Submission to the Senate Standing Committee on Environment and Communications References Committee

Inquiry into the management of the Great Barrier Reef

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This submission to the Senate Committee on the *Inquiry into the management of the Great Barrier Reef* addresses elements of the Terms of Reference and more generally how effectively Governments are managing and protecting the Great Barrier Reef (GBR), a World Heritage Area (WHA).

The Great Barrier Reef World Heritage Area (GBRWHA) is a world icon and we are seeing an unprecedented growth of industrial activities occurring within and adjacent to the GBR. The GBR is now under serious threat due to the increasing and competing uses and the cumulative impacts of these activities, which include serious shifts in ocean temperature and acidity. This submission outlines the science and evidence of the increasing danger to, and degradation of, the GBR, as well as outlining the urgency to act by putting in place adequate management measures based on evidence and offers practical solutions for the long-term sustainability of the GBRWHA.

Sincerely,

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The Great Barrier Reef World Heritage Area

The GBR is the world's largest continuous coral reef ecosystem. It is home to hundreds of thousands of plants, animals and other forms of life. As with coral reefs elsewhere it is an unrivalled storehouse of biological diversity, as much as 25% of ocean life being associated with coral reefs like the GBR. These organisms and ecosystem processes provide enormous benefits to coastal Queensland and Australia in general. Not only does a healthy GBR support commercial and recreational activities, such as fisheries and tourism, but a Deloitte's economic study estimated that the value-added economic contribution of the GBRWHA to the Australian economy in 2011-12 was $5.68 billion per annum, with the Park generating almost 69 000 full time equivalent jobs (Deloitte Access Economics 2013). In addition to these direct socio-economic benefits, the outer reef systems of the Great Barrier Reef provide ecosystem services such as protecting Queensland coastlines, securing human infrastructure and shielding critical ecosystems such as mangroves and sea-grasses from the power of ocean waves and storms. These ecosystem benefits are irreplaceable, but if the GBR is managed effectively, are ongoing benefits in perpetuity.

For these reasons, it is important that State and Federal governments heed the conclusions of the best science for responding to any threats to this valuable part of Queensland's ecological assets. In this regard, the Great Barrier Reef Marine Park Authority (GBRMPA) has developed science-based management of the Great Barrier Reef, complete with the rezoning of the Marine Park, which was carried out from 1999 - 2004 in order to protect a greater amount and diversity of GBR habitats and ecosystem components. By engaging with national and international scientific communities, GBRMPA has developed a clear understanding of the major threats to the health of the Great Barrier Reef and the ongoing processes such as the recent vulnerability assessment (Johnson & Marshall 2007) the ongoing State of the Reef reports (e.g. GBRMPA 2006) and the GBR Outlook Report (GBRMPA 2009). Through these careful scientific processes, both changes to ocean temperature (climate in general) plus water quality were identified as the most serious threats to the health of the GBR.

The adequacy of the Australian and Queensland Governments' efforts to stop the rapid decline of the Great Barrier Reef, including but not limited to:

Management of the impacts of industrialisation of the reef coastline, including dredging, offshore dumping, and industrial shipping, in particular, but not limited to, current and proposed development in the following regions or locations:

i. Gladstone Harbour and Curtis Island
ii. Abbot Point,
iii. Fitzroy Delta, and
iv. Cape Melville and Bathurst Bay

Recent activities along the coast of Queensland, as well as proposals for further changes and increased coastal development adjacent to the GBRWHA, have heightened concerns among experts who study physical, chemical and biological systems associated with the Great Barrier Reef. While serious issues remain with respect to coastal agriculture, approvals have been given for further disturbances to coastal Queensland (eg. Abbott Point). These activities include industrialization, dredging, offshore dumping of dredging spoils, and international shipping, all of which further contribute to the problems that Queensland is facing with respect to the health of its GBR. These industrial activities and their impacts are adding to agricultural run-off issues, which have not been resolved to date.

