



**Tropical
Water
Quality
Hub**

National Environmental Science Programme



**Reef &
Rainforest**
RESEARCH CENTRE

Tropical Water Quality Hub Research Plan

Version 1 – APPROVED



National Environmental Science Programme

Tropical Water Quality Hub

RESEARCH PLAN

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CONTENTS

Introduction.....	3
Hub Administration & Governance	6
Research Priorities.....	7
List of Research Projects	12
Expected Outcomes.....	16
Expected Outputs.....	17
Communication and Knowledge Brokering	17
Monitoring & Evaluation	18
Collaboration and Partnerships	20
Indigenous Engagement	24
Funding.....	25
Attachment A: Research Project Schedules	27
Attachment B: Hub level Risk Assessment and Treatment Plan	174
Attachment C: Budget Tables.....	175

Introduction

The National Environmental Science Programme (NESP) is a long-term commitment to support environmental and climate research. The key objective of the NESP is to improve our understanding of Australia's environment through collaborative research that delivers accessible results and informs decision making. The focus of NESP is on practical and applied research that informs on-ground action and that will yield measurable improvements to the environment.

The Programme will build on its predecessors - the National Environmental Research Program and the Australian Climate Change Science Programme – in securing for decision makers the best available information to support understanding, managing and conserving Australia's environment.

The NESP is delivered through multi-disciplinary research Hubs or consortia, hosted by Australian research institutions.

The NESP seeks to achieve its objective by supporting research that:

- Is practical and applied and informs on-ground action
- addresses the needs of the Australian Government and other stakeholders by supporting and informing evidence-based policy and improving management of the Australian environment
- is innovative and internationally recognised
- enhances Australia's environmental research capacity
- is collaborative and builds critical mass by drawing on multiple disciplines, research institutions and organisations to address challenging research questions
- produces meaningful results accessible to government, industry and the community
- includes synthesis and analysis of existing knowledge
- builds relationships between scientists and policy-makers to encourage collaborative problem solving on environmental issues.

NESP end-users will be a broad range of stakeholders whose decisions may impact on the environment, and include the Australian Government, state governments, industry, business, community groups and Indigenous land managers (or Indigenous Communities).

The intended outcomes of the NESP are:

- Enhanced understanding of, and capacity to manage and conserve Australia's environment.
- Improved climate and weather information for Australia through a greater understanding of the drivers of Australia's climate.
- Timely research that is used by policy and decision-makers to answer questions and provide solutions to problems.
- Research outcomes that are communicated clearly to end-users and the general public, and stored in a manner that is discoverable and accessible.

Hub Role

The NESP will assist decision-makers to understand, manage and conserve Australia's environment by funding world-class biodiversity and climate science. The NESP Tropical Water Quality (TWQ) Hub will research coastal water quality and coastal management focused on the Great Barrier Reef and other tropical waters. The NESP TWQ Hub will provide innovative research for practical solutions to maintain and improve tropical water quality from catchment to coast under three research themes, each of which has an experienced Program Leader:

Theme 1: Improved understanding of the impacts, including cumulative impacts, and pressures on priority freshwater, coastal and marine ecosystems and species.

- Further development of a systematic approach to crown-of-thorns starfish (COTS) eradication. Identify and trial risk abatement, and prioritisation strategies in response to COTS outbreaks, extreme events and biosecurity threats. Develop and implement a plan to reduce COTS numbers by two million.
- Develop practical improvements to land management practices that will influence behavioural change and improve outcomes for tropical water quality and ecosystem health.
- Improve our knowledge of cumulative pressures on environmental and social values of the Great Barrier Reef to determine more effective management actions.
- Improved information on ocean acidification through the Heron Island ocean acidification monitoring project.
- Evaluate the practicalities of restoring connectivity to freshwater, coastal and marine ecosystems and the resilience of dependent species.

Theme 2: Maximise the resilience of vulnerable species to the impacts of climate change and climate variability by reducing other pressures, including poor water quality.

- Improve our understanding of the consequences of climate change for the health and resilience of vulnerable freshwater, coastal and marine species, and ecosystems.
- Develop practical, cost-effective, climate change adaptation options that are accessible to the managers of coastal and marine ecosystems and their catchments.
- Identify practical management actions capable of protecting and improving water quality on the Great Barrier Reef. Including evaluating actions with the potential to reinstate severely impacted ecosystems and species.
- Quantify the water quality and economic benefits of using organic compost to encourage its uptake and use by farmers.
- Investigate the feasibility of water quality improvement where reduced nitrogen use on cane farms can be turned into a credit that can be traded.
- Identify sustainable populations and the effectiveness of zoning on the health and resilience of target fish species and tropical ecosystem biodiversity.

Theme 3: Natural resource management improvements based on sound understanding of the status and long-term trends of priority species and systems.

- Identify and trial practical methods to improve reef resilience, such as the transplantation of coral and coral genetics.

- Understand trends in dugong and turtle populations, including breeding cycles and trends in seagrass and habitats. Develop better methods for the protection of important habitat for dugong and turtles.
- Combine existing indicators and monitoring programmes to develop a cost-effective integrated monitoring programme to support natural resource management, evaluate results and communicate trends.
- Identify regionally-specific management interventions to achieve or maintain realistic desired states for tropical environmental, social, cultural and economic values.
- Develop and implement better tools, including spatial information, to support the prioritisation of on-ground investments and interventions and assess their success.
- Explore the opportunities for citizen science and Indigenous participation to improve tropical water quality awareness and outcomes.

By engaging research-users in a collaborative process to co-develop projects in current and emerging priority areas, including:

- Cumulative catchment, coast and marine impacts and habitat repair
- Sediment and nutrient dynamics
- Crown-of-thorns starfish outbreak mitigation
- Indigenous co-management of cultural keystone species and habitats
- Developing the framework for optimisation and investment prioritisation

Purpose of Research Plan

This Research Plan has been developed by the NESP TWQ Hub, in consultation with the Department of the Environment and other key stakeholders.

The purpose of the Research Plan is to outline:

- the research priorities the Hub is funded to investigate
- the research projects that will address these priorities
- how the output of the research will be communicated and brokered to key stakeholders
- how the impact of the research will be measured
- how Hubs will work collaboratively within and across Hubs



This Research Plan also provides appropriate detail on the management and governance of the Hub, including outlining the broader funding profile, key staff and research organisations, and the risks needing to be monitored to ensure success.

Hub Administration & Governance

Hub Leadership and governance

Hub governance will evolve from the NERP model to a more stakeholder engaged framework, with stronger cross-Hub interactions and enhanced linkages to key national initiatives such as Northern Australia Development, Reef 2050 Long Term Sustainability Plan, and the Indigenous Advancement Strategy. The NESP TWQ Hub is hosted by the Reef and Rainforest Research Centre Ltd (RRRC), a consortium of research providers, key industry groups, and an independent Chair, Dr Ian Poiner.

Governance of the NESP TWQ Hub will include direct communication lines between the Hub Host (RRRC) and the six partner institutions, the Hub Leader (Dr Damien Burrows) and the Department of the Environment. The Independent Hub Steering Committee chaired by Leith Bouilly will report directly to the Department, and have open communication lines with the Hub Leader. Research results will be disseminated to stakeholders via strategic and quality controlled mechanisms, such as the Knowledge Brokering and Communications Plan, Indigenous Engagement and Participation Strategy, nominated Program Leaders, and Project associates (Figure 1).

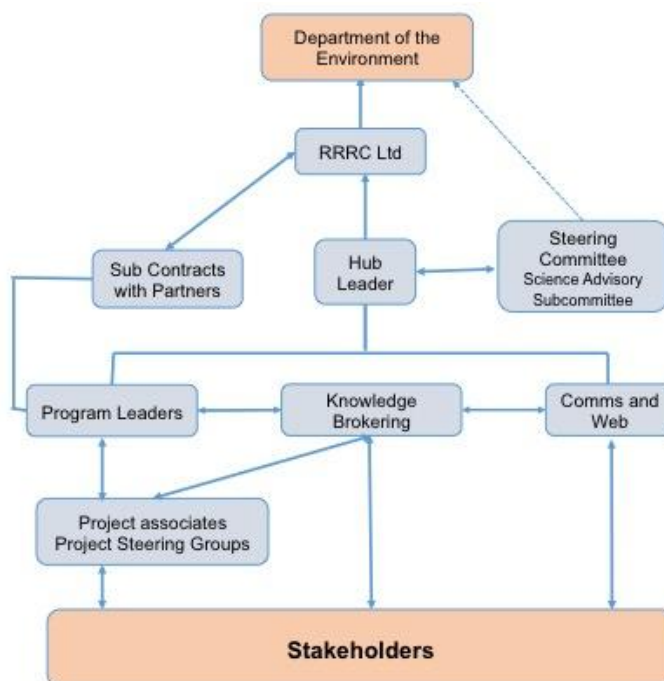


Figure 1. Governance structure of the NESP Tropical Water Quality Hub

Steering Committee

The Hub Steering Committee provides strategic supervision over the Hub's performance against its objectives. The roles, responsibilities and membership of the Steering Committee are outlined in its terms of reference, and include:

- ensuring the alignment of research activity to the policy needs and interest of the Department and other key stakeholders;
- connecting the Hub's research questions, activities and outputs to relevant research activity and policy initiatives outside the Department;
- overseeing the development and implementation of the Research Plan, including the review and amendment of the Research Plan, as required;
- directing, and endorsing, the development, and delivery of any reporting, monitoring and evaluation requirements under this agreement; and
- review, monitor and guide project performance.

The Department of the Environment

The Department of the Environment has responsibility for managing the National Environmental Science Programme, including the approval of this Research Plan, assessment of progress of projects under this Research Plan and payment of any funding associated with the Hub agreement

Importantly, the Department is the key end user of research under the NESP, and works closely with the Hub and other key stakeholders in determining and negotiating the delivery of research under the Research Plan.

The Minister

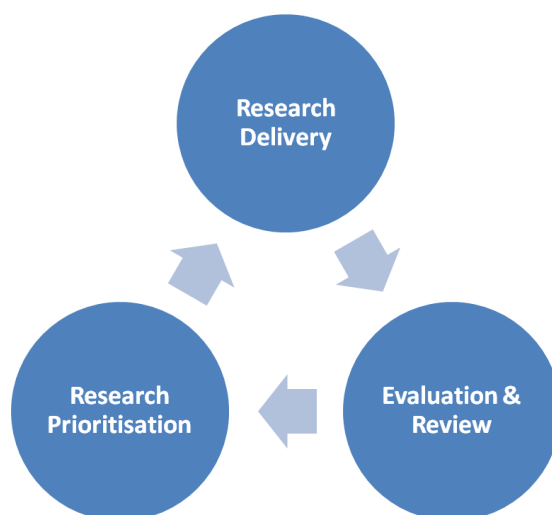
The Minister for the Department of the Environment provided approval to fund the NESP TWQ Hub and is the sole delegate with authority to approve major changes to the scope and funding allocation to the Hub. The Minister will approve Version 1 of this Research Plan and endorse the subsequent annual versions of the Research Plan.

Research Priorities

The NESP TWQ Hub is committed to a body of activity that includes short and long-term research projects. Each activity year the Department of the Environment will work with the Minister, the Hubs and other key stakeholders to identify and refine research priorities and develop projects that align with these priorities.

This research prioritisation is a rolling process and key milestones in each activity year, like the Annual Progress Report and submission of the next Research Plan, will inform the process. The Biennial Programme Evaluation, which will review the impact and success of the programme, also plays an important role in informing research priorities.

This constant consideration and evaluation of research output and impact will give confidence in the performance of the Hub and the effectiveness of the programme. It will also provide the basis for the flexibility needed in the NESP TWQ Hub to engage in new themes of research in an adaptive manner, and ensures that the Hubs' focus is fixed on the delivery of relevant and practical research.



The research priorities of the NESP Tropical Water Quality Hub are outlined below. These are the research priorities provided by the Minister for the Environment, with further regional detail provided as points under most topic areas.

Theme 1: Improved understanding of the impacts, including cumulative impacts, and pressures on priority freshwater, coastal and marine ecosystems and species.

- 1.1 Further development of a systematic approach to crown-of-thorns starfish (CoTS) eradication. Identify and trial risk abatement, and prioritisation strategies in response to CoTS outbreaks, extreme events and biosecurity threats. Develop and implement a plan to reduce CoTS numbers by two million.
 - Improve understanding of CoTS life history, including distribution, population dynamics, larval survival, predation of juveniles, and dispersal for the purposes of integrated management.
 - Understanding the role of water quality and associated factors in determining abundance of CoTS.
 - Develop optimised tools for local eradication of CoTS in priority locations to assist in the eradication (reduction) of CoTS numbers.
 - Develop advanced tools and methods to detect and monitor CoTS at different life history stages and outbreak phases.
- 1.2 Develop practical improvements to land management practices that will influence behavioural change and improve outcomes for tropical water quality and ecosystem health.
 - Develop practical improvements to on-farm land management practices that will influence behavioural change and improve outcomes for tropical water quality and ecosystem health and evaluate the outcomes.
 - Identify practical strategies to increase adoption of improved resource management actions, ensuring engagement with relevant stakeholders/institutions.

- Design of an appropriate sub-catchment scale water quality monitoring and modelling program to underpin a new regulatory or market-based trading framework for reef water quality improvement.
- 1.3 Evaluate management activities in wetlands and other natural habitats to improve tropical water quality and ecosystem health.
- 1.4 Improve our knowledge of cumulative pressures on environmental and social values of the Great Barrier Reef to determine more effective management actions.
- Develop better capacity to predict ecosystem decline due to cumulative pressures to guide planning and management practices.
 - Determine critical ecosystem thresholds for cumulative stress to guide environmental decision-making and policy under coastal development scenarios.
 - Identify environmental stress indicators for key reef species and habitats to support cumulative impact assessments.
 - Improved estimates of the long-term fate of dredged sediment in the context of other existing processes and pressures such as land run-off.
 - Improved turbidity and sedimentation thresholds and sub-lethal health-indicators for key marine organisms based on to GBR-relevant dredging scenarios to inform cumulative impact assessments.
 - Quantify and/or document the chronic impacts of maintenance dredging on key adjacent GBR habitats and species.
- 1.5 Improved information on ocean acidification through the Heron Island ocean acidification monitoring project.
- 1.6 Evaluate the practicalities of restoring connectivity to freshwater, coastal and marine ecosystems and the resilience of dependent species.

Theme 2: Maximise the resilience of vulnerable species to the impacts of climate change and climate variability by reducing other pressures, including poor water quality.

- 2.1 Improve our understanding of the consequences of climate change for the health and resilience of vulnerable freshwater, coastal and marine species, and ecosystems.
- Evaluate synergistic vulnerability of climate change and other pressures on northern Australian marine ecosystems to guide resilience actions and environmental decision-making.
 - Determine the resilience and acclimatisation potential of key marine species and habitats under current and projected climate change scenarios.
 - Quantify impacts of climate change on communities and industries and flow on effects for water quality.
- 2.2 Develop practical, cost-effective, climate change adaptation options that are accessible to the managers of coastal and marine ecosystems and their catchments.
- Determine critical ecosystem thresholds for climate change impacts to guide environmental decision-making and adaptation actions (e.g. adjusted water quality targets).

- Prioritise and/or develop novel engagement and participation mechanisms to support social learning and adaptive management for the management of coastal and marine ecosystems and their catchments.
- 2.3 Identify practical management actions capable of protecting and improving water quality on the Great Barrier Reef. Including evaluating actions with the potential to reinstate severely impacted ecosystems and species.
- Update and improve knowledge of sources, and identify roles of key pollutants (including emerging contaminants), and their long-term fate to enable the identification of key sources of, and vulnerable regions to, poor water quality.
 - Develop environmental standards and spatial health indices to quantify ecosystem condition with the goal of maintaining healthy marine water quality and ecosystems.
 - Evaluate and/or propose institutional and governance arrangements for the management of risk and uncertainty in relation to pressures on tropical water quality.
- 2.4 Quantify the water quality and economic benefits of using organic compost to encourage its uptake and use by farmers.
- Identify practical strategies to increase trust in, and the legitimacy of, resource management actions, policy settings and institutions.
- 2.5 Investigate the feasibility of water quality improvement where reduced nitrogen use on cane farms can be turned into a credit that can be traded.
- 2.6 Identify sustainable populations and the effectiveness of zoning on the health and resilience of target fish species and tropical ecosystem biodiversity.

Theme 3: Natural resource management improvements based on sound understanding of the status and long term trends of priority species and systems.

- 3.1 Identify and trial practical methods to improve reef resilience, such as the transplantation of coral and coral genetics.
- Evaluate the ecological, economic and social feasibility of marine restoration and intervention to enhance marine resilience.
- 3.2 Understand trends in dugong and turtle populations, including breeding cycles and trends in seagrass and habitats. Develop better methods for the protection of important habitat for dugong and turtles.
- Improve understanding of dugong and marine turtle habitats including migratory corridors.
 - Improve understanding of trends in dugong and marine turtle populations including their breeding cycles and the links between these trends and the trends in their habitats.
 - Evaluate the effectiveness of current and potential future zoning and/or other management initiatives on the resilience of dugong and marine turtle populations and these habitats.
- 3.3 Combine existing indicators and monitoring programmes to develop a cost-effective integrated monitoring programme to support natural resource management, evaluate results and communicate trends.
- Review and evaluate existing and new indicators and monitoring programs to support development of the LTSP monitoring program.

- Design monitoring to assess the current ecological status and trends in the condition of Torres Strait section of the GBR marine and coastal environments, and current and emerging threats.
 - Understanding the role of water quality and associated factors in determining abundance of Irukandji jellyfish, identify key issues for industries, environmental and communities, and develop strategies for control and mitigation.
 - Explore the opportunities for improved tropical water quality awareness and outcomes, for example through report cards etc.
- 3.4 Identify regionally-specific management interventions to achieve or maintain realistic desired states for tropical environmental, social, cultural and economic values.
- Identify, evaluate and prioritise regionally-specific¹ desired states for environmental, social, cultural and economic values associated with tropical water quality.
 - Identify and prioritise social and economic risks and uncertainties associated with natural resource management and evaluate the impacts these have on management and policy options for natural resource management and improvements to tropical water quality.
 - Identify and evaluate drivers of decision-making in natural resource management, including an understanding of socioeconomic pressures on tropical water quality and measuring and understanding relevant socioeconomic trends so as to prioritise options to improve tropical water quality at both enterprise and sector levels.
- 3.5 Develop and implement better tools, including spatial information, to support the prioritisation of on-ground investments and interventions and assess their success.
- Review policy and regulatory instruments to assess their effectiveness and appropriateness in promoting improved land and water management.
 - Evaluate and develop better tools (for example, economic, spatial information, statistical, systems and/or predictive models) to support the prioritisation and evaluation of on-ground investments and interventions.
 - Trial and implement novel and improved mechanisms that lead to cost effective practice change and improved on-ground adoption.
 - Evaluate and develop planning and communication tools for northeast Australia that incorporate understanding of environmental values and ecosystem resilience, likely impacts of development and appropriate use and management.
- 3.6 Explore the opportunities for citizen science and Indigenous participation to improve tropical water quality awareness and outcomes.
- Identify opportunities to incorporate traditional knowledge in NRM and decision-making.
 - Develop methods that facilitate participation of Indigenous people in environmental management.
 - Assist in the development of skills for rangers and agencies implementing NRM on Country.

¹ NRM regions

- Identify opportunities for Indigenous participation to improve water quality awareness and outcomes, including capturing and conveying cultural values.
- Evaluate the effectiveness of different policy mechanisms to achieve Indigenous engagement in NRM and assessment measures.

List of Research Projects

Table 1 provides a list of all current research projects funded under the NESP TWQ Hub. For more detail on each specific project, please refer to Attachment A – Research Projects.

Table 1. List of year 1 short-term research projects recommended for funding under the NESP TWQ Hub.

Project Number	Project Name	Project Leader	Lead Organisation	NESP Funding	Other Contributions	Timeframe
1.1	Establishing the future NESP CoTS research framework including an ecologically-based approach to the management of CoTS at multiple scales	David Westcott	CSIRO	100,000	119,710	01/07/2015-31/12/2015
1.2	Developing an approach to evaluate the effectiveness of investments in riparian management in the GBR catchments	Rebecca Bartley	CSIRO	99,972	84,972	01/07/15-31/03/16
1.3	A validation of coral geochemical records to reconstruct suspended sediment loads to the Great Barrier Reef lagoon	Stephen Lewis	JCU	22,500	38,950	01/07/15-01/02/16
1.5	Legacy of the Lower Burdekin Water Quality Tender	Romy Greiner	JCU	39,795	79,590	01/07/15-31/12/15
1.6	Multiple and cumulative impacts on the GBR: assessment of current status and development of improved approaches for	Sven Uthicke	AIMS	99,944	109,507	01/07/15-31/12/15

	management					
1.7	Reducing sediment sources to the Reef: testing the effectiveness of managing alluvial gully erosion	Andrew Brooks	GU	100,000	380,000	01/07/2015-31/03/2016
1.8	Sub-catchment scale monitoring, modelling and extension design to support reef water quality improvement	Aaron Davis	JCU	100,000	160,000	01/07/2015-31/03/2016
1.9	The establishment of a future NESP dredging research investment framework	Britta Schaffelke	AIMS	25,000	18,094	01/07/2015-30/12/2015
1.10	Identification, impacts, and prioritization of emerging contaminants present in the Great Barrier Reef and Torres Strait marine environments	Frederieke Kroon	AIMS	100,000	139,340	01/07/2015-31/12/2015
2.1	Assessing the cumulative impacts of climatic disturbances on inshore GBR coral reefs, identifying key refuges and testing the viability of manipulative reef restoration	Geoff Jones	JCU	85,000	180,612	01/07/2015-31/03/2016
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	99,721	232,820	01/08/2015-29/02/2016
3.1	Seagrass mapping synthesis – A resource for	Rob Coles	JCU	36,000	54,500	30/06/2015-31/12/2015

	marine park and coastal management					
3.2	Improving historical estimates of abundance and distribution of dugongs and large green turtles in western and central Torres Strait	Helene Marsh	JCU	97,674	342,236	01/07/2015-31/03/2016
3.3	Light thresholds for seagrasses of the GBR: a synthesis and guiding document for managing seagrass	Catherine Collier	JCU	29,755	51,308	01/07/2015-31/12/2015
3.4	Developing and refining biological indicators for seagrass condition assessments in an integrated monitoring program	Catherine Collier	JCU	68,584	201,665	01/07/2015-31/12/2015
3.5	Assessment of key dugong and turtle seagrass resources in the northern Torres Strait.	Michael Rasheed	JCU	99,696	149,768	01/07/2015-31/03/2016
3.6	Establishing a research framework for future NESP investment into better understanding of the presence of Box-Jellyfishes (Irukandji) and risks in the Great Barrier Reef	Mike Kingsford	JCU	30,000	57,705	01/07/2015-28/02/2016
3.7	Monitoring the effects of zoning on coral reefs and their associated fish communities in the GBR Marine Park	Hugh Sweatman	AIMS	100,000	225,450	01/07/2015-30/12/2015

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	100,000	110,000	01/07/2015-01/12/2015
3.9	Indigenous capacity building and increased participation in management of Queensland sea country	Melissa George	NAILSMA/CSIRO	100,000	100,000	01/07/2015-31/12/2015
3.10	Benchmarking costs of NRM improvements for the GBR	John Rolfe	CQU	29,487	65,193	01/07/2015-15/12/2015
3.11	Monitoring and adaptively reducing system-wide governance risks facing the GBR	Allan Dale	JCU	55,537	99,286	01/07/2015-31/12/2015
3.12	Development of an offset financial contribution calculator for Reef Trust	Martine Maron	UQ	80,595	95,153	01/07/2015-31/03/2016
3.13	eAtlas 2015 - NESP data management, Torres Strait NRM plan delivery platform and Torres Strait reef mapping	Eric Lawrey	AIMS	98,040	110,740	01/07/2015-31/12/2015
TOTAL FUNDING \$				1,797,300	3,206,599	

Expected Outcomes

The expected outcomes of the NESP are to produce research that:

- enhances our understanding of Australia's environment, climate and weather
- is communicated clearly to relevant stakeholders and the general public
- is discoverable and accessible
- informs decision-making and addresses environmental priorities.

Research under the NESP is expected to inform the policy and programme delivery of the Department of the Environment. More broadly, it will engage and inform all key stakeholders with an interest in the outputs of environmental and climate science research, including state and local governments, business and industry, community groups, Indigenous land managers (or Indigenous Communities) and education institutions.

Predicted Hub Outcomes

Recognising the interests, rights and knowledge of all end-users in the region, including industry, NRM groups, Traditional Owners and community, the predicted NESP TWQ Hub outcomes are:

- Innovative research that provides practical solutions to maintain and improve tropical water quality from catchment to coast to:
 - mitigate water quality impacts
 - predict indirect and cumulative effects of human activities
 - provide optimised management options and interventions
 - facilitate Indigenous co-management and co-governance
 - identify and prioritise regionally-specific management interventions
- Facilitate Indigenous participation in Hub governance and research.
- Conduct research that is relevant to and benefits end-users, involving end-users in the design and research, where applicable.
- Provide opportunities for Indigenous engagement, employment, skills transfer, sharing knowledge and increasing cultural awareness.
- Capacity building in the region through Indigenous and non-Indigenous research scholarships, early career researcher opportunities, TAFE Certificate courses, and a tropical environmental cohort program for PhD candidates and ECRs involving all partner institutions and end-users.
- Extension and sharing of Hub research findings with end-users including industry, NRM groups, Traditional Owners and community, using a variety of approaches, for example, technical reports, fact sheets, informal forums, posters, audio-visual and social media.
- Collaborative research with other NESP Hubs to produce complementary and coordinated research outcomes.

Expected Outputs

Detailed project schedules (Attachment A) specify the obligations of each research project including outputs for each project. Expected types of outputs include:

- Milestone reports that report progress against identified project objectives and deliverables,
- Data exchange and data management of eAtlas online products to allow for accessible data,
- Stakeholder workshops and meetings, including focus meeting with Department staff to inform policy and decision-making,
- Communication products such as technical reports, fact sheets, informal forums, posters, audio-visual and social media outputs,
- Technical reports with clear plain English summaries that synthesise the key areas of relevance to the Department and end users,
- Decision-support tools that can be applied to policy development and decision-making,
- Annual or biennial Hub conferences targeting delivery of outputs to end users,
- Annual progress reports (with traffic light indicators) of project progress and science delivery, and
- Audited annual finance reports.

Communication and Knowledge Brokering

Integral to the success of the NESP in influencing decision-making is the clear and effective communication and brokerage of research outputs to key stakeholders. The NESP TWQ Hub has developed and maintained a Knowledge Brokering and Communication Strategy that:

- strongly aligns with this Research Plan
- describes how the Hub will facilitate knowledge sharing between researchers and end-users
- includes activities that bring researchers, policy makers and environmental managers together to facilitate evidence-based decision-making
- details the research products and promotional material to be developed by the Hub
- describes how data produced by the Hub will be stored and made accessible to the general public
- identifies the FTE Communications and Knowledge Brokering roles associated with these activities.

The two primary outputs for knowledge brokering and communication are: (1) a research-user engagement framework, and (2) a suite of communication products and reporting tools that include web-based information, technical reports, newsletters, and peer reviewed publications.

Data Accessibility

The NESP guidelines expect that all information (including research data) produced under the programme is made publically and freely available on the internet. The NESP TWQ Hub recognises the need to promote open access to public sector and publically funded information.

The information and results generated by the NESP TWQ Hub are aimed at facilitating real improvements in sustaining the ecosystems and catchments of the Great Barrier Reef and the Torres Strait marine regions. Accordingly, a substantial knowledge brokering, communication and engagement framework will support Hub research activities and data management and accessibility.

The e-Atlas hosted by AIMS was established during MTSRF (2006-2010) and will continue to be a primary data repository for the NESP TWQ Hub. The e-Atlas is an innovative website (<http://eatlas.org.au>) and mapping system for preserving, sharing and facilitating the use of environmental data. It has substantial data from the CRC Reef, CRC Torres Strait, MTSRF and NERP Tropical Ecosystems Hub already available, and has promoted greater use and application of research information by environmental managers, scientists and the community. The role of e-Atlas within the NESP TWQ Hub program is to ensure metadata, imagery and research products are captured, documented, made easily accessible and discoverable via the web. During the NERP program (2011-2014) many of the e-Atlas systems were redeveloped or improved to allow integration with national data management standards and services, improved scalability for handling more datasets, better documentation of datasets and support for multiple sub-sites custom-made for different regions and topics. These capabilities allowed the development of a regional e-Atlas for Torres Strait (<http://ts.eatlas.org.au>) and a topic based e-Atlas for the Social and Economic Long Term Monitoring Program (SELTMP) (<http://seltmp.eatlas.org.au>) in addition to the e-Atlas. These data access tools have broad community and stakeholder appeal and will be fundamental access points for NESP TWQ Hub data. The e-Atlas content continues to grow and now contains over 2,500 map layers, 140 datasets, 370 photos and 85 articles, as well as an extensive library of reference and research data.

Monitoring & Evaluation

Monitoring & Evaluation Plan

The Monitoring & Evaluation Plan (M&E Plan) provides the framework through which the progress and success of the Hub will be measured. It will enable clear performance assessment via a common set of high level indicators used across the programme, along with qualitative, narrative based reporting of project progress and impact.

Key Performance Indicators for each NESP Hub will be aligned to a number of key themes (Figure 2).



Figure 2. Key Performance Indicators under the main themes for the NESP Tropical Water Quality Hub.

Two important elements of the Monitoring and Evaluation Plan are annual project reporting and the biennial programme evaluation.

Project and Financial Reporting

Under the terms of the NESP funding agreement, the following reports are required to be submitted to demonstrate Hub performance and project progress;

- **Annual Progress Report:** to be submitted in April of each year and describes, in quantitative and qualitative terms, the progress of work against the Research Plan.
- **Audited financial information:** submitted alongside the Annual Progress Report and demonstrates the income and expenditure of the Hub.
- **A Final Report:** submitted at the conclusion of all Hub activity.

Biennial Evaluation

Under the Portfolio Budget Statements for the Environment Portfolio, the single key performance indicator for the NESP is biennial qualitative assessments that show Departmental staff, state governments, business, community groups and others are using research output from the NESP to inform policy development.

The outcomes and findings of the Biennial Evaluation will inform and direct the future delivery of the programme, including the research priorities. The biennial review will be used to inform the review and evaluation of the NESP after two and four years as requested by the Minister in making his funding decision for the NESP.

Under the terms of the funding agreement, the NESP TWQ Hub is required to participate in any programme evaluations or reviews planned during the life of the NESP.

Collaboration and Partnerships

The NESP encourages a collaborative, multi-disciplinary approach to environmental and climate science research. Key to the success of the Hub will be the capacity to foster partnerships across Hubs and with a wide range of relevant research stakeholders.

The NESP TWQ Hub Administrator has an established track record of working collaboratively with other research programs and centres to maximise science output value. Negotiations are underway to ensure future collaboration of the NESP TWQ Hub research with the Northern Australia Environmental Resources, Marine Biodiversity, Threatened Species Recovery, Earth Systems and Climate Change and Clean Air and Urban Landscapes Hubs. Research priorities that cut across these hubs and the TWQ Hub will be addressed through collaborative partnerships between hubs to maximise value from cross-hub capacity. These joint priorities will be further addressed in future versions of the Research Plan.

The NESP TWQ Hub partners have collaborated for nearly two decades, and have established an extensive network of research end-users across government, industry, NGO's, Indigenous groups and other community groups. The creation of credible biophysical, social and economic information to policy makers, natural resource managers, industry, community and other scientists has been, and will be, one of the key success elements for the NESP TWQ Hub.

Using the operational strategies below, the Hub will ensure outputs are useful to, and adopted by, end-users through processes that:

- Develop research projects through an iterative process that identifies and addresses end-user issues; designed to encourage additional end-user co-investment.
- Conduct annual syntheses of current issues, knowledge gaps and possible solutions.
- Commission a series of industry dialogues on key issues in the form of end-user products.
- Each project will have an end-user partner involved through all stages of the project from conception to final delivery.

The NESP TWQ Hub and the NESP Northern Australia Environmental Resources Hub have discussed developing a shared approach and potential formal collaborations in joint thematic areas, which may include:

- Indigenous co-management of natural systems including IPA and ILUA management, integration of traditional ecological knowledge and capacity building of Indigenous rangers in rainforest land and sea country;
- Catchment and coastal planning and governance including in rainforest areas (Northern land-use planning for sustainability);
- River connectivity, the source, transport and processing of sediments and nutrients in a changing system; and
- Sustainability indicators for rainforest, catchment and reef resources.

Other potential cross-Hub linkages will be further investigated with the Marine Biodiversity Hub, Clean Air and Urban Landscapes Hub, Threatened Species Hub, and the Earth Systems and Climate Change Hub and will be identified including, but not limited to:

- Effective on-ground responses to reduce threats and promote recovery of threatened species (Threatened Species Hub);
- Maximising the efficacy of managing Australia's marine environment (Marine Biodiversity Hub);
- Improving our understanding of pressures on the marine environment (Marine Biodiversity Hub);
- Improving our understanding of the marine environment including biophysical, economic and social aspects (Marine Biodiversity Hub);
- Quantifying the benefits of urban greening for humans and other species in cities to inform Australian Government policy and programmes, and management actions by all levels of government, the community and industry (Clean Air and Urban Landscapes Hub);
- Specific threatened species and water quality integrated projects to optimise planning and investment to benefit multiple threatened species as well as maximise water quality outcomes;
- Specific water quality and climate change related projects;
- Marine monitoring related projects;
- Decision support research and tools related to management of key threats across Australia's marine estate (Marine Biodiversity Hub, Northern Australia Environmental Resources Hub, Threatened Species Recovery Hub).

The NESP TWQ Hub will also promote relevant joint PhD projects and scholarships with other Hubs.

The Hub intends to link knowledge brokering and communications activities with other Hubs, particularly the Northern Australia Environmental Resources Hub, enabling synergies between engagement frameworks and critical analysis of contrasting approaches for continuous improvement.

The six partner institutions of the NESP TWQ Hub are:

Australian Institute of Marine Science

Over its 40-year history, AIMS has earned its reputation as an impartial and trusted advisor on tropical water quality issues. AIMS have the commitment and capacity to undertake multidisciplinary, long-term and large-scale scientific research that addresses the NESP TWQ Hub priorities. AIMS research has made significant contributions to the development and implementation of policies and guidelines, especially as part of the Reef Water Quality Protection Plan (Reef Plan). AIMS research has focused on documenting and understanding the condition, dynamics and trends of water quality and coral reef communities in the GBR region, and linking these to changes in catchment and coastal use. AIMS has a strong track record of targeted research on current issues, such as the impacts of sediments, nutrients and agrichemicals on key organisms and communities, the impact and ecology of Crown-of-Thorns seastars on coral reefs, and the ecological responses and adaptation of marine species to future temperature increases and ocean acidification.

AIMS is well positioned to contribute to TWQ Hub priority outcomes through its niche capabilities in:

- *Water quality analysis and monitoring* to assess the fate and effects of pollutants and to provide sound baselines and trends to evaluate the success of long-term management activities.
- *Ecosystem monitoring and understanding* to provide long-term data series on ecosystem health. This data underpins ecosystem assessments and attribution of changes and impacts, including the development of novel health indicators on a molecular or microbial level.
- Development and application of *integrated hydrodynamic, water quality sediment transport and ecosystem response models* for long-term scenario testing.
- *Quantification of ecological responses to cumulative pressures* using world-class controlled environment experimental facilities (Seasim).
- *Ecotoxicology* using relevant tropical and sub-tropical species to test the effects of pollutants, such as herbicides, metals and hydrocarbons.

