Reef & Rainforest RESEARCH CENTRE

5th November 2019

Committee Secretary
Senate Standing Committees on Rural and Regional Affairs and Transport
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Thank you for the opportunity to make a submission to the Senate Standing Committee on Rural and Regional Affairs and Transport inquiry into the *Identification of leading practices in ensuring evidence-based regulation of farm practices that impact water quality outcomes in the Great Barrier Reef*. With specific regard for the terms of reference of this Senate Inquiry we seek to address matters *(a) the existing evidence-base on the impact of farm water runoff on the health of the Great Barrier Reef and catchment areas; (b) the connectivity of farm practices throughout the Great Barrier Reef catchment areas to water quality outcomes in the Great Barrier Reef Marine Park; and (f) any related matters* via the provision of information to the Senate Standing Committee.

The Reef and Rainforest Research (RRRC) is a consortium of research organisations and key stakeholder groups with interests in environmental management of marine and rainforest ecosystems and connected agricultural lands, and community well-being. The RRRC was formed in response to the loss in 2005 of the Cooperative Research Centre (CRC) for Reef and the CRC for Rainforest from North Queensland. Since that time, the RRRC has successfully tendered for three National Environmental Science Hubs, two Water Quality Research programs and the Crown of Thorns Starfish Control Program:

- Marine and Tropical Science Research Facility (2006-2010)
- National Environmental Research Program - Tropical Ecosystems Hub (2011-2014)
- National Environmental Science Program - Tropical Water Quality Hub (2015-2020)
- Reef Rescue Marine Monitoring Program (2007-2011)
- Reef Rescue R&D Water Quality Program (2011-2013)
- Crown of Thorns Starfish Integrated Pest Management Control Program (2015-2019)

These programs were part of the Australian Government's Great Barrier Reef commitment. The programs differ in scope and application from traditional discovery research approaches. In awarding tenders, the Australian Government sought strong and impactful stakeholder engagement in the development and conduct of applied research activities. This approach has meant that many stakeholders in the Great Barrier Reef community have been actively involved in the research conducted and have had opportunity to contribute to its design and oversee the outcomes of that research. Whilst this approach has at times, presented challenges to the more than 300 scientists undertaking the research, it has resulted in more meaningful outcomes. At all times, the Australian Government Department of Environment insisted on effective participation of stakeholders and community through the establishment of stakeholder dominated Hub Steering Committees that select the research to be undertaken and give final approval to the reporting. The Hub Steering Committees

have always been chaired by an outstanding independent member of the Community. The current Chair of the National Environmental Science Program – Tropical Water Quality Hub is Ms Leith Boully. Attached to this submission is the body of research undertaken by scientists from multiple research institutions and funded through the programs identified above relevant to water quality. The reports are all publicly available and easily accessible, which is a requirement of the Australian Government programs.

The research generally focuses on the source, transport, fate and impact of nutrients, sediment and pesticides on catchment systems and contiguous function of the Great Barrier Reef.

This extensive body of work identifies the spatial and temporal impacts of these pollutants on the full range of ecosystems associated with the Great Barrier Reef. This includes the rivers, floodplains, mangroves, seagrass beds and inshore reef ecosystems of the Great Barrier Reef. Whilst these impacts are well documented, it is very important that the extent of the impacts are clearly identified and the responsible efforts to reduce the flow of nutrients, sediment and pesticides is effectively targeted. As an example, the current National Environmental Science Program supported investment into new technologies allowing grower-led, real time empirical monitoring of nutrients across an entire river catchment. The Russell/Mulgrave catchment in north Queensland has been modelled and identified as one of the high priority catchments for reducing nutrient contribution to the Great Barrier Reef. Real-time monitoring via the National Environmental Science Program has allowed growers to identify the actual quantity of nutrients from the catchment, identify 'hot spot' areas that require attention and to discover what growers are responsible for and what they are not. This approach has fundamentally changed the trust arrangements between growers and researchers and has allowed growers to 'own' their need to manage nutrients and to have the locally specific evidence base to demonstrate effectiveness of actions taken.

The unique approach to research afforded by these stakeholder focused programs has allowed for a partnership approach to identifying and addressing water quality issues and provides an effective model for future research and engagement.

