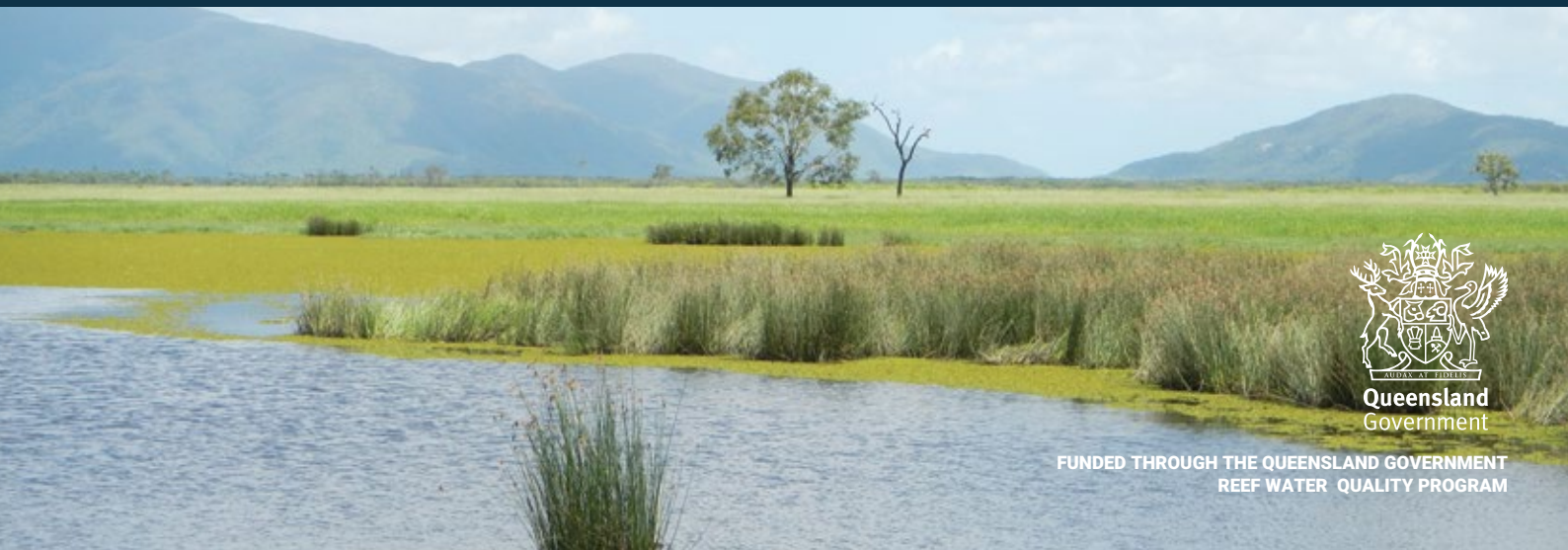
BURDEKIN SUGAR

ENHANCED EXTENSION COORDINATION

Regional Extension Plan



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This Plan has been compiled by the Terri Buono, Burdekin Sugar Regional Extension Coordinator based in the Department of Agriculture and Fisheries, in collaboration with the members of the Burdekin Cane Extension Group.

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The Burdekin Sugar Regional Extension Plan has been developed by the Burdekin Sugar Regional Extension Coordinator with the assistance and significant technical contributions of members of the Burdekin Cane Extension Group, the Enhanced Extension Coordination in GBR project team, researchers and others.

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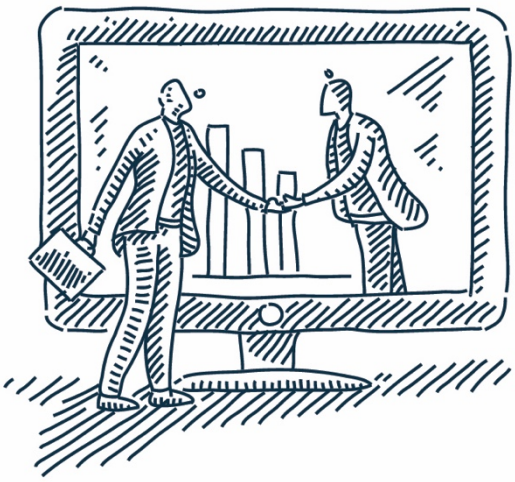

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Summary

ENHANCED EXTENSION COORDINATION IN GBR PROJECT

The **Enhanced Extension Coordination in GBR Project** is operating in six GBR Natural Resource Management regions in Queensland. The Burdekin Sugar Regional Extension Coordinator is delivering the project in partnership with the Burdekin Cane Extension Group (BCEG) to improve extension services supporting the cane industry in the Lower Burdekin.

SOME KEY PROJECT OUTCOMES:

- Enhanced communication, coordination and planning
- A Community of Practice to coordinate extension delivery
- A framework to co-design and implement effective collaboration
- Empowering local decision making
- Improving extension officers' skills and capacity
- New ways of working together

BENEFITS...

FOR GROWERS:

- ✓ Enhanced delivery of extension services
- ✓ More coordinated and effective support for growers
- ✓ Better access to improved information and highly skilled extension officers
- ✓ Opportunities for Peer to Peer grower groups

Did you know funds have already supported seven projects in the Burdekin including the Lower Burdekin Irrigation Extension Action Plan

FOR EXTENSION STAFF:

- ✓ Connection to regional extension networks
- ✓ Up-to-date information on project work, funding programs and opportunities to collaborate with colleagues
- ✓ Opportunities to be part of decision-making and coordinated program design
- ✓ Access to training and professional development opportunities and specialised expertise

Did you know funds have already supported six training workshops for Extension Officers including Soil Health

REGIONAL EXTENSION PLAN

A Regional Extension Plan (REP) for Burdekin Sugar was developed to improve coordination and collaboration in the Lower Burdekin extension network and more efficiently target delivery of agronomic extension advice to sugarcane growers.

A collaborative approach will enhance local capacity and ensure sugarcane growers can easily access information, technology and technical support. This enables growers to make informed decisions around optimal farming practices to improve water quality and profitability of the sugarcane sector.

THE LOWER BURDEKIN EXTENSION NETWORK

Sugar producers have access to a wide range of extension providers including industry organisations, private consultants, agri-businesses, NRM organisations and government agencies. These organisations and bodies comprise the Lower Burdekin extension network.

The Burdekin Sugar Regional Extension Coordinator has developed a collaborative and coordinated approach to extension delivery in the Burdekin through the Burdekin Cane Extension Group (BCEG).

This group includes partner organisations that either provide extension advice or manage water quality projects. The BCEG recognises that by working collectively together they can better service the needs of growers and help them to improve farming practices, profitability and demonstrate associated benefits to water quality.

BURDEKIN CANE EXTENSION GROUP

- AgriTech Solutions • Burdekin Bowen Integrated Floodplain Management Advisory Committee (BBIFMAC)
- BRIA Irrigators Ltd • Burdekin Productivity Services • Canegrowers Burdekin Ltd
- Department of Agriculture and Fisheries • Farmacist • NQ Dry Tropics • Sugar Research Australia
- Wilmar Sugar

PROJECTS FUNDED IN THE LOWER BURDEKIN

All decisions on projects are made locally through a collaborative approach by extension providers.