James Cook University

James Cook University (JCU) has significant expertise across all aspects of the Tropical Water Quality Hub's Research Investment Strategy. JCU is the most cited institutions in the world for coral reef ecology (ISI Essential Science Indicators 2008–2013), received the highest rating for ecological applications and environmental science and management in the last round of Excellence for Research in Australia (ERA 2012) and is one of the top two Australian universities and in the top 30 in the world in environmental sciences and ecology (US News and World Report and NTU global rankings).

JCU staff have led large-scale, integrated, end-user driven research programs in the tropics for the last 25 years through their involvement in the CRC Reef and Torres Strait, Coastal CRC, TRaCK, MTSRF and NERP, and have developed trusted affiliations with key organisations including: GBRMPA, Wet Tropics Management Authority, Torres Strait Regional Authority, Queensland Government, local governments, NRM regional bodies, Traditional Owners, Regional Development Associations, tourism groups, agricultural and fisheries representative bodies and managers, environmental NGOs and port authorities.

CSIRO

Through the 'Land and Water', 'Agriculture' and 'Oceans and Atmosphere' Flagships, CSIRO is conducting long term, strategic and as well as industry relevant, applied research in the Great Barrier Reef and other tropical water systems to ensure the long-term protection and restoration of coastal and Reef ecosystems and the sustainability of agricultural land uses.

CSIRO is investing in integrated environmental, social and economic research to support the development, implementation and evaluation of on-ground actions, plans, policies and governance arrangements to improve tropical water quality.

In recent years our research has focused on:

- understanding the main pollutant sources and the process that affect pollutant loads
- informing the design and prioritization of land management strategies for water quality improvement
- helping with the selection of effective mechanisms for implementation of land management strategies
- enabling managers to strategically deal with the intrinsic uncertainty around the success of water quality improvement plans

- examining the factors that influence governance arrangements, partnerships, and stakeholder contributions and commitment to the effective delivery of water quality plans and policies
- informing the monitoring, reporting and adaptation of water quality improvement
- understanding the impacts of pollutant loads on freshwater and marine aquatic ecosystems.

CSIRO's project experience includes preparation of the Water Quality Improvement Plan - Tully Basin, and the successful completion of numerous Reef Rescue funded projects that quantified nutrient and sediment loads to the GBR, and identified priority areas within catchment for remediation of surface and gully erosion in grazing systems.

Central Queensland University

Central Queensland University (CQU) research is closely aligned with water quality issues and the natural environment in northern Australia. There is particular expertise in economics, water quality science, freshwater ecology, ecotoxicology, coastal ecosystems and social sciences. Researchers have focused on issues in the marine systems, as well as the agricultural-environmental interface which impacts on water quality draining into the Great Barrier Reef.

The expertise in resource economics translates community concerns about water quality and ecosystem health issues into policy settings, as well as linking ecosystem sciences and production issues together in bioeconomic models to identify opportunities for improved agricultural management to improve water quality. The expertise in freshwater science and ecology systems is relevant to a number of monitoring and restoration programs, as well as efforts to measure and report ecosystem health.

The location of CQU's campuses place substantial research expertise in the central and southern regions of the Great Barrier Reef and associated catchments, providing linkages to industry and stakeholders in the regions. Researchers have strong and ongoing involvement with major ecosystem and water quality programs in the Gladstone Harbour, Fitzroy River and other coastal and catchment areas.

University of Queensland

As a demonstration of our commitment to the NESP TWQ Hub Strategic Plan, the University of Queensland (UQ) has assembled an exceptionally strong team of researchers from the Global Change Institute, the Faculty of Science and the Faculty of Engineering, with demonstrated strength in water quality optimisation, social adaptation, environmental assessment and modelling, and coastal management. UQ takes a multi-disciplinary approach, engaging a range of expertise across UQ, Australia and beyond, to undertake research addressing coastal and marine resource management issues and leading to on-ground solutions.

UQ is the lead university within the state for both research output and quality. It is currently a national leader in a range of water quality and coastal management research fields and incorporates these through a number of mechanisms to influence policy change. Expertise in relation to innovative monitoring techniques (e.g. remote sensing and economics), whole-of-system and cumulative modelling, historical baselines to understand status and long-term trends in coral reef systems, as well as socio-cultural implications of solutions are amongst the areas that UQ innovates in water-related and coastal management research, delivering world-class science in both fundamental and applied areas.

Griffith University

Griffith University's highly respected Australian Rivers Institute (ARI) has the largest group of university based scientists, with expertise in river, catchment and coastal research, in Australia. ARI's research capacity spans the biophysical, social and economic sciences and will generate important insights into the linkages, interconnectedness and interdependencies which affect water quality from the catchments to the reef.

Specific expertise includes: catchment and river processes; resource economics; fluvial geomorphology; rehabilitation science; ecosystem-scale modelling; aquatic ecology; nutrient and sediment processing, transport and tracking; coastal and estuarine ecosystem processes; ecotoxicology; aquatic ecosystem health monitoring and assessment; natural resource management (land owners and indigenous); and spatial optimisation and prioritisation of investment and management action.

With this expertise, ARI researchers can improve our understanding of the source and cause of sediment, nutrient and ecotoxin loads affecting the health of the reef, develop and test approaches to reduce this load, generate the processes and framework to optimise the investment in management actions while meeting multiple objectives (environmental, economic, social and cultural) and develop monitoring methods and tools to assess the effectiveness of actions and the response from the freshwater, estuarine and coastal ecosystems.

Indigenous Engagement

The NESP TWQ Hub is committed to meaningful Indigenous engagement and collaboration during all phases of the delivery of the NESP. Consideration will be given to actively involving key indigenous stakeholders in research prioritisation, research delivery and, especially, the communication of research output. The Hubs approach to indigenous engagement is detailed in its Indigenous Engagement and Participation Strategy.

The NESP TWQ Hub is strongly focused on the sustainable management of environmental assets of the GBR, Torres Strait, other tropical waters and their catchments. These geographical areas are strongly connected to the region's Aboriginal and Torres Strait Islander peoples. There are approximately 70 Traditional Owner clan groups whose land and sea country include the Great Barrier Reef Marine Park and coastal ecosystems. The Torres Strait has 20 Traditional Owner groups (19 Torres Strait Islander Corporations and one Aboriginal Native Title Corporation). Eight land and sea Indigenous Protected Areas (IPAs) and seven Traditional Use of Marine Resource Areas (TUMRA) are identified within the geographical region of the TWQ Hub. Indigenous ecological knowledge is a fundamental pillar for the sustainable environmental management of the natural resources of north Queensland. The NESP TWQ Hub recognises the importance of Indigenous engagement in the understanding and management of north Queensland's natural assets.

A draft Indigenous Engagement and Participation Strategy (IEPS) has been prepared. The overall goal of the IEPS is to ensure a meaningful two-way engagement relationship that will recognise the interests, rights and Indigenous ecological knowledge (IEK) of Traditional Owners in land and sea country. The aim of this IEPS is to ensure research leaders consider and include opportunities for the engagement of Traditional Owners within projects. At all stages, research with Indigenous peoples must be founded on a process of meaningful engagement, respect, trust and collaboration between the research project team and Indigenous peoples.

The following objectives will guide the achievement of the Indigenous Engagement and Participation Strategy:

1. NESP TWQ Hub research is to be relevant and of benefit to Indigenous communities and organisations.
2. NESP TWQ Hub research is to be conducted according to the highest ethical standards and respects Indigenous priorities and values.
3. NESP TWQ Hub research will provide opportunities for Indigenous engagement, employment, skills transfer, sharing of knowledge and the increase of cultural awareness amongst all parties.
4. NESP TWQ Hub generated knowledge, data and research results will be effectively shared and communicated between Indigenous peoples, communities and organisations.
5. NESP TWQ Hub will facilitate effective Indigenous participation in Hub governance.

The final IEPS will be developed through a working partnership with Indigenous groups and Hub representatives.

Funding

The NESP TWQ Hub is supported through funding from the Australian Government's National Environmental Science Programme. Under the Department of the Environment Portfolio Budget Statements, the NESP provides for around \$142 million over the life of the Programme.

Table 2 describes the funding from the NESP available to the TWQ Hub over the life of the agreement.

Table 2. Annual funding for the TWQ Hub over the 6-years of the NESP.

2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
\$2,200,000	\$5,630,000	\$5,400,000	\$5,400,000	\$5,400,000	\$5,400,000	\$2,550,000

Expenditure of NESP funding under the Hub is expected to align with percentages along three key items (Table 3).

Table 3. Allocation of funding along three key hub items.

Research	81%
Knowledge Brokering & Communication	13%
Administration	6%

Under the terms of the NESP, the minimum total for recipient and other contributions per year is 100% of the funds paid by the Department under this agreement.

At Attachment C are the budget tables for the Hub for calendar year 2015 onward. It describes the budget for each Hub project, and includes recipient and other contributions.

Attachment A: Research Project Schedules

(Round 1 Short-term Funding)

Project Number	Project Name
1.1	Establishing the future NESP CoTS research framework including an ecologically-based approach to the management of CoTS at multiple scales
1.2	Developing an approach to evaluate the effectiveness of investments in riparian management in the GBR catchments
1.3	A validation of coral geochemical records to reconstruct suspended sediment loads to the Great Barrier Reef lagoon
1.5	Legacy of the Lower Burdekin Water Quality Tender
1.6	Multiple and cumulative impacts on the GBR: assessment of current status and development of improved approaches for management
1.7	Reducing sediment sources to the Reef: testing the effectiveness of managing alluvial gully erosion
1.8	Sub-catchment scale monitoring, modelling and extension design to support reef water quality improvement
1.9	The establishment of a future NESP dredging research investment framework
1.10	Identification, impacts, and prioritization of emerging contaminants present in the Great Barrier Reef and Torres Strait marine environments
2.1	Assessing the cumulative impacts of climatic disturbances on inshore GBR coral reefs and identifying key refuges for recovery and resilience
2.2	A tradable permit scheme for cost effective reduction of nitrogen runoff in the sugarcane catchments of the Great Barrier Reef
3.1	Seagrass mapping synthesis – A resource for marine park and coastal management
3.2	Improving historical estimates of abundance and distribution of dugongs and large green turtles in western and central Torres Strait
3.3	Light thresholds for seagrasses of the GBR: a synthesis and guiding document for managing seagrass
3.4	Developing and refining biological indicators for seagrass condition assessments in an integrated monitoring program
3.5	Assessment of key dugong and turtle seagrass resources in the northern Torres Strait.
3.6	Establishing a research framework for future NESP investment into better understanding of the presence of Box-Jellyfishes (Irukandji) and risks in the Great Barrier Reef
3.7	Monitoring the effects of zoning on coral reefs and their associated fish communities in the GBR Marine Park
3.8	Towards an integrated monitoring program: identifying indicators and existing monitoring programs to cost-effectively evaluate the Long Term Sustainability Plan
3.9	Indigenous capacity building and increased participation in management of Queensland sea country
3.10	Benchmarking costs of NRM improvements for the GBR
3.11	Monitoring and adaptively reducing system-wide governance risks facing the GBR
3.12	Development of an offset financial contribution calculator for Reef Trust
3.13	eAtlas 2015 - NESP data management, Torres Strait NRM plan delivery platform and Torres Strait reef mapping

Project 1.1 – Establishing the future NESP CoTS research framework including an ecologically-based approach to the management of CoTS at multiple scales

Project length – 6 Months

Project start date – 01 July 2015

Project end date – 31 December 2015

Project Leader – David Westcott (FTE – 0.1)

Lead Research Organisation – CSIRO

Total NESP funding - \$100,000

Total Recipient and Other Contributions (co-contributions) - \$119,710

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$100,000	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$119,710	x	x	x	x	x	x

Project Summary

This project will lay the foundations for the development of a reliable CoTS surveillance and control program based on detailed understanding of i) CoTS ecology, population dynamics and movement, ii) the CoTS control program’s capabilities and constraints, and, iii) IPM principles. In the project’s initial phase a COTS Integrated Pest Management (IPM) Workshop will be conducted. This workshop will bring together managers and researchers with purpose of defining a tactical approach to current COTS management and a strategic approach for the management of future outbreaks.

This will be achieved through the development of **management-focused** qualitative models of the CoTS/control system. These models will be used to identify key system components and associated knowledge gaps and will provide the logical structure of a future quantitative simulation model to test and compare alternative management scenarios. These two frameworks, and the data needs identified to operationalise them, will form the basis for the development of a COTS Strategic Research plan. It is envisaged this Project will lead into the COTS IPM Program and provide the direction for COTS research under future NESP investment.

Problem Statements

Problem

Effective pest management strategies invest management resources based on an understanding of the pest’s distribution, movement and population dynamics, such that key population events are targeted at critical locations and times with appropriately scaled management resources. Current CoTS control, in contrast, is largely reactive; operating on human scales (e.g. dive sites) rather than those of CoTS population processes, and focusing on tactical metrics (e.g. animals killed) rather than strategic goals (e.g. preventing coral loss).

How Research Addresses Problem

In this pilot project, experts in Integrated Pest Management (IPM), systems modelling, CoTS biology and CoTS field management will develop a qualitative model of the CoTS/control system i) at the scale of active management and ii) at the scale of the phenomenon. These models will be used to reach consensus on the structure of the system, to identify management relevant knowledge gaps in our understanding of CoTS ecology and control, and, to identify realistic control objectives. These models will be used to drive the integration of current and planned research efforts and to structure a COTS research program. Ultimately, these models will also form the basis of models of the spatial and temporal interactions between CoTS populations and control efforts and enable scenario testing

to identify the most efficient and effective strategies for surveillance and for modifying CoTS population dynamics in order to avoid/limit outbreaks.

The process by which this is achieved is critical. It is essential that the stakeholders (DotE, GBRMPA, AMSTO etc) and researchers are engaged and collaborating so that the CoTS research and control activities are backed by an agreed research agenda that i) delivers strategic information needed to progress workable 'real life' solutions for COTS control and ii) contributes to the priorities and strategies of the key agencies (DotE and GBRMPA). To this end, a series of workshops, including a facilitated event, with key researchers and stakeholders will be held to establish the research and Integrated Pest Management Framework for future NESP investment in COTS control in the GBR.

Without an integrated pest management approach to COTS, supported by an agreed research framework and projects that contribute to it goals, well intended research work will occur in isolation and opportunities to integrate and apply research results will be missed. To this end, a series of workshops, including a facilitated event, with key researchers and stakeholders will be held to establish the research and Integrated Pest Management Framework for future NESP investment in COTS control in the GBR.

Alignment with NESP Research Priorities

1.3 Further development of a systematic approach to management of Crown of Thorns Starfish (CoTS) outbreaks.

Research

Description of research

Working with the Department through the RRRRC and directly with managers, end users and CoTS teams we will:

- 1) Clearly define and specify the management requirements to be addressed by an integrated COTS modelling program
- 2) Participatively define the scope and scale of the COTS IPM Program through a dedicated Workshop to ensure that:
 - a. Fulfils DotE's objectives in regard to reef protection and investment,
 - b. It reflects the goals of GBRMPA's COTS Long-term Research and Monitoring Agenda
 - c. Data needs and gaps based on key ecological and management processes identified in the qualitative model are identified to form a COTS Strategic Research Plan, and
 - d. A framework for longer term investment under the future NESP is provided.
- 3) Develop a qualitative model of surveillance, management actions and COTS ecology suitable for:
 - a. identifying important interrelationships and available data sources
 - b. identifying likely points of intervention for ecologically informed control
 - c. implementation in a quantitative individual based model for optimization in future research
- 4) Ensure collaborative, workable and outcomes focused relationships between researchers, key decision makers and industry are established and supported
- 5) Design a longer-term COTS Integrated Pest Management framework and produce a Strategic Research Plan focused on managers' practical requirements and the objectives and priorities of DotE and GBRMPA.

Working with CoTS managers through a facilitated workshop and in ongoing control processes, we will:

- 1) Conduct a series of workshops that bring managers, policy makers and researchers together to
 - i) define the CoTS control system, to identify knowledge gaps and research needs, ii) to

integrate existing and planned research activities (e.g. Pratchett's Marine Biodiversity Hub, AIMS' Accelerate Project), and, iii) to scope an IPM Research Framework to guide management and research and meet the priorities and objectives of DotE and GBRMPA.

- 2) Develop qualitative models of surveillance and control actions, population ecology and spatial distribution of CoTS populations across the region currently managed by AMPTO and at the scale of their activities. Developing the models collaboratively with on-water managers and CoTS ecologists will ensure it is focused at spatial and temporal scales necessary to inform and increase the cost effectiveness of management actions.
- 3) Identify likely points of intervention for ecologically informed management strategies, for quantitative optimization in the longer term research project.

Links with other projects and hubs

This project will link to all research project proposals investigating COTS. The research framework may link with the Marine Biodiversity Hub and the research in that Hub being led by Prof. Morgan Pratchett, a collaborator on this project.

Related research

The project proposes direct engagement with the Reef Fund COTS Control Program, with decision makers, end users and the relevant researchers. Discussions with AIMS Accelerate program have been held to ensure that the projects are fully integrated and complementary and agreement and a pathway for this has been reached. Working closely with field operations this project will underpin a more systematic approach to CoTS Integrated Pest management. This work will directly support decision-making processes that inform the ongoing efforts to cost effectively controlling COTS populations at the level of individual reef operations. GBRMPA are collaborators on the project and the project will develop in the light of their objectives and their yet to be released COTS Long-Term Research and Management Strategy.

Expected Outcomes

Outcomes

The project will

- Deliver a workshop of end users, researchers and decision makers to integrate and develop a shared understanding of all relevant research, and management requirements and the spatial and temporal scales which are important for making management decisions.
- Provide a coordinated research framework and integrated pest management program that reflects the priorities and objectives of DotE and GBRMPA and will guide future research investment into COTS Control and Management in the GBR.
- Provide practical recommendations of likely points of intervention for structuring and operationalising ecologically informed management strategies that meet the Department's and managers' objectives

Specific management or policy outcomes

- CoTS managers will influence and provide assessment of the concepts and approaches underpinning the development of the surveillance and eradication strategies as they are being developed. In the past our experience in other systems has been that the process of designing the qualitative model provides fresh insights for managers on how they can improve their approach to managing their pest species.
- In the long term these contributions will ensure that the simulation model is acceptable to them and fit for purpose. This will ultimately mean that the modelling can provide managers with guidelines for optimizing their operations and ensuring maximum effectiveness of their management and the probability of achieving i) the goal of reducing CoTS populations to improve reef health, and, ii) of modifying population dynamics in their region of concern such that outbreak conditions are avoided.

Value

The development of an IPM Framework will guide both research and control activities by providing a strategic focus that ensures alignment between activities to achieve common and agreed upon management outcomes.

This project will involve the development of a qualitative ecologically based model that will indicate the likely surveillance and control points that will be most efficient in reducing CoTS populations, as well as preventing future outbreaks and improving coral cover, as a necessary step in the development of an cost effective, applied and long term COTS integrated pest management strategy.

The process of developing this model will require researchers and managers to think critically about the issue of CoTS management and to develop and assess a set of realistic management objectives and an understanding of the likelihood and consequences of achieving those goals. This will allow managers to improve both the efficiency and effectiveness of their activities, an effect that will be amplified by the subsequent development of the model.

Planned Outputs

- The Workshop will bring together all key stakeholders for the crafting of the Integrated Pest Management framework and developing a COTS Strategic Research plan
- The project will be conducted as collaboration with on-water managers. As a consequence of their direct involvement in the project they will be informed about progress as it happens throughout the project. Their involvement began in discussions over the past eight months and includes their participation in the development of this proposal.
- Project updates via AMPTO and RRRC
- Regular meetings and project collaboration with AMPTO and other managers

Delivery of Project

Project leader's track-record

Westcott, Fletcher and Murphy have worked extensively on the development of ecologically-informed management of pest species. This includes transformative research into the management of invasive plants, the management of feral pigs, and responses to emerging infectious diseases.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP
On signing of contract		\$50,000
Report describing: <ul style="list-style-type: none"> a. The outcomes of the workshop detailing Integrated Pest Management framework and developing a COTS Strategic Research plan b. The workshop will discuss existing datasets and, if relevant, the possible submission of this material to eAtlas. 	15 December 2015	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr David Westcott	Principal Investigator	CSIRO	david.westcott@csiro.au	0.10
Prof. Morgan Pratchett	Co-Investigator	JCU	morgan.pratchett@jcu.edu.au	0.05
Dr Cameron Fletcher	Co-Investigator	CSIRO	cameron.fletcher@csiro.au	0.20
Dr Helen Murphy	Co-Investigator	CSIRO	helen.murphy@csiro.au	0.05
Mr Adam McKeown	Research Assistant	CSIRO	adam.mckeown@csiro.au	0.05
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Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
CSIRO	In-kind
Other stakeholders	In-kind

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Association of Marine Park Tourism Operators	Col McKenzie
GBRMPA	Jen Dryden

Knowledge Brokering and communication

- Stakeholders, key researchers and end users will be participants in the COTS IPM Workshop and collaborators on the COTS IPM Research plan to ensure that the approach and strategies are relevant
- The qualitative model will also be developed participatively with input from key end-users and stakeholders
- The qualitative model will be refined for implementation in a quantitative individual based model and presented to end-users and stakeholders for discussion of data availability and knowledge gaps.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	71,371	-	83,579	-	31,131	\$186,081
Operating (incl. equipment, travel and communication) – include \$30K for Workshop	28,629	-	-	-	5,000	\$33,629
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$100,000	-	\$83,579	-	\$36,131	\$219,710

Location of Research

The workshop will be based in either Cairns or Townsville. The research framework will focus on the Great Barrier Reef.

Indigenous Consultation and Engagement

Indigenous stakeholders (particularly those with sea country) will be consulted and engaged in the development of the Integrated Pest Management framework and COTS Strategic Research plan. As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

In-scope activities for this project include research, management and consultation activities that are specifically focused on improving the management response to CoTS outbreaks. This will include workshops and consultation intended to describe the CoTS-management system, preliminary modelling activities to operationalize the outputs of these meetings and potentially some basic research to fill data gaps identified as important and urgent. The scope of future work will have a greater focus on research (modelling and fieldwork) to fill identified, management relevant, data gaps.

Exclusions (out of scope)

Out of scope work for this current proposal will include research that is not directly linked to data needs for the development of improved management strategies. This project will operate under the assumption that other modelling projects are covering connectivity at the scale of the GBR (Hock and Mumby) and the question of where and whether management action should be undertaken (Walshe and MacNeil) and as a consequence will seek to complement these activities rather than replicate them.

Risks

- Loss of key staff
- Effective CoTS management requires a multi-scale understanding of both CoTS population dynamics and controllers and the physical and economic constraints of managers. In this project we will:
- Deliver a qualitative model only – in a subsequent project this will underpin a simulation model used to assess and refine alternative control strategies.
- Focus specifically at the scale of active management, specifically the region between Lizard Is. and Innisfail and at the scale of individual reefs.
- Work with the Model Integration project of Babcock et al., AIMS's Accelerate Project and other modelling activities (e.g. Karlo and Mumby, UQ) to ensure that our efforts are complementary and effectively integrated.
- Difficulty in getting collaboration or agreement between workshop participants resulting in continued uncoordinated research

Project Keywords

Integrated Pest Management (IPM)
Surveillance strategies
Control strategies
Movement
Crown of thorns starfish (CoTS)

Project 1.2 – Developing an approach to evaluate the effectiveness of investments in riparian management in the GBR catchments

Project length – 9 Months
 Project start date – 01 July 2015
 Project end date – 31 March 2016

Project Leader – Rebecca Bartley (FTE – 0.17)
 Lead Research Organisation – CSIRO

Total NESP funding - \$99,972
 Total Recipient and Other Contributions (co-contributions) - \$84,972

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$49,986	\$49,986	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$84,972	x	x	x	x	x	x

Project Summary

The current tools used to estimate the contribution of bank erosion to the Great Barrier Reef (i.e. SourceCatchments model), are based on empirical relationships using little or no data from tropical river systems. This project proposes to develop a revised methodology for estimating (a) the natural or bench-mark rates of bank erosion in tropical rivers (b) how this information can be coupled with improved data sets on channel morphology, site connectivity and sediment particle size to develop a more robust approach for identifying sites amenable to remediation and (c) where riparian restoration has occurred, evaluate the effectiveness of the remediation.

Problem Statements

Problem

Streambank erosion is estimated to contribute ~30-40% to end of catchment sediment yields in the Great Barrier Reef (GBR) catchments. However, our understanding of the degree of alteration of bank erosion with the introduction of agriculture, and the success of methods for remediating bank erosion sites (using approaches such as riparian vegetation, fencing and stock removal), is limited. Without a robust understanding of these issues it is difficult to target sites for remediation as well as to evaluate the costs and benefits of undertaking remediation in the riparian zone.

How Research Addresses Problem

Risk frameworks, previously known as A,B,C,D frameworks, are used to evaluate the influence of improved grazing land management on hillslopes in rangelands, and for nitrogen use in sugarcane. No such risk framework exists for riparian management. Before such a framework can be developed, we need an improved understanding of the rates of bank erosion and channel change we can expect in natural or well managed landscapes. Without such information we don't know what we are trying to restore bank erosion rates to, and if the remediation actions being implemented (e.g. fencing) will be effective at reducing sediment delivery from bank erosion.

Alignment with NESP Research Priorities

- 1.2.1 Update and improve knowledge of sources, and identify roles of key pollutants and their long term fate to enable the identification of key sources of poor water quality.

Research

Description of research

The major objective of this project is to develop the methodology for a riparian zone management framework that will take into account:

1. The range of natural rates of bank erosion in tropical river systems in the GBR. The natural variability of bank erosion is not currently considered, and this may be biasing sites that are selected for restoration. This information will be derived from sites with in-tact riparian zones.
2. The amount of riparian vegetation, but also the channel morphology (bank height and angle), connectivity of the site to the end of the catchment, and improved information on particle size of the bank material.

The main tasks that will be undertaken as part of this preliminary project is to:

1. Hold a workshop that will bring together the project team to:
 - a) Identify the key data sets available for measuring (a) riparian vegetation cover change e.g. a combination of Foliage Protective Cover (FPC) + Radar imaging (b) channel morphology (Lidar, high resolution SPOT and ortho-rectified aerial photo products). No new on-ground data collection will be carried out as part of this project.
 - b) Develop a framework for using the various data sets (that have different spatial and temporal resolutions) to help understand the relationships between riparian vegetation and channel erosion at (i) undisturbed (ii) disturbed and (ii) remediated sites.
 - c) Identify the key software (e.g. DEM's of difference software), data sharing and licensing constraints.
 - d) Identify key sites that have been re-vegetated in the last 5-20 years in both wet and dry catchments.
2. Deliver a report that describes the framework, and test the new data sets and frameworks on two case study catchments (one wet tropical and one dry tropical catchment).

Links with other projects and hubs

This project will link to other projects focused on erosion (1.7) and evaluating on-ground investments (1.5).

Related research

This project builds upon extensive research into the benefits of riparian ecosystems and the management of bank erosion including recent investments of the Reef Trust.

Expected Outcomes

Outcomes

Riparian zones have many positive benefits in the landscape and are therefore a popular tool for remediation. Despite their extensive use, there has been minimal evaluation of their effectiveness. Evaluation is critical to justify the use of Government funding, but also as a marketing tool to encourage other farmers to undertake remediation. This project will provide:

- New data sets to test and evaluate the current bank erosion models. It is difficult to improve the current bank erosion models without measured data of channel change and erosion. These data can be used to derive improved algorithms and process understanding that relate channel erosion to changes in the amount of riparian vegetation and fencing.
- More robust benchmarking of future riverbank remediation interventions based on new quantitative data collected from GBR catchments. This will provide increased confidence in targeting future investments and lead to improved water quality from catchments.

Specific management or policy outcomes

The results of this project will provide much greater focus for on-ground investments in riparian vegetation by the Regional bodies. It will also provide greater focus for policy groups at State and Federal levels as there will be measured data to bench mark management actions, and a framework to help prioritise and evaluate investment outcomes.

Value

Bank erosion is a major (30-40%) source of sediment and particulate nutrients to the GBR. Understanding how much this contribution has changed over time and with land use, will allow much better targeting of sites for remediation, leading to more effective remediation investments. This project will also determine how much change we can expect from riparian zone investments.

Planned Outputs

1. A report that describes the framework, and test the new data sets and frameworks on two case study catchments (one wet tropical and one dry tropical catchment).
2. A briefing with key DoE staff in Canberra to discuss the implication of the results for evaluating the effectiveness of riparian management at the whole of GBR scale.
3. At least one technical workshop/meeting with the Queensland modelling team to discuss how the results may be integrated into existing modeling frameworks and tools.

Delivery of Project

Project leader's track-record

Each of the researchers in this project team have a long and established history working on erosion related issues in the GBR (Bartley), investigating riverbank and floodplain processes (Croke), analysing remotely sensed vegetation products (Tindall) and linking these data sets within a GIS environment (Henderson). Evidence of the team's high impact publication record, current projects, awards, students and affiliates can be found below. This includes one of the only published studies in the GBR catchments on bank erosion and channel change (see Bartley et al., 2008).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$49,986
1. A report that describes: <ol style="list-style-type: none"> a. The framework, and tests the new data sets and frameworks on two case study catchments (one wet tropical and one dry tropical catchment). 2. Summary of the: <ol style="list-style-type: none"> a. Briefing with key DoE staff in Canberra to discuss the implication of the results for evaluating the effectiveness of riparian management at the whole of GBR scale b. A technical workshop/meeting with the Queensland modelling team to discuss how the results may be integrated into existing modeling frameworks and tools. 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$49,986
Total NESP Funding		\$99,972

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Rebecca Bartley	Principal Investigator	CSIRO	Rebecca.bartley@csiro.au	0.17
Assoc. Prof. Jacky Croke	Geomorphologist	UQ	Jacky.croke@uq.edu.au	0.05
Dan Tindall	Remote sensing expert	QDSITIA	Dan.tindall@dsitia.qld.gov.au	0.1
Anne Henderson	Spatial analyst	CSIRO	Anne.henderson@csiro.au	0.2
Remote sensor	Remote sensor	QDSITIA		0.2

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DoE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Queensland State Government (Landscape Science)	Paul Lawrence and team
Key Stakeholders (organisation/programme)	
Regional Bodies (e.g. NQ Dry Tropics)	Scott Crawford and team
GBRMPA	Donna Audas

Knowledge Brokering and communication

The Federal and State Government, and the Regional Bodies, all invest in riparian zone management as a method for reducing and ameliorating sediment and nutrient delivery to the GBR. The key stakeholders that will be engaged in this process include:

- Department of Environment (Reef Program): Kevin Gale and team (kevin.gale@environment.gov.au)
- Queensland State Government (Landscape Science): Paul Lawrence and team (paul.lawrence@science.dsitia.qld.gov.au)
- Regional Bodies (e.g. NQ Dry Tropics): e.g. Scott Crawford and team (Scott.Crawford@nqdrytropics.com.au)

Commensurate with the above stakeholder audiences, we will develop tailored communication processes and products that will include:

- A briefing with key DoE staff in Canberra to discuss the implication of the results for evaluating the effectiveness of riparian management at the whole of GBR scale.
- At least one technical workshop/meeting with the Queensland modelling team to discuss how the results may be integrated into existing modeling frameworks and tools

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	84,972	-	49,972	-	35,000	\$169,944
Operating (incl. equipment, travel and communication)	15,000	-	-	-	-	\$15,000
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$99,972	-	\$49,972	-	\$35,000	\$184,944

Location of Research

Research output will impact upon GBR catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, all projects will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

New information on channel change derived from remotely sensed products (e.g. SPOT, Lidar, aerial photos) will be included in this project. This will provide information on the relative erosion rates we can expect in vegetated and un-vegetated landscapes. These data will allow the development of framework to evaluate the effectiveness of riparian management. Any field derived data collected in previous studies will also be included (e.g. from Burdekin and Daintree).

Exclusions (out of scope)

No new on-ground data collection will be carried out as part of this project. There is insufficient time to collect data across an entire wet season, and a single wet season is generally not representative of long term channel erosion processes.

Risks

The major risk with this project will be related to deriving bank erosion rates from un-impacted (currently fully vegetated) stream systems. We are confident, however, that new approaches in remote sensing technology will allow data to be derived for use in this project.

Project Keywords

Bank erosion
Sediment
Particulate nutrients
Remediation
Vegetation

Project 1.3 – A validation of coral geochemical records to reconstruct suspended sediment loads to the Great Barrier Reef lagoon.

Project length – 7 Months
 Project start date – 01 July 2015
 Project end date – 01 February 2016

Project Leader – Stephen Lewis (FTE – 0.10)
 Lead Research Organisation – James Cook University

Total NESP funding - \$22,500
 Total Recipient and Other Contributions (co-contributions) - \$38,950

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$11,250	\$11,250	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$38,950	x	x	x	x	x	x

Project Summary

While coral geochemistry records are widely cited as evidence for increased suspended sediment loads delivered to the Great Barrier Reef since the 1850s, there has been little replication or quantification of the records. Indeed, most records are based on cores collected prior to the year 2000 when limited catchment monitoring data existed to ‘validate’ the interpretations that certain trace element ratios provided proxies of annual sediment loadings. This project will analyse the geochemistry of coral cores collected in 2012 from sites in the central GBR and compare the ratios to measured sediment and particulate nutrient loads from the Burdekin River.

Problem Statements

Problem

While previous studies have speculated that the Ba/Ca, Y/Ca and Mn/Ca ratios in corals are related to land use change and sediment loading from adjacent river catchments (e.g. McCulloch et al., 2003; Lewis et al., 2007), this would be the first study to directly examine the link between these trace element ratios in corals and measured sediment and particulate nutrient loads from the Burdekin River. If a correlation can be established, this novel, independent technique can be used to quantify pre- and post- European suspended sediment loads to the GBR.

How Research Addresses Problem

The outputs of the study will allow the changes in sediment loads to be better quantified and hence help inform the setting of water quality targets within the GBR Water Quality Protection Plan and help calibrate Source Catchments Modelling of pollutants exported to the GBR. For example, it appears that suspended sediment loads from the Burdekin River increased considerably following the stocking of the catchment with sheep and cattle in the late 1800s and early 1900s (Lewis et al., 2007), although the construction of the Burdekin Falls Dam in 1987 now traps a large amount of the sediment (~ 70%) delivered from the upper catchment area (Lewis et al., 2012).

Alignment with NESP Research Priorities

1.2.1 Update and improve knowledge of sources, and identify roles of key pollutants (including emerging contaminants), and their long-term fate to enable the identification of key sources of, and vulnerable regions to, poor water quality.

Research

Objectives

1. Examine the replication and variability of coral trace element ratios across individual and different sites influenced by the Burdekin River and determine their ability to faithfully record water quality information.

This objective will confirm that coral geochemical records (like the luminescent line records) record annual river discharge and loads. We will also identify which trace elements provide the more reliable reconstruction of river discharge and loads. Indeed the now extensive record of measured Burdekin sediment (27 years of data) and particulate nutrient (16 years) loads can be used to test our hypothesis that Ba/Ca and Y/Ca ratios reflect bulk sediment load and Mn/Ca reflect top soil inputs (and perhaps a finer particle size).

2. Correlate the trace element composition in coral cores with sediment and particulate nutrient loads.

The development of this method will allow the production of long, annual records of historical sediment and particulate nutrient fluxes from the Burdekin River as well as for other regions. Such records will establish reliable baseline, pre-European sediment loads and hence quantify changes in sediment loadings post settlement. This will allow a better representation of anthropogenic loadings and as such refine catchment targets.

