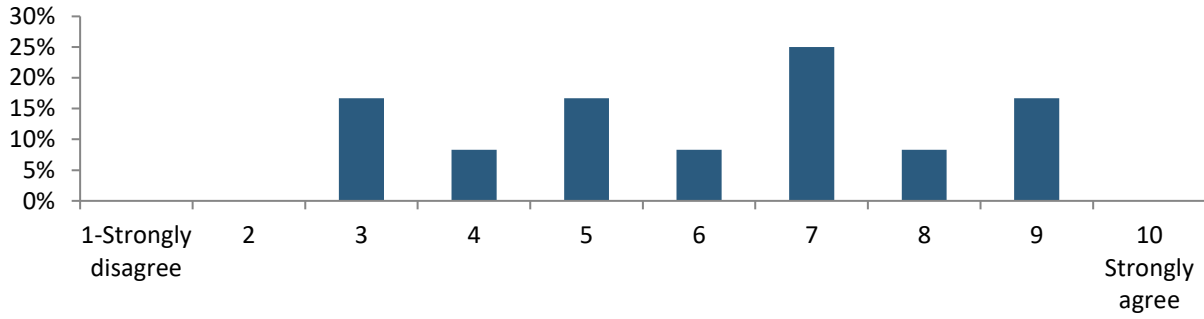
Q4. The workshop process provided appropriate mechanisms for securing a broad consensus of expert opinion.
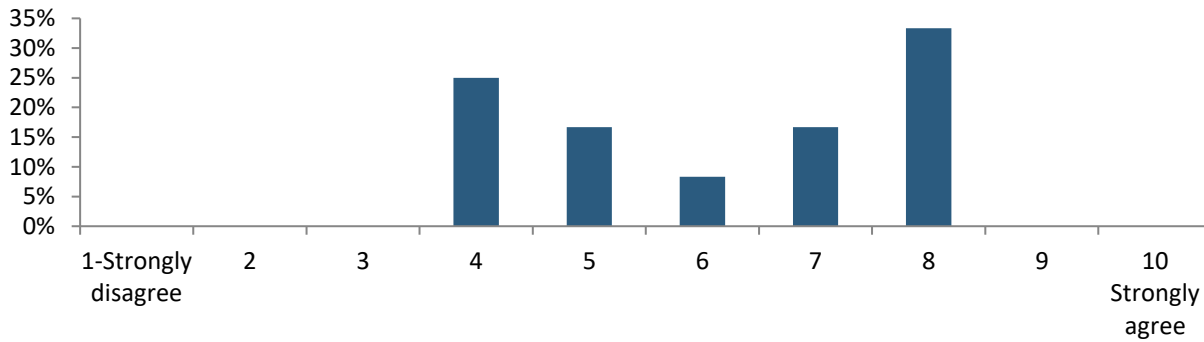
Q5. Arrangements to resolve any persisting disagreements amongst the experts seem appropriate.
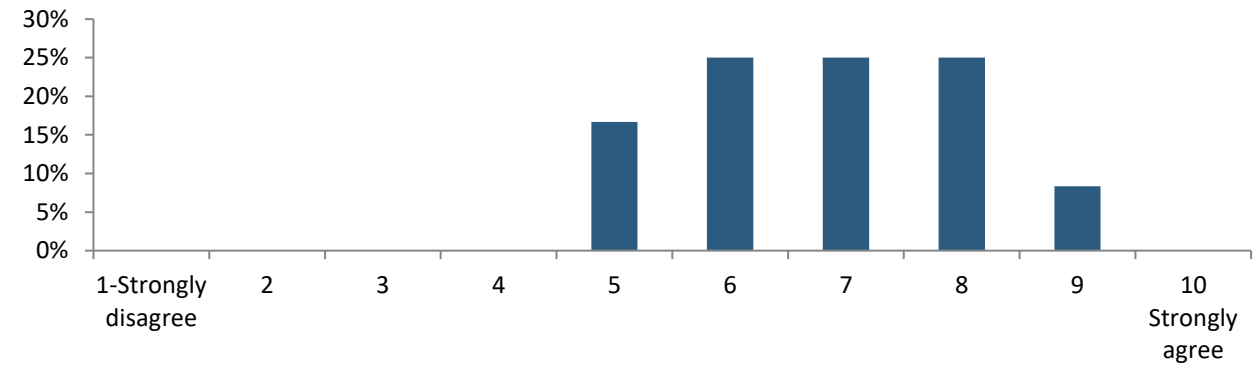
