COSTS OF ACHIEVING THE WATER QUALITY TARGETS FOR THE GREAT BARRIER REEF:

EXTERNAL PEER REVIEW

29 July 2016

Dr Christine Williams (chair), Department of Science, Information Technology and Innovation, Queensland Government

Mr Euan Morton, Synergies Economic Consulting

Dr Stuart Whitten, CSIRO

Mr Robin Smale, Director, Vivid Economics, UK

Professor Quentin Grafton, Australian National University

Professor John Rolfe, CQUniversity

Mr Stuart Richardson, CDM Smith

Dr Grant Woollett, Department of Science, Information Technology and Innovation, Queensland Government

Key points

Affordable, cost-effective actions that can significantly improve catchment water quality can be pursued now e.g. the Alluvium report shows that $0.6 billion could deliver 50% progress towards the reef water quality targets.

- The review panel strongly endorses the Alluvium costing study's finding that there is a raft of effective, lower-cost, lower risk abatement actions (including improving land and farm management practices) that can be pursued immediately and will have a significant impact on pollutant loads in Great Barrier Reef (GBR) catchments. For example, the costing study shows that investment of just $0.6 billion could deliver 50 per cent progress towards meeting the reef water quality targets.

- The review panel notes that earlier draft costings in the public domain did not take into account the pollution abatement achieved since the inception of the Reef Water Quality Protection Plan in 2009. Additionally, the modelling methodology initially used by Alluvium resulted in the water quality targets being exceeded rather than met, which built in additional and unnecessary cost. Correction of these issues has resulted in the headline cost estimate falling from $16.0 billion to $8.2 billion.

The headline total cost of $8.2 billion includes some high-cost, high-risk actions which are impractical and unlikely to be implemented.

- The review panel believes that the value of the costing study is not in the headline cost estimate but rather in the estimates of the relative unit costs and impact of various abatement actions. There are a number of reasons why the headline number should not be regarded as the final or definitive word on the investment required to achieve the reef water quality targets:

  a. the $8.2 billion includes some very expensive, high-risk actions that the review panel does not believe to be practical or affordable, particularly given the assumed 24 month commencement timetable - for example, $5.6 billion (or 68% of the projected total cost) is associated with just one abatement action, gully remediation, in one catchment (Fitzroy), with abatement costs ranging up to $233 per tonne of fine sediment;

  b. the costs stated in the report are average costs – it is clear from work already undertaken as part of the reef program that there is a high variability in farming enterprises and regional biophysical factors that could be exploited to deliver equivalent abatement at a lower cost;

  c. in the panel's view, it is likely that additional research, development and innovation to expand the range of cost-effective abatement actions would see the cost estimate fall.

Continuing to identify and develop cost-effective abatement actions is critical to minimising the long-term cost.

The Alluvium methodology should be an important input to any future reviews of reef water quality targets.

- The panel's strong view is that the costing study's methodology, with some refinements, should be an important input to any future reviews of the reef water quality targets.

The Alluvium costing study is a useful first step delivered in a short timeframe, and there is a range of areas where future studies could adopt improvements.

- By identifying the regions where the marginal and total abatement costs are at their highest, the costing study effectively identifies the locations where innovative approaches are desirable to enable targets to be met more affordably.
- The review panel has highlighted a number of areas where the costing study's methodology could be improved in future studies of this type. However, these issues should not detract from the value of this costing study and the key findings listed above.

Context

The Queensland Government's Department of Environment and Heritage Protection, on behalf of the Great Barrier Reef Water Science Taskforce (the Taskforce), commissioned a consortium of economists and modellers, led by Alluvium, to estimate the costs of achieving regional water quality targets for GBR catchments, based on the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan).

The Reef 2050 Plan targets are to:

- reduce nitrogen run-off by up to 80% in key catchments such as the Wet Tropics and the Burdekin by 2025;
- reduce total suspended sediment run-off by up to 50% in key catchments such as the Wet Tropics and the Burdekin by 2025.