Method

- Measure the trace element composition (Ba/Ca, Y/Ca, Mn/Ca etc) in replicated short (~ 50 cm: i.e. continuous growth record from ~1970 to 2011) coral cores collected from the central Great Barrier Reef (GBR) on a laser ablation inductively coupled plasma mass spectrometer (LA-ICPMS) at the Australian National University. The coral cores were collected in 2012 from Magnetic Island (Geoffrey Bay and Nelly Bay), Havannah Island, Pandora Reef and Pelorus Island.
- Use a method developed by Lewis (unpublished) to calculate the amount of trace elements incorporated by the coral in the water year and compare to sediment and particulate nitrogen and phosphorus loads delivered from the Burdekin River. We will also examine if the correlation exists between the coral trace elements and various sediment particle fraction loads (data available from 2006 to 2011).
- Establish a calibration of the loads with the coral trace element data so that the method can be applied to long coral records (records back to early 1800s) to reconstruct annual loads and produce a pre-European settlement load, a pre-Burdekin Falls Dam load (e.g. 1970 to 1987) and a post Burdekin Falls Dam load (since 1987).

Links with other projects and hubs

Links with projects aiming to reduce sediment runoff to the marine environment.

Related research

This project builds upon previous investments in MTSRF and NERP TE. It also will inform setting of water quality targets within the GBR Water Quality Protection Plan and help calibrate Source Catchments Modelling.

Expected Outcomes

Outcomes

- The development of pre-European loads will allow an improved quantification of the 'anthropogenic' sediment load so that refined targets can be set (i.e. there are large discrepancies between the anthropogenic Source Catchments load (~ 2150 kt) and the anthropogenic loads suggested by changes in catchment erosion rates and sediment core accumulation rates (~ 3500 kt)). Indeed a 20% reduction in the anthropogenic sediment load (current Reef Plan target) could mean a reduction of 500 kt (Source Catchments) or 700 kt of sediment depending on the method. Hence this will help determine the level of investment needed in the Burdekin catchment.
- Understanding the historical changes in annual Burdekin sediment loads will highlight the importance of managing drought-breaking flood events in the catchment.

Specific management or policy outcomes

Improved knowledge of dynamic changes in sediment and particulate nutrient loads and their responses to drought-breaking floods, extreme flow events and dam construction will allow the better management and prioritisation of sediment erosion in the catchment.

Value

- The research will help refine catchment-based targets which will ultimately reduce sediment loadings leading to improved water quality in the inshore GBR.
- Preliminary research suggests that drought-breaking floods generally translate to a doubling/tripling of Burdekin River sediment loads (to be confirmed in this study) highlighting the importance of identifying and managing these scenarios. The Burdekin catchment is likely to see more highly variable discharge under the influence of climate change and hence sediment and particulate nutrient loads delivered to the GBR will need increased management.

Planned Outputs

- A technical report
- A peer-reviewed publication
- Presentation of project findings (and a general overview of current knowledge) to key government stakeholders in relevant Queensland and Federal Government departments such as Queensland DEHP, Department of Environment, Department of Agriculture and Reef Policy.

Delivery of Project

Project leader's track-record

The project team has the experience to deliver on the project objectives and proposed outcomes. The team has a strong track record of research publication, stakeholder engagement and project deliverables with considerable knowledge of river catchments and physical and geochemical coral records. Indeed, the project team has specific research interests and publications on coral geochemistry and the reconstruction of pollutant loads to the Great Barrier Reef, which has been developed through previous funding sources such as CRC Reef, Marine and Tropical Sciences Research Facility and Queensland Department of Environment and Heritage Protection.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payments
On signing of contract		\$11,250
1. Final report describing: a. the historical changes in annual Burdekin sediment loads will highlight the importance of managing drought-breaking flood events in the catchment. b. Summary of the presentation to key stakeholders and end users. 2. Status of peer-reviewed publication. 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines.	1 February 2016	\$11,250
Total NESP Funding		\$22,500

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Stephen Lewis	Principal Investigator	JCU	stephen.lewis@jcu.edu.au	0.10
Dr. Janice Lough	Co-Investigator	AIMS	j.lough@aims.gov.au	0.03

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Department of Agriculture	
Key Stakeholders (organisation/programme)	
Queensland DEHP	
NQ Dry Tropics NRM	
GBRMPA	Katherine Martin

Knowledge Brokering and communication

The outcomes from this work will be directly communicated to NQ Dry Tropics NRM staff and their relevant stakeholders. The project outcomes will be further communicated through a technical report and a peer-reviewed publication. We have budgeted to present our project findings (and a general

overview of current knowledge) to key government stakeholders in relevant Queensland and Federal Government departments such as Queensland DEHP, Department of Environment, Department of Agriculture and Reef Policy.

Expenditure Summary

	Project Costs					
	NESP	Applicants		Other stakeholders		TOTAL
	cash	cash	In-kind	cash	In-kind	
Salaries	13,000	-	11,000	-	6,750	\$30,750
Operating (incl. equipment, travel and communication)	9,500	-	-	-	-	\$9,500
Admin support (in-kind only)	-	-	21,200	-	-	\$21,200
TOTAL	\$22,500	-	\$32,200	-	\$6,750	\$61,450

Location of Research

No fieldwork in this project.
Research will impact upon Burdekin River catchment.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, all projects will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

A brief statement to highlight what elements are in the scope of the project

Exclusions (out of scope)

A brief statement to highlight what elements are out of the scope of the project

Risks

- There is little risk in the establishment of a correlation between sediment load and the coral Ba/Ca and Y/Ca ratios as the proponents have already developed this method using coral cores collected prior to large catchment-scale monitoring. However, the correlation between particulate nitrogen and phosphorus loads with coral trace elements has not previously been attempted.
- As we are using archival coral core samples, there are no risks related to the collection of new materials.

Project Keywords

Sediment loads
Anthropogenic load
Particulate nutrients
Coral geochemistry
Ba/ca ratio

Project 1.5 – Legacy of the Lower Burdekin Water Quality Tender

Project length – 6 Months

Project start date – 01 July 2015

Project end date – 31 December 2015

Project Leader – Romy Greiner (FTE – 0.4)

Lead Research Organisation – James Cook University

Total NESP funding - \$39,795

Total Recipient and Other Contributions (co-contributions) - \$79,590

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$39,795	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$79,590	x	x	x	x	x	x

Project Summary

This project conducts an ex-post evaluation of a water quality tender (auction) project. In 2007-08, a water quality pilot tender was trialled in the Lower Burdekin River area, funded by the Australian Government through the National Market Based Instruments and co-funded and administered by the NQ Dry Tropics. This project will collaborate with NQ Dry Tropics and engage with tender participants to review design, operational, administrative and other matters of the trial. It will evaluate the effectiveness of the tender to achieve long-term change and identify strengths as well as opportunities for improvement. The research will inform economic theory and future tenders.

Problem Statements

Problem

Market-based instruments (MBIs) are postulated as an approach for achieving the adoption of water quality improvement practices by farmers. Among MBIs, tenders are thought to be particularly effective and efficient as farmers compete for funding. Few tenders have been conducted and there is a distinct lack of ex-post evaluation. This project will review one tender trial so that lessons learnt can help improve theory and the design of future tenders.

In 2007-08, a Water Quality Tender (WQT) was conducted in the Lower Burdekin area, part of the Burdekin River Catchment. It was a pilot project, funded by the Australian Government through the National Market Based Instruments Program, with additional support provided by the NQ Dry Tropics. The tender had a funding scope of \$600,000 and attracted 88 submissions from cane growers and graziers, of which 34 bids were subsequently selected for funding.

No evaluation of the WQT was ever conducted and it is consequently unknown what the experiences of participants and contracting agency were, and whether the funded activities have persisted and continue to make a positive contribution to water quality in the GBR.

How Research Addresses Problem

This project proposes to undertake a systematic review of the WQT. The learnings can strengthen WQT design and implementation processes, including future funding rounds of the Reef Trust Tender.

Alignment with NESP Research Priorities

3.5.1 Review policy and regulatory instruments to assess their effectiveness and appropriateness in promoting improved land and water management

Research

Description of research

The ultimate purpose of the project is to generate learnings, both theoretical and practical, from the ex-post evaluation of trial water quality tender program. The review will deliver much needed empirical evidence about all aspects of the trial tender performance and lessons learnt from the outcomes of this review can help improve the design of future tenders.

Tenders remain a key policy instrument for water quality improvement, as evidenced by the recent release (20 January 2015) of the \$5 million Reef Trust Tender in the Wet Tropics. Arguably, the design of any policy instrument can be improved, and its effectiveness and efficiency increased, by considering the experience of previous applications of the same type of instrument. Gleaning such experience requires the systematic and comprehensive ex-post review of the performance of past instrument applications.

This project provides a comprehensive and systematic ex-post evaluation of the Lower Burdekin WQT. This tender trial is of particular relevance for the NESP Tropical Water Quality Hub as it was a program which (1) specifically funded water quality improvement actions and (2) was conducted within the GBR.

Method

- Examination of contractual achievements
 - Review of contract material
 - Examination of degree of contract fulfilment by WQT participants
- Design and approval of a survey of farmers who made submissions to the WQT.
 - A questionnaire will be designed for interviewing of successful WQT participants to explore, *inter alia*,
 - Whether and to what extent the contracted activity was completed;
 - Whether any difficulties were encountered in fulfilling the contract and how these were resolved;
 - How the experience with this Tender would influence likely participation in future tenders.
 - A questionnaire will be designed for interviewing of WQT participants whose bids were not successful to explore, *inter alia*,
 - Whether any of the proposed activities were undertaken in the absence of an incentive payment.
 - An Informed Consent Form and Plain English Language Statement will be prepared.
 - Approval will be obtained from the JCU Human Ethics Committee for roll-out of the survey.
- Implementation of a face-to-face survey of Tender participants
 - Identification of participants in Burdekin WQ Tender
 - Tender participants will be contacted and invited to participate in the research
 - An interview date and time convenient to respondents will be negotiated
 - Interviews will be conducted in a face-to-face fashion, on location
- Survey data analysis to establish administrative, operational and communication dimensions of Tender instrument
- Re-estimation of Environmental Benefits Metric to establish long-term environmental benefits
- Synthesis of findings into on-line fact sheet, conference presentation and journal paper.

Links with other projects and hubs

This project has links to economic leverage projects such as 3.10 and 2.2.

Related research

This project will evaluate a trial, which was previously conducted but has to date not been evaluated.

Expected Outcomes

Outcomes

The ex-post review of the trial water quality tender will deliver empirical evidence of the level of success achieved by documenting and assessing the extent of change in land use and water quality management it has generated, and the permanency of that change. Other aspects associated with communication, implementation and administration of the WTQ will be evaluated.

The practicality of the project outcomes relate to their direct relevancy for the improved design of future tenders on the basis of empirical evidence.

Specific management or policy outcomes

This research contributes to the knowledge foundations for the effective design of policy instruments, which is likely to assist in the improved design and implementation of MBLs in the future so that change in land and water management can be brought about more effectively and efficiently.

Value

This research contributes to the knowledge foundations for the effective design of policy instruments, which is likely to assist in the design of improved policies and programs in the future, and will therefore yield indirect benefits to the environment.

Planned Outputs

- NQ Dry Tropics was the organization which implemented the Burdekin WQ Tender. This NRM group will be intimately involved in the roll-out of this project. Indeed NQ Dry Tropics contributes in-kind resources in the form of staff time (assisting with the design of the questionnaire; locating contracts issued under the WQT; contacting WQT participants and organizing a field itinerary of the principal investigator; providing a vehicle for conducting of field work). This will build capacity for the organization and administration of potential future investments of a similar nature.
- Cane growers and graziers who participated in the WQT will be involved in the survey and have the opportunity to review and recount their experience with the Tender and articulate their learnings.

Delivery of Project

Project leader's track-record

The research project will be lead and principally conducted by Professor Romy Greiner (PI), who is an environmental economist with specialist knowledge in the theory of market-based instruments. The PI has a wealth of empirical research applications in the GBR and beyond and has previously conducted policy reviews and worked with the sugar cane and grazing industries. The PI has a proven track record of high quality project delivery and relevant scientific publications.

The PI was instrumental in designing the 2008 Burdekin WQ Tender, as was Professor John Rolfe, who will provide expert input into the project. The Burdekin WQT was implemented and administered by the (now) NQ Dry Tropics, which holds the contractual baseline data and will facilitate contacts with the participating in the tender. The CEO of NQ Dry Tropics, Dr Scott Crawford, will provide expert input and and relevant officers within the organisation will provide operational support.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$19,898
1. Submission of a factsheet synthesising the results of the evaluation identifying strengths and opportunities of the Burdekin WQT. 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 December 2015	\$19,897
Total NESP Funding		\$39,795

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Prof. Romy Greiner	Principal Investigator	JCU	romy.greiner@jcu.edu.au	0.40
Prof. John Rolfe	Expert Reviewer	CQU	j.rolfe@cqu.edu.au	0.02
Dr Scott Crawford	Expert Reviewer	NQ Dry Tropics	scott.crawford@nqdrytropics.com.au	0.02
Paul Duncanson	NRM contact	NQ Dry Tropics	Paul.duncanson@nqdrytropics.com.au	0.03
Various, TBA Industry contact,	Research assistance	NQ Dry Tropics	TBA	0.10

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Ami McGrath Kevin Gale Ingrid Cripps
Key Stakeholders (organisation/programme)	
NQ Dry Tropics	Scott Crawford
GBRMPA	TBC

Knowledge Brokering and communication

The target audiences for this research are people who influence policy and program design in the Australian Government and the Queensland Government, and program and operations managers of the Reef NRM Boards.

- The research will be synthesized into a fact sheet, which will be available for download from the NESP website.
- The research will be presented at a conference with water quality improvement focus.

Another target audience are environmental economists who develop theory which underpins the design of tenders and other market-based instruments.

- The research will be summarized in a peer reviewed journal paper, published in a relevant international journal.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	37,595	-	39,795	-	34,835	\$112,223
Operating (incl. equipment, travel and communication)	2,200	-	-	-	4,960	\$7,160
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$39,795	-	\$39,795	-	\$39,795	\$119,385

Location of Research

Lower Burdekin catchment

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

This project conducts a social survey with farmers who participated in the 2008 Lower Burdekin Water Quality Tender. Data will be collected that document to what extent the investments funded in 2008 have achieved enduring water quality improvements.

Qualitative data analysis will be conducted to explore what aspects support enduring benefits.

Learnings will be documented to inform the design and administration of future tenders and similar investment strategies.

Exclusions (out of scope)

This project is geographically limited to the Lower Burdekin.

This project is limited in scope to dealing with farmers who participated in the LBWQT and are willing to participate in this ex post review.

This project does not propose to generate a sufficiently large sample of respondents for advanced statistical analysis.

Risks

There are no significant risks and constraints associated with the project.

There is a minor risk that participants in the 2008 Burdekin WQ Tender may not wish to participate in the research, resulting in low sample size for the survey. Best-practice survey design and choice of survey format being face-to-face will minimize this risk and a mostly qualitative approach has been adopted to ensure relevancy of results.

Project Keywords

Market-based instruments
Ex-post evaluation
Program review

Socio-economic research
Farmer interviews

Project 1.6 – Multiple and cumulative impacts on the GBR: assessment of current status and development of improved approaches for management

Project length – 6 Months
 Project start date – 01 July 2015
 Project end date – 31 March 2016

Project Leader – Sven Uthicke (FTE – 0.1)
 Lead Research Organisation – AIMS

Total NESP funding - \$99,944
 Total Recipient and Other Contributions (co-contributions) - \$109,507

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$99,944	x	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$109,507	x	x	x	x	x	x

Project Summary

This project will synthesize experimental and field data from NERP, MTSRF and other work for key coral reef organisms and processes to produce a quantitative approach or how multiple pressures lead to cumulative impacts on the GBR. Applying quantitative tools developed for ecotoxicology and water quality guidelines, we will investigate critical interactive effects, environmental thresholds and their uncertainties, and their application in risk assessments. In addition, we will develop a roadmap that clearly articulates the steps towards a management framework to assess and manage the cumulative impacts of multiple local stressors within the context global pressures on the GBR.

Problem Statements

Problem

The GBR is affected by multiple local and global stressors from point source pollution to climate change. While considerable research through MTSRF and NERP has investigated these impacts, there has been little quantitative integration of that work and significant gaps remain in our understanding of how multiple stressors affect key components and processes of reef systems, and how this may vary both spatially and temporally across the GBR. These gaps have hindered the development of effective ecosystem models and management strategies. As a consequence, environmental managers and regulators have been forced to deal with considerable uncertainty concerning critical thresholds, levels of interaction and cumulative impacts when making decisions about developments and activities that potentially impact conservation values of the GBR.

How Research Addresses Problem

This project will synthesise existing knowledge of the impacts of individual and multiple stressors affecting key components (e.g. coral, seagrasses) and processes underpinning the health and resilience of the GBR. We will identify critical gaps to guide future strategic research on cumulative impacts on the GBR, and build a framework that ensures the outcomes of fundamental empirical field and experimental work are incorporated into guidelines, products and processes that enable managers and regulators to critically assess development and land-use scenarios, and optimise management and policy options.

Alignment with NESP Research Priorities

- 1.4.1 Develop better capacity to predict ecosystem decline due to cumulative pressures to guide planning and management practices.
- 1.4.2 Determine critical ecosystem thresholds for cumulative stress to guide environmental decision-making and policy under coastal development scenarios.
- 1.4.4 Improve our understanding of the consequences of climate change for the health and resilience of vulnerable freshwater, coastal and marine species, and ecosystems.
- 1.4.5 Improved turbidity and sedimentation thresholds and sub-lethal health-indicators for key marine organisms based on to GBR-relevant dredging scenarios to inform cumulative impact assessments.

Research

Description of research

The objectives of this project are to:

1. Conduct a comprehensive synthesis of existing qualitative and quantitative data (NERP, MTSRF, other) that describe the cumulative impacts of local and global pressures on critical reef organisms and processes to identify knowledge gaps and future research priorities (SeaSim experimental and field studies); and
2. Develop a roadmap that clearly articulates a process to develop a practical framework (incorporating quantitative approaches for assessing the risk of multiple stressors) to support the assessment and management of cumulative impacts on the GBR.

The outcomes of this project will be:

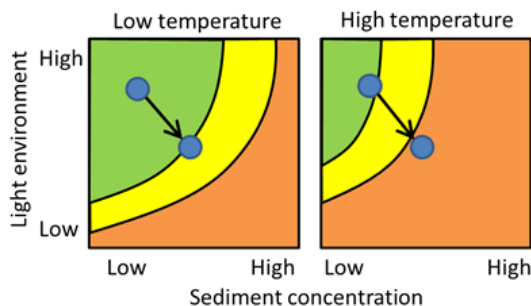
1. Improved understanding of the impacts of individual and interactive pressures leading to cumulative risks for GBR ecosystem functions
2. A scientifically rigorous foundation for the development of exposure thresholds and guidelines based on quantitative empirical experimental and field data
3. A sound scientific basis to assess both current and likely future impacts on the GBR of potential development and land use changes within the context of global change
4. Reduced uncertainty in decision-making concerning new development proposals
5. A credible, transparent and scientific basis for developing a Multiple and Cumulative Impacts Policy for the Reef with GBRMPA, DotE and Qld Gov.

Method

Available data and concepts will be collated in one overall report. We will synthesize available data, conduct numerical analyses to determine thresholds where supported by sufficient evidence, and identify research gaps. Specifically, the report will cover the following sections:

- 1) Synthesis and gap analysis of NERP, MTSRF and other experimental and field data on cumulative impacts on corals and other reef organisms
- 2) Assess ecotoxicological approaches (such as species distribution curves and exposure-response curves) for application to climate and contamination data from both the laboratory and the field as an approach to investigate and report on multiple and cumulative pressures
- 3) A synthesis of our understanding of multidimensional environmental thresholds into a practical set of guidelines to inform management and policy decisions on new development proposals considering the likely cumulative impacts of local, regional and global pressures.
- 4) An analysis how environmental thresholds can be identified for key biological processes (niche boundaries) for corals influenced by multiple pressure variables. The figure below illustrates how a turbidity event under cool versus warm conditions can push a coral species from within (green) to outside (orange) its niche. The analyses allow exploration of how different pressure combinations

lead to compliance vs exceedance of thresholds (yellow zones, Anthony & Connolly 2004 – *Oecologia* 141). Sublethal and lethal risks will be assessed by integrating cumulative exposure over time.



Links with other projects and hubs

This project links to 3.8, which is also underpinning the development of the Long Term Sustainability Plan for the GBR.

Related research

Work under NERP and MTSRF provides the experimental and observational basis for this desktop study.

Expected Outcomes

Outcomes

- Improved understanding and reduced uncertainty of cumulative impacts, including species at risk and ecosystem thresholds
- Development of sound scientific approaches to support improved guidelines, management strategies and policy development for cumulative inputs to maintain the values of the GBR.
- Identify priorities for future applied research on cumulative inputs

Specific management or policy outcomes

- Adoption of a scientifically robust approach to assessing the cumulative impacts and sustainability of activities affecting the GBR
- Enhanced ability to identify which pressure(s) lead to the highest risk
- Improved ability to identify which management actions can best alleviate the risk of cumulative impacts

Value

Cumulative impacts are identified as one of the key knowledge gaps for environmental management. Our synthesis will lead to an improved capacity to deal with this complex issue, both for short-term EIS and for strategic long-term planning. This will lead to improved metrics to measure management success and better reporting tools.

Planned Outputs

- Presentations of results to DoE, GBRMPA, NRM groups and State Government representatives, both through the final workshop, and through a Report that covers the five main topics of this study.
- Implementation of research recommendations into a longer term NESP proposal.

Delivery of Project

Project leader's track-record

All researchers involved are highly experienced in cumulative impact studies and in general reef ecology. All researchers were involved in previous NERP and MTSRF projects, and have a long track record for demonstrated timely delivery of high quality research outputs and outcomes.

S. Uthicke - <http://data.aims.gov.au/staffcv/jsf/external/view.xhtml?partyId=100000189>

Senior Research Scientist specializing in cumulative and interactive effects of local and global stressors on coral reef invertebrates calcifying algae. Project leader of NERP 5.2.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$49,972
1. Final report describing: <ol style="list-style-type: none"> a synthesis of existing qualitative and quantitative data (NERP, MTSRF, other) that describe the cumulative impacts of local and global pressures on critical reef organisms and processes to identify knowledge gaps and future research priorities development of a roadmap that clearly articulates a process to develop a practical framework (incorporating quantitative approaches for assessing the risk of multiple stressors) to support the assessment and management of cumulative impacts on the GBR. 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$49,972
Total NESP Funding		\$99,944

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Sven Uthicke	Principal Investigator	AIMS	s.uthicke@aims.gov.au	0.10
Dr. Katharina Fabricius	Co-Investigator	AIMS	k.fabricius@aims.gov.au	0.10
Dr. Andrew Negri	Co-Investigator	AIMS	a.negri@aims.gov.au	0.10
Dr. Ken Anthony	Co-Investigator	AIMS	k.anthony@aims.gov.au	0.05
Dr. Murray Logan	Co-Investigator	AIMS	m.logan@aims.gov.au	0.05
Mr Sam Noonan	Co-Investigator	AIMS	s.noonan@aims.gov.au	0.1
Ass. Prof. Michael Warne	Co-Investigator	Griffith & UQ	michael.warne@dsitia.qld.gov.au	0.05
Dr. Rachael Smith	Co-Investigator	Griffith	rachael.smith@dsitia.qld.gov.au	0.05

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
GBRMPA/Hayley Gorsuch	-Alignment with GBRMPA's cumulative impact policy development (0.05FTE*)

* FTE is an in kind contribution from GBRMPA, no salary recovery sought through NESP.

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Department of the Environment – Chemical Assessments section	Glen Walker
Department of the Environment – Environmental Assessments and Compliance Division	Felicity McLean Michael Ward (Director)
Key Stakeholders (organisation/programme)	
GBRMPA (Cumulative Impacts Management Strategy)	Hayley Gorsuch
NRM Groups	
Queensland Government	

Knowledge Brokering and communication

Most members of the team were involved in NERP projects on cumulative impacts and frequently discussed with all stakeholders during IG meetings. SU/AN organized a workshop on cumulative impacts in 2014 with many stakeholders. The team will frequently consult with GBRMPA's team working on a Cumulative Impacts Management Strategy (Hayley Gorsuch) and GBRMPA's team developing a strategy for how cumulative impacts indicators can be captured in an integrated monitoring program (Molloy and Gibson). In addition, we will conduct a workshop with key research users at the beginning of this study to scope the work, and a second one towards the end to present outcomes.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	81,944	-	99,944	-	9,563	\$191,451
Operating (incl. equipment, travel and communication)	18,000	-	-	-	-	\$18,000
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$99,944	-	\$99,944	-	\$9,563	\$209,451

Location of Research

Great Barrier Reef Marine Park

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

In order to improve understanding and management of cumulative impacts, this study will synthesise existing data that describe the cumulative impacts on critical reef organisms and processes. Knowledge gaps and future research priorities will be determined. A roadmap to develop a practical framework to support the assessment of cumulative impacts on the GBR will be developed.

Exclusions (out of scope)

This is a short-term desktop study only, no new field or experimental data will be generated.

Risks

The study addresses a complex issue, however the team is highly experienced in finding solutions for dealing with complex environmental problems. As a desktop study the risks for this project are therefore low. In addition, risks associated with data availability are negligible as AIMS and the project team are the custodians of a large proportion of existing empirical experimental and field data describing the cumulative impacts of individual and multiple pressures affecting the GBR.

Project Keywords

Cumulative risks and impacts
Multiple pressures
GBR management
Impact assessment

Project 1.7 – Reducing sediment sources to the Reef: testing the effectiveness of managing alluvial gully erosion

Project length – 9 Months
 Project start date – 01 July 2015
 Project end date – 31 March 2016

Project Leader – Andrew Brooks (FTE – 0.4)
 Lead Research Organisation – Griffith University

Total NESP funding - \$100,000
 Total Recipient and Other Contributions (co-contributions) - \$380,000

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$50,000	\$50,000	x	x	x	x	x
Cash co-con	\$40,000	x	x	x	x	x	x
In-kind co-con	\$340,000	x	x	x	x	x	x

Project Summary

Alluvial gully erosion contributes 20-40% of fine sediment from the three largest sediment contributing catchments to the GBR, yet there has been limited effort to manage this major sediment source. Cost effective reduction of sediment from these alluvial gullies requires data on effective management strategies. We will take advantage of a ‘natural experiment’ that occurred when Cyclone Ita passed over [existing trial](#)⁶ management sites in the Normanby catchment. The project will evaluate the effectiveness of different management strategies to reduce erosion from alluvial gullies. To complement this, we will collect baseline data at additional sites in the Normanby and Burdekin catchments.

Problem Statements

Problem

Following significant investment through the Federal Government’s first Reef Rescue program, alluvial gully erosion was shown to be a dominant source of fine sediment pollution (20-40%) to the GBR, particularly from the large, dry, grazing-dominated catchments in the tropics (eg. Cape York, the Burdekin). However research into the optimal methods for reducing this major source of sediment pollution significantly lags behind research in the management of other, less dominant sources.

How Research Addresses Problem

There is a pressing need to determine effective management practices to reduce sediment yields from alluvial gullies if targets for sediment reduction to the reef are to be met. This project will build on previous investment in gully management trials in the Normanby catchment, particularly as these sites were impacted by Cyclone Ita in early 2014. It will determine which interventions were effective in reducing erosion, particularly during an extreme event and collect baseline data in additional sites (Normanby, Burdekin) ready for further trials of active and passive management approaches. This will provide evidence for the development of cost effective sediment management intervention in key GBR catchments.

Alignment with NESP Research Priorities

- 1.2 Identify and prioritise practical management actions capable of protecting and improving water quality in the Great Barrier Reef region, Torres Strait and other aquatic ecosystems.
- 1.2.2 Develop practical improvements to on-farm land management practices that will influence behavioural change and improve outcomes for tropical water quality and ecosystem health and evaluate the outcomes.

Research

Description of research

Objectives:

- Collect/synthesize data on both passive and active management approaches to alluvial gully erosion in the areas that are dominated by this process.
- Quantify relative sediment reduction with the different active and passive interventions in the Normanby, particularly in response to severe Cyclone Ita which passed over these sites since they were last monitored in 2013.
- Review existing gully mapping data and the particle size, geo-chemistry and nutrient data on key sediments sourced from alluvial gullies
- Burdekin catchment and identify key sites requiring intervention
- Establish baseline data on the alluvial gully condition of key sites in the Normanby and Burdekin.
- Determine particle size, geo-chemistry and nutrient data on key sediments sourced from alluvial gullies
- Establish a citizen science program to engage with the community about alluvial gully erosion

Outcomes:

- Targeted reduction of diffuse sediment pollution in the GBR based on effective, evidence-based mitigation strategies of alluvial gully erosion
- Prioritised alluvial gully sites for intervention (and/or trials) in the Burdekin catchment
- Community engagement through Citizen science alluvial gully erosion mapping program
- Improved understanding of the bio-available nutrients contained within alluvial gully sediments
- Improved understanding of the variability of alluvial gully geochemistry

Methods:

- All existing trial sites for which we have existing airborne LiDAR data will be re-flown - and change detection analysis completed
- Repeat Terrestrial LiDAR surveys will be completed at all sites previously surveyed in the Normanby, with change detection completed, and baseline surveys completed at new control and treatment sites in the two catchments
- Repeat vegetation surveys will be completed at all sites with existing data
- Baseline LiDAR and vegetation surveys will be completed at new gully trial sites
- Rising stage and integrated sediment samplers will be deployed in a number of gully sites for the collection of samples for nutrient and geochemical analysis.
- Samples will be processed for nutrients and geochemistry at the DSITI laboratory using standard protocols

Links with other projects and hubs

This project links to other erosion management projects such as 1.2

Related research

This project builds upon extensive investments in erosion management funded through Reef Rescue and Reef Trust

Expected Outcomes

Outcomes

- evidence for the most effective approaches for tackling major sources of fine sediment
- identification of key hotspots and potential management trials (Burdekin)
- community engaged in the extent and management of alluvial gully erosion
- inform strategies for on-going management intervention projects (e.g. Greening Australia trials)

Specific management or policy outcomes

- Implementation options for managing alluvial gully erosion across the major sediment contributing catchments to the GBR.
- ensuring effective, cost-efficient and best practice approaches are used in major investments in sediment reduction (e.g. Reef Trust, Reef Rescue, Greening Australia, etc)

Value

- provides empirical evidence to quantify sediment supply reduction under different intervention strategies.
- effectiveness of interventions will be monitored against baseline data (as opposed to modelled outputs) which will align more accurately with observed environmental data

Planned Outputs

- Project outputs will be published on several websites, including <http://www.capeyorkwaterquality.info/>, CYNRM, CYSF, BDT, Greening Australia and the NESP TWQ Hub website.
- Dedicated policy briefing event
- Citizen science outreach program initiated to appeal directly to landholders.
- Peer-reviewed publications
- Key findings 'brochure' prepared, targeted at the generalist reader
- Presentation of results at relevant conferences
- Communication of key findings in media releases (coordinated with the NESP)

Delivery of Project

Project leader's track-record

- 10 years of experience undertaking research on alluvial gully erosion in northern Australia.
- This team coined the term "alluvial gully" and recognized it as a distinctly different process to the standard "hillslope gully" model that dominates the scientific literature.
- Brooks is a geomorphologist with >10 years experience working in gully erosion and sediment budgets in tropical systems, and > 20 years in river & catchment management
- Shellberg is hydrologist/geomorphologist who completed his PhD on alluvial gully erosion in north Qld and has ~15 years experience working with traditional owners in northern Australia and the Pacific Northwest of the USA on river and catchment management issues
- Spencer is a geomorphologist & GIS expert with 15 years experience in river and catchment management
- Burton is a geochemist/soil scientist with > 10 years research experience in Qld catchments
- precursor research - Reef Rescue/MTSRF/NERP program (Normanby catchment)

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: <ol style="list-style-type: none"> evidence for the most effective approaches for tackling major sources of fine sediment identification of key hotspots and potential management trials (Burdekin) community engaged in the extent and management of alluvial gully erosion strategies for on-going management intervention projects 2. Key findings brochure for generalist audience 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Andrew Brooks	Principal Investigator	GU	andrew.brooks@griffith.edu.au	0.4
Dr. Jeff Shellberg	Co-Investigator	GU	j.shellberg@griffith.edu.au	0.1
Mr John Spencer	Research Assistant	GU	j.spencer@griffith.edu.au	0.2
Dr Jo Burton	Co-Investigator (in-kind)	DSITI	Joanne.Burton@dsitia.qld.gov.au	0.1

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
CYSF	Cash and in-kind
Greening Australia	Cash and in-kind

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Cape York NRM	Peta Standley
Cape York Sustainable Futures	Trish Butler
Greening Australia	Ross Andrewartha
GBRMPA	Katherine Martin

Knowledge Brokering and communication

- This and complementary projects (see below) were developed following consultation with a range of stakeholders including; BDT, CYSF/CYNRM, and various landholders where the trials will be conducted (incl. Springvale, Crocodile & Kings Plains Stations).
- Complements a large project proposed to the Reef Trust by Greening Australia, JCU and GU, that intends to implement large scale field trials of channel and gully erosion mitigation measures in the Burdekin.
- Complements a project on *hillslope* gully erosion model development being conducted by CSIRO in the Burdekin
- Engagement planned with individual landholders in identified hotspots (this project) in the Burdekin

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	88,000	-	-	-	-	\$88,000
Operating (incl. equipment, travel and communication)	12,000	10,000 ²	-	30,000 ⁴	50,000 ² 150,000 ³	\$252,000
Admin support (in-kind only)	-	-	140,000 ¹	-	-	\$140,000
TOTAL	\$100,000	\$10,000	\$140,000	\$30,000	\$200,000	\$480,000

¹ Institutional support

² Airborne LiDAR data - funds provided by CYSF/GU

³ CYSF – Funding for on-ground gully management activities over the 2015-16 financial year which this project will help design and for which we will undertake monitoring

⁴ Lab analysis costs for the processing of sediment particle size, geochemistry and nutrients of gully derived sediments funded through the parallel Greening Australia project

Location of Research

Burdekin and Normanby catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

The project will be restricted to existing sites within the Normanby catchment that have been the subject of previous work (as per Brooks et al., 2013; Shellberg and Brooks, 2013) and some additional sites identified within existing LiDAR blocks (in consultation with CYSF). Priority sites will be identified in the Burdekin following consultation with key stakeholders, landholders and some reconnaissance mapping.

Exclusions (out of scope)

The field component is restricted to the areas within the Burdekin and Normanby catchments (as outlined above). Complementary work with Greening Australia is dependent on their proposal being successfully funded. In particular the additional \$30K for LiDAR is wholly dependent on GAs successful Reef Trust proposal. In the event that they are not funded, alternative demonstration sites that are the focus of rehabilitation efforts by other parties will be sought out, but the additional LiDAR will not be able to be provided (unless an alternative source of funding subsequently becomes available).

Risks

- Wet season fails, or prevents access within the available time
 - this risk is mitigated by a number of sites located in highly accessible sites
- Larger associated projects building on this one do not go ahead, thereby limiting the potential for the outcomes to be translated into widespread on-ground actions.
 - this project will still deliver valuable information fro management
- Reduced resources from third parties
 - minimal risk as these contributions are based on long term relationships with the third parties
- The knowledge is not incorporated into management actions and the potential is not realised

Project Keywords

Catchment management

Alluvial gullies

Suspended sediment

Baseline data

Active management

Project 1.8 – Sub-catchment scale monitoring, modelling and extension design to support reef water quality improvement

Project length – 9 Months
 Project start date – 01 July 2015
 Project end date – 31 March 2016

Project Leader – Aaron Davis (FTE – 0.2)
 Lead Research Organisation – James Cook University

Total NESP funding - \$100,000
 Total Recipient and Other Contributions (co-contributions) - \$160,000

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$50,000	\$50,000	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$160,000	x	x	x	x	x	x

Project Summary

- Design of a pilot sub-catchment scale monitoring, modelling and extension program, based on end-user workshop, existing risk assessments, monitoring and modelling programs, for subsequent implementation with farmer’s support to identify reef pollutant “spikes/hotspots”, their causes and the necessary areas for extension to improve management.
- Pilot implementation to test the design with the assistance of farmers, extension providers, etc in a particular local area to underpin future initiatives such as nutrient trading
- ¹Subsequently, implementation, monitoring and evaluation of an extension program based on any refinements resulting from the pilot study findings
- ¹Use of additional information from implementation as one line of evidence assisting in development and trialing of market based instruments

¹ Indicates outcomes of this project that will be subsequently implemented and funded by DEHP, etc. (and hence do not form any directly funded part of this proposal)

Problem Statements

Problem

The problem being addressed is the need for better spatial and extension targeting of management action change to reduce nutrient and pesticide runoff in cane areas in order to meet Reef Plan targets.

