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Queensland Reef Water Quality Program
Annual Investment Report 2018−2019

#32051

Contents

Introduction

The Queensland Reef Water Quality Program (QRWQP) is the Queensland Government's key response to addressing water quality impacts affecting the Great Barrier Reef. It delivers activities as part of implementing the Reef 2050 Water Quality Improvement Plan 2017–2022 (Reef 2050 WQIP) which supports the water quality theme of the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan).

In 2017–2018, a new five-year Investment Plan 2017–2018 to 2021–2022 was developed outlining the delivery of the Queensland Reef Water Quality Program. Part A of the five-year investment plan describes the key areas of investment as they align to the actions under the Reef 2050 WQIP. Part B is a table that sets out the activities and corresponding investment amounts across the Queensland Reef Water Quality Program. Both documents can be accessed at www.qld.gov.au/environment/coasts-waterways/reef/reef-program.

This annual report covers activities and investments for the 2018–2019 financial year.

The Office of the Great Barrier Reef (OGBR) in the Department of Environment and Science (DES) is responsible for overseeing the Queensland Reef Water Quality Program, working with the other DES divisions, the Departments of Natural Resources, Mines and Energy (DNRME) and the Department of Agriculture and Fisheries (DAF).

Program investment

The five-year Investment Plan 2017–2018 to 2021–2022 detailed $63,990,043 to deliver projects and activities in 2017–2018. During the 2017–2018 year, $43,373,717 was expended across the program.

Planned 2018–2019 investment against actual expenditure is shown in the following investment tables. Any unspent funds will be carried into future investments or re-allocated to other projects.

The total in the table that follows differs from the amount shown above because of additional co-contributions provided by partner agencies.

The QRWQP Investment Plan for 2019–2020 will detail the planned investment for the coming financial year. The overall program's five-year budget remains the same.

Measuring success

The program was delivered through two work areas, aligning to the structure of the Reef 2050 WQIP: Responding to the challenge, and Enabling delivery (see Figure 1). The following investment tables, report activity progress against these areas.
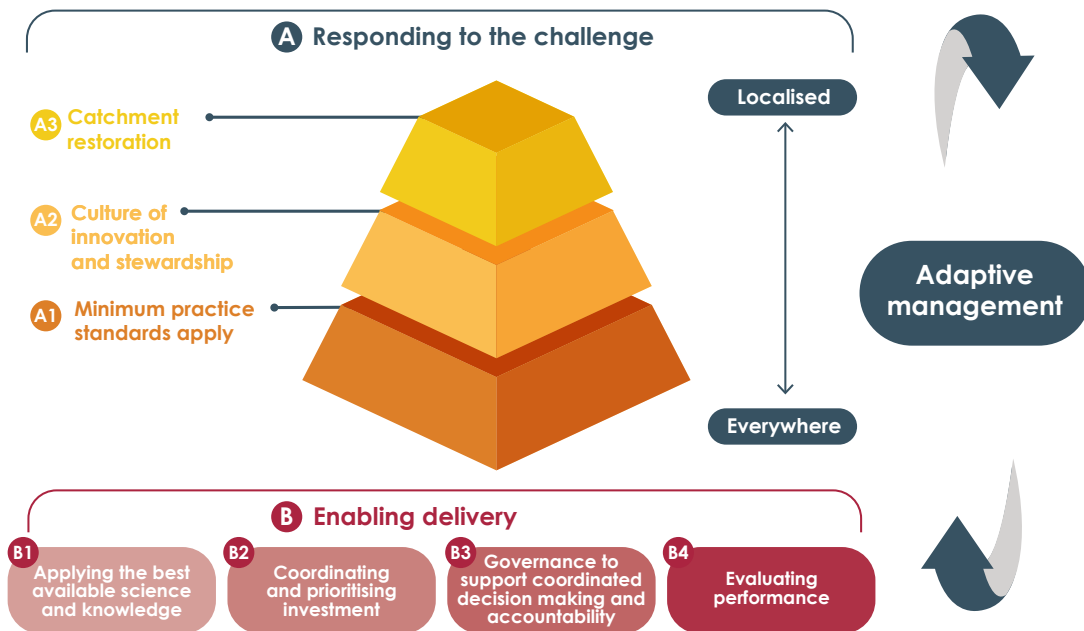

Figure 1: Implementing Reef 2050 WQIP

(Reference: 2018, State of Queensland, Reef 2050 Water Quality Improvement Plan 2017–2022 www.reefplan.qld.gov.au/about/)

Funding categories

Annual: Queensland Government annual funding

Additional: Additional funding over five years, supporting the Great Barrier Reef Water Science Taskforce recommendations

Co-contributions: Includes funding from:
- an existing departmental program that supports Reef water quality work
- a broader state program where funding can be clearly separated into Reef regions
- a state program where an approximate funding allocation is made for Reef regions achieving Reef 2050 WQIP targets.

Investment tables

Acronyms

DAF: Queensland Department of Agriculture and Fisheries; DES: Queensland Department of Environment and Science; DNRME: Queensland Department of Natural Resources, Mines and Energy; GBR: Great Barrier Reef; OGBR: Office of the Great Barrier Reef; QRWQP: Queensland Reef Water Quality Program

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
Responding to the challenge: actions to progress towards targets							
Minimum practice standards							
1.1 Implement minimum practice standards for agricultural industries, which can be met either voluntarily, e.g. through industry-led best management practice (BMP) programs or as a result of regulation.	Support to voluntary industry-led BMP programs in cane, grazing, grains, and banana industries, including continual improvement of BMP modules, benchmarking of producers' operations and accreditation to industry standard.	$7,764,318	$5,101,585	Annual	DES	*Banana nutrient trials* The Banana nutrient rate trials aim to provide a robust scientific basis on which to judge how the proposed regulated minimum standards will affect current banana production from a research perspective and within a commercial setting. They are assessing if optimum banana bunch size and economic return are possible using the minimum standard nutrient rates within commercial production systems, consistent with normal production timeframes, and based on conventional crop management production practices. Replicated banana field nutrient trials will assess the agronomic performance of specific nutrient management treatments primarily focused on nitrogen with secondary focus on phosphorus. Soil and water nutrient levels in conjunction with leaf nutrient testing results will be used to underpin crop growth, marketable yield, and economic performance analysis in both the initial plant and two subsequent ratoon crops.	*Banana nutrient trials* Nutrient trials began in November 2018, in a new plant crop, and will run until December 2021. This timeframe will allow the collection of replicated, robust data, from the initial plant crop and two ratoon crops from a rigorous on-station trial and multiple commercially-applicable on-farm trials throughout the major banana growing areas of the Wet Tropics (Tully, Innisfail/South Johnstone, Bartle-Frere/Russell).
						Best Management Practice (BMP) programs The Smartcane BMP Phase 3 was signed in August 2018, extending Phase 2. Land managed under the Smartcane BMP was increased. Land managed under the Grazing BMP was maintained through the Grazing BMP Interim Project. Land managed under the Banana BMP was increased. Activity in the Grains BMP was maintained.	*Best Management Practice (BMP) programs* At the end of June 2019, the area of land that has been benchmarked in Reef catchments under the Smartcane BMP is approximately 71% (287,335 ha). At the end of June 2019, the area of land that has been benchmarked in Reef catchments under the Grazing BMP is approximately 45% (13,404,407 ha). At the end of June 2019, the area of land that has been benchmarked in Reef catchments under the Banana BMP is approximately 35% (9,718 ha). At the end of June 2019, the area of land that has been benchmarked in Reef catchments under the Grains BMP is approximately 15% (169,461 ha).

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
						Hort360 A new project to support horticultural producers in Reef Catchments, was launched in 2018 in partnership with industry to address priority actions required to achieve best management practices across the Great Barrier Reef catchments, demonstrate improved nutrient, pesticide, sediment and water management, and achieve environmental certification as best practice producers. The project includes developing a horticulture certification pathway enabling growers to be recognised as best practice custodians of land in Reef catchments.	*Hort360* Land managed under the new Hort360 BMP GBR project was increased and a certification pathway for growers to demonstrate best practice in horticultural production has commenced.
	Proposed changes to the Reef regulations of the *Environmental Protection Act 1994*. Reef regulation implementation.	$2,322,288 $100,000	$1,408,699	Additional and Annual	DES	*Water quality credit trading* The project aims to determine whether trading in water quality offsets/credits can cost-effectively offset emission increases from new development, whilst ensuring that end-of-catchment pollution loads stay within designated nitrogen and sediment limits. *Erosion and sediment control capacity building* The project seeks to deliver a range of activities to build the capacity of local councils and other stormwater managers to improve urban water quality objectives through erosion and sediment control practice improvement and frameworks. *Data project* The project aimed to identify how relevant data can be obtained to help understand where fertiliser is applied, and how this information could be used as a proxy for determining locations and farms contributing to high levels of fertiliser run-off.	*Water quality credit trading* Point source data from the Water Tracking and Electronic Reporting System (WaTERS) for the Wet Tropics, and diffuse sources of dissolved inorganic nitrogen (DIN) from sugarcane areas in the Wet Tropics have been finalised and integrated in the nitrogen-credit trading model. *Erosion and sediment control capacity building* DES and Healthy Land and Water (HLW) supported two workshops to discuss successes and challenges of implementing and maintaining water sensitive urban design (WSUD) principles and devices. Council representatives and private industry were invited to attend four information sessions on new online resources to improve water sensitive urban design practices. Other engagement activities included an urban stormwater workshop and bus tour in Mackay and stormwater and erosion and sediment control workshops. *Data project* The project was delivered by AgTrix Pty Ltd, which submitted its final report in October 2018 and provided briefings to key stakeholders and government officers.
	Build compliance capacity for erosion and sediment control during urban, industrial and infrastructure construction and maintenance.	$0 Completed					