PROJECT HIGHLIGHTS SO FAR:

- ✓ A collaborative approach to improving irrigation efficiency in the Lower Burdekin
- ✓ Access to innovative practices, ideas and technology from other regions
- ✓ Women in the sugar industry are empowered to tackle the challenges they may encounter in the future
- ✓ New ways to address water quality through innovations

BBIFMAC staff member analysing water in a sugar cane paddock.

TRAINING AND CAPACITY BUILDING:

The Training Development Manager is providing training and capacity building to local extension providers by identifying and delivering regional needs and providing subsidies for participants on completion of courses.

Training for extension staff has included: facilitation and communication skills, irrigation management, soil health and social science.

To find out more about the Burdekin Sugar Regional Extension Plan and extension networks, please contact Terri Buono, the Burdekin Sugar Regional Extension Coordinator based at the Department of Agriculture and Fisheries in Townsville.

Terri.Buono@daf.qld.gov.au or phone 3330 4509.

This program is funded by the Queensland Government Reef Water Quality Program and delivered by the Department of Agriculture and Fisheries with partner organisations: Cape York NRM, Terrain NRM, NQ Dry Tropics, Fitzroy Basin Association and Burnett Mary Regional Group.

Queensland Government

BURDEKIN SUGAR

ENHANCED EXTENSION COORDINATION

Regional Extension Plan

BURDEKIN SUGAR REGIONAL EXTENSION PLAN

INTRODUCTION

Extension is the process of enabling change in individuals, communities and industries involved in the primary industry sector. Extension has a long-term benefit contributing to the social capital of a region through enabling social change and cohesion in managing agriculture and limited resources, sharing of knowledge and supporting enterprise development (Vanclay & Leach, 2011). It helps communities improve their own production and lifestyles, while safeguarding public good assets, such as the Great Barrier Reef (GBR).

In 2016, the Great Barrier Reef Water Science Taskforce (the Taskforce) recommended that the Queensland Government invest in more targeted and coordinated extension to support large-scale land management practice change that would result in improved water quality outcomes for the GBR and accelerate achieving the objectives of the Reef 2050 Water Quality Improvement Plan 2017-2022 (Reef WQIP 2050), (State of Queensland, 2019).

In response, the Queensland Government engaged an independent consultant to review the status of extension and education (E & E) systems in reef catchments to inform an implementation strategy for the Queensland Government and guide the delivery of funding aligned to the Taskforce Recommendation 3: Extension and Education under the Queensland Reef Water Quality Program (DEHP, 2016). The final report: *Practice Change, Education and Extension in Reef Catchments* (Coutts et al., 2017)[1] was published in June 2017.

A constant theme reported in the E & E Review was the fragmentation of the extension effort, also highlighted in the Taskforce findings and the need for better integration and planning of funded programs prior to implementation in the regions. The review identified a range of issues and made 65 recommendations on the E & E systems to build on extension capacity in GBR catchments under the following themes:

- Improved coordination and collaboration of extension projects,
- Skills gaps and the need for training and capacity building, and
- More effective monitoring and evaluation of the extension effort and outcomes.

[1] Here after referred to as the E & E Review https://reefextension.couttsjr.com.au/.

In consultation with the reviewer, two projects to address recommendations of both the Taskforce and the E & E Review commenced in 2016/17. These were; a pilot capacity building program to provide extension training and work placement to graduates administered by the Queensland Farmers' Federation (QFF); and the Enhanced Extension Coordination in GBR project administered by the Department of Agriculture and Fisheries (DAF).

The first of these projects was successful in training six graduates in extension services who were all offered positions in extension organisations in GBR catchments. Through the second project Regional Extension Coordinators (RECs) have been appointed to engage local coordination groups/networks and develop Regional Extension Plans (REPs) in the six GBR Natural Resource Management (NRM) regions (Cape York, Wet Tropics, Burdekin, Mackay-Whitsunday, Fitzroy and Burnett Mary). The Burdekin Sugar Regional Extension Plan (REP) is one of these plans and applies to the sugarcane growing areas of the Lower Burdekin (**Figure 1**).

Figure 1: *Map of the two sugarcane growing management areas in the Lower Burdekin catchment, the BRIA and the Delta. Source: NQDT (2016).*