How Research Addresses Problem

By using the method described below, farmers and associated industry service providers (agrichemical re-sellers etc.) will have an evidence-based approach to motivate them to fix related management issues on their properties, with the support of the extension and science providers.

- Initial workshop prioritisation of sub-catchment scale ‘hotspots’ for improved nutrient and pesticide management intervention within GBR canegrowing districts.
- Design of a sub-catchment scale monitoring and modeling program for high priority sub-catchment hotspots to identify reef pollutant “spikes or hotspots”, track back their causes with extension providers and farmers and, with them, identify the necessary areas for improvement in on-farm management.

- Engagement with extension providers, industry and EHP policy officers to identify information and communication pathways to influence on-ground decisions eliciting practice change
- Test the design with a pilot program in two high priority areas (i.e., potentially pesticide management in lower Burdekin or Mackay-Whitsunday, nutrients in the Wet Tropics).
- ¹Refine the design and roll out a broader program in high priority reef sub-catchments

Alignment with NESP Research Priorities

- 1.2.2 Identify and support practical strategies to increase adoption of improved resource management actions, ensuring engagement with relevant stakeholders/institutions.
- 1.2.1 Update and improve knowledge of sources, and identify roles of key pollutants (including emerging contaminants), and their long-term fate to enable the identification of key sources of, and vulnerable regions to, poor water quality.
- 1.3 Evaluate management activities in wetlands and other natural habitats to improve tropical water quality and ecosystem health.

Research

Description of research

Objective:

- Design and pilot a sub-catchment scale^{2*} monitoring, modelling and extension program to underpin a targeted regulatory/extension or market-based trading framework for reef water quality improvement.

Outcomes:

- A pilot sub-catchment scale monitoring, modelling and extension program design, based on existing risk assessments, monitoring and modelling programs (e.g. Paddock to Reef), and liaison with extension staff, which can be implemented with farmers support to identify pollutant “spikes”, their causes and the necessary areas for extension to improve management.
- Subsequent pilot implementation and testing of the design with the assistance of farmers, science, policy and extension providers in two identified priority areas. This will focus the areas for improved management and increase farmer understanding of the need for, and adoption of, improved management practices (one pilot to be funded under NESP, one pilot to be funded separately by EHP)
- Identification of extension mechanisms and gaps in existing extension processes to be targeted for future investment in consultation with existing networks
- Innovative application of monitoring and modelling at a fine scale.
- Design and costing for an extended monitoring program (for EHP-led implementation) based on the results of the pilot
- ¹Use of the additional information from implementation as one line of evidence to assist in development and trialing of market based instruments

Method:

- Deliver an end-user focused workshop to determine design priorities and parameters.
- Using existing risk assessments, Paddock to Reef monitoring and modelling program results, etc to design a pilot sub-catchment scale monitoring and modelling program for priority cane areas in the Wet Tropics, Burdekin, Mackay-Whitsunday or Burnett-Mary regions.
- Liaise with farmers, extension providers, etc in identified priority areas to agree on focus sub-catchments with support of these partners for on-ground implementation and testing of such a

* Sub-catchment scale is meant to take monitoring to a local sub-catchment where the group of farmers work collaboratively to identify and reduce their sub-catchments’ reef pollutant loads with assistance from this project’s outputs

pilot (to increase their understanding of the need for, and adoption of improved management practices)

- In the agreed area(s), document the design and costing of a program and undertake two pilot implementations
- If necessary, make modifications to the design of the pilot program to enhance the outcomes in subsequent broader scale roll-out of pilot design

Links with other projects and hubs

The outcomes of this project will link with projects informing the LTSP. The potential to link with projects from other NESP Hubs will be further investigated.

Related research

This project builds upon extensive research funded through MTSRF, NERP-TE, Reef Rescue and other reef-related investments.

Expected Outcomes

Outcomes

- improved focus on the spatial areas to target for improved management and extension effort in canegrowing areas
- increased farmer understanding of the need for and adoption of improved management practices
- identification of extension mechanisms for future investment support
- better supporting information for extension providers and policy officers, including nutrient trading

Specific management or policy outcomes

- improved focus on the spatial areas for extension providers and EHP policy initiatives to maximize improved management
- increased farmer adoption of improved management practices
- implementation of broader scale cane industry monitoring, modeling and extension program as a result of project outcomes that can inform future nutrient trading, regulation etc.

Value

- Initially, the pilot implementation and testing of the design will better focus extension and management change investment in priority areas for water quality improvement, and with the associated monitoring and evaluation of the outcomes at the local scale of the pilot study
- subsequently, implementation, monitoring and evaluation of an extended program based on any refinements resulting from the findings of the pilot
- quantification of practice change on the part of participating growers (pre- and post-pilot study implementation)
- Outcomes will improve the parameterization of the paddock-scale modelling for nutrient and pesticide movement.

Planned Outputs

- farmers, industry service providers (i.e. agri-chemical re-sellers), extension providers, etc in the pilot area and subsequently in the extended focus areas will be involved in the design workshop, implementation and monitoring and evaluation of the project.
- Materials will be prepared for policy officers on the pilot outcomes to inform future management
- the results will then be extended to broader areas based on the pilot and then the extended program utilizing (in the main) existing extension mechanisms and agencies (District Productivity Services extension groups, NRM regional bodies, State Government extension programs) in relevant areas.

Delivery of Project

Project leader's track-record

The project team has long-standing experience in water quality collection, catchment management activities and cane industry liaison across a range of spatial scales (including significant recent involvement in major Reef Plan initiatives).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: a. improved focus on the spatial areas to target for improved management and extension effort in canegrowing areas b. increased farmer understanding of the need for and adoption of improved management practices c. identification of extension mechanisms for future investment support d. better supporting information for extension providers and policy officers, including nutrient trading 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE (days)
Dr Aaron Davis	Principal Investigator	JCU	aaron.davis@jcu.edu.au	0.2* (40)
Dr Jane Waterhouse	Co-Investigator	JCU	j.waterhouse@c2o.net.au	0.1* (15)
Prof. Jon Brodie	Co-Investigator	JCU	jon.brodie@jcu.edu.au	0.05* (8)
Dr Colette Thomas	Co-Investigator	JCU	colette.thomas@jcu.edu.au	0.05* (8)
Ryan Turner	Stream monitoring	DSITI	Ryan.Turner@dsitia.qld.gov.au	0.05 (8)
Mark Silburn	Farm Modeling	DNRM	Mark.Silburn@dnrm.qld.gov.au	0.05 (8)
Beth Clouston	Economist	DEHP	Beth.Clouston@ehp.qld.gov.au	0.05 (8)
Michael Warne	Stream monitoring (ecotoxicology)	DSITI	michael.warne@dsitia.qld.gov.au	0.05 (8)
Rachael Smith	Stream monitoring (pesticides)	DSITI	rachael.smith@dsitia.qld.gov.au	0.05 (8)

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
Nil	

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs/ Reef Trust)	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Queensland Department of Environment and Heritage Protection	Jean Erbacher Chris Johnson John Bennett Dominic Henderson Rae Schlecht
GBRMPA	Katherine Martin

Knowledge Brokering and communication

- The initial extension focus will target small grower collectives in spatially prioritised ‘hotspots’ in the pilot stage of program, in collaboration with local industry extension agencies
- Subsequent refinement and extension of results and pilot project design to broader industry audience will occur during implementation phases, with specific mechanisms for this information diffusion also identified from pilot program.
- Outcomes will be workshopped with government stakeholders to ensure the benefits of the research are understood, and seek feedback on improvements.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	50,500	-	-	-	30,000	\$80,500
Operating (incl. equipment, travel and communication)	49,500	-	-	-	-	\$49,500
Admin support (in-kind only)	-	-	130,000	-	-	\$130,000
TOTAL	\$100,000	-	\$130,000	-	\$30,000	\$260,000

Location of Research

Priority cane areas in the Wet Tropics, Burdekin, Mackay-Whitsunday or Burnett-Mary regions.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

Field and extension work in identified pilot areas to identify monitoring and extension processes/plan to change farmer's behaviours in cane growing industry.

Exclusions (out of scope)

This project is currently limited to cane industry (not focused on other commodities such as grazing or horticulture), and scope is limited to plan and pilot study implementation in 2 priority areas (not broader roll-out of plan at a GBR scale).

Risks

- Seasonal conditions that might impact on available time for field activities (although spatially prioritized areas will likely include canegrowing areas such as the lower Burdekin, where paddock irrigation tailwater (rather than rainfall runoff) can be monitored more easily during the dry season).
- Resistance by grower groups to engage with proposal (although several grower collectives across multiple canegrowing districts have already been identified by extension groups that are amenable to underlying premise of proposed project).

Project Keywords

Monitoring
Modelling
Policy instruments
Extension
Market based instruments

Project 1.9 – The establishment of a future NESP dredging research investment framework

Project length – 6 Months
 Project start date – 01 July 2015
 Project end date – 31 December 2015

Project Leader – Britta Schaffelke (FTE – 0.01)
 Lead Research Organisation – AIMS

Total NESP funding - \$25,000
 Total Recipient and Other Contributions (co-contributions) - \$18,094

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$25,000	x	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$18,094	x	x	x	x	x	x

Project Summary

The project will conduct an inclusive facilitated workshop with key researchers and stakeholders to identify the future knowledge needs for improved management of dredging activities in the GBR. Building upon the recent dredging synthesis and other resources, this workshop will distill a clear, prioritized research framework to inform future NESP investment into dredging research. The framework will: (i) define the scope of work required to develop and apply improved sediment transport models for the GBR lagoon, (ii) identify and quantify the type and extent of ecological impacts, especially of maintenance dredging activities and (iii) identify management options including innovative amelioration approaches.

Problem Statements

Problem

The project will conduct a facilitated workshop with key researchers and stakeholders to establish the research framework for future NESP investment in dredging research in the GBR. Improved certainty in the information utilised for management decisions on dredging projects in the GBR, will result in less adversarial debate and more focus on innovative solutions. The recently completed report “Synthesis of current knowledge of the biophysical impacts of dredging and disposal on the GBR” outlined knowledge gaps important for the future improved management of dredging activities in the GBR. This document, together with the findings of the currently underway dredging science node of the Western Australian Marine Institution (WAMSI), which AIMS plays a major role in, will inform the future NESP TWQ Hub dredging research agenda prior to the investment of significant funding by the Australian Government.

How Research Addresses Problem

It is essential that the stakeholders and researchers set an agreed research agenda that delivers strategic information needed to allow the debate to progress towards developing workable ‘real life’ solutions for the Ports Industry while addressing water quality decline and ecosystem health impacts in the GBR. Without an agreed research framework, well-intended research work will occur in isolation and may struggle to achieve end-user acceptance.

Alignment with NESP Research Priorities

- 1.4 Improve our knowledge of cumulative pressures on environmental and social values of the GBR region to determine more effective management actions.
- 1.4.4 Improved estimates of the long-term fate of dredged sediment in the context of other existing processes and pressures such as land run-off.
- 1.4.5 Improved turbidity and sedimentation thresholds and sub-lethal health-indicators for key marine organisms based on to GBR-relevant dredging scenarios to inform cumulative impact assessments.
- 1.4.6 Quantify and/or document the chronic impacts of maintenance dredging on key adjacent GBR habitats and species.

Research

Description of research

The objective of the workshop is to establish the research framework to address key information gaps in the understanding of:

1. the fate, transport, deposition, re-suspension, consolidation, mixing, assimilation and armouring processes associated with fine sediment movement in the GBR;
2. the relative contribution of key sources/drivers to suspended sediments;
3. the impacts of dredging on light climate and water quality, including the differential effects of sediment particle sizes, and the potential release of pollutants;
4. the relative ecological impacts on key organisms, processes and habitats; including better defining 'environmental windows' for dredging operations;
5. sediment models and application;
6. appropriate indicators and monitoring approaches; and
7. innovative management options.

Method:

The project will design and conduct a facilitated workshop with key stakeholders and researchers to:

- formulate agreed objectives for future NESP TWQ dredging research
- identify key knowledge gaps and information needs for both stakeholders and researchers
- identify the priority and timeframe for delivery of information
- identify the mechanisms to enable stakeholder feedback into the research agenda and maintain stakeholder engagement

The project team will review and consider recent findings and gap analysis conducted in other initiatives (Dredge synthesis panel run by AIMS and GBRMPA, WAMSI dredging node), and prepare a research framework that will guide the future NESP investment into dredge management.

Links with other projects and hubs

This project has similarities with other projects setting research frameworks – 1.1 (CoTS) and 3.6 (jellyfish)

Related research

This builds upon commercial and research investments into dredging management (esp. modelling of suspended sediment movement and seagrass monitoring) and upon the recent Dredge Synthesis Panel report.

Expected Outcomes

Outcomes

The project will provide a coordinated research framework, based on best available current knowledge to guide the timing, direction and extent of future research investment into dredge management in the GBR.

Specific management or policy outcomes

Delivery of this project will focus the strategic investment of NESP research funds in dredge management to progress the current debate towards a solution focus as part of Australian Government's commitment to protect the conservation values of the GBR.

Value

The project will improve the environment through strategically focusing the NESP investment.

Planned Outputs

A coordinated research framework, based on best available current knowledge to guide the timing, direction and extent of future research investment into dredge management in the GBR.

Delivery of Project

Project leader's track-record

AIMS and JCU have the capability, experience and network to lead the workshop and establish the research agenda. The Hub leader and administrator will assist AIMS in this undertaking. The project team includes the current WAMSI Science Node Leader (RJ) and Theme Leader (AN) and four of the authors of the recent dredge synthesis report (BS, RJ, RB, MR).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$12,500
1. Final report detailing: a. A research framework that will guide the future NESP investment into dredge management. b. The workshop will discuss existing datasets and, if relevant, the possible submission of this material to eAtlas.	15 December 2015	\$12,500
Total NESP Funding		\$25,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Britta Schaffelke	Principal Investigator	AIMS	B.Schaffelke@aims.gov.au	0.01
Dr. Richard Brinkman	Co-Investigator	AIMS	R.Brinkman@aims.gov.au	0.02
Dr Ross Jones	Co-Investigator	AIMS	R.Jones@aims.gov.au	0.02
Dr Andrew Negri	Co-Investigator	AIMS	a.negri@aims.gov.au	0.02
Dr Michael Rasheed	Co-Investigator	JCU	michael.rasheed@jcu.edu.au	0.02
Ports sector representative	Advisor	tbc		tbc
Government sector representative	Advisor	tbc		tbc

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
Nil	

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs/ Reef Trust)	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Port Authorities	
GBRMPA	Kevin Edison kevin.edison@gbrmpa.gov.au
Queensland Government	

Knowledge Brokering and communication

The intent of the project is to inclusively engage key stakeholder at the start of the research process and to build confidence and understanding in the research outputs. Close and adaptive engagement between researchers and stakeholders in establishing the research agenda will improve and future uptake of information.

Expenditure Summary

	Project Costs					TOTAL
	NESP Cash	Applicants		Other stakeholders		
		Cash	In-kind	Cash	In-kind	
Salaries	15,000	-	14,788	-	1,460	\$31,248
Operating (workshops costs, incl. funding of travel of limited number of workshop participant, if required)	10,000	-	-	-	-	\$10,000
Admin support for workshop organisation (in-kind only)	-	-	1,846	-	-	\$1,846
TOTAL	\$25,000	-	\$18,094	-	\$1,460	\$43,094

Location of Research

No on-ground work. Research outputs impact upon GBR.

Indigenous Consultation and Engagement

Indigenous communities have a relevant and active role to play in setting the research agenda and will be assisted to engage in the workshop process.

Inclusions (in scope)

- Effective engagement with research end users and key stakeholders, including participation in workshop, to ensure relevance of the to-be-established dredging research investment framework and uptake of future research findings;
- Clear formulation and prioritisation of research needs to deliver information and knowledge to improve the management of dredging operations in the GBR;
- Review and consideration of experiences from other dredging research initiatives, such as WAMSI.

Exclusions (out of scope)

- Any field work to collect data on sediment and water quality in the GBR;
- Any laboratory experiments to assess the impacts of dredging on marine organisms, processes and habitats or to derive indicators;
- Any modelling of transport and fate of fine sediment in the GBR;
- Quantitative risk assessment of fine sediment contributed from different sources.

Risks

The risks associated with this project are minimal. Failure to achieve an outcome will delay further Hub investment into this topic.

Project Keywords

Dredge management
Sediment
Turbidity

Project 1.10 – Identification, impacts, and prioritization of emerging contaminants present in the Great Barrier Reef and Torres Strait marine environments

Project length – 6 Months

Project start date – 01 July 2015

Project end date – 31 December 2015

Project Leader – Frederieke Kroon (FTE – 0.11)

Lead Research Organisation – AIMS

Total NESP funding - \$100,000

Total Recipient and Other Contributions (co-contributions) - \$139,340

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$100,000	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$139,340	x	x	x	x	x	x

Project Summary

Increased human activities in the GBR and Torres Strait regions are expected to increase the sources and diversity of contaminants in their marine environments. Here, we will (i) determine the presence and locations of emerging contaminants based on monitoring data and the types of human activities present, and (ii) prioritize the identified emerging contaminants based on their potential risk to these marine environments. Based on the list of priority emerging contaminants, we will develop and recommend key areas of research to inform management and policy decisions that will maintain and improve the condition of the marine environments in the GBR and Torres Strait regions.

Problem Statements

Problem

Current policy and management for marine water quality focusses on suspended sediment, nutrients and PSII herbicides. Other contaminants are known to be present in the marine environment, including emerging pesticides, endocrine disrupting chemicals, coal dust, hydrocarbons, metals, microplastics, pharmaceuticals and personal care products. While emerging contaminants are a topic of intensive research internationally, little is known about their sources, role and fate in the GBR and Torres Strait regions. Furthermore, changes in agricultural practices and land uses, increasing coastal development including urban and industrial land uses and ports, and associated projected shipping increases are likely to result in new contaminants being released into their marine ecosystems in the near future.

The project addresses whether risks of emerging contaminants to GBR and Torres Strait marine ecosystems are currently under-estimated.

How Research Addresses Problem

1. Targeted desktop studies to identify, assess the risk of, and prioritize emerging contaminants based on monitoring and source data.
2. Focused workshop with project team, end users and key stakeholders to (i) examine the risk of emerging contaminants to the GBR and Torres Strait marine environments, and (ii) determine the specific project outputs.
3. Recommend key areas of research to inform management and policy decisions that will maintain and improve the condition of the marine environments in the GBR and Torres Strait regions.

Alignment with NESP Research Priorities

- 2.3.1. Update and improve knowledge of sources, and identify roles of key pollutants (including emerging contaminants), and their long-term fate to enable the identification of key sources of, and vulnerable regions to, poor water quality

Research

Description of research

Objectives:

- Determine the presence and locations of emerging contaminants based on monitoring data and the types of human activities present
- Prioritize the identified emerging contaminants based on their potential risk to the marine environment within the context of current contaminants (sediment, nutrients, PSII herbicides)

Outcomes:

Provide management and regulatory agencies with:

- An informative list of emerging contaminants (likely to be) present in the GBR and Torres Strait marine environments,
- Improved knowledge of sources, impacts and fate and comparative risks of emerging contaminants,
- New water quality guideline values for four non-PSII pesticides commonly found in GBR waters,
- Recommendations for the development of water quality guideline values for other emerging contaminants, and
- Recommendations for key areas of research focussed on priority emerging contaminants.

Method:

- Tabulate list of classes of emerging contaminants relevant to the GBR and Torres Strait marine environments, based on expert knowledge from the project team and international studies (desktop)
- Compile monitoring data to identify the presence, concentration and location of emerging contaminants in the GBR and Torres Strait marine environments (desktop)
- Predict the likely presence of emerging contaminants in the GBR and Torres Strait marine environments based on the types of human activities present (e.g. sewage treatment plants, current and planned agricultural land uses, etc.) (desktop)
- Develop quality assured species sensitivity distributions and water quality guideline values for four non-PSII pesticides commonly found in GBR waters (desktop)
- Examine the risk of emerging contaminants to the marine environment based on (i) exceedances of Australian and international guidelines, (ii) (potential) presence and location, and (iii) expert knowledge from project team and international studies (workshop and desktop)
- Develop a list of priority emerging contaminants based on the risk to the GBR and Torres Strait marine ecosystems (workshop and desktop), within the context of current contaminants (sediment, nutrients, PSII herbicides)
- Develop recommendations for the development of trigger values/guidelines for priority emerging contaminants (workshop and desktop)
- Develop recommendations for key areas of research focused on priority emerging contaminants (workshop and desktop)

Links with other projects and hubs

This project will link with other projects within the NESP TWQ Hub focused on contaminants and pesticides. There is potential for linkages with projects within the Marine Biodiversity Hub as well.

Related research

This project builds upon NERP-TE and Reef Rescue investments into pesticides and other contaminants.

Expected Outcomes

Outcomes

- Identification and awareness of priority emerging contaminants that may pose a risk to the GBR and Torres Strait marine ecosystems
- New water quality guidelines for four non-PSII pesticides for GBR waters
- Comparative analysis of national and relevant international guidelines for emerging contaminants (including international bans e.g. imidacloprid)
- Inform the development of monitoring strategies and spatially-specific management approaches for protection of marine ecosystems

Specific management or policy outcomes

Improve policy and management of future GBR and Torres Strait water quality by:

- No-surprises early awareness of emerging contaminant issues
- Incorporating priority emerging contaminants into current monitoring programs
- Prioritization of emerging contaminants for guideline development
- Refined implementation of control measures at the source (location and timing)

Value

This research will

- Increase our understanding of the status of the GBR and Torres Strait marine environments and potential sources of emerging contaminants,
- Derive new ecologically relevant targets for four non-PSII pesticides for the Reef Water Quality Protection Plan, and
- Inform management and policy on risks associated with priority emerging contaminants.

Planned Outputs

- Target audiences: GBRMPA, Federal and Qld Government Agencies, Tourism, NRM Boards, Torres Strait Regional Council, Local Councils, Port Authorities and Industry, Traditional owners/Indigenous communities, Pesticide Working Group, Agricultural industries, Scientists
- Planned outputs: This will be discussed in more detail with the project team during the workshop. We anticipate that the outputs will include a synthesis report including key areas for future research, journal paper, seminars/presentations to target audiences, and a communication strategy for broader audiences (including traditional and social media)
- eAtlas: emerging contaminant information will be submitted to provide public access to the data

Delivery of Project

Project leader's track-record

The senior investigators in this multi-disciplinary and cross-institutional team are (inter-) national leaders in the field of contaminant research (please see on-line profiles), including in the GBR lagoon and other tropical coastal and marine environments. Combined, we have delivered numerous high level research projects on tropical water quality issues, often directly involving end-users and stakeholders that have informed regional, national and international government policy, planning and on-ground management.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: a. Improved understanding of the status of the GBR and Torres Strait marine environments and potential sources of emerging contaminants b. New water quality guidelines for four non-PSII pesticides for GBR waters c. Prioritization of emerging contaminants for guideline development 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	15 December 2015	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Frederieke Kroon	Principal Investigator	AIMS	f.kroon@aims.gov.au	0.11
Dr Andrew Negri	Co-Investigator	AIMS	a.negri@aims.gov.au	0.04
Dr Jeffrey Tsang	Co-Investigator	AIMS	j.tsang@aims.gov.au	0.04
Dr Rai Kookana	Co-Investigator	CSIRO	Rai.Kookana@csiro.au	0.05
Dr Stephen Lewis	Co-Investigator	JCU	stephen.lewis@jcu.edu.au	0.07
Dr Aaron Davis	Co-Investigator	JCU	aaron.davis@jcu.edu.au	0.07
Dr Dominique O'Brien	Co-Investigator	JCU	dominique.Obrien@jcu.edu.au	0.20
Assoc Prof Frederic Leusch	Co-Investigator	GU	f.leusch@griffith.edu.au	0.05
Dr Jason van de Merwe	Co-Investigator	GU	j.vandemerwe@griffith.edu.au	0.05
Dr Peta Neale	Co-Investigator	GU	p.neale@griffith.edu.au	0.05
Dr Steven Melvin	Co-Investigator	CQU	s.d.melvin@cqu.edu.au	0.20
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Dr R. Smith	Co-Investigator	DSITI	rachael.smith@dsiti.qld.gov.au	0.10
Ms Olivia King	Co-Investigator	GU	olivia.king@griffithuni.edu.au	0.20

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs / Reef Trust)	Amy McGrath Kevin Gale
Department of the Environment (International section)	Damien Hall
Key Stakeholders (organisation/programme)	
Department of Environment and Heritage Protection	
GBRMPA	Katherine Martin
DSITI	
AMPTO	Col McKenzie
Tourism Bodies	
GBR NRM Groups	
Torres Strait Regional Council	
Torres Strait Regional Authority	Shaun Barclay
Coastal Local Councils	
Port Authorities and Industry	
Traditional owners/Indigenous communities	
Pesticide Working Group	
Agricultural industries (e.g. Canegrowers, GrowCom, Queensland Farmers' Federation, AgForce etc.)	

Knowledge Brokering and communication

Direct involvement of end-users and stakeholders will be ensured through (i) participation in the planned workshop, (ii) synthesis of monitoring and source data on emerging contaminants from end-user, stakeholder and project team organisations, and (iii) presenting of the results and outcomes to end-users/stakeholders.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	92,000	-	41,908	-	97,432	\$231,340
Operating (incl. equipment, travel and communication)	8,000	-	-	-	-	\$8,000
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$100,000	-	\$41,908	-	\$97,432	\$239,340

Location of Research

Research impact upon Great Barrier Reef and its catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully. Traditional owners and Indigenous communities are identified as a stakeholder of this project.

Inclusions (in scope)

- Effective engagement with research end users and key stakeholders, including participation in workshop, to ensure relevance and uptake of research findings
- Complete list of emerging contaminants (potentially) present in GBR and Torres Strait marine environments based on monitoring and source data
- Prioritisation of emerging contaminants based on potential risk to GBR and Torres Strait marine environments within the context of current contaminants (sediment, nutrients, PSII herbicides)
- New ANZECC water quality guidelines for four non-PSII pesticides for GBR waters
- Inclusion of collated monitoring datasets into the eAtlas
- Research plan to inform management and policy decisions around high priority emerging contaminants in GBR and Torres Strait marine environments

Exclusions (out of scope)

- Field work to collect information on emerging contaminants in the GBR and Torres Strait marine environments
- Laboratory experiments to assess the impacts of emerging contaminants on marine biota
- Detailed quantitative risk assessment of emerging contaminants

Risks

- Loss of key personnel - the project involves several researchers with extensive expertise in different aspects of emerging contaminants research. The pool of capability in the team will allow timely mitigation.
- Failure to obtain monitoring information – the institutions are custodians of most of the monitoring information on emerging contaminants in the GBR and Torres Strait marine

ecosystems, with the researchers having excellent contacts with partner organisations holding additional monitoring and/or source information.

- Lack of data on some emerging contaminants – where data are unavailable we will build on information from international studies and propose pilot studies to monitor these contaminants in the GBR and Torres Strait marine ecosystems.

Project Keywords

Emerging contaminant

Sources

Impact

Fate

Great Barrier Reef

Project 2.1 – Assessing the cumulative impacts of climatic disturbances on inshore GBR coral reefs, identifying key refuges and testing the viability of manipulative reef restoration

Project length – 9 Months

Project start date – 01 July 2015

Project end date – 31 March 2016

Project Leader – Geoff Jones (FTE – 0.1)

Lead Research Organisation – James Cook University

Total NESP funding - \$85,000

Total Recipient and Other Contributions (co-contributions) - \$180,612

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$42,500	\$42,500	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$180,612	x	x	x	x	x	x

Project Summary

The Keppel Islands, southern GBR, suffered successive climatic disturbance events (coral bleaching, flood plumes) between 2006 and 2013. Long-term monitoring at 26 sites revealed significant declines in coral cover and fish abundance on both no-take reserve (green zone) and fished reefs. In February 2015, Cyclone Marcia (Category 5) hit the Keppel Islands. We propose to re-survey all 26 monitoring sites to quantify cyclone damage and to identify remaining refuge areas that can support reef recovery and long-term resilience. We also propose to conduct a pilot-scale experiment on degraded reefs in the Keppel Islands to assess the viability of active reef restoration.

Problem Statements

Problem

Inshore GBR reefs are subject to chronic impacts from reduced water quality and sedimentation, as well as acute climatic disturbances. It is essential that we monitor the status and condition of these reefs, identify key stressors, quantify the effects of management actions and assess the viability of additional measures to enhance biodiversity conservation and resilience. The project team monitored 26 reef sites in the Keppel Islands between 2004 and 2013. The dynamics of coral and fish communities were tracked and temporal changes were attributed to the implementation of new green zones in 2004, a coral bleaching event in 2006, and successive Fitzroy River major flood events between 2008 and 2013. In 2013, most reefs in the Keppel Islands were severely degraded, however several reefs had retained moderate live coral cover and continued to support productive fish communities. Cyclone Marcia crossed the Keppel Islands in February 2015 and the extent of additional impacts on the reefs is yet to be quantified. We propose to re-survey the monitoring sites in 2015, determine the cumulative effects of recent disturbances, and identify highly resilient refuge reefs that will provide a valuable source of recruitment for future recovery.

How Research Addresses Problem

The project will identify and map key local refuge reefs that are critical to the replenishment of the degraded reefs. The team will assess the role of marine park zoning in mitigating disturbance effects, enhancing recovery and building long-term ecosystem resilience. The project team also propose a pilot-scale experiment to investigate the viability of reef restoration and coral transplantation. This experiment would be conducted during the coral spawning and recruitment

season between October 2015 and February 2016. This component of the project will provide the basis for cost and benefit analyses for broader-scale reef restoration trials.

Alignment with NESP Research Priorities

- 2.1 Improve our understanding of the consequences of climate change for the health and resilience of vulnerable coastal and marine species, and ecosystems.
- 2.2 Develop practical, cost-effective, climate change adaptation and variability options that are accessible to the managers of coastal and marine ecosystems and their catchments.

Research

Description of research

Objectives:

- Assess the current condition of coral reef communities in the Keppels following a series of disturbances between 2006 and 2015.
- Quantify the effectiveness of no-take marine reserves in supporting enhanced spawning stocks of key fishery species within the degraded reef system.
- Identify and map critical post-disturbance refuges for both coral and fishes.
- Assess the viability of reef restoration in the Keppel Islands via a pilot-scale experiment.
- Engage with the Woppaburra Traditional Owners, the North Keppel Island Environmental Education Centre and local tourism operators to develop a framework for collaboration on a broader reef restoration project in the Keppel Islands.

Outcomes:

- Delivery of information on the current condition, and short- to medium-term recovery potential of reefs in the Keppel Islands based on monitoring data spanning 12 years.
- Advice on the effectiveness of existing Marine Park zoning in protecting critical post-disturbance refuge reefs in the Keppel Islands.
- Advice on additional local management actions that may improve protection of refuges for enhanced recovery of degraded reefs and long-term resilience.
- Assessment of the viability and costs of conducting manipulative reef restoration on degraded inshore GBR reefs.
- Opportunities for training and involvement of traditional owners, local recreational divers and commercial aquarium collectors in longer-term reef monitoring and restoration actions.

Methods:

Reef monitoring surveys

- Underwater visual census (UVC) of coral and fish communities at 26 long-term monitoring sites in the Keppel Islands during September/October 2015 using previous methods.
- Temporal analyses to assess site-specific changes and the extent of zoning effects.
- GIS mapping of the current condition of reefs, key refuges, and spatial protection provided by existing marine park zoning.

Reef restoration experiment

- Begin experiment in September/October 2015.
- Six experimental sites will be established on degraded Keppel Island reefs dominated by dead branching coral and macroalgae.
- A single experimental treatment group and a control group will be used.
- Three 1m x 1m quadrats will be assigned to both the treatment and the control group at each site (i.e. 6 quadrats per site).
- Treatment quadrats will be cleared of dead coral and algae to expose reef pavement, while dead coral and algae will be left intact in the control quadrats.
- A single live coral colony (*Acropora* sp.) will be transplanted into each treatment and control quadrat.
- Quadrats will be photographed and surveyed before, and several days after the establishment of the experiment.
- Repeat (final) surveys of experimental sites will be conducted in February 2016 to assess the condition of transplanted corals and to record the extent of any algal regrowth on cleared quadrats.
- Final reporting and briefing meetings will be conducted in March 2016.

Links with other projects and hubs

This project will link with other NESP TWQ Hub projects concerned with GBR zoning and coral reef health. It will also link with Marine Species hub projects.

Related research

This project builds upon investments from MTSRF and NERP-TE.

Expected Outcomes

Outcomes

- This project will provide specific information on the location and quality of the remaining fringing reef refuges for live hard coral and reef fishes in the Keppel Islands.
- We will deliver a direct assessment of the degree to which no-take marine reserves may have sustained populations of targeted fishes on degraded and refuge reefs.
- The manipulative experiment will provide insight into the viability of reef restoration actions on inshore GBR reefs.
- Extrapolation of the costs associated with the pilot-study will facilitate estimates for broader-scale reef restoration efforts.

Specific management or policy outcomes

A range of management actions could be taken based on the findings of this project, including;

- Modification of the marine park zoning plan in the Keppel Islands region to provide increased protection of high-resilience refuge reefs.
- Temporary closures of fishing and collecting on key refuge areas to protect remnant populations and facilitate population replenishment through recruitment.

- The establishment of additional no-anchoring areas on refuge and degraded reefs.
- Installation of additional moorings at reef refuge sites to reduce anchor damage and to improve access for reef tourism operators.
- The implementation of broader-scale reef restoration and coral transplantation projects to enhance recovery of degraded reefs and improve resilience in the Keppel Islands and elsewhere in the GBR Marine Park.

Value

- This project will identify and map highly resilient refuge reefs that will provide critical local sources of coral and fish larvae for the replenishment of degraded reefs.
- The key objective of the pilot-scale restoration project is to assist the recovery of hard coral dominance on degraded reefs that are currently dominated by macroalgae. The experiment will clearly be limited both spatially and temporally, however it will provide a basis for cost-benefit analyses for future up-scaled reef restoration projects.

Planned Outputs

- We expect that at least two peer-reviewed scientific publications will arise from this proposed project.
- Briefing meeting for GBRMPA, QDAFF and NPRSR staff to deliver project findings, discuss implications and future directions for improved management.
- Meeting with Woppaburra TUMRA Steering Committee to communicate research findings and discuss options for the development of a community-based reef restoration program in the Keppel Islands.
- Meeting with staff at the North Keppel Island Environmental Education Centre to discuss options for integrating reef monitoring and restoration activities into their programs.
- Presentation to the LMAC to update stakeholders on the current condition and future recovery prospects for their local reefs.