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	Data and project management system for Reef projects.	$183,170	$183,170	Additional	DES	A Proof of Concept (PoC) based on the Commonwealth Scientific and Industrial Research Organisation Atlas of Living Australia (CSIRO-ALA) BioCollect System assessed the suitability of this system to meet the QRWQP data system requirements. Queensland Cyber Infrastructure Foundation (QCIF), a CSIRO-ALA partner organisation transitioned the BioCollect PoC System Hub to a QCIF hosted environment, establishing a QRWQP data system, named CORAL. This provides a register of all the QRWQP projects coupled with a repository of key project documents and artefacts. Having this information available from an interactive database supports: 1. project planning, execution and governance 2. collection, management and reporting of (any) mandated data 3. analysis of project/ program outputs and outcomes achieved 4. sharing of relevant data and information with internal and external stakeholders.	A limited number of customisations implemented by CSIRO-ALA enabled use of the PoC System to: • Establish a projects register capturing a basic profile of some 150 projects. • Provide a spatial view of the location and distribution of projects across the regions. • Capture a basic set of data on project status, e.g. risks and issues, project budget information. • Capture a summary of outcomes resulting from the project activities. • Provide a dashboard showing an overview of a selected project and generate a project summary for reporting purposes. • Provide a dashboard showing an overview of the overall QRWQP program of activities. • Download project metadata from the projects register for analysis. • Demonstrate how a summary of landholder practice data for a region may be uploaded from an external system and viewed. Development and implementation is ongoing.
	Enhance integration of data and use the Water Tracking and Electronic Reporting System (WaTERS) to capture point source release monitoring and tracking data online for Environmentally Relevant Activities (ERAs).	$125,000	$123,096	Additional	DES	This study primarily involved a census of nutrient-related point source ERAs in the GBR catchment, using information contained in Environmental Approvals (EA). A database was developed to capture and interrogate information from all relevant EA holders as of December 2018. The study also involved a standards review with respect to license conditions and onsite management practices associated with sewage treatment. This information will be used to inform guidelines and policy in relation to sewage treatment in the GBR catchment. A case study review of leading practice examples for sewage treatment, will inform GBR councils of potential alternate wastewater treatment options.	• The data enables the contribution of point source activities to nutrient loads in the GBR catchment to be predicted with greater accuracy, including which catchments are most potentially affected. • The data can be used to fine tune the way nutrient-related point source activities in the GBR are carried out, thereby helping to reduce nutrient loads to the Reef. • Information regarding leading practice in sewage wastewater management will provide a pathway for more rapid uptake of alternative treatment strategies and, therefore, nutrient load reductions.
	Targeted compliance program under the *Environmental Protection Act 1994*.	$1,630,000	$1,317,817	Annual	DES	The Reef compliance program administers the regulatory provisions of Chapter 4A of the *Environmental Protection Act 1994* (the Act), covering the three priority areas of the Wet Tropics, Burdekin and Mackay-Whitsunday regions.	• A total of 364 compliance activities were completed during 2018–2019. • Impacts of the severe monsoon event in parts of the Wet Tropics and Burdekin impacted access to some farms. • The program continues to contribute to water quality monitoring in the Wet Tropics.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
	Transition program to support the cane, grazing and banana industries in Reef catchments to transition to new minimum standards.	$0					
Culture of innovation and stewardship							
2.1 Support land managers and industries to adopt improved management practices, e.g. through coordinated extension, education and awareness programs.	**Extension and education**						
	Boost extension resources, providing greater access for farmers to extension services to enable greater practice change in Great Barrier Reef farming communities and building long-term capacity in the advisory services.	$2,455,000	$2,440,000	Additional	DAF	These projects support enhanced education and extension co-ordination by establishing and expanding regional partnerships, strengthening the links between extension and other programs, facilitating knowledge transfer between key stakeholders, minimising duplication of effort across extension activities and responding to the relevant areas of need identified in the independent review of Reef extension.

The project is developing regional extension networks so they have clear and transparent structures, systems and processes to coordinate extension programs. | Regional extension co-ordinators are working together to support cross-regional and cross-industry links and coordination in extension programs.

Co-ordinators are facilitating regional extension groups in each Reef region, made up of public and private extension service providers, to share information and identify extension needs and gaps. Regional extension co-ordinators have developed regional extension plans to strategically coordinate extension projects and prioritise future investment to build on and value add to current extension programs, address skills gaps and training needs, and develop innovative ways to accelerate adoption of improved management practice and water quality outcomes.

58 projects were funded in 2018–2019 by regional extension working groups and are being rolled out across the six GBR regions. |
| | | $1,000,000 | $900,000 | Annual | DES | *Agricultural Extension Work Placement Program*
This project is a one-year placement program for up to six early career extension officers (trainees), who are graduates (holding at least a Certificate IV in a related field) and have no more than one year of experience as extension officers. Trainees will be placed in organisations, preferably across the six Great Barrier Reef regions, and will be supported by an appropriate mentor(s) who can provide them with on-ground experience in specific extension-based skills. | Six graduates have been placed with host organisations across the different Reef regions. They are receiving training and support to work on Reef projects that focus on improving uptake of cane and grazing farming practices. |
| | Extension and education activities targeted at increased adoption of voluntary industry-led BMP programs. | $4,120,000 | $3,466,000 | Annual | DAF | DAF scientists and agronomic specialists develop innovative solutions, provide on-ground support to producers and mentor those delivering extension services to the industry-led cane, grazing, grains and horticulture BMP programs.

The winding up of the Grazing and Grains BMP Alliance is changing the way DAF delivers support to the grazing and grains industries with new projects to be rolled out in 2019–2020 building on the networks established under the previous programs. | • DAF's grazing extension team engaged 163 businesses in the Burdekin catchment (approximately 25% of beef businesses and 29% of the catchment) and an additional 46 businesses within neighbouring catchments. 78% of the businesses improved their knowledge/skills in grazing land management, animal production and business management. 48% of the businesses indicated they were highly to very highly likely to make a management practice change within 12 months.
• 620 sugarcane producers were engaged in DAF activities in 2018–2019, exceeding the target of 500. The 92% of producers engaged in DAF activities reported an improvement of KASA (Knowledge, Attitude, Skills and Aspiration). |

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						The sugarcane extension project continues to provide leadership by introducing, developing and trialling new technologies, and building technical knowledge in industry support networks. The banana and horticulture projects are focussed on trials to address and disseminate knowledge of what is best practice nutrient, sediment and pesticide management in these industries. This work assists producers to improve practices and reduce sediment, nutrient and pesticide run-off to the Reef.	• DAF is at the forefront of introducing and evaluating the role of Unmanned Aerial Vehicle (UAV) technology in sugarcane farming systems. DAF is evaluating the use of UAVs for yield variability, weed identification, elevation and precision UAV herbicide application, and the results are promising. It is likely this technology will become a pivotal part of the Australian sugar industry as it embraces 'digital farming' as the next tool to improve its environmental and business sustainability. • DAF invested in developing a 'pesticide risk matrix' and an agribusiness training program to 'train the trainer'. The program is assisting advisors to consider environmental risk when selecting the most appropriate pesticides to recommend to producers to solve pest and weed issues. • Regional Reef Pesticide Working Group workshops were held in the three priority regions: Mackay Whitsunday (Mackay), Burdekin (Ayr) and the Wet Tropics (Cairns). Over 100 regional stakeholders attended the three workshops which was double the attendance of the previous GBR-wide workshops held in Townsville. Outcomes from the workshops will be included in the Regional Extension Plans and the Reef Pesticide Response Strategy Action Plan. • The DAF Sustainable Grain Practices project and DNRME Water Science Unit delivered targeted field days with 79% of attendees indicating their involvement had caused them to consider changes to their practices.
	Enhanced education and extension coordination to support large-scale land management practice change through: • stakeholder engagement to achieve practice change • a review of current extension and education approaches • developing a three-year program plan and implementation strategy developing a framework for education and extension. • pilot an agriculture capacity building program focusing on extension training networks and interns.	$1,510,000	$1,510,000	Additional	DAF	This project is delivering a training program to address the high priority extension and technical skill areas identified from the training needs analysis and regional extension plans.	• Training needs analysis completed and training and development activities have been delivered including Certificate III in Irrigation, Agronomy in Practice and Soil Health workshops. • Delivered a Reef extension Think Tank in Townville in May 2019, together with a half-day peer-to-peer learning workshop.
		$110,000	$213,652	Additional	DES	The pilot project included three components; an extension-training component, a work placement component, and an evaluation component. The work placement component was highly successful in placing six trainees in six organisations and providing training and mentoring to the trainees.	In its first year, the pilot project was successful in recruiting five of the six graduates to ongoing positions with their host organisation. As part of the work placement program, a mid-term and a final evaluation were completed with participating trainees, mentors and host organisations. Results of the review are highly positive indicating the project is successfully helping organisations to increase their capacity to deliver extension services.