For the costing study, these were translated into the following catchment-specific targets (compared to a 2009 baseline):

- a 20 per cent reduction in anthropogenic end-of-catchment fine sediment loads for the Mackay-Whitsunday and Burnett-Mary catchments, with a 50 per cent reduction in the Fitzroy, Burdekin and Wet Tropics catchments by 2025;
- a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen for the Mackay-Whitsunday and Burnett-Mary catchments and an 80 per cent reduction in the Burdekin and Wet Tropics catchments by 2025.

The project team was tasked with assessing the marginal and total costs and cost effectiveness of various abatement actions by relevant industries, to achieve these catchment-specific targets.

The costing study supplements and reinforces the final report of the Taskforce, delivered in May 2016, and draws on past research into the science, modelling and monitoring of the GBR and the relevant catchments.

An external peer review panel was established to provide independent comment on the methodology and findings of the costing study. The panel has also noted future work that should be undertaken to support robust decisions on improving GBR water quality.

It is noted that the study has benefited from the significant expertise of consortium members Alluvium, Marsden Jacob, C_2O, Mainstream Economics and Policy, CQUniversity, and Natural Decisions as well as an internal review team consisting of senior Queensland Government officers and Taskforce members (refer to Attachment 1).

Key findings

While noting the significant uncertainty and variability associated with input data and assumptions, the costing study contains a number of findings that are important and useful from a policy perspective, including:

- Some of the actions are much more cost-effective than others. For example, the cost-effectiveness of fine sediment abatement actions evaluated in the study ranged from $3 per tonne to $419,000 per tonne.
- A substantial share of the estimated $8.2 billion total cost comes from very expensive and uncertain actions. However, the costing study also notes that a substantial share of each abatement target can be met with a suite of relatively cost-effective actions. For example, it is estimated that the costs of meeting 50 per cent and 75 per cent of the dissolved inorganic nitrogen and sediment targets are $0.623 billion and $3.86 billion, respectively.
- The study notes that the most appropriate immediate policy focus is the actions that are comparatively cost effective, which could be commenced relatively quickly, while further research is undertaken to reduce the uncertainty and cost of the least cost-effective actions and to identify new more cost-effective actions.
- Policies, regulations and decisions need to be cognisant of regional circumstances and the efficient pathway to achieve targets for specific regions and loads. Generic GBR-wide policies and inflexible targeting may inadvertently increase the cost of meeting those targets.
- New pollutant sources (e.g. from future urban development) could significantly increase the cost of meeting the targets because all of the cost curves show sharp inclines as the targets are approached. This reinforces the need to ensure policies are in place to mitigate the impacts of future development.

Opinion on the costing study's methodology and findings

In the panel's view, the exercise undertaken by the project team to estimate the cost of meeting the 2025 reef water quality targets was broadly appropriate given the terms of reference, timeframe and resources available.

The analysis by the project team spanned a large volume of historical research and modelling relating to the GBR, catchments, and abatement actions. It is the panel's view that the meta-modelling and results provided by the project team form a useful basis for future analysis of reef water quality strategies and cost comparisons of alternative abatement actions.

The costing study is transparent in acknowledging that there are numerous constraints to meeting the targets, such as existing technological and implementation capacity, delivery arrangements, adoption take up and time lags between on-ground actions and pollution abatement.

Overall, the review panel considers that the results of the analysis (particularly the headline cost figure) are indicative only, pending further research and analysis. The review panel's findings and recommendations are set out below. While many of these issues are noted in the costing study, the review panel considers that the additional emphasis provided by their inclusion here will facilitate a more informed interpretation of the projected costings.

