Improved dredge material management for the Great Barrier Reef Region: Interpretive statement of findings and management implications of the technical reports for the Great Barrier Reef Strategic Assessment

The strategic assessment

The Australian and Queensland governments are working together to undertake a comprehensive strategic assessment of the Great Barrier Reef World Heritage Area and the adjacent coastal zone. The strategic assessment will help identify, plan for and manage existing and emerging risks to ensure ongoing protection and management of the unique environmental values of the World Heritage Area and adjacent coastal zone.

This will be achieved by:

1. investigating the adequacy of the existing management arrangements for the Great Barrier Reef World Heritage Area
2. assessing current and future development policies and planning in the World Heritage Area and the adjacent coastal zone and analysing likely direct, indirect and cumulative impacts.

The Great Barrier Reef Marine Park Authority (GBRMPA) is undertaking the strategic assessment for the World Heritage Area (that is, the marine area and associated Commonwealth islands). The Queensland Government is undertaking the strategic assessment for the adjacent coastal area.

The Australian Government has invested in new research to inform the strategic assessment. The research has been targeted to address key information gaps relating to the future management of the World Heritage Area and to address issues raised by the World Heritage Committee. It includes a range of technical assessments to describe ecological, social, cultural and economic values of the Reef and enhance understanding of how different threats and pressures (for example, those associated with coastal development, tourism, shipping and island management) impact on those values.

As part of the new research, GBRMPA commissioned consultants to prepare a number of technical reports in relation to dredge material management in the World Heritage Area. These were subject to a constrained timeframe that only allowed for limited consultation with affected stakeholders.

Aim of the dredge material management technical reports

The technical reports sought to:

- perform a literature review and cost-benefit analysis that synthesises the available literature on the environmental and financial costs associated with land-based re-use and land-based disposal options for dredge material at six locations (Port of Gladstone, Rosslyn Bay State Boat Harbour, the Port of Hay Point, the Port of Abbot Point, the Port of Townsville, and the Port of Cairns)
- develop a generic water quality monitoring framework that can be applied to developing a water quality monitoring and management program for any dredge material placement site
- identify potential alternative dredge material placement areas within 50 kilometres of the six port locations, based on environmental, socioeconomic, and operational considerations, as well as hydrodynamic modelling of bed shear-stress.

This interpretative statement has been developed for the purpose of informing the readers of these reports — be they members of the public, scientists or agency staff — on their findings and limitations. It also demonstrates how GBRMPA interprets the reports and how the reports may be used. During the development of the statement, GBRMPA consulted with stakeholders including the Australian Institute of Marine Sciences, the Department of Environment and the Queensland Ports Association.

Broader context

The results of this study should be considered in the context of the broader body of knowledge relating to the movement and impact of dredge material and the changing condition of the Great Barrier Reef ecosystem. This includes:

- insights gained from monitoring associated with dredging and disposal activities
- the *Great Barrier Reef Outlook Report*[1] *2009* (which rated the risks posed from dredging and spoil dumping as medium)
- the Reef Plan *2013 Scientific consensus statement – land use impacts on Great Barrier Reef Water Quality and ecosystem condition* (which found point sources of sediment could be locally, and over short-time periods, highly significant)
- the *Great Barrier Reef Biodiversity Conservation Strategy 2013* and supporting vulnerability assessments
- the *Informing the Outlook for Great Barrier Reef Coastal Ecosystems* report.

GBRMPA's Outlook Report 2009 rated coastal development as having a high impact on environmental values (p. 113), where the term coastal development includes all the development activities within the Great Barrier Reef catchment, such as rural land use, mining and industry, population growth, urban infrastructure and port development (p.99). In the Outlook Report 2009 risk assessment, dredging and spoil dumping was rated as a

[1] Great Barrier Reef Marine Park Authority, 2009, *Great Barrier Reef Outlook Report 2009*, Great Barrier Reef Marine Park Authority, Townsville

'medium' and localised risk, being only one of the multiple sources of disturbance of coastal habitats.

More recently, there have been a number of proposals to expand several major ports and develop several 'greenfield' sites. Between 2000 and 2012, the total volume of material placed in designated dredge material placement areas within the Great Barrier Reef World Heritage Area from capital dredging was approximately 14 million cubic metres. Material placed in the dredge material placement areas, resulting from maintenance dredging of shipping channels and berths, averaged about one million cubic metres per year. Over the coming decade, the need to place dredged material within the World Heritage Area will potentially be significantly higher[2].

Since the Outlook Report 2009, GBRMPA has released two science based reports: the *Great Barrier Reef Biodiversity Conservation Strategy 2013*[3] and the *Informing the outlook for Great Barrier Reef coastal ecosystems*[4]. These highlight the issue of declines and losses of species and communities in the southern inshore Great Barrier Reef. Through a combination of historical and more recent impacts, some of the most significant components of the Reef ecosystem (including coral, seagrass and dugong) are at their lowest recorded levels, particularly in southern inshore areas.