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	Increased use and improved function of grazing extension tools for extension service providers to support the capacity of graziers to make climate responsive management decisions using decision support tools such as Forage and VegMachine.	$584,000	$567,000	Annual	DES	The joint DES and DAF project leverages funding through the Drought and Climate Adaptation Program to provide the tools graziers need to maintain land condition in Queensland's drought-prone climate, which will ultimately reduce sediment loads to the Reef.	*Enhanced information products:* • Released FORAGE fire scar and Pasture Growth Alert reports. • Continued development of a prototype of the Spatial FORAGE web interface – My FORAGE Map. • Released updated Grazing Land Management land type mapping, and incorporated these into GRASP, FORAGE, and AussieGrass. • Made available via subscription, seven FORAGE reports as part of the grazing industry support. • Visualisation of rainfall and pasture growth through Rainfall Poster Map App providing a history of beneficial rainfall and drought sequences relative to Queensland over the last 130 years. *Industry extension:* • Continued to work with DAF beef extension officers and consultants to support grazing industry adoption of FORAGE through workshops and field days.
	Project Cane Changer – a large-scale social change program in the Wet Tropics, to better understand motivations and associated benefits of behaviour change to encourage cane farmers to adopt actions that will improve water quality outcomes.	$728,111	$642,500	Additional	DES	Project Cane Changer was an initiative designed to better understand sugarcane growers and help increase the adoption of best management farming practices. The project drew on evidence-based principles of psychology and human behaviour to design, implement, and evaluate an industry-wide program that aims to understand the day-to-day challenges facing sugarcane farmers and to recognise, value and accelerate their efforts to adopt farming practices that help protect the Reef. Focused in the Wet Tropics region, the project was driven by CANEGROWERS, in partnership with human behaviour experts, Behaviour Innovation. The project, which commenced in 2016, was completed in early 2019.	The implementation of several key strategies to effect behaviour change and environmental and social benefits were undertaken through the last phase of the project, which was completed in early 2019. The behaviour change strategies covered the following areas: women and families, monitoring change, innovation, and leadership and ownership. The leadership and ownership strategy saw the formation of leadership groups within each district in the Wet Tropics consisting of all local CANEGROWERS board members. • A communication and destigmatisation strategy was implemented; as a result of this strategy over 200 Cane Changer communication materials were published online, as well as two peer-reviewed behaviour science papers. • 246 cane farmers signed the Cane Changer commitments, accounting for over 32,000 hectares of land under cane. • Both the former and the current Minister for the Great Barrier Reef, signed Cane Changer Commitments. • Over 660 sugarcane farmers were engaged through the project, with 57 farm visits and over 260 workshops, meetings and project activities. • Since Project Cane Changer commenced in 2016 there has been a 316% increase in Smartcane BMP accreditations in active project areas covering 35% of the total land under cane in the Wet Tropics. This rate of change is attributable to a range of projects and industry activities throughout the Wet Tropics, including this project.

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							• Project Cane Changer has been recognised internationally for its innovative approach to behaviour change including recognition at the World Economic Forum.
	On-ground wetlands demonstration case studies, wetlands extension with clients, management of local wetlands committees, development and delivery of wetlands information and tools for landholders.	$100,000	$102,000	Annual	DAF	The project supports treatment system trials, delivers capacity building events and develops decision support tools to increase awareness, knowledge and implementation of treatment systems and wetland management on farms. The project maintains regional stakeholder networks in the Wet Tropics, Burdekin and Mackay Whitsunday regions to share information and assist in the coordination of activities to improve water quality and wetlands in agricultural environs in the GBR catchment.	A 'Treatment Systems for Water Quality Improvement' regional forum was held in November 2018. 65 people from industry, natural resource management, government and research institutions attended to hear the latest information on treatment technologies, such as bioreactors, algae treatment and micro-nutrient dosing. The forum increased participants' knowledge of treatment systems for improving water quality and as a result 68% of respondents stated they intend to incorporate the learnings into their work. DAF facilitated seven regional wetland stakeholder group meetings in the Mackay Whitsundays, Burdekin and Wet Tropics regions. As a result of these meetings, stakeholders are more aware of other wetland and treatment system projects, resources and research in the GBR. This helps stakeholders to plan and implement on ground actions to improve water quality and ecosystem health in the GBR catchment.
	Targeted extension approach to accelerate adoption of improved grazing management practices in priority areas in the Burnett Mary region.	$345,493	$278,343	Additional	DES	The project aligns to the following research question – Investigate options to encourage practice change beyond simply paying landholders. The project provides an opportunity for the Burnett Mary Regional Group (BMRG) to implement their innovative STEP extension approach, contributing directly towards research gaps: Improving water quality outcomes through producer involvement in innovative approaches and communication and extension methodologies, which leads to improved practices. BMRG was successful in securing $620,000 to drive a targeted extension program to accelerate the adoption of improved grazing management practices on previously unengaged graziers. Targeted priority areas include the Lower Baffle, Lower Kolan, Lower Burnett and the Gregory and Isis sub-catchments of the Burrum basins.	The BMRG has continued to successfully deliver the Better Beef for the Reef project. Since the commencement of the project, 40 grazing businesses have been engaged. Extension officers have also focused on one-on-one extension, partnering with industry stakeholders and monitoring the progress of the demonstration sites of which three out of the six have now been contracted. Property maps, detailing existing infrastructure such as fences, yards and watering points, have been developed for a total of 13 grazing businesses, including the six demonstration site landholders. The property maps have provided the opportunity to continue to engage with landholders who were unsuccessful in receiving demonstration site funding. Landholders are actively using these and have referred to their maps during property visits with the Grazing Extension Officer.
	Implementation of two Major Integrated Projects (MIPs) in the Wet Tropics and Burdekin regions to pilot a range of activities with producers and the community to reduce nutrient, pesticide and sediment loads into local waterways and ultimately the Great Barrier Reef.	$12,450,898 $324,504	$14,108,927	Additional and Annual	DES	The objective of the MIPs is to work closely with groups of landholders in focus areas within the Wet Tropics and Burdekin regions, to trial a range of regionally tailored, coordinated actions that reduce nutrient, sediment and pesticide loads entering Great Barrier Reef waters. Through the MIPs, the progress in achieving land management practice change, economic benefits for landholders and pollutant load reductions will be closely monitored and results will inform adaptive management.	Year two focused on delivering actions identified in stage one (program design) and evaluating outcomes achieved in the first year. The following key activities have been delivered, as well as regular project panel and Steering Committee meetings to continue engaging local communities and broader stakeholders in the MIPs. Burdekin MIP: • 30 grazing properties contracted and undertaking management practice change.

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						It is hoped that by concentrating effort into one or two areas and closely involving landholders in the design and implementation of the projects, greater improvements in water quality will occur.	• Large scale gully site at Mt Wickham remediated and being monitored. • Four cluster groups established with landholders working together to improve practice. • Policy round table held to enhance communication between landholders and government. • Over 25 landholders involved in the grader project which delivered small scale erosion works. • New incentives grants rolled out and supporting landholders to implement improved practice. • Work done with other landholders including council to develop educational packages for best practice erosion control. • Community water sampling completed and results presented back to the graziers. Wet Tropics MIP: • Over 200 farmers engaged via a variety of initiatives including industry workshops, shed meetings, training events, field visits, one-on-extension, and the Leadership Program. • Nine demonstration sites established to showcase best management practice, pathways of pollutants loss, real time water quality data and economic estimates. • Five catchment repair and treatment systems implemented. The bioreactor, high efficiency sediment basin and in-drain wetland are operational with the constructed wetland and landscape wetland close to completion. • 30 new water quality-monitoring sites established and operating at a range of scales and land uses. Growers are key recipients of the data generated through 15 local shed meetings. • Reef Credit scheme in development with 22 growers interested in the Reef Credit pilot to reduce nutrient run-off from their farms, while generating income from providing this environmental service.
	DES's scientific information, technical expertise and advice supports research agendas underpinning Reef 2050 Plan and the Queensland Government.	$162,000	$156,000	Annual	DES	The investment supports DES Science's technical expertise, analysis, advice and science and research programs underpinning the Reef 2050 Water Quality Improvement Plan and the Queensland Reef Water Quality Program. Program support includes facilitation and participation in governance arrangements, committees and technical working groups	• Provided scientific and technical advice and information to inform and value add to the development of Reef policies and programs. • Participated in Reef governance and collaborated across Reef stakeholders to support integrated delivery of policy, science, monitoring, modelling and evaluation, particularly to ensure consistency in field data collection standards, and monitoring programs across organisations. • Co-funded the development of an online visualisation dashboard for pesticide guidelines exceedance reporting to improve the science communication of GBR Catchment Loads Monitoring Program outputs.

