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

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

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

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

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

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