It is important to note that conditions in terrestrial catchments are strongly connected with marine receiving waters therefore land-based impacts, such as from ports, need further assessment and research (Beger et al 2010, Alvarez-Romero et al 2011, Brodie & Waterhouse 2012). Therefore, it is absolutely vital that disturbances to catchments along the Queensland coastline are being decreased as opposed to being increased. This is consistent with the 2013 Scientific Consensus Statement on land use impacts on Great Barrier Reef water quality and ecosystem condition, published by the State of Queensland in 2013. This scientific consensus statement highlights that while the current management interventions are starting to address water quality in the GBR, sustained and greater effort will be needed to achieve the ultimate goal of no detrimental impact on the health and resilience of the GBR (State of Queensland 2013). Adding further impacts, coastal development and the dumping of dredge spoil within the GBRWHA is not consistent with these scientific conclusions and consensus.

Management of the impacts of agricultural runoff

There is strong scientific consensus that key Great Barrier Reef ecosystems such as reef building corals are showing declining trends in condition due to continuing poor water quality, cumulative impacts of climate change, and increasing intensity of extreme events (State of Queensland 2013). Declining marine water quality, influenced by terrestrial runoff, is recognised as one of the most significant threats to the long-term health of the GBR (Productivity Commission 2003, GBRMPA 2009). Management of this issue will improve ecosystem resilience to other pressures including those associated with a changing climate (State of Queensland 2013).

While global climate change is undoubtedly the most serious threat to the GBR over the longer term (i.e. multi-decadal; IPCC 2014), declining water quality poses challenges on a much shorter timeframe (Productivity Commission 2003). Over the past century, increasing agricultural activity within catchments and coastal areas (deforestation, increased agriculture and grazing) has increased the amount of settlements and nutrients flowing into coastal regions of Queensland. Many organisms, including reef-building corals, are very susceptible through impacts such the smothering of corals by sediments, as well as reductions in light levels due to the increased turbidity of coastal waters as a consequence of settlements and algal blooms (triggered by the increased amounts of nutrients). Studies such as those of Wachenfeld (1997) show many photographic examples where corals have disappeared coastal Queensland over the past century.

Over the past 40 years, impacts from predators such as Crown of Thorns Starfish (COTS) have increased, primarily as a result of the increased availability of nutrients within Great Barrier Reef waters (Fabricius et al. 2010). These changes have led to the decline of approximately 50% of the crucially important reef building corals of the GBR (De'ath et al. 2012). In the latter case, a rigorous long-term study carried out by the Australian Institute of Marine Science, found that the unprecedented decline was identified as being due to tropical cyclones (48%), predation by Crown-of-Thorns Starfish (COTS; 42%), and coral bleaching from ocean warming (10%) (De'ath et al. 2012). Given that there is limited evidence that demonstrates that the frequency and intensity of cyclones has increased dramatically within the GBR region, impacts from disturbances such as cyclones, COTS and bleaching are clearly aggravated by a background decline in the health and hence ability of corals to grow back after disturbances (referring back to the concept of aggregated impacts). There is also evidence that reef-building corals have declined in their growth rate by 14% since 1990 (De'ath et al. 2009). This throws an

additional spotlight on water quality as a key parameter to be managed carefully if the sustainability of the coral dominated Great Barrier Reef is to be preserved.

Management of non-agricultural activities within reef catchments impacting on the reef, including legacy mines, current mining activities and practices, residential and tourism developments, and industrial operations including Yabulu

It is essential to protect the Reef from the impacts of future unsustainable development. One-off major developments, such as ports, can have significant impacts, as too can the cumulative impact of numerous smaller developments. To improve Reef health, we need to significantly invest in better management of current activities, such as cutting farm pollution, reducing overgrazing of our catchments, improving port management, as well as restoring key ecosystems that have been lost over past decades and century.