Q6. The logistics, the facilitator and the venue arrangements were appropriate to enable an effective workshop.
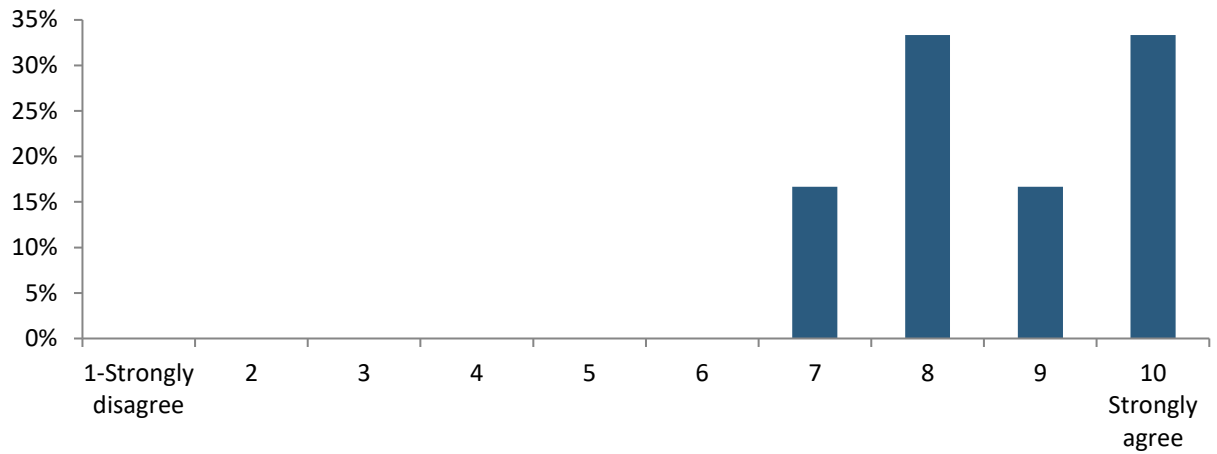
Q7. In general, I support the process and the outcomes.
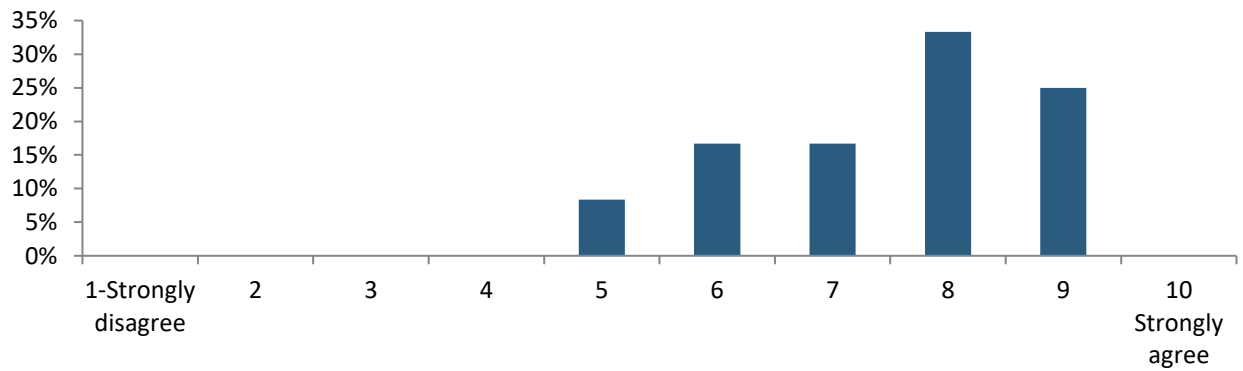
Q8. I expect that the outcomes provide a robust basis for Outlook 2019.
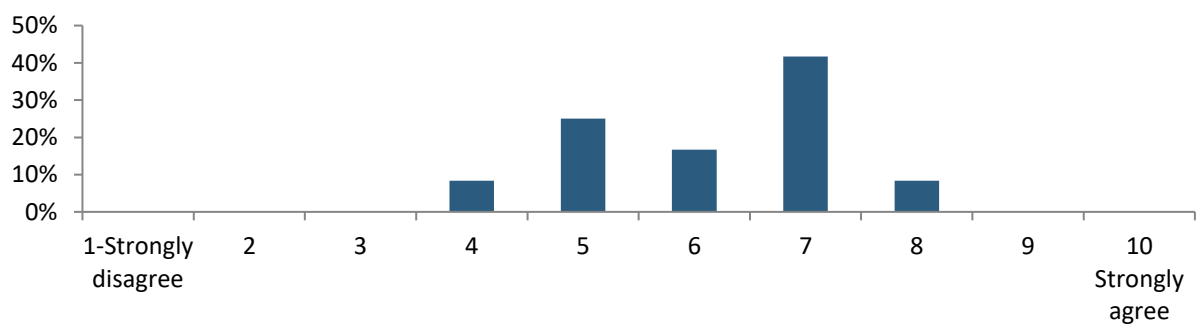
Appendix 1. Grading statements