We look forward to discussing any of these matters further if required.

Regards

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APPENDIX

List of Water Quality Projects undertaken by RRRC with links to the Project page and associated publication.

NESP 1.3	A validation of coral geochemical records to reconstruct suspended sediment loads to the Great Barrier Reef lagoon	Stephen Lewis, JCU
NESP 1.5	Legacy of the Lower Burdekin Water Quality Tender	Romy Greiner, JCU
NESP 1.6	Multiple and cumulative impacts on the GBR: assessment of current status and development of improved approaches for management	Sven Uthicke, AIMS
NESP 1.7	Reducing sediment sources to the Reef: testing the effectiveness of managing alluvial gully erosion	Andrew Brooks, GU
NESP 1.8	Sub-catchment scale monitoring, modelling and extension design to support reef water quality improvement	Aaron Davis, JCU
NESP 1.10	Identification, impacts, and prioritization of emerging contaminants present in the Great Barrier Reef and Torres Strait marine environments	Frederieke Kroon, AIMS
NESP 2.2	A tradable permit scheme for cost effective reduction of nitrogen runoff in the sugarcane catchments of the Great Barrier Reef	Jim Smart, GU
NESP 3.3	Light thresholds for seagrasses of the GBR: a synthesis and guiding document for managing seagrass	Catherine Collier, JCU
NESP 3.4	Developing and refining biological indicators for seagrass condition assessments in an integrated monitoring program	Catherine Collier, JCU
NESP 3.8	Towards an integrated monitoring program: identifying indicators and existing monitoring programs to cost-effectively evaluate the Long Term Sustainability Plan	Prue Addison, AIMS
NESP 3.10	Benchmarking costs of NRM improvements for the GBR	John Rolfe, CQU
NESP 2.1.2	Scoping options for low-lying, marginal cane land to reduce DIN in priority wet tropics catchments	Nathan Waltham, JCU
NESP 2.1.3	Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: an action research project	Lynne Eagle, JCU
NESP 2.1.4	Demonstration and evaluation of gully remediation on downstream water quality and agricultural production in GBR rangelands	Rebecca Bartley, CSIRO
NESP 2.1.5	What's really damaging the Reef? Tracing the origin and fate of the environmentally detrimental sediment	Stephen Lewis, JCU
NESP 2.1.6	From exposure to risk: novel experimental approaches to analyse cumulative impacts and determine thresholds in the GBRWHA	Sven Uthicke, AIMS
NESP 2.1.7	Engaging with farmers and demonstrating water quality outcomes to create confidence in on-farm decision-making (also known as Project 25)	Aaron Davis, JCU
NESP 2.1.8	Improved water quality outcomes from on-farm nitrogen management	Mike Bell, UQ
NESP 2.1.9	Risk assessing dredging activities	Ross Jones, AIMS
NESP 2.1.10	The application and adaption of mine site rehabilitation approaches to alluvial gully rehabilitation in the Bowen Catchment	Andrew Brooks, GU