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	Economic validation of practices						
	Validating the economics of management practices that improve water quality and providing this information to landholders in decision support tools and as part of the extension program.	$1,395,000	$1,223,000	Annual	DAF	The Reef Water Quality Economic Evaluation Project addresses gaps in economic knowledge of best management practices, and communicates findings to improve profitability and sustainability. Information developed from this project informs the profitability, cost-effectiveness and prioritisation of investment. The project has four major components: 1. Validation of Management Practices 2. Decision Support Tool Development and Support 3. Economics Extension and Education 4. Economic Modelling. DAF's agricultural economists engage directly with growers and industry stakeholders, including in collaboration with industry organisations, government departments and Natural Resource Management Groups. Key commodities of focus include sugarcane, grazing, bananas and grains.	• DAF's economists engaged over 340 agricultural producers and farmers through workshops, field days and on-farm activities. Feedback from these events was very positive with greater than 85% rating these as very useful and 81% intending to make changes to their management. Feedback also shows a high demand for economic activities and information to be embedded in extension programs. • DAF collaborated with industry organisations, government departments and Natural Resource Management groups to evaluate the economics of Best Management Practices for sugarcane, grazing, grains and bananas. Key project themes in 2018-2019 included nutrient and pesticide management practices, soil health, grazing cover management, gully rehabilitation and sugarcane harvesting. • A gap analysis report "Understanding the economics of grain cropping management practices and systems for improving water quality run-off in the Great Barrier Reef catchment areas" was completed. The report identifies knowledge and gaps in the practices recommended by the Paddock to Reef Practice Framework for improving water quality in the grains industry. This report will assist in prioritising research activities in grains.
2.4 Identify and address barriers to change and practice improvement uptake through programs and policy.	**Innovation**						
	Great Barrier Reef Innovation Fund addressing agricultural management practices, water treatment systems and water and support to the Coral Abundance Innovation Challenge.	$2,477,506	$2,010,000	Additional	DES	The Innovation Fund is delivered through a suite of projects: *Innovative gully remediation* • The innovative gully remediation project is a collaboration between the Queensland Government and Greening Australia. The primary purpose of the project is to trial different techniques for gully remediation (in the Burdekin) to deliver more cost-effective solutions that can be applied across Great Barrier Reef regions. The works and activities are being implemented at Strathalbyn Station. *Barratta Creek* • The construction and monitoring of a surface-flow treatment wetland to trap and reduce dissolved inorganic nitrogen and other contaminants contained in sugarcane irrigation tail-water before it enters Barratta Creek *Bentonite and limestone use in sugarcane* • A trial in the Mackay Whitsunday sugarcane region to test two different types of agricultural limestone for water quality and soil health benefits.	*Innovative gully remediation* • A minimum of 12 hectares of direct interventions were undertaken during the year. • A monitoring station was installed by DES, downstream of the trial sites. • The results from the Phase 1 monitoring program have been collated and are being interpreted by an independent expert. • The monitoring program has been reviewed and lessons learned will be documented in the Monitoring Strategy. • Learnings from the current works implementation are being applied at a second gully complex on the property and in a new project funded by the Great Barrier Reef Foundation. *Barratta Creek* • Ongoing monitoring of the effectiveness of the system at treating water. *Bentonite and limestone use in sugarcane* • Monitoring at the original site and the establishment of a new site to assess the effectiveness of the different limestone types in improving nutrient retention in sugarcane. *Validation of water quality improvement – wetland treatment trains in the Mackay Whitsunday region*

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						Validation of water quality improvement – wetland treatment trains in the Mackay Whitsunday region • Water quality monitoring of existing wetland treatment systems as an alternative to traditional sediment basins and cane drains in improving water quality once it has left the farm gate. *Cheaper nitrogen sensors* • The cheaper nitrogen sensor challenge funded the development and trial of significantly cheaper nitrogen sensors for monitoring in Great Barrier Reef catchments. Additional funding was provided for an additional field trial following completion of the trial. *Coral abundance* • The Queensland Government in collaboration with the Australian Government sought innovative solutions to boost coral abundance on the Great Barrier Reef in response to recent coral bleaching events. *Denitrifying bioreactors in the Russell catchment* • The establishment of water quality monitoring in the Wet Tropics, focusing on the effectiveness of bioreactors at reducing dissolved inorganic nitrogen. *Bioreactors for GBR* • The establishment of monitoring of denitrifying bioreactors in the Burdekin region. *Remote Livestock Management Systems (RLMS)* • The Fitzroy Basin Association (FBA) in conjunction with Precision Pastoral Pty Ltd is trialling Remote Livestock Management Systems (RLMS) on grazing properties in the Fitzroy over three years from 2017. This solar powered system is designed to identify, weigh and draft cattle remotely. Information is matched with satellite data on the 'greenness' of pastures in a paddock to help guide more timely decision making for better animal performance and reducing overgrazing. The project is determining how effective graziers find this technology in guiding timely decisions such as when to adjust stocking rates, market and sell cattle, and supplement to reduce pressure on pastures and maintain land condition. *Variable rate tech* • The variable rate tech project will advance the adoption of precision agriculture (PA) and variable rate (VR) practices in intensively cropped and irrigated horticulture in the Wet Tropics (Barron River basin)	The continued monitoring and analysis of water quality data to determine the effectiveness of treatment wetlands in improving water quality in cane areas. *Cheaper nitrogen sensors* • The proof-of-concept field trial was carried out across the Wet Tropics and Mackay Whitsunday regions, enabling wet season data comparisons with established sensors and lab samples. A small additional field trial was carried out during the wet season to further test the capabilities of nitrogen sensor probes. *Coral abundance* • The completion of feasibility studies and the commencement of proof-of-concept projects for selected solutions. *Denitrifying bioreactors in the Russell catchment* • The construction of a new bioreactor site and the ongoing monitoring of all sites to determine the effectiveness of mitigating nitrogen run-off. *Bioreactors for GBR* • The establishment of new bioreactors and the ongoing monitoring of water quality outcomes. *Remote Livestock Management Systems (RLMS)* • Since starting in 2017, Remote Livestock Management Systems have been set up on three grazing properties across different land types in the Fitzroy. Each landholder has a different enterprise and uses the system differently. The weighing system has been used to easily draft, manage cattle and sell a mob before they started to slip. FBA made links between average daily gains in cattle and falling land condition. Graziers are still learning from experts as to what the changes in 'greenness' of pastures from the Normalised Difference Vegetation Index (NDVI) means for decision making on their property. Work is also underway to determine how well 'greenness' data can be used to predict pasture yields. *Variable rate tech* • Site specific management plans to address soil health and precise crop nutrition have been developed and implemented • Ground-truthing is completed on two out of three properties on the plans implemented. • Run-off and sediment modelling has been initiated on one farm to understand the risk of sediment and nutrient transport under irrigation and rainfall events. *Radishes for water quality* The trial has progressed well. Radish growth is strongly influenced by seasonal rainfall variation. Results to date have been promising based on soil health measures and soil moisture data.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
						and Burdekin (Haughton and Don River basins) to optimise the precise placement of fertiliser, amendments and irrigation. *Radishes for water quality* The project is trialling the use of deep-rooted daikon radishes to improve water infiltration and decrease run-off from citrus crops in the Wet Tropics region.	
2.6 Trial and implement innovation in technologies for on-ground management, water treatment and monitoring.	Implement projects to build on successful trials of on-ground management practices. DAF's agricultural research and development projects in relation to grazing, sugarcane, grains, bananas and horticulture are delivered with partner organisations including industry and universities. These projects provide significant Reef water quality benefits through exploring new technology and practices, improved pesticide and fertiliser management, economic evaluation and incorporating improved management into farming systems.	$1,240,000	$1,240,000	Annual—co-contribution	DAF	DAF's agricultural research and development projects are trialling innovative practices in cane, grazing, grains and horticulture. Monitoring data is used to validate the water quality impact and economic benefits for farm businesses.	• A Next Generation fertiliser project has identified several promising fertiliser formulations including those that can decrease leaching losses, increase overall nitrogen uptake and increase late-season nutrient uptake. Trial plots have been established in the Wet Tropics and Burdekin cane growing districts in collaboration with industry partners to test these formulations. • Significant progress is being made in research to improve integrated pest and weed management in bananas including the screening of new chemical, biological and material products for pest control; the evaluation of legumes and grasses for resistance to soil pests; and viral and fungal diagnostics. • DAF completed 16 economic evaluation case studies of innovative management practices in the sugar cane industry for the Project Catalyst program in 2018–2019. Case studies included trickle irrigation, alternate row irrigation, nutrient and pesticide applications, and matching cane varieties to soil type. Case studies can be found on the Queensland Government website. • Research to improve the climate forecast model output for northern Australia will provide agriculture in northern Australia with better and more skilful forecasts for decision making. A case study of the north Queensland flood event indicated the new model output provided some predictability of the event occurring and its size, but not the extent of the extreme nature of the event. Future refinement of the model should provide better and more skilful forecasts. • Feedback from key sugar industry stakeholders on prototype extreme climate event forecasts has indicated the new forecasts for shorter-term, multi-week out to monthly and seasonal forecasts, three months ahead, may be very useful for industry decision making across the sugar industry value chain. Additionally, the format in which products are presented to users will be modified using stakeholder feedback to ensure the final products are user friendly to improve land management decision making.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
	Science in the Paddock						
	Targeted projects of direct action to address water quality pollutants across all agricultural industries based on priorities through the Science in the Paddock program.	$3,968,832 $364,648	$3,785,965	Annual and Additional	DES	The Science in the Paddock program is delivered by a suite of projects across all Reef catchments.	Science in the Paddock program 35 projects were underway in 2018–2019, across areas including: • Improved knowledge of nutrient and sediment processes in agricultural systems. • Pesticide monitoring and progress towards guidelines. • On-ground demonstration of improved practice.
	Demonstration projects to encourage improved practice uptake at a local scale.	$496,450	$646,450	Annual	DES	*Engaging Burdekin sugarcane farmers for improved water quality outcomes* This project will show that farming profit, productivity and environmental benefits can result from practice change. The engagement strategy and model achieved is anticipated to be applicable across the region. *Protecting our chemicals for the future through the acceleration of Best Management Practices project in the Wet Tropics.* Initiated in 2016, the project set objectives to improve management practices around chemical use in sugarcane in the Tully, Innisfail/Babinda and Mulgrave milling areas by extending research findings through grower group work and field demonstrations. A broad range of research focusing on reducing losses of herbicides at the paddock scale was informed practices demonstrated by the project. This included: • Developing an alternative herbicide management strategy to replace PSII herbicides in the Wet Tropics. • The Paddock to Reef Integrated Monitoring, Modelling and Reporting Program Mackay Whitsunday research trials. • Reducing the risk of herbicide run-off in sugarcane farming through controlled traffic and early-banded application. • Precision application (band spray) of herbicides on sugarcane in the Burdekin region.	*Engaging Burdekin sugarcane farmers for improved water quality outcomes* The project successfully engaged the 14 cane farms adjoining Horseshoe and Lilliesmere lagoons. Water monitoring results were provided to each farmer in a personalised report. A number of farmers trialled new practices including different nitrogen products and some application rate reductions. Various tools and activities were designed and delivered addressing gaps in knowledge and barriers to practice change. At project completion, most farmers have shown a willingness to adopt the trialled practices more broadly across the farm, and many are interested in continuing their involvement in trialling. All participating growers increased their knowledge, understanding and awareness of the connections between cane farming and wetlands. *Protecting our chemicals for the future* has been a successful project for practice change outcomes. The project has also influenced messaging around herbicide use across multiple programs in the Wet Tropics. Interest in the project findings extended outside of the project area, resulting in opportunities for future expansion. Using social science to inform the project processes has prompted careful consideration about activities, messaging and taking more time to talk with and listen to growers and industry.
	Burdekin cane farmer engagement: complete nutrient management planning for cane farming.	$492,000	$423,600	Annual	DES	The aim of the project is to engage 210 cane farms in the Burdekin area to adjust their fertiliser rates in line with SIX EASY STEPS, as required for their crop. This will contribute to Reef 2050 WQIP objective of achieving a 60% reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads.	• The project engaged a further 47 farms in 2018–2019 delivering the full program including personalised nutrient management plans, calibrations, baseline and post practice surveys while providing on-farm and over the telephone support to the growers for a full year. • Google Earth and SIX EASY STEPS training was offered to all growers. • The project achieved a 58 tonne reduction in nitrogen application across engaged farms in 2018–2019 with 194 tonnes saved over the three years of the project.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
Catchment restoration							