1. A key device that the project team uses to explain its projections is the Marginal Abatement Cost Curve (MACC). This is a tool that has been commonly used in the climate change literature. The MACC sets out the unit cost of reducing pollution for a range of potential abatement actions. It typically has an upward curve and slope, reflecting the fact that the marginal abatement cost rises as the scope for cheaper abatement actions is progressively exhausted. The review panel affirms that the MACC approach is a useful framework for considering the relative merits of a range of abatement actions, and facilitates a strategic approach to investment at least cost. This analysis is the first of its kind for a GBR catchment-wide study.
2. However, care must be taken when interpreting the MACCs that were developed in the costing study:
    a. The MACC approach is broad brush, estimating the average cost of pollutant reductions for each action by catchment, and then summing them. This hides substantial cost variation within actions and within catchments. There are likely to be some lower-cost reductions that can be achieved within each action and each region. Research commissioned by the Taskforce demonstrates the feasibility of modelling at a finer geographic scale[1,2], which would aid the identification of these lower-cost actions.
    b. In order to meet the terms of reference, the project team had to include very expensive, high-risk actions that, in the panel's view, are unlikely to be adopted, particularly within the 2025 timeframe. These expensive actions appear at the upper end of the MACCs and drive most of the estimated total cost. For example, $6.46 billion (or 78% of the estimated total cost) is associated with just one abatement action, gully remediation, in just one catchment (Fitzroy), with abatement costs ranging up to $233 per tonne of fine sediment.
    c. The consultants have chosen a real discount rate of 7 per cent. In the panel's view, this is too high and the costing study would benefit from, at the least, a sensitivity analysis that includes a lower discount rate (e.g. around 4% real).
3. In the panel's view, the principal value of including the very high unit cost actions needed to fully achieve the targets (such as gully remediation in the Fitzroy) is that it highlights the areas where research and innovation is desirable to identify potential new lower-cost abatement actions. The panel regards fostering innovation in this area as an important element of any long-term reef water quality strategy.
4. The panel notes that the reef water quality targets were set in the absence of any cost estimates. In the panel's view, a future dialogue between the cost modelling and the target review process would potentially yield improvements to both the targets and the cost estimates from a policy perspective.
5. While the costing study has a logical focus on cost-effectiveness, the review panel suggests that the level of uncertainty associated with each measure is also important. Taking uncertainty into account may change the order of actions proposed in the costing study. Additionally, there has not yet been an assessment of the risks to the effectiveness of abatement actions from future climate change or extreme events. The consideration in future work of a wider

[1] Whitten S M, Kandulu, Coggan A and Marinoni O., 2015, *Marginal abatement cost curves for sugar cane in the Great Barrier Reef*, Report prepared for the Queensland Government by CSIRO Land and Water (unpublished).
[2] Star M, East M, Beutel T, Rust S, Northey A, McCoser K, Ellis R, Darr S and Rolfe J. 2015, *Understanding the cost of policy mechanisms for sediment reductions, for rangelands grazing in the Burdekin and Fitzroy Basin* – Report to the Office of the Great Barrier Reef, Department of Environment and Heritage Protection (unpublished).

range of risks and their effect on abatement costs and efficacy is likely to better inform policy choices.

6. The cost estimates are based on the scientific data and relationships implicit in the Reef Source catchment models for the GBR catchments. While these models have been reviewed and found to be fit-for-purpose, all models are a representation of available science and data. It is noted that the program of work proposed under the Queensland Government's investment strategy is likely to improve both the data and the understanding of processes in the GBR catchments and thus allow improvements to be made to the Reef Source catchment models. This will improve the accuracy of costing estimates derived from these models.

7. The project team was not able to rely on a complete chain of scientific evidence linking on-the-ground abatement actions with end-of-catchment water quality and GBR health. Consequently, the project team needed to make assumptions in critical areas in order to complete the exercise, which is not unusual in applied scientific work. The review panel notes and supports that the Taskforce has recommended funding for monitoring, modelling and reporting (Recommendation 7). The review panel recommends that the costing study be a key input to decision-making about what additional research is undertaken. Critical assumptions and issues noted by the panel were:

    a. The significant share of catchment pollutant load from 'undefined' sources in some catchments – while it is noted that this relates mainly to conservation areas, the panel felt that additional measurement relating to this issue and possible policy actions is needed.