PROGRAM LOGIC

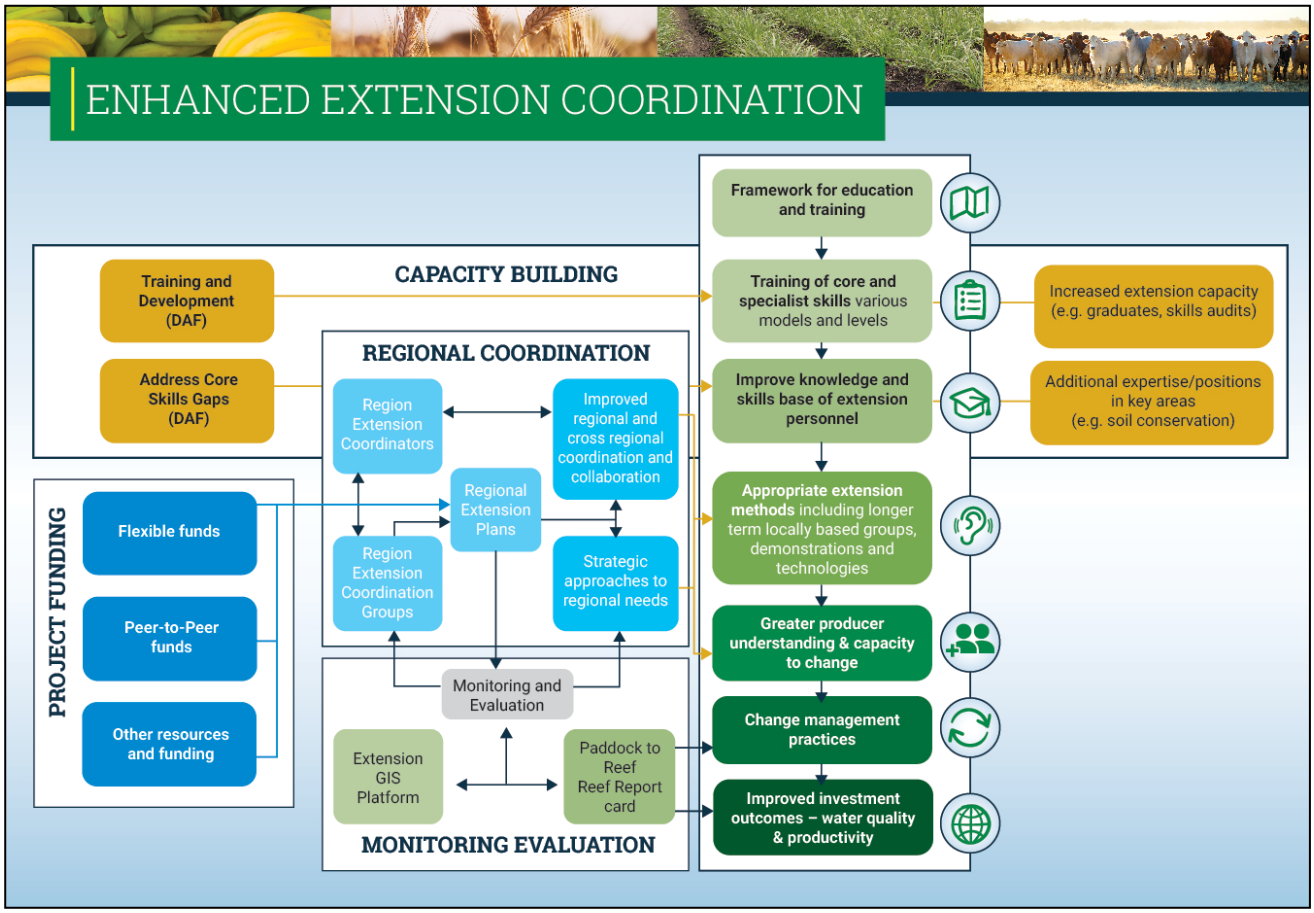


Figure 2: *Project logic of the Queensland Government's implementation of the E & E Review: Practice change, Education and Extension in Reef Catchments (Coutts et al., 2017).*

Figure 2 outlines the project logic of how the Queensland Government in partnership with NRM organisations and industry is implementing the recommendations of the E & E Review. The objectives of the REPs are to:

- Respond to the relevant areas of need identified in the E & E Review report, including new and innovative approaches to extension and education,
- Enhance and support the increased extension effort provided through projects such as Reef Trust Phase 3 and future funding and the increased urgency for this to lead to on ground practice change outcomes for GBR water quality, and
- Strengthen links, collaboration and leverage product development between researchers/scientists (reef, industry etc.) and extension staff to maximise knowledge transfer.

DAF will administer funding to each region for extension activities prioritised in the REPs that facilitate improved coordination and collaboration to deliver better on-ground services for producers and to support producer Peer-to-Peer learning activities. In addition, DAF will manage projects to build extension capacity and service high priority skills gaps and training development needs across regions.

PURPOSE OF THE BURDEKIN SUGAR REGIONAL EXTENSION PLAN

Developed to improve coordination and collaboration in the Lower Burdekin extension network, this REP will enable more efficiently targeted delivery of agronomic extension advice to sugarcane farmers. A collaborative approach will enhance local capacity and ensure sugarcane farmers can easily access information, technology and technical support leading to improved water quality and profitability of the sugarcane sector. The REP essentially consists of three parts:

1. The first is to introduce the Enhanced Extension Coordination in GBR project and explain what the REP is all about, including a description of activities and key outcomes that have been achieved in 2018/19.
2. The second part, from the Situation Analysis section onwards, is the forward planning part of the REP and describes, justifies and prioritises what activities the REP is attempting to achieve going forward.
3. The final part describes how the effectiveness of these activities will be monitored and evaluated and sets out the Monitoring Evaluation Reporting and Improvement (MERI) Plan for this REP.

Figure 3 provides an outline of the REP and the information it contains, including an overview of the Lower Burdekin region. The REP explains the relevant 2025 water quality targets and priorities outlined in the Reef 2050 WQIP and the Burdekin Water Quality Improvement Plan 2016 (Burdekin WQIP 2016), (NQDT, 2016a).

The REP also describes the regional extension networks and current programs, assimilates the information on water quality priorities and targets, and explains how current programs and activities are working toward achieving these targets in the Lower Burdekin. This information is then used to inform the prioritisation of project work supported through this REP based on the needs and gaps that have been identification by regional stakeholders.

A detailed situation analysis informs the decision making process to allocate funding and other resources to address regional water quality priorities and to strategically invest Flexible, Peer-to-Peer and Personnel and Expertise funds to enhance and value-add to current activities.

Figure 3*: Burdekin Sugar Regional Extension Plan, overview of components and contents. Source: DAF (2019).*

In addition to the REP, a *Burdekin Sugar Communication and Engagement Plan* (C&E Plan) and a *Regional Collaboration Strategy* (Collaboration Strategy) have been developed to enhance communications and deliver strategies to improve collaboration and coordination. The Collaboration Strategy is based on findings from a series of regional workshops and the recommendations detailed in Hardy (2019). The C&E Plan and Collaboration Strategy are both addendums to this REP and used by the Burdekin Regional Extension Coordinator (REC) to support the local extension network.

BENEFITS...

FOR GROWERS:

- ✓ Enhanced delivery of extension services
- ✓ More coordinated and effective support for growers
- ✓ Better access to improved information and highly skilled extension officers
- ✓ Opportunities for Peer to Peer grower groups

BENEFITS...

FOR EXTENSION STAFF:

- ✓ Connection to regional extension networks
- ✓ Up-to-date information on project work, funding programs and opportunities to collaborate with colleagues
- ✓ Opportunities to be part of decision-making and coordinated program design
- ✓ Access to training and professional development opportunities and specialised expertise

REGION AND WQIP

THE LOWER BURDEKIN REGION

The REP applies to the sugarcane growing areas of the Lower Burdekin. The Lower Burdekin, is largely captured by the Burdekin Shire Local Government Area, an area of 5,052.5 km^2 (Wikipedia, 2019). The area includes a major section of the coastal floodplains of the Burdekin NRM region. The Lower Burdekin region and its landscapes and industries are described in detail in the Burdekin Dry Tropics Natural Resource Management (NRM) Plan 2016 – 2026 (NQDT, 2016b). The most relevant boundaries for this plan are the Burdekin River Irrigation Area (BRIA) and the Delta sugarcane growing areas (**Figure 1**), collectively referred to as the Lower Burdekin sugar growing areas. The key characteristics of the BRIA and Delta areas in the Lower Burdekin are described in **Table 1**.

Table 1: Key characteristics of the BRIA and Delta sugarcane growing areas in the Lower Burdekin. Reproduced from Burdekin Water Quality Improvement Plan, Lower Burdekin Implementation Plan: Water quality improvement through improved irrigation management in sugarcane – Phase 1 – Knowledge synthesis, evaluation of past programs and identification of preliminary strategies for implementation (Waterhouse et al.,2018).