3.2 Use guidelines, Traditional knowledge, and other decision support tools to design and inform interventions.	Queensland Wetlands Program including:
	• provision of wetlands tools and WetlandInfo web site
	• delivery of Walking the Landscape whole-of-catchment management understanding.
		$200,000	$156,000	Annual	DES	The Queensland Wetlands Program continues to provide policy, governance, tools, information and stakeholder relationships in order to ensure the effective delivery of the Wetlands in the GBR catchments Management Strategy 2016–2021.	• Maintained and updated the WetlandInfo website.
							• Maintained and provided secretariat support for the GBR Wetland Network.
							• Delivered Walking the Landscape and management intervention workshops and built capacity in regional Natural Resource Management bodies to facilitate their own workshops. Workshops held during 2018–2019 include:
							  o Saltwater Creek, Gregory River, Rocky Dam Creek, Plane/Sandy Rivers.
							• Six additional catchment stories were released on WetlandInfo:
							  o Ross River, Bohle River, Lower Burdekin, Pioneer River, Black River, Magnetic Island.
							• Ensured good governance via the Queensland Wetlands Program Governance Group.
							• An additional 79 projects added to the Wetland Projects Search Tool (an interactive online spatial tool that features on-ground wetland-related projects across all of Queensland, with a focus on the catchments of the Great Barrier Reef – hosted on WetlandInfo) bringing the total number of projects to 730.
							• Treatment systems pages created on WetlandInfo to provide easy-to-use, authoritative advice on the selection, implementation and management of treatment systems to improve water quality.
							• Updates were made to the Assessment Toolbox and Wetland site management and rehabilitation pages on WetlandInfo to ensure stakeholders have relevant, up-to-date information to effectively manage wetlands.
							
							Contribute to and support applied scientific research into priority knowledge gaps. Key publications supported: Waltham et al (2019) _Lost Floodplain Wetland Environments and Efforts to Restore Connectivity, Habitat, and Water Quality Settings on the Great Barrier Reef_. Front. Mar. Sci. 6:71. Adame et al (2019) _Managing threats and restoring wetlands within catchments of the Great Barrier Reef, Australia_. Aquatic Conserv: Mar Freshw Ecosyst. 2019;1–11. Adame et al (2019) _Nitrogen removal by tropical floodplain wetlands through denitrification_. Marine and Freshwater Research.

3.3 Trial and implement innovation in catchment repair and restoration projects to reduce sediment and nutrient delivery to the Reef.	Targeted projects of direct action through sustainable landscape management and system repair including riparian revegetation, gully repair, streambank stabilisation and coastal wetlands rehabilitation.	$4,024,000	$4,434,690	Annual	DNRME	Five Natural Resource Investment Program (NRIP) Reef Water Quality projects were awarded in the first round of funding. NRIP is a four-year program funded until 2022. Overall expenditure across the four years will be within budget.	Highlights in the first 12 months include: • project planning and design • stakeholder engagement • identifying priority locations for projects via various methods including Walking the Landscape workshops