Not only is increased investment needed from the private and public sectors, we need to ensure this money is spent to most cost-effectively address the key risks to the Reef's health. A cost-effective prioritization of management actions that explicitly considers the economic costs, feasibility, and biodiversity benefits of a range of marine and terrestrial management actions to identify priorities has not been done in the GBR, and is urgently required if we want to spend the limited budget effectively.

Ensuring the Great Barrier Reef Marine Park Authority has the independence, resourcing and capacity to act in the best interest of the long-term health of the Reef.

The most fundamental information required for sound environmental management to ensure the long term health of the reef is knowledge of, and capability to measure, what is in the environment and how it is changing over time. In the context of the Great Barrier Reef Marine Park - one of these requirements is a map of all reef locations/boundaries, their dimensions (depth) and their composition in terms of benthic communities and substrate types, and in more detail the amount of coral cover. Currently there are no existing maps and no plan to establish a baseline map or to regularly update a map that provides details of the location, depth and composition (benthic communities and substrate types) of the entire Great Barrier Reef. The majority of Australian Local government, catchment and State environmental monitoring and management programs in terrestrial environments invest significant resources in producing and updating these baseline maps and use them extensively for mapping, monitoring, modeling and management. These maps are used in association with intensive on-ground sampling at select sites. The GBR does have a number of long term field programs measuring coral cover and other variables that control the health or conditions of corals. More effective use can be made of these data sources in association with maps of coral reef extent and composition.

The second most critical source of information is the collection of data using repeatable and consistent methods. This provides an ability to measure and detect changes in the composition and condition of the reefs that make up the Great Barrier Reef from site scales (m^2) to the entire reef system ($10^6 km^2$). Although there are *in-situ* long term monitoring programs, they cover selected environmental variables and sample a limited section of the entire reef system (< 1%). As a sampling technique they are effective, however they can be significantly enhanced by inclusion of spatial information for the entire reef system collected on a regular basis covering 100%. Again, best practice environmental monitoring and management by Australia's Local governments, catchment and State environmental monitoring and management programs in

terrestrial environments implements these approaches routinely, for example the Statewide Land Cover and Tree Survey in Queensland which provides the base data for multiple environmental monitoring programs.

Whether government decision processes impacting the reef are consistent with the precautionary principle

The *precautionary principle* states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus (collective judgment, position and opinion of the community of scientists in a particular field of study) that the action or policy is harmful, the burden of proof (obligation rests with those laying the charges to produce the evidence) that it is **not** harmful falls on those taking an action.

The principle is used by policy makers to justify discretionary decisions in situations where there is the possibility of harm from taking a particular course or making a certain decision when extensive scientific knowledge on the matter is lacking. The principle implies that there is a social responsibility to protect the public from exposure to harm, when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result.

In regards to the Great Barrier Reef the GBR Marine Park rezoning process (undertaken from 1999-2004) followed world-class systematic spatial decision making methods (Fernandes 2005). This decision-making process has been exemplary and the resulting Marine Protected Area (MPA) system is consistent with the precautionary principle. However, smaller scale decision-making and development approvals appear to follow this principle to a lesser extent. For example, the Port Hinchinbrook development was approved to the detriment of local mangrove habitats, yet the hope of attracting tourism and people to Cardwell was apparently not well-founded within market trends, because the site was never taken up. Similarly, recent port development approvals and offset strategies build on the assumption that the impact of dredging on seagrass and reef habitats is quantifiable when this is not consistent with the precautionary principle – where in this case we are assuming high potential impacts when there is high uncertainty with impact predictions given operational schedules of construction and operation of these developments.

The identification and protection of off-limits areas on the reef coastline to help protect the health of the reef

The network of marine protected areas in the GBR is world-class. However, additional areas may be required to accommodate emerging threats in a changing climate. The current zoning plan should be revisited at least every 10 years to assess if new areas are required to protect the coastline in place of or in addition to existing areas, due to changes within and adjacent to the GBR, such as an increasing coastal population and associated impacts (i.e. increasing urban and industrial activities). However, unless the catchments are well managed, marine ecosystems may continue to degrade despite establishing new protected areas. Thus, any rezoning should comprehensively consider the impacts of land based activities when deciding what and where to protect.