NESP 2.2.1	Identifying the water quality and ecosystem health threats to the high diversity Torres Strait and far northern GBR from runoff from the Fly River	Jane Waterhouse, JCU
NESP 2.2.2	Impacts of mine derived pollution on Torres Strait environments and communities	Simon Apte, CSIRO
NESP 2.3.1	Benthic light as ecologically validated GBR wide indicator for water quality: drivers, thresholds and cumulative risks	Katharina Fabricius, AIMS
NESP 2.3.2	'Human sensors' for monitoring GBR environmental changes and quality of marine waters through harnessing Big Data analysis	Susanne Becken, GU
NESP 2.3.3	Building Indigenous livelihood and comanagement opportunities in the northern GBR-ecosystem services and conservation governance for water quality	Marcus Barber, CSIRO
NESP 2.3.4	Working with Traditional Owners and local citizens to better manage GBR estuarine wetlands	Norman Duke, JCU
NESP 3.1.2	Improving water quality for the Great Barrier Reef and wetlands by better managing irrigation in the sugarcane farming system	Yvette Everingham, JCU & Steve Attard, AgriTech Solutions
NESP 3.1.3	Harnessing the science of social marketing in communication materials development and behaviour change for improved water quality in the GBR: a desktop review (Project 2.1.3 – Stage 2)	Lynne Eagle, JCU
NESP 3.1.4	Optimizing the management of riparian zones to improve the health of the Great Barrier Reef	Keryn Paul, CSIRO
NESP 3.1.5	Ecotoxicology of pesticides on the Great Barrier Reef for guideline development and risk assessments	Andrew Negri, AIMS
NESP 3.1.6	Exploring trading in water quality credits as a cost-effective approach for managing water quality in the Great Barrier Reef	Jim Smart, GU
NESP 3.1.7	Reducing sediment loads to the Great Barrier Reef: developing optimal approaches for treating alluvial gully erosion	Andrew Brooks, GU
NESP 3.2.1	Deriving ecologically relevant load targets to meet desired ecosystem condition for the Great Barrier Reef: a case study for seagrass meadows in the Burdekin region	Catherine Collier, JCU
NESP 3.2.5	Testing and implementation of the water quality metric for the 2017 and 2018 reef report cards	Britta Schaffelke, AIMS
NESP 3.3.1	Quantifying the linkages between water quality and the thermal tolerance of GBR coral reefs	Line Bay, AIMS
NESP 3.3.2	Science evaluation of coastal wetland systems repair projects across GBR catchments	Nathan Waltham, JCU
NESP 4.2	Oceanographic drivers of bleaching in the GBR: from observations to prediction	Craig Steinberg, AIMS
NESP 4.8	'Project 25' – farmers, water quality and on-farm decision-making	Dr Aaron Davis, JCU
NESP 4.9	Gully characterisation framework to underpin GBR catchment water quality management	Andrew Brooks, GU
NESP 4.10	Evaluating the costs and benefits of agricultural land conversion to wetlands	Nathan Waltham, JCU
NESP 4.11	Sources, transformations and fate of dissolved organic carbon – implications for the GBR	Michele Burford, GU
NESP 4.12	Measuring cost-effectiveness and identifying key barriers and enablers of lasting behavioural change in the cane industry	Sharyn Rundle-Thiele, GU

NESP 5.2	From exposure to risk: Novel experimental approaches to analyse cumulative impacts and determine thresholds in the Great Barrier Reef World Heritage Area (GBRWHA)	Sven Uthicke, AIMS
NESP 5.3	Benthic light as ecologically-validated GBR-wide indicator for water quality: Drivers, thresholds and cumulative risks	Barbara Robson, AIMS
NESP 5.4	Deriving ecologically relevant targets to meet desired ecosystem condition for the Great Barrier Reef: A case study for seagrass meadows in the Burdekin region	Catherine Collier, JCU
NESP 5.8	What's really damaging the Reef? Tracing the origin and fate of the environmentally detrimental sediment and associated bioavailable nutrients	Stephen Lewis, JCU
NESP 5.9	Gully remediation effectiveness	Rebecca Bartley, CSIRO
NESP 5.10	Development and application of automated tools for high resolution gully mapping and classification from LiDAR data	Prof Andrew Brooks, GU
NESP 5.11	Improved water quality outcomes from on-farm nitrogen management	Mike Bell, UQ
NESP 5.12	Scoping land use conversion options for high DIN risk, low-lying sugarcane areas in Burdekin and Mackay Whitsunday regions	Nathan Waltham, JCU
NESP 5.13	Coastal wetland systems repair across GBR catchments – values based causal framework validation	Nathan Waltham, JCU
NESP 5.14	Identifying the water quality and ecosystem health threats to the Torres Strait from the Fly River runoff	Jane Waterhouse & Simon Apte, JCU

NERP 4.1	Tracking coastal turbidity over time and demonstrating the effects of river discharge events on regional turbidity in the GBR	Katharina Fabricius, AIMS
NERP 4.2	The chronic effects of pesticides and their persistence in tropical waters	Andrew Negri, AIMS
NERP 4.3	Ecological Risk Assessment for the GBR	Jon Brodie, JCU
NERP 4.4	Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health	Jon Brodie, JCU
NERP 5.1	Understanding diversity of the GBR: spatial and temporal dynamics and environmental drivers	Glenn De'ath, AIMS
NERP 5.2	Combined water quality and climate effects on corals and other reef organisms	Sven Uthicke, AIMS
NERP 5.3	Vulnerability of seagrass habitats in the GBR to changing coastal environments	Catherine Collier, JCU
NERP	Water Quality Synthesis Report	