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
							• commencing on-ground works including preparation of riparian repair and restoration sites • collaborating between the NRIP team and Regional Natural Resource Management bodies to standardise modelling and monitoring methodologies that will provide consistent measurement indicators of change in the management and condition of natural resources across all projects and regions.
	Streambank and gully remediation projects including innovative gully remediation in partnership with Greening Australia and erosion management plan and operational works on Springvale Station.	$1,156,141	$1,513,161	Additional	DES	*Fitzroy River Catchment Erosion Gully Restoration: reducing the GBR sediment load* The project will undertake gully restoration in conjunction with local landholders in high priority areas within the Fitzroy River catchment (e.g. located within the Mackenzie Management Unit near Blackwater or Lower Dawson) of central Queensland. Greening Australia's integrated approach focuses on building on existing work underway in this and surrounding catchments. The expected outcome will be a significant reduction in erosion and sediment run-off, and improved productive capacity of the land in the long term. The *Springvale Station Erosion Management Plan* (EMP) was delivered and will be used to guide erosion management activities on Springvale Station. Implementation of the erosion management plan will commence in 2018–2019. Over time and through appropriate land management and remediation works, the aim is to reduce the risk of new gully erosion occurring and reduce the areas subject to gully erosion and growth of established gullies.	*Fitzroy River Catchment Erosion Gully Restoration: reducing the GBR sediment load* The project contributes to: • remediating gully, streambank and riparian erosion areas • revegetating land to improve stabilisation of key sites in erosion areas and planting of native or local plants • constructing fencing to control or remove cattle or feral animals and protect gully, stream bank and riparian erosion areas • constructing porous check dams/heads cut stabilisation structures/cost effective reshaping earth works or other methods of gully and stream bank stabilisation structures • undertaking extension and other activities to encourage landholders to adopt key land management changes to protect gullies, streambanks and surrounding areas • improving knowledge of cost-effective mechanisms for gully treatments and reducing sediment • monitoring, reporting project progress and achievements and reporting on the outcomes of the gully and streambank remediation plans. *Springvale Station Erosion Management Plan* • Sections of Keetings Track have had significant form and drainage works. This will enable better access to major road gully choke points when gully remediation actions commence. • Actions to decommission Cook Dam (approximately 28 hectares), an unauthorised dam on the property with approximately 1000 megalitre capacity, have occurred including installing a fish ladder. • A program of surveying and managing feral pig and cattle distribution (benchmarking) has been undertaken and a feral pig management program has been implemented. • As part of the broader Springvale Station Communication Framework, information on Springvale including the sediment management approaches have been uploaded to the WetlandInfo's Normanby catchment Story.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
							• The project contributed to improved infrastructure for the Normanby River water quality monitoring program and the Great Barrier Reef Catchment Loads Monitoring Program. • An evaluation of the availability and sources of native seed for gully remediation works was undertaken. Native grasses, forbs and understorey vegetation were recommended to assist in the remediation of gully complexes. However, acquiring adequate amounts of native seed on Springvale is not guaranteed given prior land use. DES engaged the services of a botanist to estimate the potential seed volumes and practices that could be supplied for the remediation actions. • To undertake remediation works that address the recommendations from the Erosion Management Plan a detailed design was commissioned for gully sites along Keetings Road. • Contracted works for road gully repair and stabilising gully erosion in sections along the property track (Keetings Road to Keetings Yard), will focus on active erosion sites caused by the concentration of water run-off from road scouring and step gully crossings with no/few control berms. Sites include highly erodible alluvial soils which have caused major narrowing of the access track formation and unstable batters and on adjacent alluvial gullies.
	Reef Islands Project - protecting the Reef's most precious land and seascapes with a focus on islands and their adjacent waters.	$0. One-off investment complete.		Additional	DES		
	Reef water quality projects in the Central Queensland region seeking to reduce nutrient, pesticide and sediment losses to waterways.	$2,863,473 $260,000	$2,221,414	Additional and Annual	DES	*Delivering tailored solutions to Mackay Whitsunday growers to improve nutrient management* The project will provided tailored agronomic support to 150 farmers in the Mackay Whitsunday region with the aim of improving their confidence and providing them with the skill set to implement the SIX EASY STEPS program. Working with the respective productivity services, the project will engage 50 farmers each year from across the Mackay, Plane Creek and Proserpine catchments. Growers will be benchmarked on current practices and then work with a skilled, local agronomist, to develop a tailored nutrient plan based on the SIX EASY STEPS. *Pathways to water quality improvements in the Myrtle Creek sub-catchment* Four cane farmer groups within the Myrtle Creek sub-catchment will investigate impacts on water quality of their current farming practices, and evaluate the	*Delivering tailored solutions to Mackay Whitsunday growers to improve nutrient management* The project engaged 57 farms in its first year delivering the full program including personalised nutrient management plans, calibrations, baseline and post practice surveys while providing on-farm and telephone support to the growers for a full year. Google Earth and soils training workshops were offered to all growers. A 98 tonne reduction in nitrogen application was achieved. *Pathways to water quality improvements in the Myrtle Creek sub-catchment* The three-year project funded by DES and Sugar Research Australia, in partnership with Sugar Services Proserpine, set up eight water samplers across four paddocks to monitor and evaluate end-of-paddock water quality impacts of changed practices. Commencing in late 2018, the results from the first wet season were shared with more than 50 growers with most measurements indicating low levels of nutrient and pesticide run-off.

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						practicality, economics and water quality impacts of alternative farming practices. The project aims to achieve long-term buy-in from the cane farmers by directly involving them in evaluating current practices and in identifying and implementing practices that improve water quality so that water quality is 'built into' the farming paradigm and considered good for business. *Grassroots project* Resource Consulting Services (RCS) has focussed on reducing sediment and nutrient losses to waterways by supporting grazing businesses in the Fitzroy and Mackay Whitsunday regions to adopt better practices tailored to their circumstances. The project is designed to improve farm management capacity and profitability and facilitate the transition to A class land condition through increases in ground cover at the end of the dry season and showcasing sustainable grazing businesses which will help reduce sediment entering the GBR.	The project worked with several growers across the catchment to look at specific farming practices and how the practices impact water quality, sharing the learnings across the region. Through the project, growers engaged in a range of groups to discuss ideas and learn from each other. There were also on-farm demonstrations of innovative practices that compare water quality impacts in relation to conventional practices. *Grassroots project* Since starting in 2018, RCS has provided Grazing for Profit and Next Steps program training to 25 grazing businesses in the Fitzroy and Mackay Whitsunday regions. On farm consultation includes financial analysis/benchmarking and soil sampling, as well as providing property maps, taking ground cover measurements and monitoring sites were delivered with support from the Fitzroy Basin Association and Reef Catchments. Most businesses have subsequently planned and implemented remediation works on their property. Two field days were well attended by the grazing community.

Enabling delivery

Science and knowledge

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
4.1 Identify, prioritise and fill knowledge gaps through the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) Research, Development and Innovation Strategy (RD&I).	RD&I strategy development.	No project cost.			DES	*Coupling water quality and economic modelling* To provide a modelling tool to support water quality investment prioritisation including potential water quality benefits and economics. Continually update data and modelling to improve the current 'point in time' data system. *Reviewing pesticide guidelines* These guidelines are used to support reporting of pesticides in the Reef water quality report card, and pesticide exceedances through the Great Barrier Reef Catchment Loads Monitoring Program.	*Coupling water quality and economic modelling* This project was initiated in June 2019. *Reviewing pesticide guidelines* • Peer reviews of water quality guidelines were undertaken for the following pesticides – atrazine, ametryn, diuron, 2,4-D and imidacloprid. • This peer review is a critical step in these values being made national water quality guidelines under the Australian and New Zealand Environment and Conservation Council (ANZECC).
	Address priority gaps in the Reef 2050 WQIP RD&I Strategy through Reef water quality research and development programs.	$200,000	$71,140	Annual	DES		
4.2 Integrate forms of knowledge including science, policy, management, Traditional Owner and community through regular synthesis workshops and theme-specific working groups to support consistent communication messages and guidance for managers.	Annual synthesis workshop and projects across science, policy and management	$359,657	$85,600	Additional	DES	The annual synthesis workshop seeks to strengthen collaboration, identify pathways for future outcomes and present innovative approaches.	The 2018 Reef Water Quality Synthesis Workshop was held in Yeppoon in November. Participants came from a wide range of groups and organisations delivering Reef water quality outcomes.
4.3 Deliver decision support tools, communication and education	Communication projects.	$262,493	$120,766	Additional	DES	STEM Matters delivered the Science Communication Implementation Plan and priority tools. This project was	Deliverables included: • reviewed and updated the Reef 2050 Water Quality Improvement Plan website

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
products tailored to specific audiences.						jointly funded by the Australian and Queensland governments.	• created a podcast series to tell water quality stories from a range of perspectives • created a light-hearted video series featuring farmers and scientists covering topics including monitoring, modelling, nutrient and sediment run-off • audited existing Reef water quality science resources to identify gaps and inform the communication and content strategy • coordinated the finalisation of key messages and explored the best way for these to be distributed and used • developed written explainers content covering topical issues and frequently asked questions.
	Activities to improve communication and information to support large-scale change in practice including communication tools, workshops, communication strategies and implementation plans.	$384,464	$345,579	Additional	DES	The project supports the implementation of social indicators across all practice change projects funded through the QRWQP. Asking these questions will provide project managers and extension staff with a clearer understanding of project participants' attitudes and motivations to being involved in projects, as well as barriers to practice uptake and change. From the Queensland Reef Water Quality Program perspective, collecting the social indicator data will help inform program design, future investments and better describe the journey growers take towards practice change and will be used to track progress towards the human dimensions target of the Reef 2050 Plan. The Reef 2050 Communication Network continues to meet regularly to provide stakeholder input, coordinate, and share opportunities for communication. A range of communication activities were undertaken throughout the year to build understanding of the pressures on the Reef and how everyone can contribute to improving Reef health. DES collaborated with the Great Barrier Reef Foundation (GBRF) to build an educated and engaged community that understands and supports the protection and preservation of the Great Barrier Reef.	• After a period of consultation and pilot projects, social monitoring is now included in the project plan template for all QRWQP funded projects and six social questions have been added to the Paddock to Reef Land Management Practice Adoption survey. Training has been provided as part of the wider roll-out of social monitoring for on-ground practice change projects. Projects are expected to start reporting social monitoring data in 2019–2020 after which reporting against the Reef 2050 Plan human dimensions target will be possible. • Reef 2050 Communication Network Teleconferences were held in December 2018, March and June 2019, with a face-to-face meeting in Townsville in September 2018. • Funding was provided to run additional Reef Blitz events in Brisbane and regional locations in October 2018. The events aimed to encourage more people to become involved in helping protect the Reef and to minimise waste. They also promoted awareness and action for the International Year of the Reef. • DES partnered with the Australian Government and Reef Alliance to run the Reef Champion Awards. The Awards were expanded from recognising farmers and extension officers to include youth and community categories. The winners were announced at the Synthesis Workshop in November 2018 • A joint display with GBRF at the Royal Queensland Show in August 2018 outlined the threats facing the Reef, the actions being taken to protect it and how everyone can contribute to improving Reef health. • A joint display with GBRF at the World Science Festival Street Science Precinct in March 2019 focussed on the work of people, projects and animals to build up the Reef and what visitors could do to help the Reef. • The Love the Reef digital game-based application, developed for primary school aged children, was released in March 2019. It aims to inspire a love and respect for the Great Barrier Reef empowering children to make positive change and enhance their