Consistency of efforts with the World Heritage Committee's recommendations on what is required to protect the reef

The GBR was listed under the UNESCO World Heritage Convention in 1981 which followed the creation of the Great Barrier Reef Marine Park in 1975. The GBR was listed on the basis of its "*exceptional natural beauty and aesthetic importance*" and as an outstanding example of a property "representing significant ongoing ecological processes". In June 2011 however, the World Heritage Committee noted "with extreme concern the approval of liquefied natural gas processing import facilities on Curtis Island within the property". This then triggered a reactive monitoring mission by the World Heritage Committee to the Great Barrier Reef World Heritage site, with concern over Australia's promise during the original listing process to "ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory". In addition to stated proposals for expanding coastal ports along the Queensland coastline, these actions have collectively triggered the possibility that the UNESCO World Heritage Committee may relist the GBR as a World Heritage site 'in danger' (a real possibility that may come up in early 2015). There is a widespread view that relisting the GBR as a world Heritage site 'in danger' would pose significant threats to the very profitable (*in perpetuity*) GBR tourist industry (which would also have significant flow-on impacts to other businesses who rely on the GBR).

The UNESCO Committee requests quite clearly in its 36 Session in St Petersburg, Russia (24 June – 6 July 2012) that "the State Party to not permit any new port development or associated infrastructure outside of the existing and long-established major port areas within or adjoining the property, and to ensure that development is not permitted if it would impact individually or cumulatively on the Outstanding Universal Value of the property." Given water quality has been identified as one of the greatest threats to the GBR, recent decisions by the Minister for the Environment, Mr Greg Hunt, to dump 3,000,000 m^3 of dredging spoils from the Abbott Point expansion into GBRMPA waters is inconsistent with solving the problem of declining water quality within the GBRMPA, and with the UNESCO World Heritage recommendations. Given the other significant dredging activities that are planned along the Queensland coastline (through the Queensland Government's proposed draft Great Barrier Reefs Ports Strategy) this approach to the problem will only compound to an already serious environmental problem. Given that we are already losing critical organisms from the Great Barrier Reef at 1 to 2% per year, is not a time to increase the problem with the hope that we can offset impacts through reductions in other parts of the system.

It is our scientific opinion that further expansion of coastal activities is inconsistent with the UNESCO World Heritage recommendations. As scientific experts on many of the issues, we feel certain that advisers to the UNESCO World Heritage Committee will come to a similar conclusion. In terms of the current strategy, we also urge both State and Federal governments to evaluate the scientific evidence carefully and put the onus on parties attempting to develop port facilities to show that all risks to the Great Barrier Reef have been brought to zero. Given that the problem of water quality is increasing not decreasing, the addition of millions of m^3 of dredging spoils to the coastal waters of the GBR is currently highly inconsistent with the recommendations of UNESCO and policy making designed to address the catastrophic decline of the health of one of Australia's most valuable environment assets.

The extent to which government decisions impacting the reef, including development of the strategic assessments and Reef 2050 Plan, involve genuine, open and transparent consultation with the Australian community, affected industries and relevant scientific experts, and genuine consideration of the broader community's views in final decisions;

As a research community we look forward to the invitation to be involved in the future planning and management of the Great Barrier Reef, including the Reef 2050 Plan. The scientific community can provide the evidence-base necessary for future decision-making regarding the sustainability and resilience of the GBR. Both levels of Government in Australia have the opportunity to tap into world-class researchers sitting on the doorstep of the GBR. The evidence-base scientific experts can provide will need to be balanced with on-ground practical solutions and community views when planning for and managing the long-term sustainability of this precious World Heritage Area.