Delivery of Project

Project leader's track-record

Professor Geoff Jones is a chief investigator in the ARC Centre of Excellence for Coral Reef Studies. Geoff is a global leader in the fields of coral reef ecology and marine biodiversity conservation. He has led multiple ARC, MTSRF and NERP funded research projects and he has an outstanding track record of delivering high-quality research findings on time and within budget. <http://www.coralcoe.org.au/researchers/geoff-jones>

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$42,500
1. Final report describing: <ol style="list-style-type: none"> specific information on the location and quality of the remaining fringing reef refuges for live hard coral and reef fishes in the Keppel Islands direct assessment of the degree to which no-take marine reserves may have sustained populations of targeted fishes on degraded and refuge reefs the viability of reef restoration actions on inshore GBR reefs estimates for broader-scale reef restoration projects Capacity building for Woppaburra Traditional Owners 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$42,500
Total NESP Funding		\$85,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Prof. Geoff Jones	Principal Investigator	JCU	geoffrey.jones@jcu.edu.au	0.1
Prof. Garry Russ	Co-Investigator	JCU	garry.russ@jcu.edu.au	0.1
Dr. David Williamson	Co-Investigator	JCU	david.williamson@jcu.edu.au	0.4

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Woppaburra TUMRA Steering Committee	Bob Muir
Local tourism operators	
Capricorn Coast LMAC	Michael McCabe
GBRMPA	David Wachenfeld Leon Jackson
NPRSR	
DAFF	

Knowledge Brokering and communication

- We will directly engage with Woppaburra traditional owners to communicate previous and current research findings, and to discuss opportunities for community involvement in reef monitoring and restoration projects through expanded collaboration with the North Keppel Island Environmental Education Centre.
- We will engage with local tourism operators, commercial aquarium collectors, recreational fishers and other relevant stakeholders through the LMAC.
- We will directly engage with the GBRMPA, QLD NPRSR and QLD DAFF early in the project and deliver research outputs via a briefing meeting prior to project completion as well as circulating project reports and publications to key personnel.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	Cash	Cash	In-kind	Cash	In-kind	
Salaries	50,000	-	41,715	-	-	\$91,715
Operating (incl. equipment, travel and communication)	35,000	-	9,500	-	-	\$44,500
Admin support (in-kind only)	-	-	129,397	-	-	\$129,397
TOTAL	\$85,000	-	\$180,612	-	-	\$265,612

Location of Research

Keppel Islands, GBR

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

This project will provide specific information on the location and quality of the remaining fringing reef refuges for live hard coral and reef fishes in the Keppel Islands. The project will deliver a direct assessment of the degree to which no-take marine reserves may have sustained populations of targeted fishes on degraded and refuge reefs. The pilot-scale manipulative reef restoration experiment will assess the viability of up-scaled reef restoration activities in the GBR Marine Park.

Exclusions (out of scope)

Other impacted areas of the GBR will not be surveyed for the location and quality of the remaining reef refuges for live hard coral and reef fishes.

Risks

- The primary identified risk for this project is for another extreme disturbance (flood plume, coral bleaching event or cyclone) to impact reefs in the Keppel Islands between September 2015 and February 2016.
- Any such disturbance event would only impact upon the experimental reef restoration component of the project. The monitoring surveys and the identification of key refuge reefs would not be affected.

- The reef restoration experiment must be conducted during the coral spawning and recruitment season between October and February. We propose a project completion date of March 2016. This will allow adequate time for sampling, data analyses and report preparation.

Project Keywords

Coral reef biodiversity
Zoning management
Disturbance
Resilience
Restoration

Project 2.2 – A tradable permit scheme for cost effective reduction of nitrogen runoff in the sugarcane catchments of the Great Barrier Reef

Project length – 7 Months
 Project start date – 01 August 2015
 Project end date – 29 February 2016

Project Leader – Jim Smart (FTE – 0.25)
 Lead Research Organisation – Griffith University

Total NESP funding - \$99,721
 Total Recipient and Other Contributions (co-contributions) - \$232,820

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$49,861	\$49,860	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$232,820	x	x	x	x	x	x

Project Summary

This project will undertake a scoping study to design a pilot nitrogen trading scheme for key cane growing catchments draining into the Great Barrier Reef Lagoon. The study will synthesise the current understanding of nitrogen dynamics, local expertise and on-ground practices from the cane industry, with lessons from successful nutrient trading programs elsewhere. Tradable permit simulation will estimate the cost effectiveness of the scheme for reducing nitrogen loads into the GBR, and the financial impact on sugarcane growers. Core enablers will be identified and key steps for implementation will be formulated, including governance structure and monitoring mechanisms.

Problem Statements

Problem

Sugarcane production relies on the application of nitrogen fertiliser to enhance soil quality, but nitrogen is a highly mobile nutrient which is easily lost from the soil. Nitrogen runoff from sugarcane production is seen as one of the major sources of nitrogen impacting water quality in the GBR.

Current methods to reduce nitrogen runoff from sugarcane production use an A-B-C-D best management practice framework which relies on voluntary participation. Despite considerable effort and expenditure, these approaches have produced only modest changes in runoff rates and water quality improvements.

How Research Addresses Problem

Nitrogen trading is an alternative management approach which could potentially deliver N-load reductions more cost effectively. This requires an understanding of:

- practical constraints facing sugarcane growers
- nitrogen dynamics within catchments
- efficient operation of a nitrogen trading market
- effective governance and monitoring arrangements

Our project will synthesise these four components to develop the holistic understanding required to design a workable and effective pilot nitrogen trading scheme. Engaging with the practical expertise of sugarcane growers, NGOs and environmental regulators will be crucial to a successful outcome.

Market simulations will be used as a synthesis tool to assess likely outcomes and assist design of an efficient and effective trading market.

Alignment with NESP Research Priorities

- 3.5 Develop and implement better tools, including spatial information, to support the prioritization of on-ground investments and interventions and assess their success.
- 3.5.1 Review policy and regulatory instruments to assess their effectiveness and appropriateness in promoting improved land and water management
- 3.5.2 Evaluate and develop better tools (for example, economic, spatial information, statistical, systems and/or predictive models) to support the prioritisation and evaluation of on-ground investments and interventions
- 3.5.3 Trial and implement novel and improved mechanisms that lead to cost effective practice change and improved on-ground adoption

Research

Description of research

Objectives

- Review what does / does not work in trading schemes for water quality management
- Engage with stakeholders in sugarcane catchments to incorporate their knowledge and encourage uptake if a N-trading scheme is introduced
- Design a blueprint for pilot nitrogen trading schemes in two cane growing catchments draining into the GBR Lagoon, acknowledging interests and concerns of key stakeholders.
- Estimate the cost effectiveness of the proposed trading scheme for reducing N loads into the GBR Lagoon
- Assess the financial impacts on cane growers

Outcomes

Changes in Management Practice

- The pilot N-trading schemes will provide an alternative management option to the existing voluntary A-B-C-D best management practice framework.
- Attaching a market value to nitrogen application permits (NAPs) will provide an economic incentive to reduce fertiliser applications, and also an incentive to implement mitigation measures such as wetland restoration which reduce N-loads discharged to the coast.
- A well-developed trading scheme can also produce ancillary environmental benefits such as flood retention, riparian improvement and habitat protection.

Method

- Literature review of water quality trading schemes and nitrogen management approaches worldwide: what does / does not work, and why
- Literature review of nitrogen sources, loads and dynamics for sugarcane catchments draining into the GBR Lagoon
- Engage with stakeholders to elicit knowledge of sugarcane production in two focus locations: Burdekin and Mackay
- Use findings to identify effective nitrogen abatement / mitigation measures.
- Use cane yield - nitrogen functions on different soil types to estimate costs of fertiliser reduction ([Hasler, Smart et al 2014](#); *Water Resource Economics*). Use an input distance function approach to estimate farm-specific costs ([Coelli et al 2005](#)).

- Quantify indicative costs for mitigation measures and determine the likely variation in costs across business units
- Simulate operation of nitrogen trading market among cane growers within and between catchments under different permit trading arrangements (e.g. [Hung & Shaw 2005](#); *JEEM*); also consider trading with other N-emitters (sewage treatment plants, aquaculture, etc.)
- From simulation results, quantify the cost effectiveness of scheme for reducing nitrogen loads and estimate financial impact on sugarcane growers.
- Synthesise findings into a proposal for a GBR Nitrogen Trading Scheme, including policy framework, implementation options, governance and monitoring.

Links with other projects and hubs

This project relates to other economic evaluation projects (3.10 and 3.12)

Related research

Expected Outcomes

Outcomes

- Improved understanding of how to implement a workable nitrogen trading scheme for the GBR's sugarcane catchments
- Indication of the likely cost effectiveness of this scheme
- Estimate of the financial impact on the cane industry
- Informed and engaged stakeholder group (industry and regulators)

Specific management or policy outcomes

- Financial incentivisation to enhance uptake of improved management practice for N-reduction
- An overall reduction in the total amount of nitrogen fertilizer applied in critical catchments
- Financial incentivisation to implement nitrogen mitigation measures

Value

- Provides a blueprint for achieving desired N-load reductions at lower total cost to society
- Suggests appropriate location(s) for implementing the pilot N-trading scheme
- Recommends data collection necessary to assess performance of the pilot scheme (e.g. scheme uptake rates and the resultant measured reduction in Nitrogen loads from key catchments)

Planned Outputs

- Simulation of costs and benefits of N-trading schemes in two pilot GBR catchments
- Blueprints for pilot N-trading schemes in two cane growing catchments

Delivery of Project

Project leader's track-record

[Dr Jim Smart](#) has expertise in estimating nutrient abatement costs and optimising cost efficiency for nutrient load reductions in the UK and the Baltic. He has coordinated research projects for commercial clients and government funders in the UK, Denmark and Australia.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$49,861
1. Final report detailing: <ul style="list-style-type: none"> a. Simulation of costs and benefits of N-trading schemes in two pilot GBR catchments b. Blueprints for pilot N-trading schemes in two cane growing catchments 2. Summary factsheets for stakeholders 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	29 February 2016	\$49,860
Total NESP Funding		\$99,721

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Jim Smart	Principal Investigator	Griffith	j.smart@griffith.edu.au	0.25
Dr Adrian Volders	Co-Investigator	Griffith		0.4
Prof. Michele Burford	Co-Investigator	Griffith	m.burford@griffith.edu.au	0.15
Dr Chris Fleming	Co-Investigator	Griffith	c.fleming@griffith.edu.au	0.15
Dr Syezlin Hasan	Co-Investigator (RF2.1)	Griffith	s.hasan@griffith.edu.au	0.4

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
WWF	Nick Heath – National Manager Freshwater nheath@wwf.org.au
Canegrowers Association	Matt Kealley
GBRMPA	Jason Vains

Knowledge Brokering and communication

- Early engagement with peak bodies, interested NGOs, policy makers and regulators will provide a platform for developing an integrated proposal for nitrogen trading which acknowledges the interests and concerns of the various stakeholders.
- Initial industry engagement will be conducted through peak bodies (e.g. Canegrowers) and local producers groups.
- WWF Australia is engaged with the project and highly supportive of the approach. Government policy makers and environmental regulators will also be engaged throughout.
- Simulation modelling of the trading market will enable stakeholders' queries regarding the proposed scheme, its financial impacts and opportunities, to be addressed throughout the development.

Target audience: peak industry bodies (e.g. Canegrowers, local canegrowers in the GBR catchments, environmental regulators, policy makers and interested NGOs.

For Stakeholders:

- Plain English summary of what does / does not work in trading schemes for managing water quality
- Plain English summary of proposed trading scheme for sugarcane catchments
- Group presentations to stakeholders in the two case study catchments

For academia:

- Peer-reviewed paper detailing the results of simulation modelling and the design of the proposed trading scheme

Indigenous communities and individuals would be included if they own or manage sugarcane properties in the case study areas.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	84,121	-	52,833	-	47,850	\$184,804
Operating (incl. equipment, travel and communication)	15,600	-		-	-	\$15,600
Admin support (in-kind only) ¹	-	-	132,137	-	-	\$132,137
TOTAL	\$99,721	-	\$184,970	-	\$47,850	\$332,541

Location of Research

Great Barrier Reef catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

The project will combine academic and practical expertise to simulate the costs and benefits of N-trading schemes and draw up blueprints for pilot N-trading schemes in two cane growing catchments

Exclusions (out of scope)

The current project will not move beyond the modelling, simulation and blueprint stages i.e. it will **not** proceed to on-ground implementation. This remains a possibility for subsequent projects in the future.

Risks

The project team has well-established links with stakeholders such as Canegrowers, WWF and environmental regulators. However:

- it may prove difficult to access the (anonymised) farm-level economic data required to quantify the spread of abatement costs in the simulation model;
 - should the need arise, a more basic representation of abatement costs can be obtained solely from published data on the cane yield – N fertilizer relationship, varying across soil types
- identifying nutrient sources and parameterising nutrient dynamics from existing literature may prove challenging

The project remains confident that the project team has sufficient expert knowledge to bridge any data gaps.

Project Keywords

Nitrogen
Pollution
Nitrogen Trading
Cost Efficiency
Water Quality

Project 3.1 – Seagrass mapping synthesis – A resource for marine park and coastal management

Project length – 6 Months

Project start date – 01 July 2015

Project end date – 31 December 2015

Project Leader – Rob Coles (FTE – 0.3)

Lead Research Organisation – James Cook University

Total NESP funding - \$36,000

Total Recipient and Other Contributions (co-contributions) - \$54,500

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$36,000	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$54,500	x	x	x	x	x	x

Project Summary

Key to understanding the desired state of Queensland seagrasses is reliable data on seagrass distribution, abundance and species composition, and how this changes through time. Also valuable is the ability to reliably “drill” down from large-scale (World Heritage Area) to small-scale estuaries and meadows. TropWATER provides a composite map of seagrass for the GBRWHA available through E-Atlas, GBRMPA and Pangaea. However this layer has not been updated since 2010 and is missing changes from important areas and extensive new data, and provides no meadow-specific information. This project will recompile existing GIS layers, update with 2010-2015 data, and provide meadow-specific information.

Problem Statements

TropWATER’s seagrass maps are part of Queensland’s ecological “infrastructure”. They are used to model connectivity, assist with zoning and management, understand change, assess the impact of water quality and assess/predict vulnerability of turtle and dugong populations. However the seagrass GIS being used for research and management is out of date and incomplete. Prior to 2012 these data were updated by Queensland Government staff. This no longer occurs. Seagrass meadows can change and maps compiled 5-6 years ago may not be representative of current status. In addition the existing composite seagrass layer is of limited utility for assessing seagrass state as it is simply a boundary of anywhere seagrass has been recorded with no other specific seagrass information.

Alignment with NESP Research Priorities

3.2.1 Improve understanding of dugong and marine turtle habitats including migratory corridors.

Research

Description of research

The project will update the existing composite seagrass GIS layers, verify and include 2010 - 2015 data; expand the GIS to include, seagrass meadow area, density, species composition, sampling method and copyright. Importantly, the GIS will include survey dates for each area, details of where no seagrass occurred, and areas where no information has been collected, enabling a thorough

context for assessing change over time and the reliability (age) of the data – essential information for determining and maintaining the desired state of GBRWHA seagrasses.

- Review, check and collate existing publically available seagrass GIS layers and metadata;
- Identify and collate all new (2010-2015) spatial data sets and obtain permissions from copyright holders to include this data in the project and to make it publically available;
- Combine spatial information into new GIS layers that provide individual site and whole meadow information, including seagrass presence/absence, species composition, site biomass, meadow biomass, community type and area, intertidal/subtidal, subtidal depth, survey date, survey method, NRM region, and copyright holder of original data.
- Provide a plain English descriptive layer for users;
- Contact management agencies and traditional owners to ascertain the best location to lodge data and accessibility needs;
- Produce report and summary brochure as a basis for web information.

Links with other projects and hubs

- Will underpin other NESP projects that rely on accurate area estimates of seagrass and that seek to understand habitats of dugong and green turtles.

Related research

- Builds on previous research. See: McKenzie, Len J; Yoshida, Rudolf L; Grech, Alana; Coles, Robert (2010): Queensland seagrasses. Status 2010 - Torres Strait and East Coast. *Fisheries Queensland Cairns*, 6 pp, [hdl:10013/epic.42902.d001](https://hdl.handle.net/10013/epic.42902.d001)

Expected Outcomes

Outcomes

- A 2015 GIS composite layer of GBR seagrass meadows;
- A regional understanding of the seagrass resource against which to evaluate the desired state;
- Site and meadow-specific information contained within GIS layers to enable seagrass information to be categorized depending on management questions.
- Identify regions where seagrass information is deficient (data absent or out of date);
- Enable identification of key seagrass areas for dugong and turtles and potential new dugong protected areas and migration corridors.

Specific management or policy outcomes

The GIS produced from this project will replace the currently available seagrass map layer that is used extensively to assist development, zoning, and management planning. Data will be available for each NRM group to enable planning.

Value

- Knowledge of the location and composition of key environmental assets is essential to valuing and protecting the GBR;
- TropWATER through other projects are evaluating report card approaches to accurately measure change in seagrass parameters through time.
- Layers will enable better calibration of models of exposure to water quality impacts

Planned Outputs

- Outputs from the project are GIS layers of seagrass information that will be available for research, public and community interest and management as a common resource.
- Information will be linked to JCU's website and available as downloadable files as a free of charge public resource.
- The project will include a brochure outlining the data, how to use it and where to obtain further advice and help
- TropWATER will make contact with the DoE and Aboriginal Corporations at the commencement of the project and as required.

Delivery of Project

Project leader's track-record

The team has been the leading provider of seagrass spatial data for Queensland for over 30 years and is ideally placed to deliver this project. Coles and co-workers at TropWATER have published extensively on seagrass distribution, risk management, coastal and estuarine management and seagrass values. The team has extensive skills in seagrass and coastal habitat surveying, mapping and monitoring and in collating that data in usable forms and GIS outputs. Carter and Rasheed recently completed a similar synthesis for seagrasses of the Torres Strait.

The group is custodian of all of the seagrass spatial data and was involved directly in the surveys that form part of the synthesis. The team also includes direct links to key management end users with GBRMPA Information systems manager, Leath Muller providing guidance and input.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$18,000
1. Brochure outlining the GIS layers of seagrass information data, how to use it and where to obtain further advice and help. 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	15 December 2015	\$18,000
Total NESP Funding		\$36,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Rob Coles	Principal Investigator	JCU	rob.coles@jcu.edu.au	0.3
Dr. Michael Rasheed	Co-Investigator	JCU	michael.rasheed@jcu.edu.au	0.1
Ms. Alex Carter	Co-Investigator	JCU	alexandra.carter@jcu.edu.au	0.5
Ms. Skye McKenna	Research Officer	JCU	skye.mckenna@jcu.edu.au	0.1
Leath Muller	Project advisor	GBRMPA	Leath.muller@gbrmpa.gov.au	0.05

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment - Reef Programs / Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Great Barrier Reef Marine Park Authority	Katherine Martin
Queensland NRM Groups	
Aboriginal Corporations	All Aboriginal Corporations and Traditional Owners with Sea Country in the GBR region.

Knowledge Brokering and communication

- The seagrass team attends numerous, meetings, conferences and training sessions where the seagrass maps and data are discussed and used as a base condition
- GBRMPA Information systems staff are members of the project team ensuring uptake of results
- TropWATER staff involved in this project regularly attend independent science panels, dredging and port advisory meetings and provide advice and presentations to companies, investment banks, indigenous groups and community groups on seagrass and coastal management;
- The project team are part of local and global monitoring projects;
- The project team engage with the research community through scientific publications and research reports see; <https://research.jcu.edu.au/tropwater/research-programs/seagrass-ecology-1/seagrass-ecology>

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	36,000	-	50,000	-	-	\$86,000
Operating (incl. equipment, travel and communication)	-	-	2,000	-	-	\$2,000
Admin support (in-kind only)	-	-	2,500	-	-	\$2,500
TOTAL	\$36,000	-	\$54,500	-	-	\$90,500

Location of Research

On ground research will be based in JCU Cairns Campus TropWATER office.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, all projects will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

- This project will compile existing spatial seagrass data, up to 2015.
- This will include all seagrass spatial data within the GBRWHA.
- Data will include site- and meadow-specific information.
- Comprehensive metadata will be made available.

Exclusions (out of scope)

- There is limited spatial information for seagrass meadows deeper than 15 m below mean sea level.

Risks

Risks to this project are low;

- All expertise required are in-house;
- The majority of available data is in-house;
- There are no blocks expected to obtaining all the data required;
- A similar exercise was recently completed for other stakeholders in Torres Strait;
- TropWATER has a history of conducting research for public good.

Project Keywords

Seagrass
Management
Map
Queensland
Zoning

Project 3.2 – Improving historical estimates of abundance and distribution of dugongs and large green turtles in western and central Torres Strait

Project length – 9 Months
 Project start date – 01 July 2015
 Project end date – 31 March 2016

Project Leader – Helene Marsh (FTE – 0.05)
 Lead Research Organisation – James Cook University

Total NESP funding - \$97,674
 Total Recipient and Other Contributions (co-contributions) - \$342,236

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$48,837	\$48,837	x	x	x	x	x
Cash co-con	\$62,500	x	x	x	x	x	x
In-kind co-con	\$279,736	x	x	x	x	x	x

Project Summary

This project will improve the accuracy of aerial survey estimates of the size and distribution of dugong and green turtle populations in western and central Torres Strait by: (1) collecting and analysing data on their movements and diving behaviour, and (2) estimating the proportion of turtles seen during aerial surveys that are the large female green turtles harvested by Indigenous hunters. These data will then be used to (re)estimate the size and distribution of the populations of dugongs and harvestable green turtles in Torres Strait by (re) analysing historical aerial survey data collected in 2001, 2005, 2006, 2011 and 2013.

Problem Statements

Problem

Accurate estimates of the population size and distribution of dugongs and green turtles in Torres Strait are important for the Indigenous management of these species.

JCU has conducted dugong aerial surveys since 1987 and has also recorded turtle sightings. As proof of concept, we recently analysed aerial turtle sightings from 2013 using green turtle dive times and turtle ‘secchi disk’ experiments from outside Torres Strait to estimate the detection zones in which turtles are visible from survey aircraft under various environmental conditions. The project team estimated there were ~400,000 adult-sized green turtles in central and western Torres Strait (Fuentes et al. in press). The project aims to improve accuracy by quantifying the proportion of Torres Strait turtles that are adult-sized green turtles.

The team have also discovered that the availability of dugongs to aerial observers depends on bathymetry as well as environmental conditions. Dugongs in waters 5-12 m deep (the depths most Torres Strait dugongs and green turtles are sighted) are less available to aerial observers than animals in shallower or deeper waters.

How Research Addresses Problem

This project will improve availability estimates by collecting dive and movement data from dugong and green turtles living in Torres Strait, in turn improving information on their population sizes and distributions.

Alignment with NESP Research Priorities

- 3.2.1 Improve understanding of dugong and marine turtle habitats including migratory corridors.
- 3.2.2 Improve understanding of trends in dugong and marine turtle populations including their breeding cycles and the links between these trends and the trends in their habitats.
- 3.2.3 Evaluate the effectiveness of current and potential future zoning and/or other management initiatives on the resilience of dugong and marine turtle populations and these habitats.

Research

Description of research

Objectives

1. To improve the accuracy of the aerial survey estimates of the sizes of the dugong and green turtle populations in western and central Torres Strait by collecting and analysing data on the diving behaviour of both species.
2. To estimate the proportion of turtles seen during aerial surveys which are the large female green turtles harvested by Indigenous hunters.
3. To use data from objectives 1 and 2 to (re)estimate the size and distribution of the populations of dugongs and harvestable green turtles in Torre Strait based on analysis of historical aerial survey data collected in 2001, 2005 2006, 2011 and 2013.

Methods

Field work (NESP, TSRA, JCU)

- Operating under agreements with relevant Prescribed Body Corporates, our team will catch up to 10 dugongs and 10 green turtles with assistance from TSRA LSMU staff including sea team members, rangers, and local hunters using culturally-appropriate methodologies under JCU Ethics permits and Commonwealth, Queensland and AFMA permits.
- Animals will be fitted with satellite/GPS transmitter and Minipat archival transmitter and tracked using international networks. Minipat transmitters will release after 6 weeks and transmit records of geo-referenced time at depth.

Estimation of availability bias (NESP)

- Dive data from dugongs and green turtles will be analysed as per Hagihara et al. (2011 and 2014).
- Estimating proportion of green turtles sighted in the aerial surveys that are 'harvestable' green turtles (NESP)
- Turtle experts will use a helicopter in doldrums weather at high tide to estimate the proportion of turtles sighted during aerial surveys that are adult-sized female green turtles (January 2016).
- Re-analysis of historical aerial surveys (JCU)
- Re-analysis of dugong and turtle aerial survey data from 2001, 2005 2006, 2011 and 2013 will be based on improvements to the Pollock et al. (2006) methodology to incorporate dive data into the estimates of availability bias for dugongs and green turtles.

Links with other projects and hubs

This project will link with 3.5, which is assessing seagrass habitat resources in the Torres Strait.

Related research

Torres Strait Community Turtle and Dugong Management Plans

TSRA supported negotiations between Australian and PNG regarding expansion of Torres Strait Dugong Sanctuary and extending sanctuary to include green turtles

National Turtle Recovery Plan (in progress)

National Dugong and Turtle Protection Plan

Torres Strait Regional Authority, Torres Strait Development Plan 2014-2018

Expected Outcomes

Outcomes

1. Improved capacity for Islanders and government agencies to manage the Indigenous harvest of green turtles and dugongs in Torres Strait.
2. Increased Islander capacity in and understanding of contemporary western research methods.

Specific management or policy outcomes

1. Ongoing revisions to Torres Strait Community Turtle and Dugong Management Plans.
2. Improved science base for further negotiations between Australia and PNG regarding dugong management in Torres Strait, especially extension of Dugong Sanctuary in spatial extent and scope.

Value

N/A

Planned Outputs

For Central and Western Torres Strait:

1. More robust estimates of the size of dugong and harvestable green turtle populations.
2. More robust evaluation of trends in the size and distribution of the dugong population.
3. First evaluation of trends in the size and distribution of the harvestable green turtle population.
4. Improved understanding of the distribution and habitat use of dugongs and green turtles including local migratory corridors.
5. Additional spatial data for the e-atlas.
6. More Torres Strait Islanders trained in capturing dugongs and green turtles for research.

Delivery of Project

Project leader's track-record

- Both project leaders have successfully worked in Torres Strait for many years in established partnerships with TSRA and local communities.
- The group has GPS/satellite tracked dugongs and green turtles for many years including some experience in Torres Strait.
- Marsh's group has conducted aerial surveys for dugongs in Torres Strait since mid-1980s, plus research to improve: (1) aerial survey correction factors for animals that are unavailable to observers due to water turbidity; and (2) understanding dugong genetics and stock structure.
- Hamann's group has also conducted: (1) extensive surveys of Torres Strait turtle nesting beaches, (2) satellite tracking of flatback turtles, and (3) studies of the genetics and demography of green turtles in Torres Strait.

- Both Marsh <https://research.jcu.edu.au/portfolio/helene.marsh> and Hamann <https://research.jcu.edu.au/portfolio/mark.hamann/> have an extensive publication record in the areas of this project.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP
On signing on contract		\$48,837
1. Report detailing: <ol style="list-style-type: none"> Success of satellite/GPS transmitter and Minipat archival transmitters to dugongs and turtles and tracking results. Community engagement with at least one of the following communities: Boigu, Badu or Mabuig Dive data from dugongs and green turtles as per Hagihara et al. (2011 and 2014). Estimating proportion of green turtles sighted in the aerial surveys that are 'harvestable' green turtles (NESP) Proportion of turtles sighted during aerial surveys that are adult-sized female green turtles (January 2016). Re-analysis of historical aerial surveys (JCU) Re-analysis of dugong and turtle aerial survey data from 2001, 2005 2006, 2011 and 2013. 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$48,837
Total NESP Funding		\$97,674

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Prof. Helene Marsh	Principal Investigator	JCU	helene.marsh@jcu.edu.au	0.05
Dr Mark Hamann	Co-Investigator	JCU	mark.hamann@jcu.edu.au	0.05
Dr Susan Sobotzick	Senior Research Officer	JCU	susan.sobotzick@jcu.edu.au	0.45
Rie Hagihara	Research Officer	JCU	rie.hagihara@jcu.edu.au	0.25
Frank Loban	Ranger Co-ordinator	TSRA	frank.loban@tsra.gov.au	0.04
Shane Preston	Field Technician	JCU	shane.preston@jcu.edu.au	0.2
Chris Clegeur	Research Officer	JCU	chris.clegeur@my.jcu.edu.au	0.1

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – International	Damien Hall
Department of the Environment – Migratory species	Fiona Bartlett
Key Stakeholders (organisation/programme)	
Torres Strait Regional Authority	Shaun Barclay Stan Lui
AFMA	Selina Stoute
Malu Lamar PBC	Maluwap Nona
Torres Strait Traditional Owners – all communities	
PNG Treaty Village Association	
PNG Government – Department of Conservation	
GBRMPA	Andrew Simmonds

Knowledge Brokering and communication

- Ongoing consultation with Malu Lamar (Torres Strait Islander) Corporation RNTBC via the Chair Mr Maluwap Nona
- Community meetings in community in which tagging team will be based (Boigu, Mabuiag or Badu) before and after the fieldwork.
- Involvement of the local school children in naming the tagged dugongs and turtles.
- Dedicated web page to enable Torres Strait school children to follow tracked animals.
- Articles in Torres News.
- Interviews on Torres Strait radio.
- Briefings to TSRA Board and Land and Sea Management Unit.
- TSRA Briefings to PZJA.
- Report to NESP.
- Publications in peer-reviewed journals.

Expenditure Summary

	Project Costs					
	NESP	Applicants		Other stakeholders		TOTAL
	cash	cash	In-kind	cash	In-kind	
Salaries	38,074	-	64,760	24,000	10,500	\$137,334
Operating (incl. equipment, travel and communication)	59,600	-	67,000	38,500	10,500	\$175,600
Admin support (in-kind only)	-	-	126,976	-	-	-
TOTAL	\$97,674	-	\$258,736	\$62,500	\$21,000	\$439,910

Location of Research

Western and central Torres Strait

Indigenous Consultation and Engagement

This project can only be achieved with the involvement of the Torres Strait Regional Authority, Torres Strait Prescribed Body Corporates, Traditional Owners and community members. The research team is well known for their research and community engagement in the Torres Strait.

Inclusions (in scope)

This project will involve satellite tracking of 10 dugong and 10 green turtles to improve estimates of populations using dive data with historical aerial survey data modelling.

Exclusions (out of scope)

Aerial surveys, nesting surveys and dugong calving surveys will not be included in this project scope.

Risks

Risks

- Failure to catch planned number of dugongs.
- Failure to obtain appropriate weather for helicopter surveys of turtles.

Actions to overcome risks

- Timing of dugong catching is being developed in consultation with Traditional Owners.
- Timing of helicopter surveys will be finalized in consultation with Bureau of Meteorology.
- Field work costs have allowed for interruptions due to unsuitable weather.
- Government and ethics permits already obtained or in train.
- Extensive in-house expertise in all aspects of project.
- Excellent established relationships with Traditional Owners.

Project Keywords

Torres Strait
Dugong
Green turtle
Population estimates
Distribution

Project 3.3 – Light thresholds for seagrasses of the GBR: a synthesis and guiding document for managing seagrass

Project length – 6 Months

Project start date – 01 July 2015

Project end date – 31 December 2015

Project Leader – Catherine Collier (FTE – 0.15)

Lead Research Organisation – James Cook University

Total NESP funding - \$29,755

Total Recipient and Other Contributions (co-contributions) - \$51,308

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$29,755	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$51,308	x	x	x	x	x	x

Project Summary

Light levels (i.e. water quality/turbidity) can be managed to minimise seagrass losses. Recent attempts to define threshold levels of light required to maintain GBR seagrass state has resulted in a spectrum of recommendations with no single definitive source document to guide regulation. We will compile the available information on light thresholds into a guiding document, which will become a key reference for managers and regulators to use in generating relevant water quality guidelines and conditions for developments such as dredging programs. It will also highlight research information needs and provide interim guidelines for immediate management application.

Problem Statements

Problem

Seagrasses are dependent on light to maintain primary productivity, and when light levels become too low, seagrass loss occurs with considerable flow-on effects for GBR ecosystems (e.g. dugong and turtle mortality). In some cases, light levels (water quality/turbidity) can be managed to minimize seagrass loss. Thus, defining the amount of light (light thresholds) that seagrasses require to maintain their status has been the subject of some research effort over the previous 5 years. However, the range of approaches and methodologies used has resulted in a spectrum of recommendations with no single definitive source document to guide compliance.

How Research Addresses Problem

We will compile the available information on light thresholds into a guiding document, which will become a key reference for managers and regulators and modelers to use in generating relevant water quality guidelines. This will summarise light required to maintain the condition of GBR seagrasses and thresholds known to drive losses. This will consider different species with guidance on how to incorporate risk from cumulative impacts, such as temperature stress. An emphasis will be placed on how to apply and interpret thresholds within a regulatory framework, such as conditions applied to dredging programs and in achieving regional conditions suitable for GBR seagrass recovery.

Alignment with NESP Research Priorities

- 2.3.2 Develop environmental standards and spatial health indices to quantify ecosystem condition with the goal of maintaining healthy marine water quality and ecosystems

Research

Description of research

Objectives

- Provide clear and consistent guidance to environmental managers and regulatory authorities on light thresholds to apply for GBR seagrasses.
- Synthesise current state of knowledge of light effects on seagrasses.
- Develop a conceptual framework to guide threshold application.
- Deliver a table of light thresholds guidelines and associated indicators of stress for key seagrass species in the Great Barrier Reef for immediate application by multiple end-users (i.e. managers, regulators, modelers etc).
- Highlight critical information gaps for species and thresholds to focus future research efforts.

Methods

- The project team will bring together their extensive work and analyses on tropical seagrass light requirements and their application in management conducted as part of various research and management programs including NERP, direct industry, and government funded programs.
- A conceptual framework will be developed which outlines the factors influencing light requirements and light thresholds, and describes a decision pathway for threshold selection from available data
- All light thresholds for seagrass species that occur in the GBR will be assembled and critically assessed for their relevance to the development of GBR guidelines (including studies undertaken outside of the GBR).
- Emphasis will be placed on coastal species at risk from port and coastal development, and with sufficient data availability e.g. *Zostera muelleri*, which dominates in Gladstone Harbour and is a key species in other high-risk areas such as Cairns, Townsville and Abbot Point.
- Light requirements required to maintain seagrass state and light thresholds driving losses will be extracted considering species, habitat, duration of exposure, and impact of exceeding thresholds (i.e. the effect on seagrass state).
- Data will be compiled into an easy-to-access table designed for environmental managers and regulators to extract thresholds relevant to species, locations and seasons if available.

Links with other projects and hubs

Links to 3.4, examining indicators for seagrass monitoring

Related research

GBR Marine Monitoring Program and Ports Monitoring examining water quality, indicators and thresholds.

Expected Outcomes

Outcomes

- Practical guide to implementing seagrass light thresholds for management of activities causing light reductions (turbidity/dredging).
- Values of light required to maintain functioning healthy seagrass meadows in the GBR for regional planning and water quality guidelines.
- Practical framework for implementing compliance monitoring programs on seagrass condition during coastal developments.

Specific management or policy outcomes

- Ensure seagrasses at highest risk from direct anthropogenic impacts have adequate protection.
- Confidence and consistency in management advice and application for appropriate thresholds to protect GBR and tropical Australian seagrasses from light stress.
- A conceptual summary of factors affecting seagrass light thresholds, including a decision pathway for threshold selection.
- A synthesised and concise summary of known light requirements for maintaining seagrass condition and thresholds driving losses.
- Setting the direction for future research needs to improve ability to effectively use light thresholds for protection of seagrass and their associated ecosystem services.

Value

Direct protection of seagrasses will occur by:

- ensuring water quality guidelines for developments are ecologically relevant;
- providing scientifically defensible light thresholds to incorporate in regional water quality guidelines; and,
- providing confidence in regulatory assessments of compliance.

Success measured by existing GBR/ports seagrass monitoring programs and industry/government adoption of thresholds.