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
							environmental citizenship. The app complements the Australian curriculum and support material has been developed for a range of learning styles. There is a dedicated website to promote the app.
Governance							
6.1 Collaborate and coordinate between the Queensland and Australian governments, in line with the Reef 2050 Plan governance structures.	Secretariat support to governance groups.	$1,055,819	$779,487	Annual	DES	DES provided support to the Great Barrier Reef Foundation Traditional Owner Program Logic Workshop held in Cairns in December 2018. DES is leading a program logic process to inform the structure of the revised Reef 2050 Plan. A climate change trajectories project will develop spatially explicit trajectories for the Reef that incorporate the relative contribution of regional and local drivers of change on the Great Barrier Reef. Mapped projections will provide greater confidence in prioritising management efforts to boost Reef resilience and recovery in a warming climate future.	The Reef 2050 Plan Traditional Owner Program Logic workshop was held in Cairns in December 2018. Outputs from this workshop will contribute more broadly to the Reef 2050 Plan review. Clear Horizon facilitated two Reef 2050 program logic workshops with members of the Reef 2050 Advisory Committee and the Reef 2050 Plan Independent Expert Panel in collaboration with Australian Government and Queensland government representatives. The University of Queensland is delivering climate change trajectories modelling. Models have been developed and optimised to run the required scenarios and modelling is underway.
6.3 Ensure accountability of investment to outcomes in the Reef 2050 WQIP.	Annual Queensland Reef Water Quality Program Investment Report/Plan.	Included in Governance		Annual	DES		
	Program management.	$271,500	$43,080	Additional	DES	- The Queensland Reef Water Quality Program Five Year Investment Plan 2017–2018 to 2021–2022 was published describing the key areas of investment across the program with a supporting investment table setting out the planned activities for 2018–2019. - The Queensland Government Annual Investment Report 2017–2018 was published. - Ongoing coordination of the program including investment planning, monitoring, reporting and database development and implementation, as describe above in section 1.1 *Data and project management system for Reef projects*.	The following documents have been published to the Queensland Government website: - Queensland Government Annual Investment Report 2016–2017. - Five-Year Investment Plan and 2017–2018 Investment Plan.
Evaluating performance							
7.1 Monitor and model management practice and water quality improvements through the Paddock to Reef program.	Implementation of Paddock to Reef program						
	Great Barrier Reef ground cover, riparian vegetation, catchment loads, wetland condition and wetland mapping and extent monitoring programs.	$1,540,000	$1,296,000	Annual	DES	DES delivers key Paddock to Reef monitoring programs including monitoring sediment, nutrient and pesticide loads; using remote sensing to measure landscape indicators such as ground cover, gullies and riparian vegetation; and assessing wetlands.	Delivered data and information to inform the 2017 and 2018 Reef water quality report cards. *GBR catchment loads monitoring program* - Monitored water quality in 30 of the 35 GBR Basins, with sites in 36 catchments. 43 sites were monitored for sediments and nutrients and 34 sites for pesticides. - Provided high quality pollutant loads for sediments and nutrients and pesticide concentrations data for ms-PAF risk

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
							metric from priority catchments for validation of the Source Catchments water quality models. *Wetland condition monitoring program* • Completed 2018 wetland condition monitoring and delivered 2017 and 2018 wetland condition reporting. • Commenced implementation of intensified sampling for the Wet Tropics region. *Ground cover monitoring program* • Published spatial datasets, results and technical reports on ground cover in grazing lands. • Provided ground cover data to incorporate in other Paddock to Reef programs e.g. the catchment loads monitoring program. *Riparian vegetation monitoring program* • Published spatial datasets, results and technical reports on riparian vegetation in Reef catchments. *Wetland extent monitoring program* • Released the state-wide regional ecosystem data (version 11) including 2017 remnant extent, forming the foundation of the 2017 natural wetlands dataset. Delivered program enhancements and wider program delivery including: *GBR catchment loads monitoring program* • Delivered Esri-based online interactive reporting platform for 2016–2017 and 2017–2018 . • Developed and delivered a modelled Pesticide Baseline based on ms-PAF methodology to be reported in the Reef water quality report card. • Expanded the Pesticide Risk Metric (ms-PAF) to 22 pesticides to be reported under the Reef WQIP. • Delivered Pesticide Risk Metric (ms-PAF) data for the Wet Tropics and Mackay Whitsunday Regional Report Cards (2017–18). *Wetland condition monitoring program* • Completed the sample design for intensifying the wetland condition monitoring program to enable future regional scale wetland condition reporting for Reef water quality report cards. *Ground cover monitoring program* • Provided advice, data and support to inform other Reef programs including the Major Integrated Projects, Regional Natural Resource Management planning, Best Management Practice programs and grazing extension efforts.

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							• Maintained and improved extension and data information systems including FORAGE, VegMachine and Terrestrial Ecosystem Research Network AusCover. • Collected and curated various field data to inform re-calibration of fractional cover data (the foundational data source used for ground cover monitoring). • Enhanced fractional groundcover data and information products for applicability to new Sentinel 2 imagery to inform Reef and drought programs. *Wetland extent monitoring program* • Delivered mapping improvements for the Reef water quality report card to report on actual loss of natural and modified wetlands. • Updated previous reporting periods to incorporate the mapping improvements (2001–2005, 2005–2009, 2009–2013) and added a new reporting period from 2013–2017.
	Catchment loads modelling, gully mapping, Paddock to Reef support to Regional Natural Resource Management (NRM) body components.	$1,540,000	$1,529,678	Annual and Additional	DNRME	*Paddock to Reef support to Regional NRM body components* Targeted project to continue the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program. Activities include data collection, management and reporting, regional liaison and regional communications. This component includes funding for the cross-regional Reef coordination. *Catchment loads modelling* Models are being rebuilt with the most up-to-date data sets including new management practice adoption data, land use, ground cover and gully maps. Modelled load reduction estimates will be generated for the 2019 report card.	*Paddock to Reef support to Regional NRM body components* The achievements of this project include: • providing annual management practice adoption data • collecting annual fertiliser and pesticide use data for relevant regional industries; • holding eight regional science synthesis workshops to review and evaluate the efficacy of on-ground Reef funded activities • producing regional communication products to disseminate Paddock to Reef results to local stakeholders. *Catchment loads modelling* Best estimate of the modelled sediment, nutrient and pesticide loads for the 35 catchments draining to the Great Barrier Reef lagoon using the latest science and input data sets. Load reductions are required for the Reef water quality report card.
	Management practice adoption reporting.	$732,000	$523,000	Annual	DAF	DAF's management practice adoption project describes and monitors the farm management practices that influence off-farm water quality. All Queensland and Australian government investments that target farm management practice improvement are required to report their project impacts in a GIS-based system which is developed and maintained as part of this project.	• Water Quality Risk Frameworks were reviewed and endorsed by the Reef Independent Science Panel, and are available on the Reef 2050 WQIP website. • Report card 2017 and 2018 results and methods reports endorsed by the Reef Independent Science Panel. • Provided data and content for the first interactive online Reef water quality report card. • Major revisions to the Paddock to Reef Projector decision support tool commenced in 2019. These revisions will improve functionality for users, streamline reporting to Paddock to Reef, and update the tool to reflect the updated Water Quality Risk Frameworks and new modelling outputs.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
							• A process for investor feedback on the cost effectiveness of projects to deliver practice change has been finalised in collaboration with the Queensland and Australian governments. There are currently 79 discrete projects operating in the 2018–2019 year that will be analysed and reported to project funders. This information will help inform future government funding decisions. • Many aspects of the program's function have undergone improvements including the development of an app interface to support the reporting and evaluation of gully remediation activities, and development of an app to monitor land condition on grazing lands.
	Monitoring, modelling, evaluation and reporting. *Note: This Great Barrier Reef wide program includes a component of work for the Major Integrated Projects (MIPs), and includes a management practice adoption component which are reported in those lines.	$1,536,000	$1,260,000	Additional	DNRME	This program includes: • Catchment modelling as part of the Paddock to Reef program to estimate the effectiveness of current and alternative management practices that reduce pollutant loads. • Paddock scale water quality monitoring of priority field trials will advance knowledge of sediment, nutrient and pesticide movement from the paddock under different management practices to evaluate their effectiveness. • Assessments of farm management data form the basis of pollutant load reduction modelling which in turn informs the investments of the Queensland and Australian governments in the Reef 2050 Water Quality Improvement Plan. • Lines of evidence of management practice adoption are reviewed and validated and then provided to the modellers to evaluate progress towards the targets.	*Catchment modelling* Catchment models were rebuilt with the most up-to-date data inputs such as new management practice adoption data, land use, ground cover, gully maps and new science to provide modelled load reduction estimates for the report card with improved confidence. *Paddock scale water quality monitoring including:* • Nutrient loss in run-off from sugarcane in the Johnstone catchment, Wet Tropics. • Groundwater investigation of nutrient and pesticide loss to groundwater and surface water groundwater connectivity in the Wet Tropics – Silkwood and Mulgrave sub-catchments. • Comparison of management practices in sugarcane and multi-farm monitoring of a sugarcane-dominated catchment; Mackay. • A paired catchment comparison of the change from pre-European land use to grazing, and the effects of multiple grazing management practices on land condition, nutrient and sediment generation rates from small adjacent catchments in the Fitzroy Basin. • Run-off and water quality monitoring from dryland grains cropping and grazing at paddock and increasing catchment scales of a sub-catchment of the Fitzroy Basin. • Increase paddock modelling capacity, support the current paddock modelling and further development of the models. • Mapping gully erosion extent in priority Reef catchments to improve accuracy in catchment models.
	Wetland condition monitoring and water quality monitoring and modelling.	$1,190,000	$1,219,000	Annual—co-contribution	DES	This is DES co-investment to deliver key Paddock to Reef monitoring and modelling programs and regional report card support.	DES scientists provided additional support to projects and programs including: • GBR catchment loads monitoring program • GBR wetland condition monitoring program • ambient water quality monitoring • catchment modelling.