Characteristic	BRIA	Delta
Area	49,222 ha	41,262 ha
Establishment	Since 1980's	Since 1880's
Number of farms	347	580
Approx Farm size[1]	Up to 3,500ha Median farm size: 94 ha Average farm size: 140 ha	Up to 500ha Median farm size: 56 ha Average farm size: 72 ha
Dominant soils	Sodic duplex/ and light to medium and heavy clays (high denitrification potential)	Coarse sands, sandy loams and light to medium clays (Low denitrification potential)
Average production[2]	110 tonnes per ha	120 tonnes per ha
Fertiliser application rates[3]	214 kg N/ha Plant 227 kg N/ha Ratoon	193 kg N/ha Plant 216 kg N/ha Ratoon
DIN loss pathway	Large proportion in surface runoff	Large proportion in drainage
Modelled annual average DIN load[4]	460 t/yr	586 t/yr
Water source and use	Surface water and ground water in Northcote, Jardine and Selkirk areas 10-12 ML/ha Volumetric charge for water Gravity fed systems leading to lower electricity costs	Ground water and surface water from Water Board supply 20+ ML/ha Largely area based charges for water Pumping leads to higher electricity costs
Irrigation systems	Predominantly furrow irrigation	Predominantly furrow irrigation

Data sources:

1 Wilmar (P. Larsen, pers. comm.), September, 2018. Data extracted from end of 2017 harvest season.
2 Wilmar (P. Larsen, pers. comm.), March 2016.
3 Paddock to Reef program Survey data, NQ Dry Tropics (2016).
4 Based on modelled estimates of DIN loads from sugarcane areas using the Paddock to Reef Source Catchments model, DNRM (2015).

WATER QUALITY IMPROVEMENT PLANS

The Reef 2050 Long-term Sustainability Plan (Reef 2050 Plan), (Commonwealth of Australia, 2015) provided for the development of the Reef WQIP 2050 and regional Water Quality Improvement Plans to set regional and sub-regional water quality and management action targets. The Reef WQIP 2050 addresses all land-based sources of water pollution including agriculture, urban, industrial and public lands. The Reef WQIP 2050 focuses on the management of five main pollutants impacting the Great Barrier Reef – sediments (especially fine sediments), dissolved inorganic nitrogen (DIN), particulate nitrogen, particulate phosphorus and pesticides (State of Queensland, 2019).

The Burdekin Water Quality Improvement Plan developed for the Burdekin Basin in 2009 and updated in 2016, focused largely on reducing the water quality impacts associated with beef and sugarcane production in the region. The Burdekin Water Quality Improvement Plan 2016 (Burdekin WQIP 2016) identifies how the water quality outcomes under the broader Reef WQIP 2050 will be delivered in the Burdekin region.

The dominant water quality issues for the Lower Burdekin are DIN and photosystem II inhibiting herbicides (PSII herbicides) (Waterhouse et al. 2018). For sugar production areas, the Burdekin WQIP 2016 promotes reducing excess irrigation, nitrogen surplus and herbicide losses. Burdekin WQIP 2016 Water Quality Targets have since been superseded by the Reef WQIP 2050 and 2025 Water Quality Targets and Priorities (see section Water Quality Targets in Situation Analysis).

EXTENSION NETWORKS

BURDEKIN CANE EXTENSION GROUP

The E & E Review found that an effective Regional Extension Coordination Group was needed, driven and facilitated by a regional coordinator, with Flexible funds to allow strategic collaboration across programs and organisations to more effectively address identified regional and sub-regional priorities. A coordinated regional network would also enable more effective linkages to other programs within the broader Reef Program and through these linkages promote better ways of doing things at the local level to accelerate adoption of improved farm management practices.

A wide range of providers including; industry, private consultants, agri-businesses, NRM organisations, private contractors and government agencies undertake agronomic extension and comprise the wider Burdekin extension network.

In the Lower Burdekin, support for sugarcane farmers to improve management practices are provided by a variety of organisations including:

- AgriTech Solutions
- Burdekin Bowen Integrated Floodplain Management Advisory Committee (BBIFMAC)
- Burdekin Productivity Services Ltd (BPS)
- Department of Agriculture and Fisheries (DAF)
- Farmacist Pty Ltd
- NQ Dry Tropics (NQDT)
- Sugar Research Australia (SRA)

The Burdekin Cane Extension Group (BCEG), comprised of partners from extension providers as listed above, was established in 2008 to provide technical support to reef water quality programs being administered through NQDT. Whilst the BCEG still operates as a technical group as required, in recent times, the group's focus has revolved around communication and coordination of extension activities (**Plate 1**). To reflect the change in focus, other organisations involved in extension and water quality project delivery now participate in the BCEG, including BRIA Irrigators Ltd, CANEGROWERS Burdekin Ltd (CBL) and Wilmar Sugar. These BCEG partners, and potentially others, will continue to provide communication and coordination of extension delivery through this REP.

BURDEKIN SUGAR REGIONAL EXTENSION COORDINATOR

The REC will guide the development and implementation of the REP and will work collaboratively to provide 'backbone' support to the BCEG.

The role of the REC is to:

- Facilitate and support the continuation of the BCEG.
- Enable improved sharing of information and joint decision making so that effort and resources being put into extension activities are maximised, coordinated and reported, with learnings being shared and duplication of effort avoided.
- Work with BCEG partners to strategically plan and proactively facilitate collaborative responses to address priority water quality issues, e.g. the Pesticide Working Group (Appendix A).
- Provide initial contact points for extension staff and access to networks, information and up to date progress on key initiatives occurring in the Queensland Reef Water Quality Program (Queensland Government, 2019a).
- Provide a mechanism for information sharing, interpretation and dissemination (including research findings) across the extension network.
- In consultation with the BCEG, develop and produce the REP.

The REC works closely with the Sugar Research Australia (SRA) Regional Coordinator, and where applicable, other organisations implementing extension programs, such as the Reef Alliance Program (RAP) and the GBR Foundation Investment Program (GBRF).

At a program level, the REC collates and provides feedback on extension delivery to the Manager (Extension Coordination) and Manager (Reef Extension Training Development), both hosted within DAF. Through these positions, the Enhanced Extension Coordination in GBR project facilitates collaboration and cross-regional information sharing through a broader reef extension network and programs.

The Enhanced Extension Coordination in GBR project also provides strategic and practical advice to help inform investment programs, Queensland Reef Water Quality Program, GBRF, and the Australian Government's Reef Trust (DEE, 2019), amongst others, in relation to extension requirements and possible solutions to support large-scale land management practice change across GBR catchments. This advice assists in minimising any duplication of effort across the Australian Government and the Queensland Government and industry programs involving extension activities.

KEY OUTCOMES FOR 2018-2109

SOME KEY PROJECT OUTCOMES:

- Enhanced communication, coordination and planning
- A Community of Practice to coordinate extension delivery
- A framework to co-design and implement effective collaboration
- Empowering local decision making
- Improving extension officers' skills and capacity
- New ways of working together

ENHANCED COMMUNICATION, COORDINATION AND PLANNING

The REC has provided increased support for the BCEG, and facilitates regular meetings with BCEG partners or sub-groups for networking, information sharing or planning purposes. The REC maintains a database of contact details of all Lower Burdekin extension providers, agri-resellers and industry organisations. Events have been better coordinated using the *Burdekin Sugar Extension Calendar of Events* maintained by the REC. The calendar is used to promote upcoming events, prevent duplication, and date clashes. The calendar is emailed, on a regular basis, to the extension network to keep people informed of local activities. Communication amongst the extension network is further enhanced through the implementation of the C&E Plan. The C&E Plan details the communication needs of the REC, BCEG and other stakeholders to strategically plan communication activities. It supports the REC to deliver effective communications and increase stakeholder interest and participation in the project. For example, an outcome of the C&E Plan was to produce a glossy four-page summary document and fact sheets, to spark interest and understanding of the purpose and role of the REP in their region.