Planned Outputs

Project CI's will use existing communications pathways with Government and Ports environmental managers through project team membership on industry dredging technical advisory consultative committees (TACC's) ongoing one-on-one discussion, and membership of key regulatory staff in the project team (GBRMPA-C. Honchin). Outputs will include:

- synthesis and summary report provided to all stakeholders;
- web-based access (TropWATER website) to the framework;
- direct communication with Government and industry through the teams established networks;
- links to GBR Marine Monitoring Program and Ports Monitoring examining water quality, indicators and thresholds; and,
- a peer-reviewed publication.

Delivery of Project

Project leader's track-record

The team brings together the key researchers investigating seagrass light thresholds and their application in management programs in the GBRWHA. Collectively the JCU researchers have more than 60 years of experience working on tropical seagrasses. Collier has an extensive publication portfolio in seagrass/light relations, thresholds and indicators. Chartrand & Rasheed have been working directly with industry developing light thresholds and management applications including the first implementation of a seagrass light thresholds approach for a dredge operation in Queensland. The team also includes direct links to management and Industry to ensure rapid application and uptake of the findings through CI Honchin (GBRMPA) and CI Fletcher (Ports North) and other research team members who sit on port industry advisory panels for Queensland (Rasheed; Chartrand).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payments
On signing of contract		\$14,878
1. Final report describing: <ol style="list-style-type: none"> a. A conceptual summary of factors affecting seagrass light thresholds, including a decision pathway for threshold selection. b. A synthesised and concise summary of known light requirements for maintaining seagrass condition and thresholds driving losses. c. Setting the direction for future research needs to improve ability to effectively use light thresholds for protection of seagrass and their associated ecosystem services. 2. Status of peer-reviewed publication 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	15 December 2015	\$14,877
Total NESP Funding		\$29,755

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Catherine Collier	Principal Investigator	JCU	catherine.collier@jcu.edu.au	0.15
Katie Chartrand	Co-Investigator	JCU	katie.chartrand@jcu.edu.au	0.20
Dr Michael Rasheed	Co-Investigator	JCU	michael.rasheed@jcu.edu.au	0.05
Ms Carol Honchin	Co-Investigator	GBRMPA	carol.honchin@gbrmpa.gov.au	0.05
Mr Adam Fletcher	Co-Investigator	Ports North	Adam.Fletcher@portsnorth.com.au	0.02

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Great Barrier Reef Marine Park Authority	Carol Honchin
Queensland Port Authorities	
Queensland Government - DAF	
Queensland Government - EHP	

Knowledge Brokering and communication

Project CI's will use existing communications pathways with Government and Ports environmental managers through project team membership on industry dredging technical advisory consultative committees (TACC's) ongoing one-on-one discussion, and membership of key regulatory staff in the project team (GBRMPA-C. Honchin). Outputs will include:

- synthesis and summary report provided to all stakeholders;
- web-based access (TropWATER website) to the framework;
- direct communication with Government and industry through the teams established networks;
- links to other NESP projects and GBR Marine Monitoring Program and Ports Monitoring examining water quality, indicators and thresholds; and,
- a peer-reviewed publication.

Expenditure Summary

	Project Costs					
	NESP	Applicants		Other stakeholders		TOTAL
	cash	cash	In-kind	cash	In-kind	
Salaries	25,255	-	5,077	-	6,800	\$37,132
Operating (incl. equipment, travel and communication)	4,500	-		-	-	\$4,500
Admin support (in-kind only)	-	-	39,431	-	-	\$39,431
TOTAL	\$29,755	-	\$44,508	-	\$6,800	\$81,063

Location of Research

No fieldwork in this project.

Research will impact upon Great Barrier Reef Marine Park catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, all projects will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

Data sets that are published in peer-reviewed or grey literature will be included in the synthesis.

Exclusions (out of scope)

Ongoing studies, which are not yet finalised, will not be included within the scope of this project.

Risks

Risks are negligible because:

- this is a compilation synthesis and review of available data;
- it is a small discrete synthesis project providing a direct and simple management product; and,
- project CI's are either the direct custodians of the required data or it is publically available.

Project Keywords

Light requirements
Seagrass
Dredging
Monitoring
Thresholds

Project 3.4 – Developing and refining biological indicators for seagrass condition assessments in an integrated monitoring program

Project length – 6 Months
 Project start date – 01/07/2015
 Project end date – 31/01/2016

Project Leader – Catherine Collier (FTE – 0.2)
 Lead Research Organisation – James Cook University

Total NESP funding - \$68,584
 Total Recipient and Other Contributions (co-contributions) - \$201,665

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$34,292	\$34,292	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$201,665	x	x	x	x	x	x

Project Summary

Refinement of biological indicators for condition assessment is an immediate priority as highlighted in a recent review of the GBR Marine Monitoring Program (MMP). Seagrass carbohydrate content is an early-warning indicator of water quality impacts. Samples collected quarterly since 2008 will be analysed and used to establish baselines and optimize protocols for applying carbohydrates as an indicator for future monitoring. Furthermore, calibration formulae to convert seagrass percent cover, the principal condition indicator, to biomass will be developed allowing integration across programs critical for the Reef-wide Integrated Monitoring and Reporting Program. This project provides excellent value for money because samples have been collected in-kind.

Problem Statements

Problem

Refinement of biological indicators for condition assessment is an immediate priority under the Reef 2050 Long-Term Sustainability Plan. The MMP, the flagship monitoring program of the GBR, recently underwent a comprehensive review and is transitioning into reporting through the integrated monitoring framework.

How Research Addresses Problem

This has highlighted that sensitive indicators are required to inform management actions in a timely manner, and has recommended 1. new potential indicators, and 2. refinement of current indicators.

1. Carbohydrates, or energy reserves, are a good indicator of resilience and provide an early warning of changes in seagrass condition. Opportunistic quarterly collections (eight sites, 2008-2015) will be analysed for carbohydrate content. These data will establish baselines and be used to optimize sampling protocols. Environmental data from the same sites will be used to assess key pressures influencing carbohydrate content.
2. In addition, we will calibrate the principal seagrass condition indicator, percentage cover, for reporting as biomass. This will enable integration with other monitoring programs (e.g. Ports), which is critical for the Reef-wide Integrated Monitoring and Reporting Program, and will enable seagrass historical baselines (1984-1987) to be migrated to biomass to inform GBR desired state. The calibration will be performed on the basis of species and habitat.

Alignment with NESP Research Priorities

- 3.3.1 Review and evaluate existing and new indicators and monitoring programs to support development of the LTSP monitoring programs
- 2.3.2 Develop environmental standards and spatial health indices to quantify ecosystem condition with the goal of maintaining healthy marine water quality and ecosystems

Research

Description of research

Objectives

- Assess variability and establish baselines of a new early warning indicator for seagrass resilience.
- Link environmental pressures to changes in seagrass state to inform management actions.
- Develop simple and rapid sampling protocols for implementing the indicator into routine monitoring.

Methods

- Process (sort, dry and grind) existing samples (historical collections included as in-kind) and analyse for carbohydrate content (sugars and non-structural carbohydrates).
- Calculate baselines (2008-2015) and assess indicator variability.
- Establish the relationship between carbohydrates and seagrass abundance (percent cover).
- Establish linkages between key environmental pressures (water quality and water temperature) and carbohydrates.
- Photograph and harvest (listed as in-kind by field personnel) seagrass quadrats (0.25m² x 100) across foundational species and morphologies at MMP habitats between June and October 2015, and process (sort into species, above and below-ground biomass), measure leaf lengths of strap leaf species, dry and weigh.
- Establish relationships between seagrass biomass and percent cover for key foundational species.
- Develop calibration formulae for conversion of percent cover to biomass for implementation in future Reef Plan reporting, as feasible.

Links with other projects and hubs

Links to 3.8, which seeks to develop an integrated monitoring program, for the GBR Long term Sustainability Plan, including the use of indicators.

Related research

This project has emerged from a GBRMPA review of the MMP and during the transition towards integrated reporting and has been jointly prepared by GBRMPA and JCU to meet one of the emerging research priorities

Expected Outcomes

Outcomes

- Validate an environmental stress indicator (carbohydrates) that can be operationalized and used as an “early-warning” indicator of stress.
- Refine monitoring protocols for carbohydrates, specifically for Reef Plan reporting if outcomes demonstrate suitability as an indicator.
- Provide calibration to merge data (biomass) across monitoring programs (including ports monitoring) for Reef-wide integrated reporting.
- Provide GBR- or NRM- specific baselines.

Specific management or policy outcomes

- Improved reporting of seagrass condition through GBR Report card.
- Assess impacts on seagrass (e.g. in ports) against baselines for current condition.
- Early detection of water quality impacts on seagrass condition before considerable changes to abundance (percent cover or biomass) occur.
- Improved timeliness of management response to impacts through scientifically rigorous resilience indicators.

Value

- This project will improve our ability to detect changes in the environment, specifically, changes in seagrass condition.
- Long-term and enduring success of this project in improving the environment will be determined after implementation of the indicators within a monitoring framework, which will be beyond the 6 month timeframe.

Planned Outputs

- MMP metrics are used to derive the Reef Plan Report Card, which reports on the condition of water quality, seagrass and corals.
- Findings will have immediate uptake by GBRMPA, to other MMP providers and the Reef Plan Secretariat and communicated to key stakeholders at a range of forums (LMACs, QPWS, Indigenous Groups, Port Authorities) through the MMP and Reef Plan communication plans.
- Documentation of findings will be included in the Reef Plan Marine Monitoring Program annual report for seagrass and available from the GBRMPA website and on the Seagrass-Watch website.

Delivery of Project

Project leader's track-record

The investigators are leaders in the field of coastal monitoring, seagrass physiology and water quality. Specifically:

- C. Collier is a seagrass eco-physiologist with an excellent track record in project management on research to assess seagrass environmental requirements and which derives tangible management outcomes including thresholds and indicators.
<https://research.jcu.edu.au/portfolio/catherine.collier/>

- L. McKenzie is a seagrass and coastal ecosystems ecologist; research has focused on status and condition of seagrass resources, understanding the role of disturbance, determining thresholds of concern and investigating resilience of seagrass ecosystems; manager of inshore seagrass component of MMP, <https://research.jcu.edu.au/portfolio/len.mckenzie/>
- K. Martin is the manager of the MMP and the Reef Plan marine program leader who's previous research focused on assessing the interactive effects of co-occurring environmental factors on the structure and function of marine organisms (no research profile available for GBRMPA staff).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$34,292
1. Submit final report: <ul style="list-style-type: none"> a. the relationship between carbohydrates and abundance (percent cover). b. linkages between key environmental pressures (e.g. benthic light and water temperature) and carbohydrates. c. the relationship between seagrass biomass and percent cover for key foundational species. 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 January 2016	\$34,292
Total NESP Funding		\$68,584

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Catherine Collier	Principal Investigator	JCU	catherine.collier@jcu.edu.au	0.2
Mr Len McKenzie	Co-Investigator	JCU	Len.mckenzie@jcu.edu.au	0.1
Dr Katherine Martin	Co-Investigator	GBRMPA	Katherine.Martin@gbrrmpa.gov.au	0.05
TBA	Lab technician	JCU		0.7
Mr Lucas Langlois	Field technician	JCU	Lucas.langlois@jcu.edu.au	0.2

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
GBRMPA Reef Resilience Group	Katherine Martin
QPWS	
LMACs	
Port Authorities	
Indigenous Groups	

Knowledge Brokering and communication

- This project has emerged from a GBRMPA review of the MMP and during the transition towards integrated reporting and has been jointly prepared by GBRMPA and JCU to meet one of the emerging research priorities

Future engagement will include:

- GBRMPA Reef Resilience group: will inform the reef recovery plans and setting of environmental thresholds
- LMACs and Reef Plan Secretariat through the MMP co-ordinator and project collaborator (K. Martin)
- QPWS field management.
- Information will be provided for Reef HQ, Port Authorities and Indigenous Groups through various forums as appropriate.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	52,584	-	96,905	-	8,016	\$157,505
Operating (incl. equipment, travel and communication)	16,000	-	78,756	-	-	\$94,756
Admin support (in-kind only)	-	-	17,988	-	-	\$17,988
TOTAL	\$68,584	-	\$193,649	-	\$8,016	\$270,249

Location of Research

No fieldwork in this project.

Research will impact upon Great Barrier Reef Marine Park.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

Sites within the Wet Tropics and Burdekin Dry Tropics
Rhizome carbohydrates from quarterly collections (2008-2015)

Identification of baselines as well as spatial and temporal variability

Exclusions (out of scope)

NRM's other than the BDT and WT
Identification of thresholds

Risks

- The risks from this project are very low.
- Carbohydrate contents may be found to be unsuitable as an indicator despite sensitivity to environmental conditions. This will have saved long-term investment in an unsuitable indicator.

Project Keywords

Seagrass health indicators
Early-warning
GBR Report Card
Monitoring protocols

Project 3.5 – Assessment of key dugong and turtle seagrass resources in the northern Torres Strait

Project length – 9 Months

Project start date – 01/07/2015

Project end date – 31/03/2016

Project Leader – Michael Rasheed (FTE – 0.1)

Lead Research Organisation – James Cook University

Total NESP funding - \$99,696

Total Recipient and Other Contributions (co-contributions) - \$149,768

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$49,848	\$49,848	x	x	x	x	x
<i>Cash co-con</i>	\$80,010	x	x	x	x	x	x
<i>In-kind co-con</i>	\$69,758	x	x	x	x	x	x

Project Summary

This project fills a critical information gap for dugong and turtle habitat management in the Torres Strait. It describes seagrasses in a recently identified data deficient region in northern Torres Strait that contains large dugong and turtle populations and is the subject of a proposed extension of the existing Dugong Sanctuary. The baseline assessments will form the foundation for ongoing monitoring, and provide essential information to the TSRA, Australian and Queensland governments for dugong and turtle management plans, complimenting dugong and turtle research studies in the region and building skills and capacity of Traditional Owners and Rangers.

Problem Statements

Problem

Seagrasses provide critical habitat and food for turtle, and dugong in the Torres Strait they support the world’s largest dugong population. However, seagrasses remain undescribed or inadequately surveyed in a large area of the Torres Strait containing some of the highest population densities for dugong and turtle. This region between Deliverance and Boigu Island and extending to the PNG coastline and south to Orman Reefs (see Map) is the subject of considerable focus for dugong and turtle management with planned investigations of an extension of the Dugong Sanctuary and an increased focus of dugong and turtle management and research. Seagrass information is critical for successful planning and management in this region.

How Research Addresses Problem

This project provides baseline seagrass mapping to develop informed management plans and assessments of spatial closures, as well as a key reference point for monitoring the status of seagrass. The project applies mapping and assessment methods implemented by the team in the Torres Strait and Queensland to produce a resource atlas and GIS. The team includes our established seagrass research partners in the Torres Strait LSMU with ranger participation in the work and also direct links with dugong and turtle researchers and programs to ensure relevance and end-user uptake.

Alignment with NESP Research Priorities

- 3.2.1 Improve understanding of dugong and marine turtle habitats including migratory corridors.
- 3.3.2 Design monitoring to assess the current ecological status and trends in the condition of Torres Strait section of the GBR marine and coastal environments, and current and emerging threats.
- 3.2.3 Evaluate the effectiveness of current and potential future zoning and/or other management initiatives on the resilience of dugong and marine turtle populations and these habitats.

Research

Description of research

- Provide key information on seagrass habitats in the northern Torres Strait to inform dugong and turtle management programs.
- Fill a critical information gap on seagrass resources of the Torres Strait identified as part of recent TSRA review and synthesis of seagrass (Carter 2014) and in NERP dugong assessments (Sobtzick et al 2014).
- Produce a Geographic Information System (GIS) for the survey region and incorporate spatial data into e-atlas and existing TSRA spatial seagrass databases.
- Train TSRA LSMU rangers on seagrass assessment techniques and develop longer term monitoring strategies for addition to Ranger monitoring activities.
- Provide the seagrass habitat basis for assessment of the potential extension of the Torres Strait Dugong Sanctuary
- Compare findings with previous research to evaluate the importance of the region in terms of seagrass abundance, biodiversity, and value as a food source for turtle and dugong.
- Data and information products will include:
 - Report and atlas detailing seagrass site and meadow information, distribution, density, species composition and diversity.
 - GIS layers and plain English descriptive metadata
 - A summary brochure as a basis for web information
 - Publicly available spatial data for community and NRM groups for management application including community based turtle and dugong management plans.

Method

- Field research includes one subtidal survey (10 days; October 2015) and a helicopter survey (6 days; January 2016) in the northern Torres Strait region (see map).
- Sampling methods are those developed by the TropWATER team for seagrass habitat surveys used extensively in Torres Strait and Queensland (Carter et al. 2014):
 1. Subtidal survey - a combination of underwater video transects, deep water grabs and free diving
 2. Intertidal survey - helicopter survey conducted during spring low tides for the intertidal surveys.
- Survey data will be entered into the groups Torres Strait GIS using ArcGIS software. Three layers will be produced to describe intertidal and subtidal seagrass meadows:
 1. Site information including- seagrass species, intertidal/subtidal, percent cover, above-ground biomass, Shannon-Weaver Diversity Index, sediment type, depth
 2. Seagrass meadows - Polygon (area) layers describing seagrass meadows - intertidal/subtidal and meadow community type, cover and biomass.

3. Seagrass biomass and diversity - An inverse distance weighted interpolation will be applied to site data to describe spatial variation in seagrass biomass for each species, species diversity, cover.
- Use results to develop monitoring strategies and plans for ongoing ranger assessments, adding to the established Dugong Sanctuary seagrass program.

Links with other projects and hubs

This project links to 3.2, examining abundances of dugong and green turtles in Torres Strait.

Related research

- TSRA Board supported recommendation to investigate expansion of existing dugong sanctuary northwards into the PNG Jurisdiction of the Torres Strait Protected Zone (see map).
- Addressing key dugong conservation strategies for the Torres Strait recommended in previous NESP reporting (2014).
- Negotiations with PNG government through Protected Zone Joint Authority (PZJA) on extension of spatial closures and development of co-management arrangements.
- Community based Dugong and Turtle Management Plans for the Badu, Mabuiag and Malu Kiai Turtle And Dugong Management Areas
- Warul Kawa Island (Deliverance Island) Indigenous Protected Area (IPA) planning.

Expected Outcomes

Outcomes

- Seagrass GIS layers filling critical information gaps & essential information for spatial planning for dugong and turtle management
- Report and atlas describing seagrass, implications for turtle and dugong management and information for developing longer term strategies and identifying research needs.
- Strengthening Indigenous Ranger skill base for marine habitat assessments

Specific management or policy outcomes

- Review dugong spatial management arrangements in the Torres Strait based on key seagrass information.
- Inform negotiations with PNG on extensions to Dugong Sanctuary and joint management arrangements
- Implement longer term seagrass monitoring to inform dugong and turtle management arrangements linked to seagrass change

Value

This project will result in better management arrangements for dugong and turtle in the Torres Strait by understanding the state of key seagrass resources through:

- Setting a reference for assessing seagrass changes
- Prioritising protection for high value seagrass foraging areas
- Developing a spatial seagrass knowledge base to inform management decisions
- Link dugong and turtle population studies to seagrass condition

Planned Outputs

- Targeted end-users: TSRA, LSMU rangers, Queensland & Commonwealth Government, dugong and turtle researchers.
- Study developed in collaboration with TSRA LSMU and focuses on identified priority area
- Pre-field work consultation with Traditional Owners to access island communities and sea country.
- TSRA ranger participation in subtidal field surveys.
- Spatial information and report freely and publicly available to inform spatial management of marine habitats in Torres Strait for NRM groups.
- Direct presentation of results will be made to island communities and the TSRA
- TSRA senior officers will ensure incorporation into management plans and DFAT papers for Torres Strait treaty meetings

Delivery of Project

Project leader's track-record

The project team has extensive experience in successful delivery of Torres Strait research (Rasheed, Marsh, Lui, Carter) and have been the principal provider of seagrass mapping products for Queensland for more than 30 years. The team has an outstanding track record of engaging with the Torres Strait community in successful projects on seagrass and dugong issues including major research, mapping and monitoring projects conducted as part of the NERP, Torres Strait CRC, directly for the TSRA and for the Queensland and Commonwealth Governments. The team has active research collaborations with the TSRA LSMU and maintains extensive networks and strong relationships with the Torres Strait communities as well as the operational experience and contacts to ensure successful delivery. Rapid uptake and applicability of the research are ensured through the participation of key management (Lui) and dugong and turtle researchers (Marsh) as part of the team.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$49,848
1. Final report and GIS describing: a. Seagrass distribution, implications for turtle and dugong management and information for developing longer term strategies and identifying research needs b. Capacity building of TSRA rangers 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 March 2016	\$49,848
Total NESP Funding		\$99,696

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Michael Rasheed	Principal Investigator	JCU	michael.rasheed@jcu.edu.au	0.1
Ms. Alex Carter	Co-Investigator	JCU	alexandra.carter@jcu.edu.au	0.3
Mr. Stan Lui	TSRA project manager	TSRA	stan.lui@tsra.gov.au	0.05
Prof. Helene Marsh	Co-Investigator	JCU	helene.marsh@jcu.edu.au	0.02
Ms. Skye McKenna	Research Officer	JCU	skye.mckenna@jcu.edu.au	0.1
Ms. Jaclyn Davies	Research Officer	JCU	jaclyn.davies@jcu.edu.au	0.1
Field Research Workers x 3	Research Worker	JCU	Various technical/ field staff	0.3

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Migratory species section)	Fiona Bartlett
Department of the Environment (International section)	Damien Hall
Key Stakeholders (organisation/programme)	
Torres Strait Regional Authority	Shaun Barclay Stan Lui
GBRMPA	Andrew Simmonds

Knowledge Brokering and communication

- Summary flyer information/map of key findings distributed to Torres Strait island communities (TSRA, rangers, NRM groups, island communities).
- Spatial data available via e-atlas and TropWATER (TSRA, NRM groups, Government).
- Technical report distributed in hard copy to ranger groups, and electronically available through RRRC, TSRA and TropWATER websites (TSRA, rangers, NRM groups).
- Results included in papers of the DFAT Torres Strait Treaty meetings
- Press release coinciding with the report's release (TSRA, rangers, NRM groups, island communities).
- Manuscript submitted to a scientific journal (NRM groups, scientific community).
- Direct indigenous engagement in conception design and conduct of the research.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	51,546	-	30,758	33,330	14 000	129,634
Operating (incl. equipment, travel and communication)	48,150	-	5,000	46,680	10,000	109,830
Admin support (in-kind only)	-	-	5,000	-	5,000	10,000
TOTAL	\$99,696	-	\$40,758	\$80,010	\$29,000	\$249,464

Location of Research

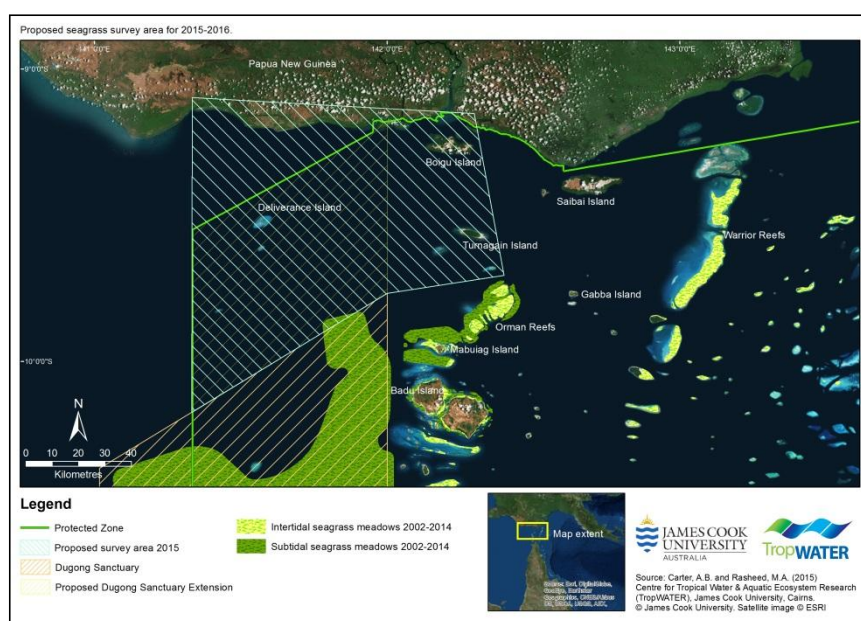
Torres Strait

Indigenous Consultation and Engagement

This project can only be achieved with the involvement of the Torres Strait Regional Authority, Torres Strait Prescribed Body Corporates, Traditional Owners and community members. The research team is well known for their research and community engagement in the Torres Strait.

Inclusions (in scope)

This project will survey in detail the seagrass distributions within the area outlined in the included map. It includes all intertidal and sub-tidal seagrasses within the zone highlighted. The project will include the full GIS as well as a report/atlas and datasets for inclusion in the eAtlas.



Exclusions (out of scope)

Areas outside of the highlighted area of the map will not be included or areas where vessels or aircraft are prohibited from entering. Seagrass information from outside this area in the Torres Strait are part of previous reports and data is already available.

Risks

Risks are low and managed.

- The expertise is in-house.
- There are no blocks expected to obtaining permits for the area.
- Team has extensive experience conducting this fieldwork in Torres Strait and has the operational contacts – Pre planning meetings with suitable helicopter and vessel operators have already occurred.
- There are two alternative times for intertidal sampling should the January survey be postponed due to weather, and an alternative time when subtidal sampling can be conducted should the October trip be postponed due weather - still allowing completion by 31st March.

Project Keywords

Seagrass

Dugong

Spatial management

Torres Strait

Turtle

Project 3.6 – Establishing a research framework for future NESP investment into better understanding of the presence of Box-Jellyfishes (Irukandji) and risks in the Great Barrier Reef

Project length – 8 Months

Project start date – 01/07/2015

Project end date – 28/02/2016

Project Leader – Mike Kingsford (FTE – 0.1)

Lead Research Organisation – James Cook University

Total NESP funding - \$30,000

Total Recipient and Other Contributions (co-contributions) - \$57,705

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$15,000	\$15,000	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$57,705	x	x	x	x	x	x

Project Summary

This project intends to conduct a workshop with key researchers and stakeholders to establish the future research framework for NESP investment into better understanding of box-jellyfishes presence and risk in the Great Barrier Reef. This will include defining the scope of work required to: identify how species of Irukandji and stingers respond to changing water quality conditions, predictions of box-jellyfishes presence based on environmental conditions, determine ecological impacts, innovative management options. We will engage with stakeholders to discuss scientific information already available, research gaps to be filled and develop a framework to guide future NESP research to meet end-user needs.

Problem Statements

Problem

The project will conduct a facilitated workshop with key researchers and stakeholders to establish the research framework for future NESP investment in box box-jellyfishes in the GBR. Currently a number of key stakeholders lack a sufficient level of confidence in the information utilized for the safety of GBR users. This results in adversarial debate regarding the extent of the issue and a reduced focus on innovative solutions.

How Research Addresses Problem

Prior to the investment of significant Australian Government funding into further research, it is essential that the stakeholders and researchers set an agreed research agenda that delivers strategic information needed to allow the debate to progress the determination of: risks of envenomation by box jellyfishes in different water conditions and ‘real life’ solutions to stakeholders to mitigate against the risks. Without an agreed research framework, well intended research work will occur in isolation and struggle to achieve end-user acceptance.

Alignment with NESP Research Priorities

- 3.3.3 Understanding the role of water quality and associated factors in determining abundance of box-jellyfish, identify key issues for industries, the environment and communities, and develop strategies for control and mitigation.

Research

Description of research

The objective of these workshops is to establish the research framework to address key information gaps in the understanding of (but not limited to):

- stakeholders key concerns
- box-jelly and water quality spatial patterns
- box-jelly envenomation hotspots
- current and future distributions of box-jelly species
- empowering stakeholder engagement in reducing the risk of envenomation

Method:

The project will design and conduct a facilitated workshop with key stakeholders and researchers to:

- construct agreed objectives
- identify key knowledge gaps and information needs for both stakeholders and researchers
- identify the timeframe for delivery of information
- identify the mechanisms to enable stakeholder feedback into the research agenda and maintain stakeholder engagement
- prepare a research framework that will guide the future NESP investment into box-jelly management.

Links with other projects and hubs

This project has similarities with other projects setting research frameworks – 1.1 (CoTS) and 1.9 (dredge management)

Related research

“What are the population dynamics, distribution and behavior of Irukandji and box jellyfish?” is identified as a ‘key science question’ (BscQ33) in GBRMPA’s Science Strategy and Information Needs 2014-2019.

Expected Outcomes

Outcomes

The project will provide a coordinated research framework that will guide the timing and extent of future research investment into box-jellyfish management in the GBR.

Specific management or policy outcomes

Strategic investment of NESP research funds in box-jellyfish management to progress the current debate towards a solution focus within the commitment Australian Governments for to address water quality decline in the GBR.

Value

The project will improve the environment through strategically focusing the NESP investment.

Planned Outputs

A coordinated research framework that will guide the timing and extent of future research investment into box-jellyfish management in the GBR.

Stakeholders to be involved include the scientific community, Association of Marine Park Tour Operator members, Queensland Tourism Industry Council, Surf Life Saving Queensland, Traditional Owners, Queensland Health, Local Government representatives.

Delivery of Project

Project leader's track-record

James Cook University has the capability, experience and network to lead the facilitated workshop to establish the research agenda. Pitt, Kingsford & Llewellyn comprise a strong, multidisciplinary team that unites expertise across three of the six research organisations (Griffith University, JCU, AIMS) involved in the TWQ Hub. Pitt & Kingsford are experts in the ecology of jellyfish, have co-authored 8 publications and have been joint investigators on an ARC Linkage project on interactions between jellyfish and nutrients. Pitt has undertaken multiple experiments on polyps of jellyfish, including Irukandji (Pitt 2000, Klein, Pitt et al 2014, unpubl.) and is maintaining a lab population of the animals. Kingsford has expertise in cubozoan jellyfish, including chemical analyses of tissues. Llewellyn is a marine biologist with expertise in analytical biochemistry and will provide specific support for chemical analyses of pesticides. Llewellyn & Kingsford are currently collaborating to develop a real-time camera-based monitoring system for cubozoan jellyfish.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payments
On signing of contract		\$15,000
1. Final report detailing: a. A research framework that will guide the future NESP investment into box-jelly management. b. The workshop will discuss existing datasets and, if relevant, the possible submission of this material to eAtlas.	15 December 2015	\$15,000
Total NESP Funding		\$30,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Prof. Michael Kingsford	Principal Investigator	JCU	Michael.kingsford@jcu.edu.au	0.1
Dr Kylie Pitt	Co-Investigator	Griffith	K.Pitt@griffith.edu.au	0.1
Dr Lyndon Llewellyn	Co-Investigator	AIMS	L.Llewellyn@aims.gov.au	0.1
Mark O'Callaghan	Project support	JCU	mark.ocallaghan@jcu.edu.au	0.1

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
Professor Jamie Seymour	JCU Jellyfish Researcher
Professor Anthony Richardson	CSIRO Jellyfish Researcher

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
AMPTO	Col McKenzie
Queensland Surf Lifesaving Association	Russell Blanchard
Queensland Tourism Industry Council	Daniel Gschwind
Traditional Owners with TUMRA and sea country	TBC
GBRMPA	Chris Jones

Knowledge Brokering and communication

The intent of the project is to engage key stakeholder at the start of the research process and to build confidence and understanding in the research outputs. Close and adaptive engagement between researchers and stakeholders in establishing the research agenda will improve and future uptake of information.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	-	-	22,117	-	28,088	50,205
Operating (incl. equipment, travel and communication)	30,000	-	-	-	-	30,000
Admin support (in-kind only)	-	-	7,500	-	-	7,500
TOTAL	\$30,000	-	\$29,617	-	\$28,088	\$87,705

Location of Research

Workshop to be held in Cairns, Townsville or Whitsundays.

Indigenous Consultation and Engagement

Indigenous communities have a relevant and active role to play in setting the research agenda and will be assisted to engage in the workshop process.

Inclusions (in scope)

The project is to review information that is relevant to the responses box jellyfishes variation in water quality. Further, to determine potential impacts and, most importantly involve stakeholders in the review. A key element of our work would be to determine what stakeholders need to empower them to make decisions. Stakeholders often have to reduce risk to the public while maintaining their businesses. We anticipate that some of the ideas we will offer at the workshop will be considered to

be innovative management options. The workshop would result in a report and where additional data can be obtained it would be submitted to meet NESP Data Management Guidelines.

Exclusions (out of scope)

The project will not involve field work or manipulative experiments in the laboratory.

Risks

Inability to bring all stakeholders together (low) – this can be ameliorated with telephone conferences, submitted information from operators and other stakeholders.

Project Keywords

Box jellyfishes
Irukandji
Water quality
Population dynamics
Workshop

Project 3.7 – Monitoring the effects of zoning on coral reefs and their associated fish communities in the GBR Marine Park

Project length – 6 Months
 Project start date – 01/07/2015
 Project end date – 30/12/2015

Project Leader – Hugh Sweatman (FTE – 0.02)
 Lead Research Organisation – AIMS

Total NESP funding - \$100,000
 Total Recipient and Other Contributions (co-contributions) - \$225,450

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$100,000	x	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$225,450	x	x	x	x	x	x

Project Summary

This project describes the activities of the AIMS long-term program to monitor the effects of zoning on coral reef communities in the period July-October 2015.

- In that period there will be one survey trip (out of four made annually) to the southern GBR (Capricorn-Bunker and Swain Reefs) using the RV Cape Ferguson
- As well as forming part of the long-term program, these reefs are interesting as they are recovering from the effects of severe storms, notably TC Hamish in 2009.
- Initial findings will be reported to stakeholder via a “Survey update”, with more comprehensive reporting when surveys of reefs in all regions are complete. (June 2016)

Problem Statements

Problem

Spatial management of human activities through zoning is the principal form of management of the GBRMP. This project continues a program that monitors the effects of zoning, particularly closure to fishing, on coral reef communities of the GBR Marine Park. The program was established following the rezoning of the GBRMP in 2004. A recent survey of fish assemblages in 87 MPAs around the world considered that effects of past fishing were still evident after more than 10 years.

How Research Addresses Problem

Continuing this program will give a quantitative assessment of the effectiveness of this fundamental form of management as fish populations rebuild, will show the effects of acute natural disturbances (cyclones, bleaching) and, if the current wave of *Acanthaster* outbreaks follows the previous pattern, will provide a robust assessment of any in the frequency of outbreaks on open and no-take reefs. This proposal covers the first of 5 fieldtrips (made every other year) which will survey selected reef pairs Capricorn-Bunker and Swain reefs.

Alignment with NESP Research Priorities

- 3.3.1 Review and evaluate existing and new indicators and monitoring programs to support development of the LTSP monitoring program.

Research

Description of research

This project will:

- Monitor any differences in status and trends in coral reef communities on reefs that were closed to fishing in 2004 and reefs that remain open to fishing
- Provide updates on trends in selected fish species targeted by fishers on fished and no-take reefs.
- Produce scientific publications on the effectiveness of a large network of marine protected areas.
- Produce scientific publications on the dynamics of coral and fish communities in relation to management and environmental drivers.

Outcomes will be:

- A rigorous and quantitative understanding of the effects of zoning to exclude fishing on coral reef communities on mid-shelf and offshore reefs of the GBR

Links with other projects and hubs

Project 2.1 is also examining the impact of zoning as part of its work program.

Related research

Adaptive management is at the core of the Reef 2050 Long-term Sustainability Plan. This program provides feedback on the effectiveness of the primary management tool for the GBRMP and will be a central part of the developing Reef Integrated Monitoring and Reporting Network.