Biodiversity

Section 54(3)(b) of the *Great Barrier Reef Marine Park Act 1975* requires "…*an assessment of the current biodiversity within …"* the Great Barrier Reef Region. This assessment is based on two assessment criteria:

- habitats to support species
- populations of species and groups of species.

Habitats to support species

Grading statement

|	
Very Good	**All** major habitats are essentially **structurally and functionally intact** and able to support all dependent species.
Good	There is **some** habitat loss, degradation or alteration **in some small areas**, leading to **minimal degradation** but no persistent, substantial effects on populations of dependent species.
Poor	Habitat loss, degradation or alteration has occurred in a **number of areas** leading to **persistent substantial effects** on populations of some dependent species.
Very Poor	There is **widespread** habitat loss, degradation or alteration leading to **persistent, substantial effects** on many populations of dependent species.

Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Populations of species and groups of species

Grading statement

Very Good	Only a **few, if any**, populations of species have deteriorated.
Good	Populations of **some** species (but no groups of species) have deteriorated significantly.
Poor	Populations of **many** species or some groups of species have deteriorated significantly.
Very Poor	Populations of **a large number** of species or groups of species have deteriorated significantly.

Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Ecosystem health

Section 54(3)(a) of the *Great Barrier Reef Marine Park Act 1975* requires "…*an assessment of the current health of the ecosystem within the Great Barrier Reef Region and of the ecosystem outside that region to the extent that it affects that region*". This assessment is based on five assessment criteria:

- physical processes
- chemical processes
- ecological processes
- outbreaks of diseases, introduced species and pest species
- terrestrial habitats that support the Great Barrier Reef.

Physical processes

Grading statement

Very Good	There are **no** significant changes in physical processes.
Good	There are **some** significant changes in physical processes in some areas, but these are **not to the extent** that they are significantly affecting ecosystem functions.
Poor	There are **substantial** changes in physical processes and these are **significantly** affecting ecosystem functions in some areas.
Very Poor	There are **substantial** changes in physical processes **across a wide area** and ecosystem functions are **seriously** affected in much of the area.
Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Chemical processes

Grading statement

Very Good	There are **no** significant changes in chemical processes.
Good	There are **some** significant changes in chemical processes in some areas, but these are **not to the extent** that they are significantly affecting ecosystem functions.
Poor	There are **substantial** changes in chemical processes and these are **significantly** affecting ecosystem functions in some areas.
Very Poor	There are **substantial** changes in chemical processes **across a wide area** and ecosystem functions are **seriously** affected in much of the area.
Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Ecological processes

Grading statement

Very Good	There are **no** significant changes in ecological processes.
Good	There are **some** significant changes in ecological processes in some areas, but these are **not to the extent** that they are significantly affecting ecosystem functions.
Poor	There are **substantial** changes in ecological processes and these are **significantly** affecting ecosystem functions in some areas.
Very Poor	There are **substantial** changes in ecological processes **across a wide area** and ecosystem functions are **seriously** affected in much of the area.

Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Outbreaks of diseases, introduced species and pest species

Grading statement

Very Good	**No records** of diseases above expected natural levels; no introduced species recorded; pest populations within naturally expected levels.
Good	Disease **occasionally above expected natural levels** but recovery prompt; any occurrences of introduced species successfully addressed; pests sometimes present above natural levels with limited effects on ecosystem function.
Poor	**Unnaturally high levels** of disease regularly recorded in some areas; occurrences of introduced species require significant intervention; pests in some areas affecting ecosystem function more than expected under natural conditions.
Very Poor	**Unnaturally high levels** of disease often recorded in **many areas**; uncontrollable outbreaks of introduced pests; opportunistic pests seriously affecting ecosystem function in many areas.

Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Terrestrial habitats that support the Great Barrier Reef

Grading statement

Very Good	**All** major habitats are essentially structurally and functionally intact and able to support all dependent species.
Good	There is **some** habitat loss, degradation or alteration **in some small areas**, leading to **minimal degradation** but no persistent, substantial effects on populations of dependent species.
Poor	Habitat loss, degradation or alteration has occurred in a **number of areas** leading to **persistent substantial effects** on populations of some dependent species.
Very Poor	There is **widespread** habitat loss, degradation or alteration leading to **persistent, substantial effects** on many populations of dependent species.
Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Indigenous and historic heritage

This assessment is based on two assessment criteria:

- Heritage values-Indigenous
- Heritage values-historic

The same grading statement was used for both components.

Grading statement

Very Good	Heritage values have been systematically and **comprehensively identified** and included in relevant inventories or reserves. Known heritage values are well-maintained and retain a **high degree of integrity**.
Good	Heritage values have been **mostly identified** and included in relevant inventories or reserves. Known heritage values are generally maintained and **retain much of their integrity**.
Poor	Heritage values have **not been systematically identified**. Known heritage values are degrading and **generally lack integrity**.
Very Poor	Known heritage values have **not been identified**. Known heritage values are **degraded and lack integrity**.
Trend	Improved Stable Deteriorated No clear trend
Confidence in condition and trend	High: Adequate high-quality evidence and high level of consensus Medium: Limited evidence or limited consensus Low: Very limited evidence, assessment based on anecdotal information

Appendix 2. Risk assessment framework

Risks to the Great Barrier Reef Region's ecosystem and heritage values

Section 54(3)(d) of the Great Barrier Reef Marine Park Act 1975 requires "…an assessment of the risks to the ecosystem…" within the Great Barrier Reef Region.

This assessment of risk is based on the current state and trends of the Great Barrier Reef ecosystem's biodiversity and health, the factors influencing the values of the Region, the effectiveness of protection and management arrangements and ultimately an understanding of the ecosystem's overall resilience.

In essence this is an assessment of the residual risk to the Region-wide ecosystem, noting the items above. For this risk assessment, threats to natural values components are categorised as Region-wide or local based on the scale of the consequence. A threat may be happening in many places but when the consequence is considered, a threat is at Region-wide scale if the Region-wide ecosystem suffers, and at local scale alone if the consequence does not impact at the Region-wide scale. For example:

- Rising sea temperature happens over a very wide area and the Region-wide ecosystem as a whole suffers.
- Ship groundings may happen in many places but the Region-wide system as a whole does not suffer.

Risks to heritage values components were assessed at the scale that was appropriate to their occurrence rather than at a regional or local scale, resulting in a single consequence score. For example, risks to historic lighthouses were considered based on the known extent of historic lighthouses in the region.

Likelihood	Expected frequency of a given threat
Almost Certain	Expected to occur more or less continuously throughout a year
Likely	Not expected to be continuous but expected to occur one or more times in a year
Possible	Not expected to occur annually but expected to occur within a 10-year period
Unlikely	Not expected to occur in a 10-year period but expected to occur in a 100-year period
Rare	Not expected to occur within the next 100 years

Consequence	Ecosystem		Heritage
	Broad scale	Local scale	
Catastrophic	Impact is clearly affecting, or would clearly affect, the nature of the ecosystem over a wide area. Recovery periods greater than 20 years likely.	—	Impact is or has the potential to destroy a class or collection of heritage places on a large scale; or is clearly affecting, or would clearly affect, a range of heritage values over a wide area.
Major	Impact is, or would be, significant at a wider scale. Recovery periods of 10 to 20 years likely.	Impact is, or would be, extremely serious and possibly irreversible to a sensitive population or community. Condition of an affected part of the ecosystem possibly irretrievably compromised.	Impact is, or would, adversely affect the heritage values of a number of places; destroy individual heritage places of great significance; or significantly affect the heritage values over a wide area.
Moderate	Impact is, or would be, present at a wider scale, affecting some components of the ecosystem. Recovery periods of five to 10 years likely.	Impact is, or would be, serious and possibly irreversible over a small area. Recovery periods of 10 to 20 years likely.	Impact is, or would, affect individual heritage places or values of significance; or affect to some extent the heritage values at a wider scale.
Minor	Impact is, or would be, not discernible at a wider scale. Impact would not impair the overall condition of the ecosystem, or a sensitive population or community, over a wider level.	Impact is, or would be, significant to a sensitive population or community at a local level. Recovery periods of five to 10 years likely.	Impact is, or would, affect heritage places or values of local significance, but not at a wider scale. Impact would not impair the overall condition of the heritage values.
Insignificant	No impact; or if impact is, or would be, present then only to the extent that it has no discernible effect on the overall condition of the ecosystem.	No impact or if impact is, or would be, present then only to the extent that it has no discernible effect on the overall condition of the ecosystem.	No impact; or if impact is, or would be, present then only to the extent that it has no discernible effect on the heritage values; or positive impact.