The REC has also organised a number of planning sessions with BCEG partners including:

1. A workshop to determine local priorities around water quality improvement (July 2018).
2. An irrigation focussed workshop to develop an Irrigation Extension Action Plan (Engagement Plan for Irrigation) and implementing recommendations from Waterhouse et al. (2018) (February 2019).
3. An information session with GBRF and the BCEG to explain how the GBRF investment strategy to improve water quality will be implemented in the Lower Burdekin (September 2019).
4. Several sub-committee meetings to develop a collaborative project for the GBRF.

A COMMUNITY OF PRACTICE TO COORDINATE EXTENSION DELIVERY

At the same time the Enhanced Extension Coordination in GBR project commenced, SRA had developed an *Adoption Strategy Planning and Investment Guide* (Industry Adoption Strategy) to support increased uptake and implementation of new and existing technologies across major sugarcane areas from northern New South Wales to the Atherton Tablelands.

There are some similarities between the Enhanced Extension Coordination in GBR project and the SRA Industry Adoption Strategy including; the appointment of regional coordinators; the development of a regional adoption advisory committee to identify regional adoption priorities and strategies; and the development of a strategic regional plan: the *Burdekin Regional Adoption Strategy* and *Annual Operating Plan*. To reduce any duplication between programs the REC and the Burdekin SRA Regional Coordinator have collaborated to support the local extension network, coordinate extension activities and identify priorities in the Lower Burdekin.

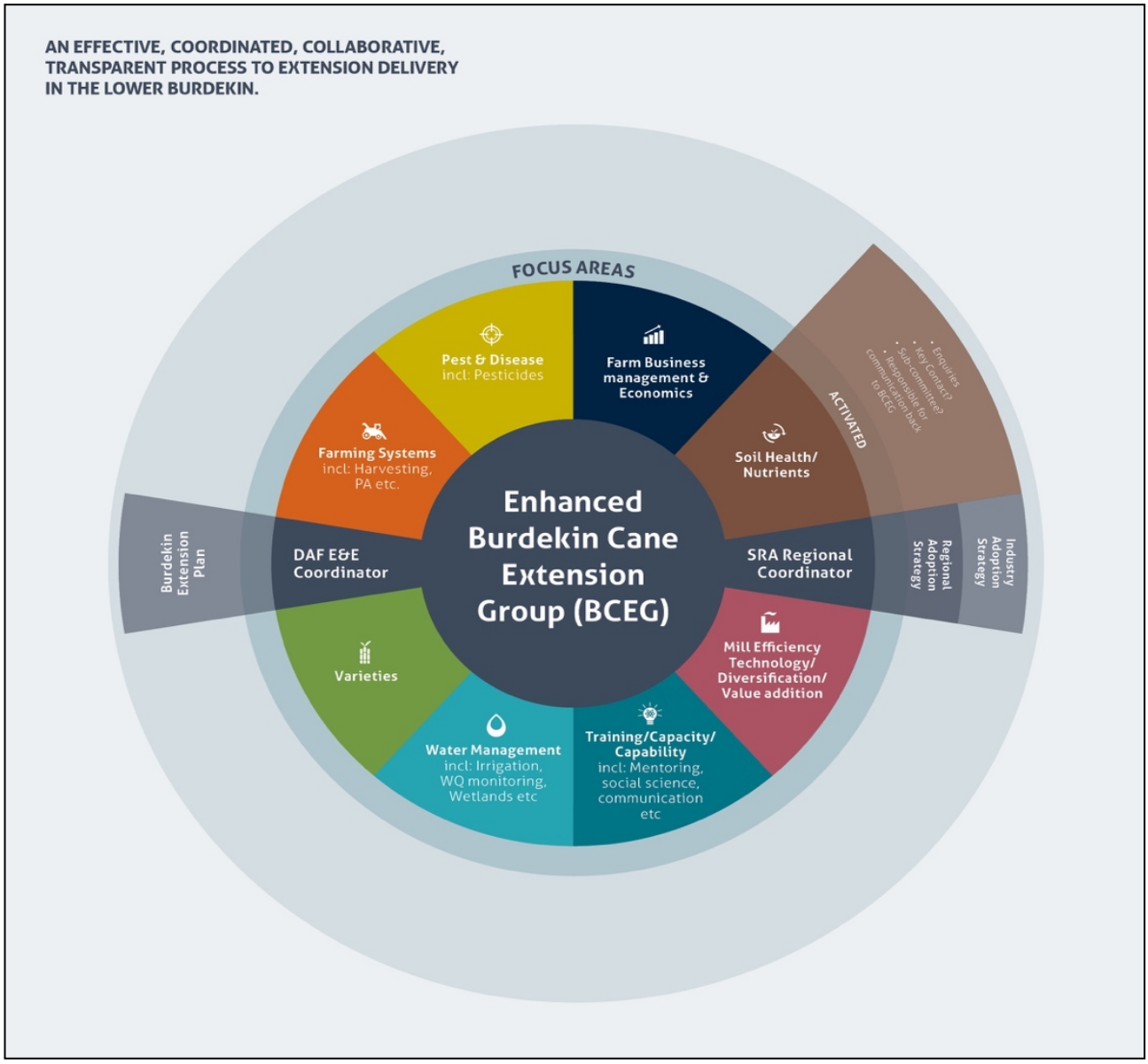


Figure 4: *Enhanced Extension Framework Lower Burdekin. Source: BCEG/DAF/SRA (2018).*

The REC and SRA's Regional Coordinator also developed an Enhanced Extension Framework with BCEG partners (**Figure 4**). This collaborative approach has demonstrated to other BCEG partners that DAF and SRA are committed to working together for the betterment of the industry. The framework sets out to improve coordination and enhances the extension effort through clearly identified focus areas and the establishment of focus groups. Importantly the approach provides for sugarcane farmers and other interested parties, to participate in decision making around extension.

Plate 1: *BCEG members at a recent quarterly meeting. Source: DAF (2019).*

A FRAMEWORK TO CO-DESIGN AND IMPLEMENT EFFECTIVE COLLABORATION

Improving collaboration is one of the key objectives of the REP. To assist this, Max Hardy Consulting was engaged to design and deliver strategies to facilitate the goal of "improved effectiveness and efficiency of extension service delivery through improved collaboration and coordination" to augment the development of the REPs. The aim was to work with and support the RECs and their networks to understand the concepts and benefits of collaborative business practices.