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	Ambient water quality monitoring, high resolution satellite imagery.	$1,500,000	$1,500,000	Annual—co-contribution	DNRME	The surface and groundwater monitoring network delivered by DNRME provides timely and reliable flow and ambient water quality data that underpins modelling tools and loads reporting within the Paddock to Reef program. The network is maintained to an ISO 9001:2015 standard. DNRME collects high resolution satellite imagery within Reef catchments that allows the estimation of changes in land cover, land use and the extent of wetlands.	DNRME continues to invest in high quality, high resolution satellite imagery which is instrumental in Great Barrier Reef catchment monitoring and disaster mapping. Surface and groundwater data was provided within agreed timeframes and quality assurance.
	Research and development improvement of water models in the Great Barrier Reef catchments through the Queensland Water Modelling Network (QWMN).	$200,000	$577,000	Annual—co-contribution	DES	The QWMN is a cross-agency initiative to address critical gaps in the state's water modelling capability in hydrology, groundwater and water quality and support greater use of water modelling by policy makers and program designers.	The QWMN supported Reef related activities in 2018–19 including: • Published the Prosser report on gully and streambank erosion. • Conducted an open tender for innovative solutions to five challenge statements supporting the QWMN Research, Development and Innovation Strategy. Four of the five proposals recommended for funding related to Reef programs (two were co-funded by DES). • Developed a first order model for gully erosion in GBR catchments (through the QWMN Reef Fellow). • Undertook a critical review of climate variability and climate change projections in Queensland water models with a case study. • Tracked the effectiveness of gully management at reducing bioavailable particulate nutrients (BPN) to inform standard BPN methods. Collection and processing of BPN data in Reef catchments supports the validation of gully and wider Paddock to Reef modelling. • Enhanced hillslope erosion predictions of Paddock to Reef catchment modelling for grazing lands through better prediction of daily rainfall and run-off peak rates. • Enhanced Reef and state-wide modelling capabilities through the QWMN External Engagement Program, e.g. mentoring of graduates in the Source model and two out of five PhD Innovation Associates had a focus on Reef catchments.
	Collection, storage, access and enhancement of information that support catchment restoration and land management as well as monitoring, modelling and reporting of outcomes in Reef catchments.	$870,000	$921,000	Annual—co-contribution	DES	This investment provides a range of foundational landscape monitoring and scientific computing infrastructure and services that underpin and support Reef programs: • Statewide Landcover and Tree Study (SLATS) • Queensland satellite image archive • Queensland Land Use Mapping Program (QLUMP) • Queensland Crop Monitoring Program • ground cover monitoring research and development	Investment highlights include: • Delivered updated Land Use and Land Use Change Mapping for the Fitzroy and Burnett Mary regions. • Released the 2016–2017 and 2017–2018 SLATS report and regional and Reef catchments data summary reports in December 2018. • Published to open data the 2016–2017 and 2017–2018 SLATS reports. • Published to open data various seasonal and monthly remotely sensed vegetation products.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
						• soil and nutrient management for productive agriculture and ecosystems services in Reef catchments • decision support and improved management practices for informed nitrogen management and nutrient efficiency • analytical laboratory services.	• Maintained high performance computing systems and satellite image archive. DES scientists provided in-kind support to the QRWQP and commissioned projects including: • Contributed to the collection of pasture biomass data in Reef catchments using field and Unmanned Aerial Vehicle approaches. • Provided advice and data to support projects extending the Wambiana grazing trials to other trial sites. • Developed land suitability frameworks for cropping lands to support the proposed Reef regulations. • Contributed technical advice for the review of sugarcane minimum standards. • The Chemistry Centre laboratories processed 3421 samples from the GBR Event Monitoring Program, with more than 19,000 tests performed.
	Data management and delivery through Science and Spatial Information Management for Reef (SSIMR).	$170,000	$59,095	Annual	DNRME	Data management and delivery for SSMIR provided through Data Recording Tool for Science (DARTS) and Science and Knowledge Information Provision (SKIP) systems.	Ongoing support was provided for the DARTS and SKIP systems. The software upgrade for DARTS was completed and the software upgrade for SKIP was advanced.
7.4 Evaluate the effectiveness of programs, governance mechanisms, and adaptations.	Develop an evaluation framework and annually evaluate and report on performance of overall Reef investment program and review governance.	$82,965 $50,000	$105,505	Annual and additional	DES	Following the evaluation framework and first year evaluation, all recommendations for improvement were resolved. Planning for the second program evaluation was progressed, with the second evaluation beginning early in the 2019–2020 financial year.	
7.5 Report progress towards targets, objectives and outcomes.	Develop and release a Reef Water Quality Report Card.	$484,131	$433,186	Annual	DES	Develop and release a Reef Water Quality Report Card.	The 2017 and 2018 Report card was published in August 2019. Results are able to be interrogated through a new interactive report card.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
7.6 Communicate regionally relevant information for management decisions and local communities.	Regional report card partnerships membership and support.	$2,278,662	$2,367,010	Annual	DES	Regional report card partnerships have a common goal of improving local waterways and the quality of water flowing to the Great Barrier Reef, through a greater understanding of regional waterway health. Funding was provided to support the continuation of the Gladstone Healthy Harbour Partnership, the Mackay–Whitsunday Healthy Rivers to Reef Partnership, the Wet Tropics Partnership, the Fitzroy Partnership for River Health, and the Townsville Dry Tropics Partnership for Healthy Waters, which formally launched as a partnership in January 2019. The Urban Stewardship Framework is a system of classifying urban water management activities into activity groups with similar management objectives and assessing how well those objectives are being achieved. It covers water management activities relating to greenfield development, brownfield development, sewage treatment plants, and operating and maintaining sewerage networks. These activities contribute to sediment and nutrient loads entering the Great Barrier Reef lagoon. Results will form part of the regional report cards. Being able to assess the effectiveness of land use management in urban areas within the GBR catchment is an action in the Reef 2050 WQIP, as is fostering innovation and improvement in (i.e. stewardship of) point source pollution management. *Deliver Reef monitoring and report cards and enhanced systems* This investment supports DES' ambient monitoring program which assesses current and long-term trends in water quality and ecosystem health and provides estuarine and freshwater fish data to support the development of regional report cards.	Regional report cards communicate regionally relevant information on the condition of freshwater, estuarine, inshore and offshore ecosystems. They also report regionally on social, cultural and economic health and stewardship. The partnerships are a collaboration of science, industry, government, community, Traditional Owners, farmers and fishers and conservation and tourism representatives, who together, have a shared vision for healthy waterways in their regions and develop annual regional waterway health and management practice report cards. • The Wet Tropics Partnership released the Wet Tropics 2018 report card. • The Townsville Dry Tropics Partnership for Healthy Waters released its pilot report card, covering 2017–18 data. • The Mackay-Whitsunday Healthy Rivers to Reef Partnership released its 2017 report card. • The Fitzroy Partnership for River Health released its 8th annual report card, covering 2017–18 data. • The Gladstone Healthy Harbour Partnership released the 2018 report card. Trialling of the new Urban Stewardship Framework, with local governments, will begin in late 2019. *Deliver Reef monitoring and report cards* • Completed the 2017–18 estuarine and event monitoring for the Wet Tropics and Mackay Whitsunday regions for the 2019 report cards. • Initiated a monthly water monitoring program in the Black River basin to support the Townsville Dry Tropics (Black/Ross) regional report card. • Appointed a fish modeller in December 2018 to undertake modelling of freshwater fish species for the Wet Tropics, Townsville Dry Tropics and Mackay Whitsunday report cards. • Completed a 1:25,000 digital elevation model of the Mackay-Whitsunday and Mulgrave-Russell (Wet Tropics) areas to underpin the fish model. • Sampled and resampled fish communities at 26 sites in the Russell and Mulgrave basins. • Assessed the ecological condition of freshwater fish communities for the Mackay Whitsunday region and Russell and Mulgrave basins with results included in the 2019 report cards.

Overarching action in Reef 2050 Water Quality Improvement Plan	Activity within the Queensland Reef Water Quality Program	2018–2019 Planned investment	2018–2019 Expenditure	Funding source	Lead agency	Investment summary	Outcomes achieved
7.7 Make data and information publicly available through a range of communication products.	eReefs	Investment commences 2019–2020					