Expected Outcomes

Outcomes

This project will:

- Monitor any differences in status and trends in coral reef communities on reefs that were closed to fishing in 2004 and reefs that remain open to fishing
- Provide updates on trends in selected fish species targeted by fishers on fished and no-take reefs.
- Produce scientific publications on the effectiveness of a large network of marine protected areas.
- Produce scientific publications on the dynamics of coral and fish communities in relation to management and environmental drivers.

Outcomes will be:

- A rigorous and quantitative understanding of the effects of zoning to exclude fishing on coral reef communities on mid-shelf and offshore reefs of the GBR

Method:

Survey Design

- Following the rezoning of the GBRMP in 2004, pairs of similar midshelf and offshore reefs were identified. Both reefs in each pair were open to fishing prior to 2004 but one reef was included in a “green zone” under the amalgamated zoning plan.
- Reef pairs are grouped in 5 regions between Cairns and the Capricorn-Bunker region
- Reefs are surveyed in alternate years.

Survey methods

- Standard AIMS [LTMP methods](#) are used to survey reef fishes and benthic organisms in a standard habitat: the NE faces of reefs.

Specific management or policy outcomes

This research monitors and reports on the effectiveness of management actions, which may then be modified following the adaptive management framework

Value

This research monitors and reports on the effectiveness of the principal measure for management of multiple use in the GBRMP. It has no direct effect on the environment.

Planned Outputs

- This project is a continuation of research that was partially funded under NERP, so there has been an extended series of meetings with staff from several sections of GBRMPA concerning this study of the effects of zoning. These meetings will continue on at least a quarterly basis.
- In addition, preliminary results from each survey trip will be reported to GBRMPA and other stakeholders through Survey Updates (circulated by email and available on the AIMS webpage)
- Presentations to GBRMPA's LMACs

Delivery of Project

Project leader's track-record

- Dr Hugh Sweatman leads the AIMS Long-term Monitoring Program and has extensive experience in coral reef ecology
- The six members of AIMS' Long-term Monitoring Program team have been engaged full time on monitoring reefs since the early 1990s and with monitoring the effects of zoning under this program since 2006

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: <ul style="list-style-type: none"> a. Results of survey trips in the Capricorn-Bunker and Swain reefs 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	11 December 2015	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr Hugh Sweatman	Principal Investigator	AIMS	h.sweatman@aims.gov.au	0.02
4 x members of the AIMS Monitoring team (TBA)	Co-investigators	AIMS		4 x 0.09 = 0.36

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DoTE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
GBRMPA	Fergus Molloy Darren Cameron

Knowledge Brokering and communication

- Preliminary results from each field trip will be reported to GBRMPA and other stakeholders through Survey Updates (circulated by email and available on the AIMS webpage)
- Seminar at the GBRMPA (and possibly DoTE) after the completion of each survey season
- This project has provided several articles for the e-Atlas, more will be added as appropriate
- Presentations to GBRMPA's LMAs

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	\$77,824	-	\$23,850	-	-	\$101,674
Operating (incl. equipment, travel and communication)	\$22,176	-	\$201,600*	-	-	\$223,776
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$100,000	-	\$225,450	-	-	\$325,450

*use of the AIMS research vessel RV Cape Ferguson (or equivalent)

Location of Research

Southern GBR

Indigenous Consultation and Engagement

The Capricorn-Bunker reefs lie within the Port Curtis Coast TUMRA region, the project will endeavour to engage with the Port Curtis Coral Coast Traditional Owner groups, which include Gooreng Gooreng, Gurang, Bailai and Tarebilang Bunda.

Inclusions (in scope)

This project involves the first bi-annual surveys of a few reefs that form part of a much larger project, reporting will therefore be preliminary and inferences will be restricted.

Exclusions (out of scope)

All other regions of the GBRMPA will be excluded from monitoring within this project.

Risks

This proposal involves fieldwork in a remote area of the GBR Marine Park, so bad weather or, less probably, equipment failure or sickness can interfere with surveys.

Project Keywords

No-take zones
MPA networks
Coral trout
Biodiversity
Disturbance

Project 3.8 – Towards an integrated monitoring program: identifying indicators and existing monitoring programs to cost-effectively evaluate the Long Term Sustainability Plan

Project length – 6 Months

Project start date – 01/07/2015

Project end date – 31/12/2015

Project Leader – Prue Addison (FTE – 0.35)

Lead Research Organisation – AIMS

Total NESP funding - \$100,000

Total Recipient and Other Contributions (co-contributions) - \$110,000

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$100,000	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$110,000	x	x	x	x	x	x

Project Summary

This project addresses a series of critical initial steps required to develop a cost-effective integrated monitoring program. First, environmental, social and economic elements and indicators will be identified that could be monitored to enable an integrated evaluation of the Long Term Sustainability Plan (LTSP) targets. Second, existing monitoring programs will be evaluated against the newly developed LTSP targets, to ensure that the relevant aspects of these monitoring programs are considered for inclusion in an integrated monitoring program. Finally, the statistical performance of the AIMS Long Term and Marine Monitoring Programs will be evaluated to illustrate how these programs could cost-effectively contribute to an integrated monitoring program.

Problem Statements

Problem

As an initiative of the Reef 2050 Long Term Sustainability Plan (LTSP), an integrated monitoring program (IMP) is being developed for the Great Barrier Reef (GBR). This project addresses a series of critical initial steps required to develop a cost-effective IMP: (1) to identify a suite of environmental, social and economic elements and indicators that could be monitored to enable an evaluation of the LTSP targets; (2) to evaluate existing environmental, social and economic monitoring programs against the newly developed LTSP targets, to ensure that the relevant aspects of these monitoring program are considered for inclusion in an IMP; and, (3) to evaluate how the AIMS Long Term and Marine Monitoring Programs can cost-effectively contribute to the IMP.

How Research Addresses Problem

The components of this proposed project have been identified as critical aims of the Reef Integrated Monitoring and Reporting Network (RIMRN) Program Design working group, and are listed as monitoring and reporting actions of the LTSP that must be undertaken over the next five years. This project will be led by AIMS, with ongoing consultation with the RIMRN working groups to ensure the research undertaken best informs the development of a cost-effective IMP to support adaptive management under the LTSP.

Alignment with NESP Research Priorities

- 3.3.1 Review and evaluate existing and new indicators and monitoring programs to support development of the LTSP monitoring program.
- 2.3.2 Develop environmental standards and spatial health indices to quantify ecosystem condition with the goal of maintaining healthy marine water quality and ecosystems.

Research

Description of research

(1) Indicator development:

Objective: To identify the environmental, social and economic elements (e.g. ecosystem components) and indicators (e.g. specific measures of ecosystem components) that could be monitored to evaluate the LTSP targets.

Outcome: A proposed suite of environmental, social and economic elements and indicators to be considered for the integrated monitoring program (IMP).

Management implications: This work directly addresses the LTSP monitoring and reporting actions on indicator development.

(2) Assessment of existing monitoring programs:

Objective: To assess existing monitoring programs to identify the elements and indicators that are currently monitored that can address the LTSP targets.

Outcome: A summary of existing monitoring programs and indicators that could address the LTSP.

Management implications: This work acknowledges the vast amount of monitoring conducted, and will ensure that the relevant aspects of these programs are considered for inclusion in an IMP.

(3) Evaluate how the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP) can cost-effectively contribute to the integrated monitoring program:

Objective: To assess the statistical performance (e.g. power analysis) of the LTMP and MMP in addressing the LTSP targets.

Outcome: A report outlining the statistical performance of the LTMP and MMP in addressing the LTSP targets, using a subset of indicators that may be included in an IMP.

Management implications: This work will serve as a useful case study to illustrate how existing monitoring programs can be evaluated in relation to their statistical performance to inform a new IMP.

Methods:

(1) Indicator development:

- Facilitate an initial stakeholder workshop with members of the RIMRN working groups (e.g. end-users: DotE, GBRMPA, and Qld EHP; see full list of stakeholders on p 4) to ensure that the research conducted is consistent with existing investment and frameworks of the LTSP and end-users.³
- A content analysis of the LTSP targets will be undertaken to identify the elements and indicators that could be monitored to address the LTSP targets.
- This work will build on the approach to selecting indicators for an IMP recommended by Walshe et al. (2014)⁴, and will be done in consultation with the RIMRN Program Design

³ Note that this workshop will be aligned with one of the initial RIMRN program design working group meetings to minimize costs to participants. Workshop costs (e.g. venue and catering) will be covered by funding from the GBRMPA, AIMS and/or the RIMRN program design working group.

⁴ Walshe, T., A. MacNeil, A. Archer, H. Sweatman, E. Lawrey, L. Bay, P. Addison, and K. Anthony. 2014. Integrated monitoring, modelling and management of the Great Barrier Reef World Heritage Area – demonstration case for the Mackay region. Final Report to the Department of the Environment. Australian Institute of Marine Science, Townsville.

working group (see 'Stakeholder Engagement' for stakeholder organisations) as this directly addresses one of their core aims.

(2) Assessment of existing monitoring programs:

- We will conduct a desktop assessment of existing monitoring programs to identify the elements and indicators that are currently monitored that can directly address the LTSP targets.
- This work will build on the assessment conducted by Hedge et al. (2013)⁵, and will include an evaluation of environmental, social and economic monitoring programs against the newly developed LTSP targets.
- Stakeholder consultation with lead scientists will ensure up-to-date information is collated on the monitoring programs.

(3) Evaluate how the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP) can cost-effectively contribute to the integrated monitoring program:

- We will investigate the statistical performance (e.g. power analysis) of the LTMP and MMP in addressing the LTSP targets.
- This desktop assessment will focus on a subset of indicators and evaluate the programs' ability to detect different temporal trends or shifts away from current condition, which may be included as quantitative targets under the LTSP.

Links with other projects and hubs

This project will relate to other projects developing indicators (e.g. 3.3 and 3.4 for seagrass) and those developing long-term monitoring programs (e.g. 1.8 for water quality and 3.7 for fish).

Related research

This project will build upon extensive work on indicator development and long-term monitoring program development and assessment.

Expected Outcomes

Outcomes

- (1) Indicator development: A proposed suite of environmental, social and economic elements and indicators to be considered by the RIMRN Program Design working group for inclusion in an integrated monitoring program. These will build on a Driver/Pressure/State/Impact/Response framework¹ to link environmental causal factors to condition and trend, and to assess which indicators represent early warnings and which can support diagnostics of ecosystem change.
- (2) Assessment of existing monitoring programs: A summary of existing monitoring programs and indicators (environmental, social and economic) to be considered by the RIMRN Program Design working group for inclusion in an IMP.
- (3) Evaluate how the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP) can cost-effectively contribute to the integrated monitoring program: A case study to illustrate how existing monitoring programs can be evaluated in relation to their statistical performance to inform a new IMP for consideration by the RIMRN Program Design working group.

Specific management or policy outcomes

This research will contribute to the monitoring and reporting actions of the Long Term Sustainability Plan. For example, to establish condition and resilience indicators of ecosystem health (EHA29),

⁵ Hedge, P., et al. (2013). An integrated monitoring framework for the Great Barrier Reef World Heritage Area, NERP Marine Biodiversity Hub, NERP Tropical Ecosystems Hub, NERP Environmental Decisions Hub, the Great Barrier Reef Marine Park Authority, and the Australian Institute of Marine Science.

and to identify key biodiversity indicator species (BA17). Other relevant monitoring and reporting actions that will be addressed include: EH30, HA11, WQA23, and EBA17.

Value

This research is a critical step to enable the evaluation of the LTSP targets and an IMP. Most importantly the LTSP and integrated monitoring program will enable the adaptive management of the GBRWHA to ensure the ongoing protection of this world heritage area.

Planned Outputs

All outputs from this project will be developed in consultation (following an initial workshop) with and communicated to the RIMRN Program Design working group, which is likely to include the following stakeholder organisations: AIMS, CSIRO, JCU, University of Queensland, Great Barrier Reef Marine Park Authority, Department of the Environment, Qld Department of Agriculture, Fisheries & Forestry, Qld Department of Environment and Heritage Protection, Reef & Rainforest Research Centre and the Great Barrier Reef Foundation.

Key stakeholders and colleagues that will be consulted and involved in this research project to varying degrees include: Nadine Marshall (JCU/CSIRO), Natalie Stoeckl (JCU), Margaret Gooch (GBRMPA), Fergus Molloy (GBRMPA), Amanda Parr (Parks Australia), Dr. David Souter (AIMS and RIMRN Program Design working group), Ken Anthony (AIMS) and Britta Schaffelke (AIMS).

Delivery of Project

Project leader's track-record

Dr Prue Addison: Postdoctoral scientists at AIMS, with expertise in improving the use of marine biodiversity monitoring data in management effectiveness evaluation of protected areas.

Dr Terry Walshe: Decision Scientist at AIMS, with extensive expertise in the application of decision science to protected area management.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: <ol style="list-style-type: none"> Environmental, social and economic elements and indicators to be considered by the RIMRN Program Design working group for inclusion in an integrated monitoring program. Assessment of existing monitoring programs How the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP) can cost-effectively contribute to the new integrated monitoring program 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	15 December 2015	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Prue Addison	Principal Investigator	AIMS	P.Addison@aims.gov.au	0.35
Dr. Terry Walshe	Co-Investigator	AIMS	T.Walshe@aims.gov.au	0.11
Dr. Hugh Sweatman	Co-Investigator	AIMS	H.Sweatman@aims.gov.au	0.06
Dr. Aaron MacNeil	Co-Investigator	AIMS	A.MacNeil@aims.gov.au	0.04
Mr. Angus Thompson	Co-Investigator	AIMS	A.Thompson@aims.gov.au	0.04
Dr Murray Logan	Co-Investigator	AIMS	M.Logan@aims.gov.au	0.04
Manager of Social and Economic Science (name TBC – replacement for Margaret Gooch)	Co-Investigator	GBRMPA	TBC	0.10

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
Great Barrier Reef Foundation	In-kind
CSIRO	In-kind
James Cook University	In-kind
University of Queensland	In-kind
Great Barrier Reef Marine Park Authority	In-kind
Qld Department of Agriculture, Fisheries & Forestry	In-kind
Qld Department of Environment and Heritage Protection	In-kind
Department of the Environment	In-kind

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs/ Reef Trust)	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Parks Australia (Commonwealth Marine Reserves)	Amanda Parr
Great Barrier Reef Marine Park Authority	Fergus Molloy
Great Barrier Reef Foundation	
CSIRO	
James Cook University	
University of Queensland	
Qld Department of Agriculture, Fisheries & Forestry	
Qld Department of Environment and Heritage Protection	

Knowledge Brokering and communication

Planned outputs include:

- (1) **Indicator development:** A report proposing a suite of environmental, social and economic elements and indicators of the GBRWHA that could be monitored to address the LTSP targets.
- (2) **Assessment of existing monitoring programs:** A report summarising the elements and indicators that are currently monitored in existing monitoring programs, which could contribute to an IMP.
- (3) **Evaluate how the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP) can cost-effectively contribute to the integrated monitoring program:** A report outlining the statistical performance of the LTMP and MMP for selected indicators, to illustrate how existing monitoring programs can be evaluated in relation to their statistical performance against LTSP targets.

All outputs from this project will be developed in consultation with, and communicated to, the RIMRN Program Design working group. Outputs will also be communicated to the new Independent Expert Panel for the LTSP.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	94,000	-	110,000	-	-	\$204,000
Operating (incl. equipment, travel and communication)	6,000	-	-	-	-	\$6,000
Admin support (in-kind only)	-	-	-	-	-	
TOTAL	\$100,000	-	\$110,000	-	-	\$210,000

Location of Research

No fieldwork required. This project will impact upon the entire GBR.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

Elements in the scope of the project: indicator development to create a proposed list of indicators for the IMP; assessment of existing monitoring programs; evaluate the statistical performance of selected indicators from the AIMS Long Term and Marine Monitoring Programs (LTMP and MMP).

Exclusions (out of scope)

Elements are out of the scope of the project: developing a refined/finalised list of indicators that will be monitored in an IMP; evaluating the statistical performance all indicators in all existing monitoring programs; and, designing an integrated monitoring program.

Risks

This is desktop study, so there are limited risks to the project. Plausible constraints include:

- Ambiguity in the description of the LTSP targets: this may hinder the evaluation of the elements and indicators required to address the LTSP targets. This risk will be managed by ensuring close consultation with the RIMRN stakeholders.
- Restricted access to monitoring program metadata: monitoring program details should be publicly accessible, available from Hedge *et al.* (2013), or available from science partners. Accessing the metadata may be constrained by the short project timeframe.
- AIMS are the data custodians of the LTMP and MMP data, thus there are no constraints in data access.

Project Keywords

Indicator
Long-term monitoring
Condition
Trend
Management effectiveness evaluation

Project 3.9 – Indigenous capacity building and increased participation in management of Queensland sea country

Project length – 6 Months

Project start date – 01/07/2015

Project end date – 31/12/2015

Project Leader – Melissa George (FTE – 0.1)

Lead Research Organisation – CSIRO/ NAILSMA

Total NESP funding - \$100,000

Total Recipient and Other Contributions (co-contributions) - \$100,000

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$100,000	x	x	x	x	x	x
<i>Cash co-con</i>	\$15,767	x	x	x	x	x	x
<i>In-kind co-con</i>	\$84,233	x	x	x	x	x	x

Project Summary

This project intends to facilitate targeted consultations with key individuals and institutions (i.e. Torres Strait Regional Authority, GBR TO's and Land Councils, etc.) to seek feedback on the implementation of the NESP TWQ Hub Indigenous Engagement and Participation Strategy (IEPS). This will enable the evolution of a strong Implementation Strategy for the IEPS. A number of Indigenous community liaison officers (part-time) will be engaged to work at the local level to analyse, scope and prioritise Indigenous specific targets/actions identified within and arising from the 2050 LTSP and to inform future TWQ Hub research priorities (the Research Plan). The project will set the parameters for, and commence development of an Indigenous specific Implementation Strategy and investment framework for the future co-management of sea country.

Problem Statements

Problem

Traditional owners must play a key role and need a cohesive say in Reef policies and actions under the Long Term Sustainability Plan (LTSP). To date there has been a lack of Indigenous engagement in the development of the LTSP and the research agenda within the Great Barrier Reef World Heritage Area. Through targeted community consultation this project will analyse, scope and prioritise the 2050 Long Term Sustainability Plan Indigenous targets to develop an Implementation Strategy and investment framework which will both guide LTSP implementation and inform the TWQ Hub research priorities.

How Research Addresses Problem

Historically there has been a disconnect between the aspirations of Traditional Owners and research priorities. This project will address this, by refocusing the research sector and the Research Plan, to meet community research aspirations.

Alignment with NESP Research Priorities

- 3.6.2 Develop methods that facilitate participation of Indigenous people in environmental management.

Research

Description of research

The objective of this project is to investigate and analyse Indigenous specific targets within the 2050 LTSP. This will then equip the Tropical Water Quality Hub to build real capacity for meaningful engagement of Indigenous peoples in both implementation on the LTSP and the Research Plan and consequent NESP funded projects.

The intended outcome of the project, is to commence the development of a 25 year Implementation Plan and investment framework by;

- Conducting meaningful and consultative engagement of traditional owners within the GBR
- Identifying community research aspirations, including localized variations.
- Recognizing these aspirations through the development of an Implementation Strategy and Investment Framework directed to inform the both the implementation of the LTSP and the development of the TWQ Hub Research Plan.

Method

1. Engage key skills and develop communication tools to enable grass roots discussion with traditional owners on LTSP and Research Plan issues
2. Identify and engage Traditional Owner groups across the GBRWHA.
3. Discuss the LTSP and NESP TWQ Indigenous Engagement and Participation Strategy
4. Record and report community action and research priorities, specifically identifying candidacy for further NESP funded projects.
5. Actively encourage meaningful engagement in projects through research team inclusion, training, scholarships, knowledge sharing, communication of results particularly in future NESP funded projects
6. Identify project staff to work with both research project leaders and Indigenous groups.
7. Update the IEPS and NESP TWQ Research Plan and devise Implementation Strategy and Investment Framework to reflect engagement of Indigenous peoples in supported projects.

Links with other projects and hubs

This project is aiming to work with NESP Northern Australia Environmental Resources Hub in cross-boundary Indigenous engagement.

Related research

- NESP TWQ Hub Indigenous Engagement and Participation Strategy
- Queensland Indigenous Sea Country Management Policy Framework (2014)
- National Indigenous Sea Country Workshop Report (2012)
- Northern NESP Indigenous Scoping Project

Expected Outcomes

Outcomes

The project will provide a coordinated LTSP Implementation Strategy and Investment Framework and revised Indigenous engagement framework that will guide the timing and extent of future research priorities in the GBR region.

Specific management or policy outcomes

Recognising basis for longer term support of indigenous specific targets across the LTSP themes, the TWQ Hub will integrate community research aspirations as identified.

Value

Maintaining and enhancing cultural and other Indigenous values in the GBR is critical to the protection of World Heritage values and achievement of LTSP target. Non-Indigenous Stakeholders in sea country business must develop and maintain a sufficient level of cultural competency, and build and maintain productive working relationships with Indigenous sea country managers as the foundation of their relationships. This includes valuing traditional ecological knowledge (TEK) as vital to a complete understanding of sea country and the ability to manage it effectively.

Planned Outputs

- Sharing of Indigenous Ecological Knowledge and scientific expertise for the betterment of sea country, coastlines and catchments.
- Increased cultural awareness among researchers and those implementing the LTSP
- Continued engagement of Indigenous peoples throughout the NESP and any future funding arrangements
- Upskilling, training, scholarships and engagement of Indigenous peoples through partner research institutions

Delivery of Project

Project leader's track-record

Ms Melissa George is a Wulgurukaba woman and the CEO of the North Australian Indigenous Land & Sea Management Alliance Ltd and has been involved in both on ground activity, program and policy development around land and sea management for over two decades. She is currently the Chair of the Minister for the Environment's Indigenous Advisory Committee and a member of the Great Barrier Reef Marine Park Authority Board and has published on Indigenous Co-Management within the Great Barrier Reef. She has played a major role within the context of both the Tropical Ecosystems and Northern Australian NERP Hubs.

Co-researcher Professor Allan Dale has an extensive background in supporting Indigenous led management in the GBR, having facilitated the Sea Forum process in the mid-1990s and having previously led Indigenous Land and Sea policy development in the Queensland Government.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$50,000
1. Final report detailing: <ol style="list-style-type: none"> a. The coordinated indigenous framework that has been developed and how indigenous participation in sea country management can be increased. b. The project will discuss existing datasets and, if relevant, the possible submission of this material to eAtlas. 	15 December 2015	\$50,000
Total NESP Funding		\$100,000

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Melissa George	Principal Investigator	NAILSMA	melissa.george@nailsma.com.au	0.1
Dr Ro Hill	Co-Investigator	CSIRO	Ro.Hill@csiro.gov.au	0.15
Prof. Allan Dale	Co-Investigator	JCU	allan.dale@jcu.edu.au	0.1
Duane Fraser	Co-Investigator	TO Group	Duane.fraser01@gmail.com	0.6
Liz Wren	Co-Researcher	GBRMPA	Liz.wren@gbmpa.gov.au	0.1(in-kind)

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs/ Reef Trust)	Amy McGrath Kevin Gale
Department of the Environment (Science Partnerships)	Anthea Brecknell Naomi Dwyer
Key Stakeholders (organisation/programme)	
Dawul Wuru Aboriginal Corporation	Gavin Singleton
Yintingga Aboriginal Corporation	Cheryl Prestipino
Yuku Baja Muliku Land Trust	

Girringun Aboriginal Corporation	Phil Rist
Gidarjil Development Corporation	
Kuuku Ya'u People's ILUA	
Woppaburra TUMRA	
Wuthathi TUMRA	
Djunbunji Land & Sea Program	
Department of EHP	Graham Keating
GBRMPA	TBC

Knowledge Brokering and communication

- NESP TWQ Indigenous Engagement and Participation Strategy updated to reflect engagement by research projects
- Results of projects communicated back to communities in suitable formats – assisted by the Hub Administrator

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	84,233	-	-	-	20,000 (JCU) 45,000 (NAILSMA)	\$149,233
Operating (incl. equipment, travel and communication)	15,767	15,767	-	-	-	\$31,534
Admin support (in-kind only)	-	-	19,233	-	-	\$19,233
TOTAL	\$100,000	\$15,767	\$19,233	-	\$65,000	\$200,000

Location of Research

Great Barrier Reef Marine Park, TUMRAs, IPAs, ILUAs.

Indigenous Consultation and Engagement

This project is focused on meaningful Indigenous engagement within NESP TWQ Hub projects with aspirations for cross-collaboration with NESP Northern Australia Environmental Resources Hub.

Inclusions (in scope)

The scope of this project will include broadscale Indigenous engagement and strategy development. Strategy development will also draw on the literature concerning Indigenous led management.

Exclusions (out of scope)

This project will not include detailed primary research on Indigenous values in the GBR.

Risks

- Inability to bring Indigenous representatives to the facilitated workshop
 - Financial assistance available
- Research projects unable to accommodate Indigenous participation in research
 - Indigenous liaison officers to discuss ways forward

Project Keywords

Indigenous
Sea country
Capacity building
Great Barrier Reef
Co-management

Project 3.10 – Benchmarking costs of NRM improvements for the GBR

Project length – 6 Months

Project start date – 01/07/2015

Project end date – 31/12/2015

Project Leader – John Rolfe (FTE – 0.06)

Lead Research Organisation – Central Queensland University

Total NESP funding - \$29,487

Total Recipient and Other Contributions (co-contributions) - \$65,193

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$29,487	x	x	x	x	x	x
<i>Cash co-con</i>	\$7,372	x	x	x	x	x	x
<i>In-kind co-con</i>	\$57,821	x	x	x	x	x	x

Project Summary

This project aims to provide information on cost benchmarks for key management actions to improve water quality into the GBR. The project involves a review and evaluation of summary data about NRM projects that have been funded recently to address water quality issues. By pooling the data across NRM regions and different activities, it will be possible to identify the distribution of cost/outcome ratios. From this, potential benchmarks can be established (e.g. 75% of sediment reduction actions are less than \$xxx/tonne, 95% are less than \$XXX per ton). It also provides some identification of the most cost-effective strategies across actions and regions.

Problem Statements

Problem

Funding programs to improve water quality into the GBR are difficult to evaluate, and administering agencies typically need to allocate funds without a clear assessment of the cost-effectiveness of proposals. In particular, it is difficult to judge when particular proposals are too expensive, or how funds should be distributed between actions and regions.

Reef Rescue grants through the NRM bodies and other relevant funding programs provide data for a natural experiment on cost-effectiveness. For each grant, NRM groups need to report to the Australian Government the funding allocation and the planned actions and projected outputs. It is proposed to collect and consolidate that data into a single database so that it can be evaluated.

How Research Addresses Problem

The evaluation will focus on (a) developing a single measure of performance for each project, ideally as the cost of each unit of pollutant reduced, or the cost of each unit of action achieved (b) identifying the relevant variables such as the industry type, region, geographical information and type of action (c) identifying the distribution of cost-effectiveness values for each relevant action (d) identifying relevant benchmark values from each distribution (e.g. values at the 75%, 90% and 95% points), and (c) comparing cost-effectiveness between different sub-sets of categories (i.e. different actions).

Alignment with NESP Research Priorities

3.4.2 Identify and prioritise social and economic risks and uncertainties associated with natural resource management and evaluate the impacts these have on management and policy options for natural resource management and improvements to tropical water quality.

- 3.5.1 Review policy and regulatory instruments to assess their effectiveness and appropriateness in promoting improved land and water management.

Research

Description of research

The objective of the project is to identify and source data sets from NRM project allocations through working with the Commonwealth and Qld Governments, and the NRM groups. Data availability will need to be evaluated to identify which data sets should be used and how over what time period. The project will collate data into a single database which will involve identification of the key variables to record, the treatment of missing data, and the management of variations between data sets. Computation of the relevant variables for analysis will be undertaken. Ideally the most relevant variables will be input measures, output measures and outcome measures (e.g. for a riparian fencing project, the input measure would be the kilometres of new fence, the output measure would be the reduction in stock grazing days, and the outcome measure would be the reduction in sediment and nutrients). An analysis of key variables and the identification of relevant threshold values will be made.

Methods

1. Meet with key stakeholders from the Department of Environment and the NRM groups (CEOs) to identify more clearly the aims of the project and the opportunities for a collaborative approach between the researchers and the stakeholders.
2. Use a desktop review to assess existing knowledge about data sources and cost-effectiveness analysis.
 - a. CQU data and publications on five water quality tenders in GBR catchments,
 - b. Review conducted by RM Consulting Group for the Department of Environment.
 - c. Review conducted by USQ (Jutta Behr)
3. Identify a suitable methodology using Bayesian approaches where analysis can be performed on smaller sets of data and then updated as further data is available. The methodology should also suit the aggregation and combination of data that is not fully consistent.
4. Identify and source data sets from NRM project allocations through working with the Commonwealth and Qld Governments, and the NRM groups – this will involve meeting with relevant stakeholders from the Commonwealth and the NRM groups
5. Collate data into a single database - Key variables will be identified and data will be collated and entered into a database or spreadsheet.
6. Computation of the relevant variables for analysis - Key variables will be identified in consultant with Government and NRM stakeholders and estimated from available data.
7. Analysis of key variables and identification of relevant threshold values - Statistical and graphical analysis will be used to identified from analysis of data. Relevant thresholds and guides to their application will be developed from a workshop with key government and NRM stakeholders.
8. Identify from preliminary analysis how future data collection can be augmented to data analysis so that information about cost-effectiveness can be more easily and usefully generated.

Links with other projects and hubs

This project relates to other economic evaluation projects (2.2 and 3.12) and project evaluating on-ground investments (1.5)

Related research

The results of this study can be applied to assess the efficiency of a range of management and policy options to help protect the GBR.

Expected Outcomes

Outcomes

- Establish database on project cost-effectiveness. This can be in a spreadsheet or database to allow ongoing access and upgrading.
- Graphs of cost-effectiveness by NRM regions and actions. This will provide an easy-to-understand visual guide to the variations in cost effectiveness within a particular group, outliers or extremes in funding patterns, and logical points to set threshold values
- Estimates of threshold values will provide government and NRM groups with a tool to avoid funding poor value projects. Different threshold values may be adopted by groups, depending on patterns of past funding and on-ground information and feedback.
- A guide to the potential application of threshold values. The guide will provide stakeholders with background information and context about how the results can be used

Specific management or policy outcomes

- Rapid comparison of new project applications to past cost information
- Setting of maximum or threshold unit cost levels
- Better evaluation of programs against historical and cross sectional funding data

Value

- A review study, so no immediate on-ground benefits
- Benchmarking cost information should improve the allocation of funds
- Will allow more detailed and comprehensive assessment of programs
- Effects should be demonstrated by better targeting and lower average unit costs over time

Planned Outputs

- A database of GBR water quality projects by their cost-effectiveness and related variables
- Estimates of threshold values by different pollutants, actions and other variables
- A guide to the potential application of threshold values (e.g. as upper limits for funding in grant programs or as reserve values in water quality tenders).

Delivery of Project

Project leader's track-record

The investigators are experts in resource economics. Rolfe has extensive experience modeling production costs for water quality improvements.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP
On signing of contract		\$14,744
1. Delivery of: <ol style="list-style-type: none"> A database of GBR water quality projects by their cost-effectiveness and related variables 2. Report describing: <ol style="list-style-type: none"> Estimates of threshold values by different pollutants, actions and other variables A guide to the potential application of threshold values (e.g. as upper limits for funding in grant programs or as reserve values in water quality tenders). 3. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines.	15 December 2015	\$14,743
Total NESP Funding		\$29,487

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	FTE
Prof. John Rolfe	Principal Investigator	CQU	0.06
Dr. Jill Windle	Co-Investigator	CQU	0.15

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment - Reef Programs / Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
Queensland Department of Environment and Heritage Protection - Office of the Great Barrier Reef and Water Science Taskforce	
Burnett Mary Regional Group	Penny Hall
Fitzroy Basin Association	Paul Birch
Reef Catchments	Ron Cocco
NQ Dry Tropics	Scott Crawford
Terrain NRM	Carole Sweatman
NESP TWQ Hub researchers	Jane Waterhouse (JCU) Stuart Whitten (CSIRO) Peter Thorburn (CSIRO)

GBRMPA	Jason Vains
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Knowledge Brokering and communication

The project outcomes will be communicated in five main ways:

- A database of available studies that can be provided through a CQU (or other) website
- A workshop with likely users of the cost effectiveness analysis and threshold values (Government agencies/NRM staff) to identify the key variables and most suitable threshold levels and test the usability of the database and application/user guide
- A user guide to summarise the results of the project, provide the key threshold values and identify how they can be used
- A research report with key findings, gap analysis and priorities for use
- At least one academic publication

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	19,487	-	44,821	-	-	64,308
Operating (incl. equipment, travel and communication)	10,000	-	13,000	-	-	23,000
Admin support (in-kind only)	-	-	-	-	-	-
Other: CQU cash contribution	-	7,372	-	-	-	7,372
TOTAL	\$29,487	\$7,372	\$57,821	-	-	\$94,680

Location of Research

This is a desktop exercise with the project leader being based in Rockhampton. Research output will impact upon GBR catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, all projects will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

The project will focus on the cost-effectiveness of Reef Rescue funding for on-ground works for agricultural water quality improvements in very recent years, as summarised by the NRM groups in reporting to the Department of Environment. The focus of the project will be on grants awarded to landholders, and the expected outcomes and improvements to water quality that have been projected. Data on historic projects and data on projects to improve training and extension activities will be welcome but not necessarily used.

Exclusions (out of scope)

The project will not report on validation of project outcomes or project effectiveness. It is also not proposed to cover other programs to improve the health of the GBR, such as Crown of Thorns starfish control and Reef Guardian Farmers; only agricultural water quality programs will be assessed.

Risks

There are few significant risks identified with this project:

- Largely a desktop analysis
- Researchers are expert in this topic area
- Investigators have strong relationships with targeted end-users

Key risks:

- Data will be difficult to source.
 - o Australian Government has indicated support for data provision, and NRM groups will also be approached.

Other risks:

- Researcher unavailability
 - o Rolfe in full time research role after June 2015
- Not all data will be consistent or there is missing information on key variables:
 - o Use sub-sets of data, expert opinion or surrogate variables where appropriate

Project Keywords

Economics
Costs
NRM
Benchmarks
Production

Project 3.11 – Monitoring and adaptively reducing system-wide governance risks facing the GBR

Project length – 6 Months

Project start date – 01/07/2015

Project end date – 31/12/2015

Project Leader – Allan Dale (FTE – 0.8)

Lead Research Organisation – James Cook University

Total NESP funding - \$55,537

Total Recipient and Other Contributions (co-contributions) - \$99,286

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$55,537	x	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$99,286	x	x	x	x	x	x

Project Summary

Australian governments have addressed water quality issues in the Great Barrier Reef (Reef) over the last decade. While much has improved, more is needed. Reef environmental outcomes, however, depend on the interplay among diverse/fragmented governance “activities” (e.g. water allocation, ports-planning, regional NRM). Despite being recognized in the Reef 2050 *Long-Term Sustainability Plan (LTSP)*, there is no coordinated system for benchmarking/monitoring the health of the overall Reef governance system/constituent activities. NERP supported a new method for doing so. This project both delivers short term influence over key Commonwealth and State (i.e. GBR Taskforce) decisions regarding management and investment and engages new LTSP implementation/review structures and stakeholders to build commitment to institutionalizing this method over the longer. Outputs will be directly integrated into and inform five-yearly Outlook reporting.

Problem Statements

Problem

This project resolves the challenge raised in the LTSP and Jacobs (2014) that, while the nation monitors the Reef’s environmental outcomes, it does not monitor the health of the wider governance system and constituent governance activities. In anticipation of this, Dale *et al.* (2014) established a theoretically strong and engaging approach to inform both short and long- term decision making about wider governance issues among all relevant parties, but particularly within the proposed LTSP implementation and review arrangements being established by June 2015. The proposed approach involves implementing a systems-wide benchmarking, analysis and reporting (via Outlook) system to independently review the health of the overall governance system and identify high risk governance activities within it.

