Attachment 4

Letter of review from Drs Keesing and Greenwood (CSIRO Oceans & Atmosphere Research) to Luke Twomey (WAMSI CEO), received 2 July 2019.

Dear Luke

Thank you for the opportunity to review the summary of the WAMSI workshop on the Garden Island Causeway held in September last year.

It is good to see an evaluation being made of the pros and cons of modifying or removing the Garden Island Causeway and, in particular, the impact this may have on environmental values in Cockburn Sound.

CSIRO have carried out some recent work on water quality in Cockburn Sound and most of our comments here, are based on our understanding of the Cockburn Sound system developed during that work. These reports are listed below.

Although the report makes some good points, we disagree with the overall conclusion that modifying the GIC would not lead to environmental benefits.

The report states: “It was agreed that altering the GIC would not achieve an improvement in water and/or sediment quality”. It is difficult to see how the participants came to this conclusion when they were "uncertain that water quality issues were related to restricted flow", didn’t "have a complete understanding of the system", and "felt there was considerable environmental uncertainty related to the….removal of the GIC"?

We are of the view that any measure that facilitates greater exchange of water in the Sound with that from the open ocean will improve water quality in Cockburn Sound. While this can be stated categorically, the extent to which modifying the GIC will achieve this cannot be stated without a study to determine it. The potential for disbenefits should not outweigh a thorough consideration of the benefits.

A recent nutrient budgeting exercise conducted for the CSMC (Greenwood et al. 2016) highlights how slow circulation has contributed to the long-term build-up of nutrients within the sediment, that are now slowly breaking down. This is the most likely cause of sulphide accumulation in the sediment, and low oxygen content in bottom waters. The former is thought to be a significant factor in declining seagrass health (Fraser and Kendrick 2017) and the latter has been implicated in fish kills in the Sound. There is good evidence that nutrients are being released from the sediment all the time. Some of the nutrients are lost to the adjacent shelf, some lost to bacterial de-nitrification, and the rest of it is taken up by phytoplankton, and ultimately ends up back in the sediment. There is no doubt that increasing exchange with the shelf would alter the nutrient balance, but by how much, and how quickly, is presently unknown.

While we agree that more work is needed to build on our current levels of understanding of Cockburn Sound, we think that it is a mistake to shroud issues related to environmental quality in a cloak of “it’s complicated/not enough data” as this report seems to do. There has been a lot of work done on Cockburn Sound recently and we think we understand the dynamics pretty well. Historically the Sound was badly polluted by nutrients from sewage and fertiliser. Poor circulation caused high residence times and seagrass died from over growth of epiphytes. Over time, remediation works have resulted in very low inputs of nutrients to the Sound at present. Annual inputs are now predominantly from the legacy of contaminated groundwater migrating towards the Sound, and it’s likely this has peaked and will gradually reduce over time (especially as the climate continues to dry and groundwater levels fall). However, the legacy effects of an enormous amount of organic loading in the sediments coupled with little exchange of water means that the system is now essentially a recycling system and further meaningful gains in water quality from nutrient mitigation works are unlikely. This is obvious as declines in water column nutrients have not been matched by consistent declines in chlorophyll. We think now, depending on rainfall, that as little as 13% of the annual nitrogen budget depends on groundwater intrusion. Nutrient recycling from sediments fuels the phytoplankton production which now uses >90% of nitrogen used in primary production in Cockburn Sound. As a result, light levels in areas that used to support seagrass remain below 10% of surface irradiance. Couple this with the impacts of sulphide intrusion on seagrass health (Fraser and Kendrick, 2017), the inability of seagrass to recover is understandable.

We also think that some of the putative disbenefits of removing the causeway cited in the workshop report are unconvincing and that given the uncertainties referred to in the report that this comes across as lacking balance in places. The report is quite empathic about the disbenefits of removing the causeway while at the same time saying there is great uncertainty about whether removing it would provide any benefits. For example, It is difficult to see how it is possible to conclude that removing the causeway would create so much extra flow that it will scour existing seagrass beds such that they would be lost and that the increase in waves would cause significant coastal erosion AND simultaneously conclude that removing the causeway would not increase water circulation and exchange with the shelf sufficiently to improve water quality.

It is difficult to see how anything that does not facilitate further exchange of water with the open-ocean and gradual export of nutrients out of the Sound will lead to any improvement. It is also difficult to see how a solution that does not include at least partial replacement of the causeway with a bridge could achieve this. The issue warrants a thorough examination and study.

We would be happy to participate in further analysis of these issues.

Regards

John Keesing and Jim Greenwood

CSIRO Oceans & Atmosphere Research

References:

Fraser, M.W. and Kendrick, G.A. 2017. Belowground stressors and long-term seagrass decline in a historically degraded seagrass ecosystem after improved water quality. Scientific Reports, 7. DOI: 10.1038/s41598-017-14044-1

Greenwood, J., Keesing, J.K., Donn, M.J. and McFarlane, D.J. 2016. Nitrogen budget for Cockburn Sound, Western Australia. Report to the Cockburn Sound Management Council and the Western Australian Department of Water. CSIRO, Australia.

Keesing, J.K., Greenwood, J., Donn, M.J. and McFarlane, D.J. 2016. Spatial and temporal analysis of water quality monitoring data collected from Cockburn Sound and Warnbro Sound between 1982/83 and 2013/14. Report to the Cockburn Sound Management Council and the Western Australian Department of Water. CSIRO, Australia.

McFarlane DJ (ed.) (2015). Recycled water for heavy industry and preventing sea water intrusion. A report to the Australian Water Recycling Centre of Excellence Government and industry partners from the CSIRO Land and Water Flagship. http://www.australianwaterrecycling.com.au/research-publications.html

Smith AJ, Turner JV, Herne DE, Hick WP (2003) 'Quantifying submarine groundwater discharge and nutrient discharge into Cockburn Sound, Western Australia.' Joint CSIRO Land and Water Technical Report No. 01/03 and Centre for Groundwater Studies Report No. 104.

Trefry, M. G., Davis, G. B., Johnston, C. D., Gardiner, A. G. Pollock & D. W., Smith, A. J. (2006). Status of Groundwater Quality in the Cockburn Sound Catchment. Report to the Cockburn Sound Management Council. CSIRO.