The outcomes are reported in Hardy (2019), which summarises the observations and findings from an initial review of relevant reports, consultation with the RECs from each region and a series of workshops with the regional extension coordination groups on how to build their capacity to collaborate in the delivery of extension services. The workshops provided clarification around the definitions of coordination and collaboration developed a framework that described the '*Collaboration Continuum*' and explored collaboration opportunities available in the regional extension network or wider. The workshops also investigated what factors may be impeding further adoption of improved land practices over a greater area of the catchment and looked for collaborative solutions to these barriers, explaining how to co-design and implement effective collaboration.

Hardy (2019) also presented new indicators to measure and evaluate where groups are positioned on the *Collaboration Continuum* and presented these as a *Collaboration Matrix* used as a qualitative way to benchmark how an extension network is operating, or 'working together'. Each region used this matrix to assess their networks and developed a *Regional Collaboration Strategy* with recommended actions to guide how to cultivate a 'community of practice' and develop networking, cooperation, coordination and collaboration within their regional extension networks.

EMPOWERING LOCAL DECISION MAKING

The Enhanced Extension Coordination in GBR project provides funds to support sugarcane farmers directly in Peer-to-Peer learning activities, as well as, Flexible (discretionary) funds to support cross-program/organisational collaboration, value-add to current activities and support the use of innovative learning approaches and/or new tools and technologies to support on-farm learning. As well as the direct value of these projects, the allocation of these funds has enabled the BCEG to develop a rigorous and transparent decision framework that enabled them to identify and prioritise projects and strategically allocate funds.

On the 24th August 2018, BCEG partners developed and ratified a process to identify and prioritise projects to enable the strategic allocation of Peer-to-Peer and Flexible funds (Appendix B). This process involved:

1. The development of project assessment criteria based on: a situation and gap analysis and identified extension priorities developed by the BCEG (**Figure C3**); eligible and non-eligible criteria provided by the Enhanced Extension Coordination in GBR project; and Reef 2025 Water Quality Targets (Appendix C).

2. The development of project application forms by the REC, and the calling of project submissions from BCEG partners.
3. The formation of a Project Assessment Panel comprising the REC, SRA Regional Coordinator and an independent person (AusIndustry Manager), and a scoring and ranking matrix based on assessment criteria.
4. A final meeting of the BCEG to ratify the decisions of the Project Assessment Panel.

BCEG partners submitted seven projects. The Project Assessment Panel determined six projects aligned to extension priorities as outlined in the project criteria. A submission for training extension staff in a Certificate III in Irrigation was forwarded to the Manager (Reef Extension Training Development) for subsequent funding through Training Development. Six projects, totaling $161,056, were recommended for funding by the Project Assessment Panel and ratified by BCEG partners on the 3rd October 2018. There was a further $3,432 dedicated to a regional planning workshop for BCEG partners in June 2018, bringing the total amount of expended from Flexible and Peer-to-Peer funding to $164,488 (**Table 2**).

Table 2: *Allocation of funds for Flexible and Peer-to-Peer projects - projects funded, reporting dates to DAF, total funding allocated/expended and the balance remaining.*

Project Number and Name	Amount Funded	Progress Report Due	Final Report Due
BSPTP01 NextGen 2019 Tour	$20,000	31/7/19	13/12/19
BSPTP02 Empowering and Upskilling Women in the Burdekin Sugar Industry to Address Reef Water Quality Issues	$48,500	30/6/19	13/12/19
BSPTP03 Burdekin Field Walk Group	$15,000	30/6/19	13/12/19
BSPTP04 Championing Water Quality Improvement in the Burdekin Region	$15,000	31/7/19	13/12/19
Total Peer-to-Peer Funded Projects Allocated 30/6/19	$98,500		
BSFF01 Monitoring the effectiveness of a constructed wetland treatment system	$46,056	30/6/19	27/3/20
BSFF02 StoolZippa Imidacloprid Trial	$16,500	30/6/19	13/12/19
Alluvium Consulting Facilitation BCEG Strategic Planning Workshop	$3,432*	n/a	June 2018
Total Flexible Fund Projects Allocated 30/6/19	$65,998		
Total Funding Allocated	$164,488		
Total Funding Available	$187,500		
Balance remaining	$23,012		

* $3,432 had previously been allocated to engage Alluvium Consulting to facilitate a strategic planning workshop for BCEG partners in July 2018.

A balance of $23,012 remains unspent. BCEG partners will determine the most efficient and targeted use for the remaining funds. It is likely the funds will support networking and collaborative events to increase coordination, communication and collaboration across the Lower Burdekin cane extension network, or to develop spatial maps to support the extension effort.

PEER-TO-PEER FUND PROJECTS

The Enhanced Extension Coordination in GBR project provided support for three Peer-to-Peer projects (BSPTP01, BSPTP03, and BSPTP04). The projects enabled 'producer learning groups' where participants joined study tours to over 12 farming operations (dairy, grains, horticulture and sugarcane), universities, cutting-edge emerging agri industry and catchment management organisations in the Canterbury Plains region of New Zealand, the Darling Downs and Bundaberg regions of Queensland (Plate 1). The Peer-to-Peer projects enabled sugarcane growers and extension officers to learn about new approaches, technologies and ideas through the people and sites visited. Project participants have reported some interesting outcomes on their return home from these study tours including, incorporating bean crops into fallows on their farms, considering changes to irrigation infrastructure, completion of Smartcane BMP, while another has been inspired to take on an industry leadership role.

***Plate 2**: Peer-to-Peer project BSPT01 participants viewing alternative crops. Source: Burdekin Productivity Services (2019).*

A fourth Peer-to-Peer project supported *Behaviour Innovation*, a behavioural science company, well known for the *Cane Changer Project*, to conduct two workshops with women involved in the sugar industry.

Recognising that women represent key change agents in the sugar cane industry, the first workshop targeted members of the Women in Sugar Burdekin (WISB). The workshop explored ways that WISB members could support the learning and development of other women in the industry. Participants were able to interact with the Smartcane facilitator and other women who had completed their Smartcane BMP accreditation. Several WISB partners who were skeptical about the Smartcane BMP process, or whose husbands were, have subsequently signed up to do the Smartcane BMP program.

The second workshop, held in October 2019, focused on change management where all women involved in the industry were invited to attend. The workshop introduced the psychology of cognition and decision-making. Participants came away with a new appreciation of how their minds work and how they respond to change. Participants at the workshop agreed they would develop an on-going peer support network for women, including young extension officers, and would improve access to the WISB by developing strategies to attract more women members.

FLEXIBLE FUND PROJECTS

Two projects were funded through Flexible Funds in 2018/19, BSFF01 Monitoring the Effectiveness of a Constructed Wetland Treatment System and BSFF02 StoolZippa Imidacloprid Trial. Both projects supported existing initiatives, involving paddock scale or sub-catchment water quality monitoring.

BSFF01 Monitoring the Effectiveness of a Constructed Wetland Treatment System has implemented a rigorous water quality monitoring regime to monitor the efficacy of a recently constructed wetland treatment system near Barratta Creek (Plate 2). The water quality monitoring program will enhance the acceptance and understanding of the role of treatment systems in addressing farm runoff in areas where currently high volumes of runoff are unavoidable. Early data is showing promising results for reductions in sediments and nitrogen.