	Consequence				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Medium	High	Very High	Very High
Likely	Low	Medium	High	High	Very High
Possible	Low	Low	Medium	High	Very High
Unlikely	Low	Low	Low	Medium	High
Rare	Low	Low	Low	Medium	High

Appendix 3. Workshop participants and attendance

Participant name		Institutional affiliation	Day 1	Day 2	Day 3	Day 4	Day 5	Remote
Bell	Ian	Department of Agriculture and Fisheries	✓					
Bourne	David	James Cook University		✓				
Bridge	Tom	Museum of Tropical North Queensland/JCU			✓			
Brinkman	Richard	Australian Institute of Marine Science						
Burrows	Damien	James Cook University		✓				
Cantin	Neal	Australian Institute of Marine Science			✓	✓		
Ceccarelli	Danni	Consultant Marine Ecology			✓	✓		
Coles	Rob	James Cook University	✓	✓	✓	✓		
Collier	Catherine	James Cook University	✓			✓		
Diaz Pulido	Guillermo	Griffith University	✓	✓	✓			
Emslie	Mike	Australian Institute of Marine Science			✓			
Fabricius	Katharina	Australian Institute of Marine Science		✓		✓		
Grech	Alana	James Cook University	✓			✓		
Hamann	Mark	James Cook University	✓					
Hemson	Graham	Queensland Parks and Wildlife	✓	✓				
Heron	Scott	National Oceanic and Atmospheric Administration	✓	✓	✓	✓		
Heupel	Michelle	Australian Institute of Marine Science			✓			
Hoey	Andrew	James Cook University		✓	✓	✓		
Hoggett	Anne	Lizard Island Research Station						✓

Surname	First name	Institution						
Hutchings	Pat	Australian Museum	✓	✓	✓	✓		
Kahn	Amer	Department of Environment and Science					✓	
Kroon	Frederieke	Australian Institute of Marine Science	✓			✓		
Lambrides	Ariana	James Cook University					✓	
Lewis	Stephen	James Cook University						✓
Lough	Janice	Australian Institute of Marine Science						✓
Marsh	Helene	James Cook University	✓	✓				
McDougall	Andrew	Queensland Parks and Wildlife	✓	✓	✓	✓		
McKenzie	Len	James Cook University	✓	✓	✓	✓		
McNeil	Mardi	Queensland University of Technology	✓	✓				
Munday	Phil	James Cook University	✓		✓	✓		
Noad	Michael	University of Queensland		✓				
Pandolfi	John	University of Queensland						✓
Rasheed	Michael	James Cook University	✓	✓	✓	✓		
Roelofs	Anthony	Department of Agriculture and Fisheries			✓	✓		
Schaffelke	Britta	Australian Institute of Marine Science	✓			✓		
Shimada	Taka	James Cook University	✓					
Simpfendorfer	Colin	James Cook University			✓			
Smith	Grant	Bureau of Meteorology	✓	✓	✓	✓		
Stuart	Greg	Bureau of Meteorology	✓	✓	✓	✓		
Sweatman	Hugh	Australian Institute of Marine Science			✓			
Thompson	Angus	Australian Institute of Marine Science			✓			

Udywayer	Vinay	Australian Institute of Marine Science						✓
Ulm	Sean	James Cook University					✓	
Vale	Lyle	Lizard Island Research Station						✓
Webster	Nicole	Australian Institute of Marine Science		✓				
Wolfe	Kenny	University of Queensland	✓	✓	✓	✓		