Any other related matters.

1. Climate Change impacts and adaptation on the GBR

Climate change has been identified as one of the greatest threats to the health of the Great Barrier Reef, both in national (e.g. Johnson and Marshall 2007) and international assessments (IPCC 2014). Rising sea temperatures pose serious threats to reef-building corals which undergo mass coral bleaching and mortality if sea temperatures rise above 1-2°C above the long-term summer average (Hoegh-Guldberg 1999, Hoegh-Guldberg et al. 2007, IPCC 2014). These organisms are highly sensitive to what amounts to 'underwater heat waves', losing a critical symbiosis that they enjoy with dinoflagellates. This symbiosis provides enormous amounts of solar energy that ultimately drives the growth and calcification of reef building corals systems like the GBR. Prior to 1979, there were no scientific reports of mass coral bleaching and mortality, however, over the past 25 years there has been numerous bleaching events which have had significant damage to coral reefs world-wide (Hoegh-Guldberg 1999, Hoegh-Guldberg et al. 2007). In two separate events, 1998 and 2002, over 50% of the Great Barrier Reef was affected, with the loss of corals estimated to be around 10%. By mid-century, it is expected that such events will result in the loss of close to 100% of corals on the GBR.

The problem with thermal stress is exacerbated by 'ocean acidification' which is an additional consequence of rising levels of carbon dioxide in the atmosphere (Hoegh-Guldberg et al. 2007). Around 30% of the CO_2 generated by the burning of fossil fuels has been absorbed by the upper layers of the ocean. On entering the ocean, CO_2 reacts with water to create a dilute acid (Carbonic acid) subsequently reducing the pH of the ocean, while at the same time decreasing the carbonate ion concentration. The pH of the upper layers of the ocean has decreased by 0.1 pH units since the advent of the industrial revolution. Given the pH scale is exponential, this is equivalent to a 26% increase in concentration of protons and a similar decrease in the concentration of carbonate ions. There is now a growing body of experimental evidence that shows that coral growth and calcification decrease substantially as the concentration of CO_2 increases. In combination, increased temperature and acidity both kill corals and dissolve the reef framework (Dove et al. 2013). The implication of the latter may have serious consequences for the ability of reef systems to protect the Queensland coastline from waves and cyclone impacts.

When one extrapolates into the future, large-scale impacts such as mass coral bleaching and mortality threatens the long-term sustainability of reefs, with temperatures and acidity levels exceeding the known tolerance of corals and the carbon reefs that they build every year by 2050. This has highlighted the fact that a massive reduction in

emissions from fossil fuels and deforestation is required if we are to maintain the use of our invaluable ecosystems beyond mid-century (Donner et al. 2005; Frieler et al. 2013). These observations with coral reefs are consistent with the International community's acceptance that average global temperatures rise above 2°C above the Preindustrial Period will take natural and human ecosystems to climate change which will be largely unmanageable. Recent work (e.g. Figure 3, Meinshausen et al. 2009; IPCC 2014) has identified that the amount of fossil fuels that can be combusted safely under this restraint is only about 20% of the listed fossil fuel reserves. This poses a major issue for much of the corporate wealth that is currently dependent on fossil fuels as an investment (Carbon Tracker 2013). It also further emphasizes why the State and Federal governments should be even more cautious when it comes to building structures around the resource which may devalue rapidly over the coming decades. Given that the Great Barrier Reef will continue to deliver billions of dollars in jobs and benefits for the Australian people, the building of infrastructure around a resource which will only provide temporary benefits while risking the GBR doesn't make a huge amount of logic or sense.