Plate 3: *Water quality monitoring equipment installed at the wetland treatment system as part of project BSFF01. Source: BBIFMAC (2019).*

BSFF02 StoolZippa Imidacloprid Trial was designed by DAF to address issues related to the application of the pesticide, Imidacloprid. Double disc opener applicators are commonly used for applying Imidacloprid in ratoon crops. DAF identified that proper closure of the open slot behind double disc openers was critical in reducing runoff of the pesticide into waterways. The project would validate the StoolZippa in the Burdekin region where the primary mode of loss is through irrigation tailwater.

Trials compared the StoolZippa to traditional methods of application with a press wheel or chain. The project recommended that more trials were needed across different locations, including more uniform soil types. As a result, the Enhanced Extension Coordination in GBR project Personnel and Expertise funding has been provided to SRA to undertake further research and trials around Imidacloprid application.

IMPROVING EXTENSION OFFICER'S SKILLS AND CAPACITY

Through the Enhanced Extension Coordination in GBR project, resources and opportunities have also been provided for training development of extension personnel and to augment existing services and expertise for high priority skills gaps e.g. irrigation, soil health, hydrology, farming systems, and water quality. In October 2018, the Manager (Reef Extension Training Development) produced a *Reef Extension Training Needs Analysis* (TNA) to guide both the range and form of the training development activities.

In response to the TNA, training development events targeted to the Lower Burdekin extension network have been organised by DAF including; Certificate III in Irrigation, Behavioural Skills Training for Extension, Soil Health, Agronomy in Practice and Facilitation Skills. Subsidy refunds have been offered to participants, payable upon suitable completion of courses.

One particular highlight for several Lower Burdekin extension officers was participation in the two day *Reef Extension ThinkTank* held in May 2019 in Townsville. Organised by the Manager (Reef Extension Training Development), the event was designed to attract a cross-section of the estimated 200 to 500 extension service providers across the GBR catchments and pique their interest in further extension capacity building activities.

NEW WAYS OF WORKING TOGETHER

Through a greater understanding of the continuum for working together (Hardy 2019), a new paradigm of collaboration has emerged through the Enhanced Extension Coordination in GBR project. Following a meeting convened by the REC in February 2019, BCEG partners resolved to develop a collaborative project to increase the adoption of irrigation management and efficiency practices leading to improved water quality.

SRA and DAF jointly designed a Personnel and Expertise project to develop an Engagement Plan for Irrigation. The Engagement Plan for Irrigation will be informed by existing information in the Burdekin WQIP 2016, Reef WQIP 2050 and Waterhouse (2018) and will describe:

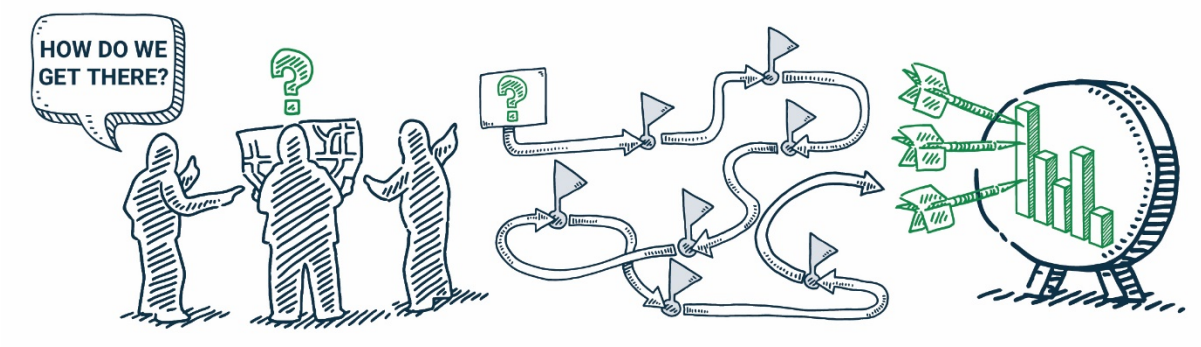
- Priority practices required to improve irrigation efficiency.
- A grower focussed engagement program.

- Extension providers, and others, best placed to provide engagement and technical expertise.

A SRA Water Management Adoption Officer will manage the development of the Engagement Plan for Irrigation, and provide leadership around irrigation issues, supported by a project management committee (SRA, DAF and NQDT), a technical advisory group and a 'water management' focus group as described in the Enhanced Extension Framework Lower Burdekin (**Figure 4**).

A united and collaborative approach to irrigation extension will provide a better service to sugarcane farmers, reduce duplication of effort and improve water quality entering the GBR.

SITUATION ANALYSIS



The purpose of this Situation Analysis is to assimilate the information on water quality priorities and targets and explain how current programs and activities are working toward achieving these targets in the Lower Burdekin. The Situation Analysis will also:

- Inform the prioritisation of project work supported through this REP,
- Input in the decision making processes to allocate funding and other resources to address regional water quality priorities, and
- Strategically invest Flexible, Peer-to-Peer and Personnel and Expertise funds to more efficiently target the delivery of agronomic extension advice and enhance and value-add to current activities.

The first step is to clarify the relevant Reef water quality targets that are to be achieved in the Lower Burdekin. Unfortunately this is not straightforward as the Reef 2050 WQIP end-of-catchment load targets have been developed at a GBR-wide scale and divide the sugar growing areas in the Lower Burdekin, resulting in very different targets and priorities (DES, 2018). In addition, the Burdekin WQIP 2016 has defined several management actions that are more specific to the region and current practices. However, these need to be modified to align with the revised Reef 2050 WQIP targets and current knowledge (Waterhouse, 2018). The targets described in both WQIPs are also catchment-wide targets and, although they do refer to the adoption of best management practices, do not in themselves explain the individual practices that are to be improved – so are difficult to interpret at the farm scale.

Agronomic extension is about enabling change on-farm and encouraging the adoption of improved practices and so extension officers are largely operating at the farm scale. However, understanding and setting local adoption objectives to achieve water quality targets has proven difficult, not the least because of confusion due to the multiple terminology for risk frameworks and best management programs.

The adoption of improved management practices in the GBR catchments is reported using industry and regional specific management practice frameworks (Water Quality Risk Frameworks), developed through the *Reef 2050 WQIP Paddock to Reef Integrated Monitoring, Modelling and Reporting program* (*P2R program*). These frameworks describe relevant farm practices and identify the management practice level, which can be expected

to result in a high, moderate, moderate-low and lowest water quality risk. They are not set out as targets as such, but identify the management practice levels, which can be expected to result in a moderate-low water quality risk and thus provide a means to guide prioritisation of project work at the farm scale.

Although, these frameworks are also not without controversy, particularly around the reliance on modelling and the use of percentage weightings used to indicate the relative potential influence of practices on off-farm water quality, as opposed to local trials and water quality monitoring. Nevertheless, they do provide a means to guide the prioritisation of project work in this REP. It is also worth noting that these frameworks, as well as being used to monitor and report on practice change, are being used to assess and rank the cost-benefit of projects being proposed under investment programs (e.g. the GBRF's – *Effective and Efficient Pathways for Investment in Improved Water Quality in the Great Barrier Reef*, 2019).