How Research Addresses Problem

With new frameworks for implementing and reviewing the LTSP and a strong/published method, a unique opportunity exists to build institutional/stakeholder commitment to such an approach. Given the continuing decline of Reef water quality, despite past regulatory/funding developments, this approach necessarily will challenge historical governance concepts. This is why we need cohesive stakeholder engagement and strong industry and community partnerships to build support for institutionalizing such an open/ independent approach linked to review/implementation of the LTSP. This engagement will be achieved via an explicit collaboration between JCU, QUT and GBRMPA to

help facilitate such discussion, and results will directly feed key learnings into Queensland's new GBR Taskforce, the GBRMPA's Outlook Report, and eventually LTSP review processes, directly influencing strategic decisions about management and funding.

Alignment with NESP Research Priorities

- 3.4.2 Identify and prioritise social and economic risks and uncertainties associated with natural resource management and evaluate the impacts these have on management and policy options for natural resource management and improvements to tropical water quality.
- 3.5.1 Review policy and regulatory instruments to assess their effectiveness and appropriateness in promoting improved land and water management.

Research

Description of research

Given that new institutional structures for implementing and reviewing the LTSP will be in place by June 2015, the objectives of this project are to engage:

- with both the State and Federal Governments, internally within GBRMPA, and with the new governance/decision-making structures charged with implementing and reviewing the LTSP, particularly the Queensland GBR Taskforce; and
- a much wider range of end users involved in Reef governance, including, but not limited to, agricultural and resources industries (including mining and fisheries), local government, regional NRM's, Traditional Owners, infrastructure builders, ports, the conservation sector, the landcare and catchment management sector, River Improvement Trusts, etc).

This engagement is specifically aimed at:

- Ensuring all parties have a strong understanding of the method developed and published by the research team and its implications for long term Reef governance;
- Developing the first full governance benchmark and exploring the willingness of all parties to see such an approach further developed and refined;
- Exploring the willingness of all parties and mechanisms for institutionalizing this approach within the longer term LTSP implementation/review mechanisms; and
- Working internally within GBRMPA to determine the best approach to integrating such an approach within the Authority's five year Outlook reporting system. It is currently intended that the trialled reporting framework be directly integrated in Outlook reporting.

To achieve the above objectives, the project method will involve:

- First round stakeholder engagement (via structured stakeholder interviews) to raise awareness and understanding of the previously published method (June to September);
- Development of a draft paper illustrating the reporting approach and covering options for implementation and long term institutionalization of such an approach (September);
- Second round stakeholder engagement (structured stakeholder interviews) to review the options paper and craft a preferred approach (or otherwise) to implementing the system and direct discussion within the State's GBR Taskforce (October);
- Structured discussions (sponsored by GBRMPA) with the new Commonwealth institutional arrangements now being established for implementing and reviewing the LTSP, exploring opportunities and approaches to institutionalizing such preferred approaches (November to December); and

- Internal discussions in GBRMPA on strategies to integrate the preferred benchmarking and monitoring approach within regularized Outlook reporting cycles, but focussed on seeing the system directly reporting within future outlook cycles (Nov/ Dec).

Links with other projects and hubs

The application of this method has transferable benefits nationally for wider biodiversity issues (Threatened Species NESP Hub) and northern Australia (Northern NESP Hub).

Related research

The method being explored in this project was NERP-funded and has already been trialed in other contexts. It has also been independently adopted in the supporting review of fisheries governance in southern Australia. For a detailed account of the governance systems and risk analysis theory underpinning the approach and detail of the methodology refer to:

- Potts, R., Vella, K., Dale, A., & Sipe, N. (2014). Exploring the usefulness of structural–functional approaches to analyse governance of planning systems. *Planning Theory*, October 9.
- Dale, Allan, Vella, Karen, and Potts, Ruth (2013) Governance Systems Analysis (GSA): A Framework for Reforming Governance Systems. *J. of Public Administration and Governance*, 3 (3).

A preliminary desktop analysis has also been trialed in the GBR and elsewhere:

- Dale, A.P. Vella, K., Pressey, R.L., Brodie, J., Yorkston, H., Potts, R. (2013). [A method for risk analysis across governance systems: A GBR case study](#) *Environmental Research Letters* 8 (1): 015037.
- Dale, A.P., Vella, K. and McKee, J. 2014. "Analysing governance of Australia's system of landscape-based greenhouse gas abatement." *Australasian Journal of Environmental Management* 21 (4): 378-395.

Expected Outcomes

Outcomes

This project will:

- Directly influence management in the GBR catchments by identifying short to medium governance reform priorities in Queensland's GBR Taskforce, influencing State action/ investment in improving Reef water quality (some \$100 million);
- Secure stakeholder willingness and agreed approaches to implementing the proposed method for long term benchmarking and monitoring of the health of the wider system of Reef governance and its constituent governance activities;
- Develop a discussion/options paper on short to medium term governance system reforms and a basis consensus-building about institutionalizing a long term monitoring approach;
- Establish a first cut, updateable, web-enabled data base describing the governance health of all key Reef governance activities, enabling regular update and adaptive monitoring;
- Provide data-based evidence concerning priority governance activities needed to underpin implementation of the LTSP and consequent management action to deliver reduced nutrient, sediment and pesticide pollution and to increase the biological health of Reef catchments, improving Reef resilience; and
- Provide evidence that Australia is taking academically-robust, international leadership in benchmarking the performance of, and continuous improvement in, Reef governance.

Specific management or policy outcomes

Through this project, the GBRMPA will be able to support the emerging new arrangements overseeing implementation of the LTSP to be able to decide upon a preferred approach to benchmark and monitor the overall health of Commonwealth aspects of the Reef governance system and its constituent parts as a basis for mid-term review. This is essential for adaptive decisions to emerge from Plan review and refinement, for the first time enabling the nation to link performance of the wider governance system to environmental outcomes. With the lead researcher having recently been appointed to the State's GBR Taskforce, project outputs will be perfectly timed to directly influence decision making about the State's priority Reef water quality policies, actions and over \$100 million in State expenditure

Apart from enabling short to medium term decisions at both Commonwealth and State levels about governance reform, it is intended that this project will also give both governments and Reef stakeholders experience with new methods to assess longer term governance performance. Based on our experience in the approach's application elsewhere, we anticipate this will lead to stakeholder support for a fully institutionalized approach to such a benchmarking/monitoring system, enabling it to support the mid-term review of the LTSP.

Value

The project will help build Reef-wide consensus about how best to use data for decision-makers to prioritise governance and institutional reforms to improve the overall management of the Reef environment. While influencing shorter term Commonwealth and GBR Taskforce decision making, the on-ground manifestation of the environmental impact of this research will also occur over the medium to long term. Through GBRMPA sponsorship, this project will support two critical decision making bodies: (i) the GBRMPA itself; and (ii) emerging governance arrangements just being established to oversee implementation/review of the LTSP. Examples of the sorts of decisions that could emerge from the work include:

- Review of policies and regulation related to Reef governance;
- Reforms in the way programs for Reef water quality improvements are prioritized and delivered; and
- Improved integration of our currently fragmented governance efforts.

This project however, while focused on engaging to explore support for the proposed method, will also develop the first full benchmark of the health of Reef governance arrangements; a benchmark aimed at establishing a basis for discussion about the longer term review and benchmarking system for new LTSP. Direct integration of this benchmarking into the next Outlook report will follow. This would enable reforms in Reef governance to be measured against environmental outcomes at the whole-of-Reef scale.

Planned Outputs

At this proposal stage, GBRMPA is the primary end user (support letter supplied)/project partner. Sections above, however, detail how wider LTSP structures/stakeholders will be engaged, particularly the State GBR Taskforce. This involves:

- Interviewing stakeholders involved in wider Reef governance;
- Building agreement about institutionalization of the proposed approach; and
- Feeding outputs directly into the State's GBR Taskforce.

As this project intends to build understanding of the proposed benchmarking method, wide State/stakeholder support has not been yet formalized, though both have been involved in method development. It should be noted that such detailed engagement is the primary purpose of this project application; avoiding rushed engagement and consensus-building about this complex issue.

Delivery of Project

Project leader's track-record

The research team has a particularly strong capability relevant to the project. The team has already demonstrated its capacity in this field through the development and international publication of the method being applied (including stakeholder engagement). The research work is also institutionally supported through internal capacity in GBRMPA, coordinated through the Manager – Social and Economic Research:

- [Allan Dale](#) is now a member of the State's GBR Taskforce and has a diverse experience across the entire Reef governance system, as a researcher in governance systems (CSIRO and JCU), as a previous Director of Natural Resource Policy in the Queensland Government, and as the CEO of Terrain NRM;
- [Karen Vella](#) has an extensive publication record relating to integrated governance in the Reef, and previously led the social research agenda within GBRMPA.

This research team has been operating collaboratively in the Reef and with GBRMPA for over 20 years.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$27,769
1. Final report describing: <ol style="list-style-type: none"> Stakeholder engagement about the willingness and preferred approach to implementing the proposed method for long term benchmarking and monitoring of the health of the wider system of Reef governance and its constituent governance activities Report and data-based evidence concerning priority governance activities needed to underpin implementation of the LTSP to deliver reduced nutrient, sediment and pesticide pollution and increase the biological health of Reef catchments, improving Reef resilience 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines	31 December 2015	\$27,768
Total NESP Funding		\$55,537

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Prof. Allan Dale	Principal Investigator	JCU	allan.dale@jcu.edu.au	0.8
Dr. Karen Vella	Co-Investigator	QUT	karen.vella@qut.edu.au	0.1
Manager, Social and Economic Sciences	Co-Investigator	GBRMPA	tba@gbmpa.gov.au	0.1

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
GBRMPA (Fergus Molloy)	Support for Outlook integration.

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment – Reef Programs/ Reef Trust	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
GBRMPA	Fergus Molloy
LGAQ	Doreen Erhart
QMC	Andrew Barger
Regional NRMs	Mike Berwick
RDA's	Jan Crase
QFF	Dan Galligan
QDA	Adrian Peak
ABGC	Doug Phillips
WWF	Nick Heath
QWALC	Rhonda Sorenson
Agforce	Paul Bourke
Canegrowers Association	Matt Keally
Tourism Queensland	Daniel Gschwind
AMPTO	Col McKenzie
Indigenous Advisory Committee	Melissa George

Knowledge Brokering and communication

The above stakeholder engagement approach outlines engagement tasks associated with the project (including engagement targets) and provides a pathway for adoption of the proposed approach. There will however, be additional communication outputs to ensure wider dissemination:

- Targeted briefings of State/Federal Ministers/Departmental leads concerning outputs/implications;
- Regular communication with processes feeding into the State GBR Taskforce and LTSP implementation arrangements;
- Web-based updates about the project and discussion through JCU's Development in the Tropics Facebook Page (365 users and increasing);
- Targeted communication through formal TWQ Hub communication platforms; and
- An international paper and one conference presentation (Earth Systems Governance Conference) relating to the preferred method/outcomes.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	50,000	-	69,037	-	13,500	\$132,537
Operating (incl. equipment, travel and communication)	5,537	-	2,000	-	-	\$7,537
Admin support (in-kind only)	-	-	14,749	-	-	\$14,749
TOTAL	\$55,537	-	\$85,786	-	\$13,500	\$154,823

Location of Research

No fieldwork in this project. Project will impact upon Great Barrier Reef catchments.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

Things that are in the scope of this project include wider review and the development of recommended reform of the wider system of governance affecting water quality outcomes in the GBR and detailed analysis of key domains.

Exclusions (out of scope)

Key things that are out of scope of this project include detailed scientific exploration of biophysical, social and economic factors influencing Reef water quality at local scale.

Risks

Key risks facing the project include:

- Failure to secure stakeholder commitment to application and institutionalization of the proposed benchmarking and monitoring method. *Risk – High*. This whole project is effectively designed to manage this risk.
- Dependence on key researchers. *Risk – Medium*. This risk is managed through the lead researchers being able to support each other effectively;
- Uptake risks. *Risk – Medium*. This risk is managed through the strong partnership arrangements being established with the GBRMPA; and
- Delivery risk. *Risk – Low*. We consider the delivery risk here is low as the method is well established and the researchers are able to commence immediately.

Project Keywords

Reef-wide governance
Risk
Policy
Regulation
Outcomes

Project 3.12 – Development of an offset financial contribution calculator for Reef Trust

Project length – 9 Months

Project start date – 01/07/2015

Project end date – 31/03/2016

Project Leader – Martine Maron (FTE – 0.1)

Lead Research Organisation – University of Queensland

Total NESP funding - \$80,595

Total Recipient and Other Contributions (co-contributions) - \$95,153

	2015	2016	2017	2018	2019	2020	2021
<i>NESP funding</i>	\$40,298	\$40,297	x	x	x	x	x
<i>Cash co-con</i>	x	x	x	x	x	x	x
<i>In-kind co-con</i>	\$50,000	\$45,153	x	x	x	x	x

Project Summary

This project will progress an approach for incorporating environmental offsets into the Reef Trust through development of a prototype calculator to assist potential approval holders and relevant agencies in determining appropriate financial payments as offsets under the Reef Trust. It will extend the methodology currently used to calculate terrestrial offsets to the marine setting. It will delineate clearly the differences in applying such a calculator to the marine–catchment continuum and terrestrial settings. A draft prototype will be tested for its consistency with operational needs and practicality among key stakeholders.

Problem Statements

Problem

The unique challenges of offsetting impacts on the marine environment include very high connectivity, substantial temporal and spatial variability, and high system complexity and uncertainty. Attributing environmental impacts and benefits to particular activities that may occur in either the marine or the terrestrial environment (including diffuse impacts) is particularly challenging. Accordingly, a simple application of the EPBC Act offsets assessment guide to the marine system is not appropriate. Appropriate costing of benefits from marine offset projects must reflect the uncertainty (e.g. in time lags, efficacy of actions and confounding external influences) and interdependencies inherent to marine ecosystems. It will reflect the true cost of implementing offset actions to achieve the desired ecological targets, with a “risk premium” pricing model that mitigates some uncertainties associated with offsetting impacts on the marine environment. This is central to ensuring that third parties are not saddled with liability for providing environmental benefits without adequate funds or realistic timeframes.

How Research Addresses Problem

This project will develop a defensible and robust approach for accounting for additionality and uncertainty in estimating benefits of particular actions, and costing those actions, to help guide decision-making about appropriate financial contributions to the Reef Trust as offsets for particular impacts.

Alignment with NESP Research Priorities

- 3.5.2 Evaluate and develop better tools (for example, economic, spatial information, statistical, systems and/or predictive models) to support the prioritisation and

evaluation of on-ground investments and interventions.

- 2.3.3 Evaluate and/or propose institutional and governance arrangements for the management of risk and uncertainty in relation to pressures on tropical water quality.

Research

Description of research

Objective

- To guide the development of an approach for incorporating environmental offsets into the Reef Trust through development of a calculator or appropriate methodology to assist potential approval holders and relevant agencies in determining the size of a potential financial offset to the Reef Trust.
- To identify approaches to account for the uncertainties associated with defining the costs and benefits of actions for offsetting impacts in the marine environment.

Outcomes:

1. Development of a repeatable and scientifically defensible financial contribution calculator/methodology and guidance for use by the Reef Trust.
2. Engagement with relevant stakeholders (such as Australian Government, GBRMPA, Queensland Government, Industry) to ensure outputs are fit for purpose and respond to related work on Cumulative Impact Assessment, Net Benefit Policy and Marine Offsets Policy.
3. Clear identification of outstanding data needs for confident application of the calculation methodology in the case of determining financial contributions as offsets for a range of impact types.

Method:

This project will:

- Identify the suite of values and habitats the calculator needs to be able to account for, and identify appropriate measurable surrogates that can be targeted through management
- Identify appropriate baseline trajectories for each surrogate against which 'maintain or improve' outcomes, or similar policy goals, are to be achieved
- Develop a framework linking impacts that result in deviation from these baseline trajectories to offset actions (and their full costs) required to counter these deviations, and so return to the desired system trajectories
- Develop appropriate multipliers (risk premiums) to reflect uncertainty, time lags, and time preference.
- Embed these relationships into a calculation approach that can be used as a framework for determining financial contributions to the Reef Trust that, with appropriate exchange rules, will generate benefits adequate to offset a given impact on the GBR.
- Demonstrate the operation of the approach for a small set of hypothetical project developments, reef values and habitats, and candidate offset actions.

Links with other projects and hubs

This project relates to other economic evaluation projects (3.10 and 2.2) and project evaluating on-ground investments (1.5)

Related research

This study builds upon the offsets calculator developed for terrestrial ecosystems in the NERP Environmental Decisions Hub.

Expected Outcomes

Outcomes

- This project will deliver a simple, accessible, transparent and repeatable methodology for calculating the magnitude of financial recompense required to offset residual impacts of proposed developments on the Great Barrier Reef.
- The calculator will help ensure an ‘improve or maintain’ outcome for marine environmental attributes or values that are impacted by development actions, consistent with Commonwealth and Queensland government offsets policy.
- It will improve clarity for proponents regarding the costs of offsetting their residual environmental impacts, and the basis for deriving these costs.

Specific management or policy outcomes

At the successful conclusion of this project, (a) stakeholders will have an informed understanding of the key elements required for calculating financial equivalence under current offsets policy, and (b) Reef Trust will have a working prototype and an agreed methodology for development of a fully operational calculator.

Value

To ensure the administration of Reef Trust offsets deliver environmental improvement, this research will incorporate appropriate multipliers or a risk premium to account for uncertainty and delay in the realisation of offset benefits.

Planned Outputs

- Two stakeholder workshops will involve:
 - Commonwealth Department of the Environment
 - Queensland Department of Environment and Heritage Protection
 - GBRMPA
 - Industry stakeholders, as advised by Reef Trust
- Workshop 1 will refine the scope of the project and ensure compatibility with stakeholder needs and policy constraints. It will identify a small set of example projects, impacted values and candidate offset investments for inclusion in a calculator prototype.
- Workshop 2 will communicate the key elements of the calculator and its conceptual basis, test for consistency with stakeholder needs, and outline data needs for application to a larger range of cases.

Delivery of Project

Project leader's track-record

Maron, Bos and Brodie co-authored the report:

Dutson, G., Bennun, L., Maron, M., Brodie, J., Bos, M., Waterhouse, J. (2015) Determination of suitable financial contributions as offsets within the Reef Trust. Unpublished report of The Biodiversity Consultancy Ltd, 3E King's Parade, Cambridge, CB2 1SJ, U.K.

Martine Maron is an ARC Future Fellow who led development of the current terrestrial offsets calculator used by the Cth Department of the Environment to assess offset adequacy for impacts on MNES under the EPBC Act. (<http://www.gpem.uq.edu.au/martine-maron>).

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payments
On signing of contract		\$40,298
1. Final report detailing: a. the key elements required for calculating financial equivalence under current offsets policy including methodology and guidelines 2. Submit completed NESP produced datasets to the e-Atlas, along with corresponding metadata, to meet NESP Data Management Guidelines.	31 March 2016	\$40,297
Total NESP Funding		\$80,595

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
A/Prof Martine Maron	Principal Investigator	UQ	m.maron@uq.edu.au	0.1 (15d)
Melissa Bos	Co-Investigator	Marine Conservation Finance	melissa.bos@my.jcu.edu.au	0.12 (25d)
Mr Jon Brodie	Co-Investigator	JCU	jon.brodie@jcu.edu.au	0.03 (5d)
Prof Hugh Possingham	Co-Investigator	UQ	h.possingham@uq.edu.au	0.03 (5d)
Prof Bob Pressey	Co-investigator	JCU	bob.pressey@jcu.edu.au	0.08 (10d)
UQ research assistant	Research assistant	UQ		0.2 (30d)

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef Trust)	Amy McGrath Kevin Gale
Key Stakeholders (organisation/programme)	
GBRMPA	Jason Vains
Queensland Department of Environment and Heritage Protection	
Industry stakeholders	

Knowledge Brokering and communication

Offsets policy and its practical implementation carries non-trivial political and administrative risks. Communication of project outcomes will be subject to the advice of Reef Trust. Communication with GBRMPA, DotE, and EHP, as well as key industry representatives, will be achieved through workshops and ongoing communication with the project team. At bare minimum, the proposed methodology developed under this project will require robust independent review.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	64,595		11,180	-	54,237	\$130,012
Operating (incl. equipment, travel and communication) <i>Workshops including travel</i>	16,000	-	19,736	-	-	\$35,736
Admin support (in-kind only)	-	-	10,000	-	-	\$10,000
TOTAL	\$80,595	-	\$40,916	-	\$54,237	\$175,748

Location of Research

No on-ground work. Research outputs impact upon GBR.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

A scientifically defensible financial contribution methodology for the Reef Trust with prototype calculator for particular examples, and appropriate guidance for use. Identification of outstanding data needs for confident application of the calculation methodology.

Exclusions (out of scope)

Final operational calculator; user interface development; ecological data and system models required for general application of the approach across the system.

Risks

The most substantial risk to the project is the willingness of key stakeholders to accept the proposed methodology. This risk will be managed through extensive consultation, including two dedicated workshops.

Project Keywords

Offsets
Financial equivalence
Pay-off
Uncertainty
Risk premium

Project 3.13 – eAtlas 2015 - NESP data management, Torres Strait NRM plan delivery platform and Torres Strait reef mapping

Project length – 6 Months
 Project start date – 01/07/2015
 Project end date – 31/12/2015

Project Leader – Eric Lawrey (FTE – 0.36)
 Lead Research Organisation – AIMS

Total NESP funding - \$98,040
 Total Recipient and Other Contributions (co-contributions) - \$110,740

	2015	2016	2017	2018	2019	2020	2021
NESP funding	\$98,040	x	x	x	x	x	x
Cash co-con	x	x	x	x	x	x	x
In-kind co-con	\$110,740	x	x	x	x	x	x

Project Summary

This proposal covers the activities of the eAtlas in 2015 (July - December). These are:

- The eAtlas has approximately 50 datasets that were recently submitted for review that are awaiting preparation, publication and visualization. This project will complete the publication process for these datasets making them available via the eAtlas and with spatial datasets also being made available via the AODN. (55%)
- Work with 1st round NESP TWQ projects to capture any new relevant data products for inclusion in the eAtlas and provide training sessions on providing data in the right format. (13%)
- Support and continue training in the use of the Torres Strait eAtlas⁶ with Torres Strait Regional Authority (TSRA) so it can be used as a publishing platform for their new Land and Sea Strategy NRM plans. (14%)
- Work with TSRA to complete the Torres Strait reef mapping, started under the NERP TE, so that it can be used by GBRMPA to process the Torres Strait coral monitoring data (RHIS) (18%⁷)

Note: Figures in brackets indicate percentage of total project cost.

Problem Statements

Problem

This project proposal describes and covers eAtlas activities from July 2015 through to December 2015.

The core value of the eAtlas is the publication of the datasets that are submitted to it. The bulk of the work in this project will be focused on expanding on this content and publishing all recently submitted relevant datasets of sufficient quality (approximately 50 datasets). The publication of each dataset takes approximately 1 - 4 days to review, clean, document, visualize and file into each of the eAtlas systems. The eAtlas received a large in-flux of submissions at the end of 2014 (approximately 95 datasets) resulting in a backlog that has carried over into 2015. This backlog of content when published will contribute over 500 new map layers providing a significant public legacy of recent research in the Wet Tropics, the Great Barrier Reef and Torres Strait.

The eAtlas team will work with new NESP TWQ projects to capture any new relevant datasets into the eAtlas. This will include providing training sessions to projects to ensure data is properly

⁶ <http://ts.eatlas.org.au>

⁷ This percentage does not include the in-kind contribution by TSRA.

managed and provided in the correct format. It is expected that only a small number of first round of NESP projects will generate new datasets.

Under the NERP TE a coral reef monitoring program was initiated in Torres Strait that TSRA rangers could maintain in the future. This monitoring program uses Reef Health Impact Surveys (RHIS) and the Eye on the Reef (EotR) database system developed by GBRMPA. Unfortunately the EotR requires spatial mapping of the Torres Strait reefs, with permanent reef IDs, to accept and process the RHIS data. No suitable map data exists for Torres Strait. In the last year of the NERP TE the eAtlas team undertook a small project to start mapping the Torres Strait reefs and islands for this purpose and to develop the basemap for the Torres Strait eAtlas. This mapping was completed to a draft level, minus the allocation of reef IDs. This part of the project will complete this reef mapping to create a spatial layer suitable for integrating RHIS data into the Eye on the Reef database.

The eAtlas team will provide assistance and further training of TSRA staff to use the Torres Strait eAtlas to publish their new Land and Sea Strategy NRM plan.

How Research Addresses Problem

The eAtlas provides an easy to access platform for all manner of end-users and the general public (including school children).

Alignment with NESP Research Priorities

- 3.5.2 Evaluate and develop better tools (for example, economic, spatial information, statistical, systems and/or predictive models) to support the prioritisation and evaluation of on-ground investments and interventions.

Research

Description of research

Objectives:

- Ensure that remaining datasets recently submitted to the eAtlas are prepared (reviewed, documented, reformatted if necessary) and made publicly accessible via the eAtlas (spatial maps, data download, metadata records).
- Complete the Torres Strait reef and island mapping spatial dataset to enable Torres Strait RHIS coral monitoring data to be processed by GBRMPA.
- Assist and provide further training to allow the TSRA to use the Torres Strait eAtlas as the web based public delivery of their Land and Sea Strategy NRM Plan.
- Ensure that new relevant datasets generated by the first round of NESP TWQ projects are captured into the eAtlas.

Outcomes:

- The backlog of high submitted datasets awaiting publication will be processed. These will be an important resource for management and future NESP projects.
- Torres Strait reef and island GIS dataset delivered to GBRMPA and TSRA. Improved Torres Strait eAtlas base map.
- Build the capacity of TSRA staff to be able to leverage the Torres Strait eAtlas to publicly deliver the Torres Strait Land and Sea Strategy NRM Plan.
- The eAtlas team will identify potential datasets from first round NESP TWQ projects and will assist NESP TWQ researchers with data management issues. Any new datasets supplied to the eAtlas will be recorded in the eAtlas enduring repository, awaiting full processing.

Method:

- The eAtlas team follows a review process of all datasets to ensure that the data is sufficiently documented to facilitate reuse by others. Where necessary dataset documentation is expanded from associated papers and reports, and remaining questions are issued to the original

researchers. This documentation is converted to public ISO19115/MCP metadata records made available via the eAtlas and subsequently exported to Research Data Australia (RDA). The data itself is reviewed for errors and cleaned if necessary (in collaboration with the researchers). Data with a spatial aspect is converted into a GIS format and made available as maps in the eAtlas and the Australian Oceans Data Network. The original data plus and derived data formats are made available for download. All original and derived work is housed in the eAtlas enduring data repository.

- NESP proposals will be reviewed for potential relevant datasets. Assistance will then be given to researchers to submit their datasets and dataset report to the eAtlas. The eAtlas team will engage with any NESP project management activities similar to the NERP Implementation Group meetings and provide a range of training sessions on data management and the best way to provide data to the eAtlas.
- Eric Lawrey will provide several training sessions to TSRA Cairns staff on the use of the Torres Strait eAtlas Content Management System. The eAtlas team will provide assistance and support to TSRA in presenting the Land and Sea Strategy via the Torres Strait eAtlas and develop any required small adaptations to the system (within the constraints of the project resources).
- The Torres Strait reef and island mapping is based on digitizing the marine features using the entire Landsat 5 and 8 archive, along with a wide range of additional reference datasets, including the Australia Gazetteer, island mapping by the Queensland Government, existing reef mapping by CSIRO and aerial imagery of community regions. The digitizing of the marine features is already complete. This project will involve checking of these features (with assistance from TSRA), grouping them and allocating reef IDs in a manner compatible with the Eye on the Reef database.

Links with other projects and hubs

This project links with all NESP TWQ projects and has the capability to link with other Hubs, their projects and data management systems.

Related research

The eAtlas is the publically available data management and repository system for the MTSRF, NERP Tropical Ecosystems Hub and NESP Tropical Water Quality Hub projects.

Expected Outcomes

Outcomes

- This project will ensure that as much of the data from recent research projects as possible is captured and made available to researchers and management agencies. This will facilitate the use of this data by managers in the future.
- Torres Strait reef and island mapping that will enable the processing of Torres Strait coral monitoring RHIS data by GBRMPA, contributing to a more complete understanding of impacts in the GBR/Torres Strait region as a whole.
- Training and assistance of TSRA will build their capacity to deliver the Land and Sea Strategy using the Torres Strait eAtlas.

Specific management or policy outcomes

- Use of the Torres Strait eAtlas for public delivery of the TSRA Land and Sea Strategy.
- Expansion of the GBRMPA Eye on the Reef database to cover Torres Strait. Ability for GBRMPA to provide feedback (outputs from the Eye on the Reef) to TSRA rangers encouraging future monitoring.

Value

- This project will ensure that data developed by recent research projects are captured and made available to future environmental managers and researchers. This good data management

facilitates informed management decisions which should lead to improved environmental outcomes.

- The Torres Strait reef and island mapping will facilitate management's use of coral reef monitoring allowing more informed management decisions.

Planned Outputs

- TSRA has requested additional training and support to use the Torres Strait eAtlas for the delivery of the Land and Sea Strategy. This project will provide this training and support.
- GBRMPA has requested the completion of the Torres Strait reef and island mapping to facilitate the integration of the Torres Strait coral monitoring into the Eye on the Reef database. The team will work with GBRMPA to ensure that the mapping dataset is suitable for their use. The eAtlas team will work closely with TSRA on the reef mapping. TSRA will assist in the checking and quality control of the reef mapping. This engagement will ensure that they will be able to use this dataset in the future.

Delivery of Project

Project leader's track-record

This project is a continuation of the NERP TE eAtlas project (13.1) and retains the same core team. Eric Lawrey has been the lead architect of the eAtlas since its inception in 2008, taking over as project leader during the NERP from 2011. Both Eric Lawrey and Gael Lafond have a proven track record in the developing leading edge data management systems that promote the reuse of research data. They have demonstrated the application of best practice data management and curation of complex environmental research data, with the eAtlas now consisting of over 200 datasets and 3500 map layers. The proposed project involves applying already established processes and procedures and capturing of new NESP datasets. This project involves a continuation of the training sessions that Eric Lawrey has previously run with TSRA staff to ensure that they build the capacity to use all of the Torres Strait eAtlas systems. This team has demonstrated the skills to perform the mapping of the Torres Strait reefs and island with the development of the draft version of this dataset⁸.

Delivery on time and within budget

The Hub Administrator will track project progress and link milestone payments to timely delivery of outputs.

Project Milestones

Milestones	Due date	NESP Payment
On signing of contract		\$49,020
1. Final summary detailing: a. Publication of recent dataset submissions. b. Torres Strait eAtlas c. Deposit of data and metadata from NESP projects.	31 December 2015	\$49,020
Total NESP Funding		\$98,040

⁸ This baselayer includes the draft version of the Torres Strait reef and island mapping: http://maps.eatlas.org.au/index.html?intro=false&z=9&ll=143.05478,-10.03280&l0=ea_ea-be%3AWorld_Bright-Earth-e-Atlas-basemap

Researchers and Staff (including early career researchers/PhDs – if names not yet known, list position/role)

Name	Project Role	Institution	Email	FTE
Dr. Eric Lawrey	Principal Investigator - Reef mapping, data management	AIMS	e.lawrey@aims.gov.au	0.36
Gael Lafond	Co-Investigator - data management, system development	AIMS	g.lafond@aims.gov.au	0.17
TBC	Metadata editor	AIMS		0.11
Melanie Stewart	Torres Strait Reef mapping	TSRA	melanie.stewart@tsra.gov.au	0.05

Co-contributors – only list contributors who are not already identified as Researchers and Staff

Organisation/name	Contribution
-	-

Research End Users and Key Stakeholders – Identify at least one section or programme within DotE who will be an end user for this project, as well as any end users external to the department.

Research End Users (section/programme/organisation)	Name/s (optional)
Department of the Environment (Reef programs/ Reef Trust)	Amy McGrath Kevin Gale
Department of the Environment (Migratory species section)	Fiona Bartlett
Department of the Environment (International section)	Damien Hall
Key Stakeholders (organisation/programme)	
Torres Strait Regional Authority	Melanie Stewart Shaun Barclay
GBRMPA	David Leverton Jen Dryden

Knowledge Brokering and communication

- NERP TE datasets will be publicly accessible to managers and researchers via the web.
- This project involves actively training and working with TSRA to assist them in the delivery of their Land and Sea Strategy using the eAtlas infrastructure. This, in turn, will assist TSRA in engaging with the broader community in their NRM plan.
- Working with GBRMPA to ensure the Torres Strait reef and island mapping that is suitable for the Eye on the Reef database is an integral part of the project and thus a vehicle for 'operationalising'/implementing this aspect of the project.

Expenditure Summary

	Project Costs					TOTAL
	NESP	Applicants		Other stakeholders		
	cash	cash	In-kind	cash	In-kind	
Salaries	92,590	-	98,040	-	12,700*	\$203,330
Operating (incl. equipment, travel and communication)	5,450	-	-	-	-	\$5,450
Admin support (in-kind only)	-	-	-	-	-	-
TOTAL	\$98,040	-	\$98,040	-	\$12,700*	\$208,780

* This in-kind figure is only an estimate.

Location of Research

AIMS, Townsville. The project gathers all data and metadata from NESP TWQ projects.

Indigenous Consultation and Engagement

As per the objectives of the NESP TWQ Hub Indigenous Engagement and Participation Strategy, this project will be advised of relevant Indigenous groups to the research project and strongly encouraged to engage meaningfully.

Inclusions (in scope)

- This project will prepare and publish approximately 50 datasets already submitted to the eAtlas, and subsequently in AODN and Research Data Australia.
- This project will assist TSRA in using the Torres Strait eAtlas as a publishing platform. This will be in the form of training and system tweaks.
- This project will develop a Torres Strait Reef mapping layer suitable for the EotR system.

Exclusions (out of scope)

- This project does not include any significant development of the eAtlas systems. It only includes bug fixes and minor improvements to facilitate its use by TSRA.
- This project does not include the preparation and publication of NESP datasets submitted at the end of the project. These will undergo a submission review and filing in the eAtlas enduring data repository and be published in 2016.
- The Torres Strait Reef mapping will not include validation of the classifications applied to features and their naming. Its focus will be mapping marine features and allocating IDs.

Risks

- **Constraint:** Not all datasets submitted to the eAtlas meet the minimum standards necessary for publication (usually due to lack of documentation, or poor data cleaning). The eAtlas team will work with researchers to resolve these issues however if researchers are not responsive to queries then the project team will liaise with the Hub leader and the Department to ensure these datasets are provided by researchers and are of a sufficient standard.
- **Risk:** The Torres Strait eAtlas may not support all the features desired by TSRA for the interactive delivery of the Land and Sea Strategy. There is only limited capacity in this project to develop new features.
- **Constraint:** The Torres Strait reef and island mapping will focus on enabling expansion of the Eye on the Reef into Torres Strait. This project will not include in situ verification of feature classifications or the collation of marine feature names. A future project will be necessary to complete these activities.
- **Constraint:** New NESP datasets will be captured into the eAtlas enduring repository, but not fully processed and published on the eAtlas as part of this project. This is because these new

datasets will only be available at the end of project. It is expected that only a few 1st call NESP projects will generate new datasets.

- **Risk:** New NESP projects may not expect to provide datasets to the eAtlas and not cooperate or invest sufficient time to document their datasets.

Project Keywords

Data management
Torres Strait
Coral reefs
Mapping
E-atlas

Attachment B: Hub level Risk Assessment and Treatment Plan

Attached as separate spreadsheet

Attachment C: Budget Tables

Attached as separate spreadsheet