This decline is also highlighted by three progressively poorer Reef Plan report cards for inshore marine ecosystems, especially for seagrasses that provide both habitat and food for numerous species (particularly dugong and green turtle). Declining marine water quality, influenced by terrestrial run-off and other factors, has been recognised as one of the most significant threats to the long-term health of the Great Barrier Reef (2013 Scientific consensus statement). One of the key causes for the recent decline in seagrass may be related to a prolonged period of intense wet seasons with associated major cyclones (for example, cyclone Yasi)[5]. Long-term monitoring of seagrass near ports by researchers from the Queensland Government (now James Cook University) has not implicated dredging or other anthropogenic influences as causes for the marked decline. However, McKenna and Rasheed (2013) acknowledge the "cumulative impacts of natural stressors combined with future developments associated with port expansions have the potential to impact seagrasses" and reduce their resilience to further impacts and stressors.

The most serious threats facing the Great Barrier Reef Region (the Region) are climate change impacts (such as mass coral bleaching caused by increasing temperatures and

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[2] Existing port and harbour project proposals, should they be approved, would result in approximately 43 million cubic metres of capital dredging over the coming decade, with up to 37 million cubic metres of the material potentially being placed offshore. One of these proposals is currently being reviewed by the proponent and volumes may be modified. The remaining proposals total 31 million cubic metres, with 25 million cubic metres proposed to be placed offshore. This estimate is based on proposals that have already progressed to the application stage under the EPBC Act. It does not include a number of large proposals in the pre-application stage of development.

[3] Great Barrier Reef Marine Park Authority, 2009, *Great Barrier Reef Biodiversity Conservation Strategy 2013*, Great Barrier Reef Marine Park Authority, Townsville

[4] Great Barrier Reef Marine Park Authority, 2009, *Informing the Outlook for Great Barrier Reef Coastal Ecosystems*, Great Barrier Reef Marine Park Authority, Townsville

[5] Drawn from JCU/QLD Government seagrass monitoring. Reports are regionally based and a number of reports indicate more recent declines in seagrass are likely to be due to heavy wet seasons and extreme weather events.

reduced coral growth though increasing ocean acidity), water quality impacts (mainly loss of seagrass and inshore hard coral assemblages, but likely also to contribute to crown-of-thorns starfish outbreaks), coastal degradation (loss of coastal habitat required by marine and estuarine species, and loss of wetland functions such as improving water quality) and direct use impacts (such as construction and habitat changes for human use). Impacts do not operate in isolation but overlap and interact with each other. Their accumulation through time and over an increasing area is affecting the ecosystems' ability to recover from disturbance, particularly in the inshore region.

In order to provide long-term protection of the Great Barrier Reef, it is very important to improve measurement and management of cumulative impacts and implement mechanisms which deliver net conservation benefits across the Region. While other factors, such as land run-off of sediments, nutrients and pesticides and climate change are the key factors affecting the health of the Great Barrier Reef, there is a need to manage the cumulative impacts associated with ports and shipping, particularly in light of the potential levels of proposed dredging and placement of dredged material at sea.

Dredge material management technical reports

The reports commissioned by GBRMPA in relation to dredge material management are mainly high level and do not replace the need for detailed environmental impact statements for individual development proposals. Each of the key reports is discussed below.

1. Literature review and cost analysis of land-based dredge material re-use and disposal options

Report findings

The study found beneficial re-use or land disposal at the six ports within the World Heritage Area are unlikely to be viable as a strategy for overall management of dredge material in the long term. This is based on the availability of suitable nearby land compared to the projected high volumes of dredge material involved.

The study also found there may be options for beneficial re-use at some ports, particularly for capital dredging of rocky or sandy material and small volumes of maintenance dredge material. These require careful assessment on a case-by-case basis, which should include consideration of opportunities to make use of new treatment technologies or find innovative uses for the material.

Report limitations

The report did not assess specific land availability at each port or include all of the costs associated with the land based disposal options (for example, costs to pump ashore which may be significant). However, it provided sufficient information to allow an assessment of the potential viability of various disposal and re-use options.

GBRMPA interpretation and future use

Assessments of land-based disposal options will continue to need to be included in environmental impact assessments. For projects that involve large volumes of fine grained material, proponents will be able to refer to this report to support the absence of viable land

based options for relocation of the material. However, case-by-case consideration of opportunities to make use of new treatment technologies or find innovative uses should be applied as well.

2. Water quality framework

Report findings

The study provides a general framework for developing water quality monitoring programs for dredging and material placement projects and presents recommendations for good practice in water quality monitoring programs. The study did not seek to develop detailed water quality triggers or management measures at the six ports.

The report also presents conceptual frameworks for multi-tiered reactive management, starting with investigative triggers and ramping up to more proactive management responses at higher levels of exceedance. The report recommends that trigger values incorporate consideration of the duration and frequency as well as the intensity of stressors.