RRRD 004	Advanced drip and optimised furrow irrigation to minimise sediment, nutrient and pesticide losses to the environment through deep drainage and runoff from sugarcane and banana industries of wet tropics in northern Queensland	David Midmore & Surya Bhattarai, CQU
RRRD 009	Runoff nitrogen generation rates from pasture legumes – an enhancement to reef catchment modelling	Craig Thornton, QLD Dept. Natural Resources and Mines
RRRD 010	Factors affecting adoption of land management practices that have water quality benefits in the GBR catchments: Evaluation scenarios for cane farming	Delwar Akbar, CQU
RRRD 011	Capturing historic small catchment study (paddock scale) data to support quantification of management impacts on water quality on the GBR	David Freebairn, RPS Australia
RRRD 016	Developing integrated assessment metrics for reporting of water quality in the GBR lagoon	Vittorio Brando, CSIRO
RRRD 020	Mineralisation of nitrogen within the sugarcane cropping system following legume fallows and its effect on water quality	Bernard Schroeder, BSES
RRRD 024	Quantifying the impacts of rehabilitating degraded lands on soil health, pastures, runoff, erosion, nutrient and sediment movement	Trevor Hall, QDAFF
RRRD 027	Getting ground cover right – thresholds and baselines for a healthier reef	Terry Beutel, QDAFF
RRRD 030	Pollutant load estimation for GBR catchments: Accounting for the uncertainty in monitoring and modelled data using data assimilation techniques	Petra Kuhnert, CSIRO
RRRD 032	Improving grazing management practices to enhance ground cover and reduce sediment loads	Scott Wilkinson, CSIRO
RRRD 037	Pesticide dynamics in the GBR catchment and lagoon: management practices in the sugarcane industry	Jon Brodie, JCU
RRRD 038	Pesticide dynamics in the GBR catchment and lagoon: management practices (grazing, bananas and grain crops) and risk assessments	Stephen Lewis & Jon Brodie, JCU
RRRD 039	Integrated assessment of Best Management Practices cost-effectiveness and decision support for regions and landholders	Stuart Whitten, CSIRO
RRRD 049	Minimising off-farm movement of nitrogen and phosphorus in the north Queensland banana industry	John Reghenzani, Terrain NRM
RRRD 054	Development of a banana modelling capability to enhance reporting of Reef Rescue outcomes	Tony Webster, CSIRO
RRRD 055	Validating the cost/benefits of improved fertiliser practices and quantifying nutrient loads and pathways from irrigated dairy pastures in the Wet Tropics and the Burnett-Mary regions.	Ruth Chalk, Queensland Dairyfarmers' Organisation
RRRD 056	Evaluating and improving A-Class practices to control nutrient losses from sugarcane	Peter Thorburn, CSIRO
RRRD 058	A novel biological method of monitoring herbicides	Ben Kefford, UTS

MTSRF 3.7.1	Marine and estuarine indicators and thresholds of concern	Katharina Fabricius, AIMS
MTSRF 3.7.2	Connectivity and risk: tracing materials from the upper catchment to the reef	Jon Brodie, JCU
MTSRF 3.7.3	Freshwater indicators and thresholds of concern	Richard Pearson, JCU & Angela Arthington, GU
MTSRF 3.7.4	Wetlands and floodplains: connectivity and hydro-ecological function	Jim Wallace, CSIRO
MTSRF 3.7.5 & 3.7.6	Socio-economic constraints to and incentives for the adoption of land use and management options for water quality improvement	Peter Roebeling, CSIRO
MTSRF 3.7.7	Analysis and synthesis of information for reporting credible estimates of loads for compliance against targets and tracking trends in loads	Bronwyn Hatch, CSIRO
MTSRF	Water Qualtiy Synthesis Reports	