Adaptation

The recent study, by the Australian National Climate Change Adaptation Research Facility, on the limits to adaptation in the Great Barrier Reef focused on the social limits to sustaining the fishing and reef-based tourism industries (Evans et al., 2013). Scenarios of future change and response were developed with stakeholders, identifying a range of adaptation strategies for both industries. Three themes were common to adaptation in both industries: *better stewardship of the reef*; improvements in business operations, such as forecasting, financial management, marketing and networking; and diversification of current and alternative income sources, including through diversification of catch and markets in the fisheries sectors, and diversification of water-based activities and markets in reef-based tourism.

The work identified that portfolios of adaptation strategies are the most effective way to delay reaching the limits to adaptation. For example, in the Great Barrier Reef, multiple strategies can help sustain fisheries and tourism, including some not obviously related to climate change. These include stewardship practices, business planning, marketing, currency devaluation, and industry support packages.

Adaptation strategies are important for decision-making for three reasons:

- First, it helps to determine which responses to climate change are practicable and legitimate, and the time scales over which adaptation may be effective
- Second, it helps to understand how people may respond to the damage to, or the loss of, things that are important to them, and whether there are potential substitutes or ameliorating policy measures
- Third, it can help prioritize adaptation strategies, refine our understanding of their intentions, and identify communities that will be well served by them.

2. Use of Offsets

Environmental offset policies have regularly been used by Commonwealth and State Governments in Australia to achieve environmental goals. Offsets can be broadly defined as 'measures that compensate for the residual impacts of an action on the environment' (Australian Government 2012). Governments should be wary of relying solely on environmental offsets to compensate for impacts on areas of national environmental significance, such as the GBR. A case in point is the findings of recent research carried out by Bell et al (2014) on whether or not the Environment Protection and Biodiversity Conservation (EPBC) policy adequately catered for offsetting impacts on marine

ecosystems (with seagrass used as an example). Bell et al (2014) stated that environmental offsets for seagrass ecosystems should be used as a last line of defense when damage from development is considered to be necessary and unavoidable.

Several offset policies relevant to seagrass are currently in place in Australia at both the State and Federal levels. Consistency amongst these government policies in-line with the most recent scientific advancements on seagrass rehabilitation will improve the likelihood that offset programs will deliver the promise of protecting environmental values. Further research is required to determine which rehabilitation strategies will be most effective (Bell et al 2014). In this case the use of the precautionary principle and utilizing scientific research to provide rigor and an evidence-base behind environmental offset decision-making is the suggested approach regarding the long-term sustainability and resilience of the GBR. Governments should also ask the question that in the absence of science, should offsets be used?

3. Setting Conservation Priorities

There is a well-established scientific field – decision science - that addresses the setting of conservation priorities, which has its fundamental roots in economics and applied mathematics. The field of decision science has provided information and tools to ensure that prioritizations deliver objective, defensible, and ultimately efficient conservation decisions (Game et al 2013). It is used for all decision-making in economics, mathematics, engineering, health, defense – pretty well everything. Existing catchment management prioritization approaches in the GBR do not use decision science and include mistakes that can undermine their authors' intention to be more rigorous and scientific in the way priorities are established and resources allocated.

Over the coming years, millions of dollars will be invested in achieving environmental outcomes in the Great Barrier Reef. As part of this, the Australian Government has committed another $200 million to continue efforts to protect the GBR through improvement to the quality of water flowing into the GBR lagoon through Caring for Our Country's Reef Rescue program. Further, $40 million is to be committed under the Reef Trust program (Klein & Possingham 2013).

A cost-effective prioritisation of management actions that explicitly considers the economic costs, feasibility, and biodiversity benefits of a range of marine and terrestrial management actions to identify priorities has not been done in the GBR, and is urgently required if we want to spend the limited budget effectively.

Conservation of the GBR has too few resources for its daunting challenge to be misapplying or not taking advantage of decision science. As a great deal of the science that underpins conservation prioritisation has been done by Australian Scientists, the Australian Government has an advantage and unique opportunity to be a global leader in showing how decision science can be applied to setting conservation priorities to secure one of the world's greatest natural assets, the GBR (Klein & Possingham 2013).

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