Report limitations

The study provides a valuable framework for water quality, but does not replace the need to develop project-specific detailed water quality monitoring and management programs informed by more comprehensive and detailed environmental impact assessment. Project specific programs also need to include ecosystem health monitoring (for example, seagrass and coral), which was outside the scope of this study.

GBRMPA interpretation and future use

The framework is suitable for reactive management, that is at detecting potentially stress-inducing water quality conditions in time to take management actions to prevent or minimise ecological impacts.

The framework needs to be incorporated into a more strategic approach for water quality and ecological monitoring in the Region, focusing on long-term monitoring and an ability to differentiate sources of sediments, be they dredging related or land based.

The framework should be adopted in the development of a detailed water quality monitoring programs as part of comprehensive environmental impact assessments for specific dredging and disposal projects.

3. Sensitive receptor risk assessment of alternative and current dredge material placement sites

Report findings

The study identified potential alternative dredge material placement areas in each port location, and used a relatively new (for dredge) plume modelling approach to compare sediment plumes and long-term migration of sediment from these hypothetical alternatives, as well as currently used placement sites. The modelling noted that periods of increased turbidity and sedimentation could often occur naturally for all of the ports considered as

currents were, on occasions, sufficient to periodically resuspend unconsolidated seabed sediments as large as coarse sand.

Modelling also indicated that placement of dredged material in deeper water further offshore than the currently used placement sites would not necessarily result in reduced migration of dredge material. The inclusion of the large-scale currents suggested that material placed offshore may be more mobile than if placed in the existing sites closer to shore.

The study highlighted the significant interannual variability in oceanographic conditions in the Great Barrier Reef Region and recommended that future predicting modelling account for this variability.

This was the first sediment plume modelling study at a scale that adopted a regional approach in the Great Barrier Reef, incorporated large-scale circulation and modelled material placement dredge plume dispersion over a 12-month period.

Report limitations

The inclusion of the large scale currents is complex and only limited field validation in the Great Barrier Reef Region is available.

Due to budget and timeframe constraints, and the technical challenges posed by the large spatial coverage and the extended period for simulation, it was necessary to make a number of simplifying assumptions. Some of these assumptions (for example, no consolidation of material, all placed material is resuspended, and no resuspension of sediments in shallow water) do not reflect real conditions, leading to a lack of alignment with existing field measurements.

These assumptions resulted in the model overestimating the dispersion of dredged material from placement sites in both the amount and distances travelled.

Consequently, the sediment plume and transport maps provided in this report do not represent actual sedimentation rates or the specific extent of dredge material dispersion and migration. In some cases, the amount of sediment deposition mapped is so small that it could not be measured. The approach adopted in the modelling study was purely to emphasise the comparison between sites and does not provide guidance on the actual impacts likely in the regions shown on the maps. As such, the maps cannot be used to determine the ecological relevance of impacts.

The model focused only on dredge material placement sites and did not investigate the combined impacts of the dredging process and the dredge material placement which could, in combination, create bigger plumes.

Based on these limitations and given the purpose of the hydrodynamic modelling was for comparison purposes, the model cannot be used in project specific impact assessment or risk assessment. The study constitutes a screening-level ‘sensitivity analysis’ of the relative merits, if any, of potential alternative placement areas.

The risk assessments included in this study were carried out for comparative purposes only and represent comparative risk between one placement site and another placement site and do not indicate absolute risk.

GBRMPA interpretation and future use

This was the first sediment plume modelling study to adopt a regional approach and incorporate large-scale circulation to model material placement dredge plume dispersion over a 12 month period. The modelling approach was consistent with the Great Barrier Reef Marine Park Authority guidelines *The use of Hydrodynamic Numerical Modelling for Dredging Projects in the Great Barrier Reef Marine Park (2012)* which state that the hydrodynamic model should take into account the tides, the wind, the waves and the mean prevailing circulation (oceanic currents).

Due to the limitations associated with this study, modelling results should not be used to determine actual dredge material movement or be used to infer where sediment could be dispersed and deposited or its ecological significance.

The model does, however, provide an insight into the direction of future modelling and is a useful tool to assess options for ocean placement of dredge material and risk assessment (if supported by robust inputs). It identifies several key principles (for example, dispersion may be greater in certain offshore than inshore areas) that will be of value in future management of dredged material.

It does not replace the need for project-specific environmental impact assessment (EIA) to assess dredge material dispersion.

The report provides guidance on the modelling approach to be adopted for future EIAs and identifies a number of key areas for research that need to be investigated to enhance future predictive modelling of dredge material in the Great Barrier Reef Region.

The reports highlight to GBRMPA and the Department of the Environment the need to establish scientific consensus about the movement, and impacts of, dredging and dredge material disposal. This may require additional research and the enhancement of existing guidelines for modelling, water quality/ecosystem monitoring and ecological studies to provide greater consistency across projects.

This can best be achieved through a strategic program, developed in consultation with stakeholders so that impacts associated with dredging and dredge material disposal can be avoided and mitigated, and ultimately offset strategies adopted to provide for net environmental benefits for the Great Barrier Reef.