    b. In the panel's view, the fact that each action is assumed to abate only one targeted pollutant is a significant modelling limitation. For example, improved grazing land management is likely to reduce dissolved inorganic nitrogen as well as sediment, while changes to water management practices in sugarcane are likely to improve outcomes for fine sediment as well as dissolved inorganic nitrogen. Hence, the modelling might understate the available reductions from abatement actions, inflating the cost of meeting both targets and potentially affecting the order of actions.

    c. It is assumed that the actions captured in the MACCs commence within 24 months and that they achieve their full adoption success and full pollution abatement impact by 2025. In the panel's view, more realistic scenarios of the rates of implementation, adoption success and abatement impact could also be included to give a clearer picture of the extent to which the water quality targets can be feasibly achieved.

    d. It is assumed that land management practice change leads to changes in land condition. More certainty is needed about this causal link over the longer term. Future research should seek to identify the specific practice changes that have the most cost-effective long-term benefits.

    e. The costs stated in the costing study are average costs, which may hide large local variability in costs because of differences in farming enterprises and regional biophysical factors. More effort is needed to identify and select the lower cost actions within each action and regional area.

8. It is the panel's view that the project team was significantly constrained by several factors, including the relatively short timeframe for the project. The costing study is, therefore, a product of the available time, and it is not the final or definitive word on the matter. There is a great deal still to be learned about the most cost effective way of meeting water quality targets and the costing study is a step forward in this process.

Conclusion

The costing study represents an important and useful contribution to understanding the abatement actions necessary to meet the reef water quality targets. It demonstrates the large variations in costs across different actions and regions, and highlights the likely most cost-effective interventions that should be pursued in the short term as well as (along with this review) suggesting the most prospective areas of further work to inform future policy decisions. However, it is only a start, and the panel is firmly of the view that considerable gain can be achieved from further assessment of the cost effectiveness of actions to improve water quality in the GBR.

ATTACHMENT 1

Alluvium consortium

Dr Neil Byron	Adjunct Professor, University of Canberra's Institute of Applied Ecology
Professor Barry Hart	Emeritus Professor at Monash University. Director, Water Science Pty Ltd
Carol Sweatman	CEO of Terrain NRM, Wet Tropics Natural Resource Management Body
Dr Steve Skull	Specialises in natural resource management, Regional Manager, Alluvium Consulting Brisbane
Matt Francey	CEO, Alluvium Consulting
Tony Weber	Specialises in catchment modelling, Alluvium Consulting
Misko Ivezich	RPEQ stream restoration engineer, Alluvium Consulting
Rohan Lucus	Environmental engineer and geomorphologist, Director, Alluvium Consulting
Jim Binney	Economics – Principal, Mainstream Economics and Policy
Dr Jeremy Cheeseman	Economics – Director, Marsden Jacob Associates
Gavan Dwyer	Economics – Associate Director, Marsden Jacob Associates
Dr Megan Star	Agricultural economist, Central Queensland University
Anna Roberts	Specialises in environmental and natural resource management, Natural Decisions
Jane Waterhouse	Specialises in reef water quality and catchment management, C2O Consulting
Jon Brodie	Specialises in reef water quality and catchment management, C2O Consulting

External Review Panel

Dr Christine Williams (Chair)	Assistant Director-General, Department of Science, Information Technology and Innovation
Mr Euan Morton	Principal, Synergies Economic Consulting
Dr Stuart Whitten	Group Leader – Economics and Future Pathways, CSIRO Land and Water
Mr Robin Smale	Director, Vivid Economics, United Kingdom
Professor Quentin Grafton	Chairholder, UNESCO Chair in Water Economics and Transboundary Water Governance, Australian National University
Professor John Rolfe	Professor of Regional Economic Development, CQUniversity
Mr Stuart Richardson	Hydrogeologist and Managing Director at CDM Smith
Dr Grant Woollett	Manager, Science Policy and Evaluation Services, Department of Science, Information Technology and Innovation