The Reef 2050 WQIP plan refers to the Water Quality Risk Frameworks as industry and regional specific management practice frameworks. However, the Sugarcane Water Quality Risk Framework 2017-2022 (DES, 2019b), does not specify any regional specific practice guidance. The BRIA and the Burdekin-Haughton Irrigation Supply Scheme (BHWSS), makes the Lower Burdekin unique in many ways compared to other sugar regions. Some practices, such as cane trash blanketing, are not as relevant and there are specific challenges, such as rising ground waters and salinity. Even within the sugar growing areas of the Lower Burdekin there are significant variations that affect water resource management, farm practices and pollutant loss pathways. Therefore, it is also important that these variations are considered as part of the regional situation analysis and extension projects working with sugarcane farmers to improve water quality and this is a major contribution of this REP.

This Situation Analysis also describes current projects that are underway in the Lower Burdekin and identifies gaps and barriers that might be hindering project implementation on-ground and are limiting progress towards achieving practice change to improve water quality. This has been done by undertaking a **'*Lower Burdekin Regional Project/Program Scan'* (Regional Scan)** of project work that is underway or recently undertaken in the Lower Burdekin and working with BCEG partners to identify gaps and barriers to develop the ***Burdekin Sugar Recommendations and Actions*.** The ***Burdekin Sugar Recommendations and Actions*** presents the outputs of the Situation Analysis and sets out specific recommended actions to be implemented through this REP. The recommended actions are to be put through a decision-making prioritisation process before allocating appropriate funding to strategically implement project activities and actions to address them.

REEF WQIP - 2025 WATER QUALITY TARGETS AND PRIORITIES

Water quality targets have been set for all catchments that drain to the GBR (DES, 2018) based on relative spatial priorities identified in the 2017 Scientific Consensus Statement (Bartley et al., 2017). The Lower Burdekin sugar growing areas, made up of the BRIA and the Delta sugarcane growing area (**Figure 1**), are contained within two Water Quality Target Catchments, also known as basins, the Haughton catchment (**Figure 5**) and the Burdekin catchment (**Figure 6**), which in the Lower Burdekin are delineated by the Burdekin River.

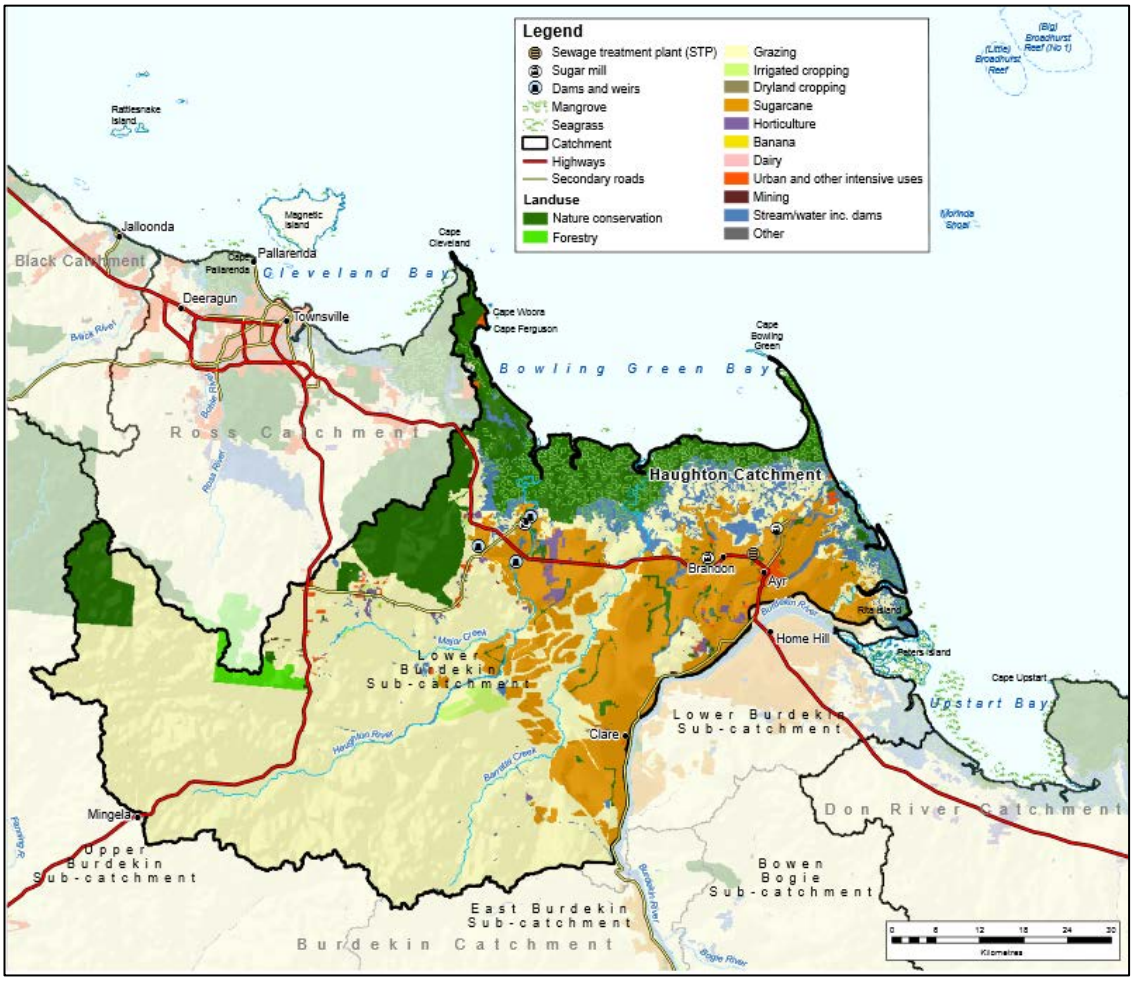


***Figure 5**: Map of the boundaries used for setting Haughton catchment specific targets in the Reef Plan 2050 Water Quality Improvement Plan. Source: DES (2018).*

The Haughton basin (**Figure 5**) includes the area used for sugar production on the north of the Burdekin River bank, taking in most of the BRIA and part of the Delta, and is where the majority of sugarcane is produced within the Lower Burdekin. This area contributes the largest anthropogenic dissolved inorganic nitrogen (DIN) loads in the Burdekin region and is one of the five highest contributors of DIN of the 35 catchments that drain to the GBR.

The Burdekin basin (**Figure 6**) contains the area used for sugar production on the south of the Burdekin River bank, which also takes in sections of the BRIA and Delta areas and is one of the top five contributors of anthropogenic DIN loads entering the GBR. In addition,

soil erosion, from eroding gullies in grazing lands; in the upper Burdekin catchment contribute by far the largest proportion of the fine sediment and particulate phosphorus nutrient loads to the end of catchment loads in the Burdekin Region (NQDT, 2016a).

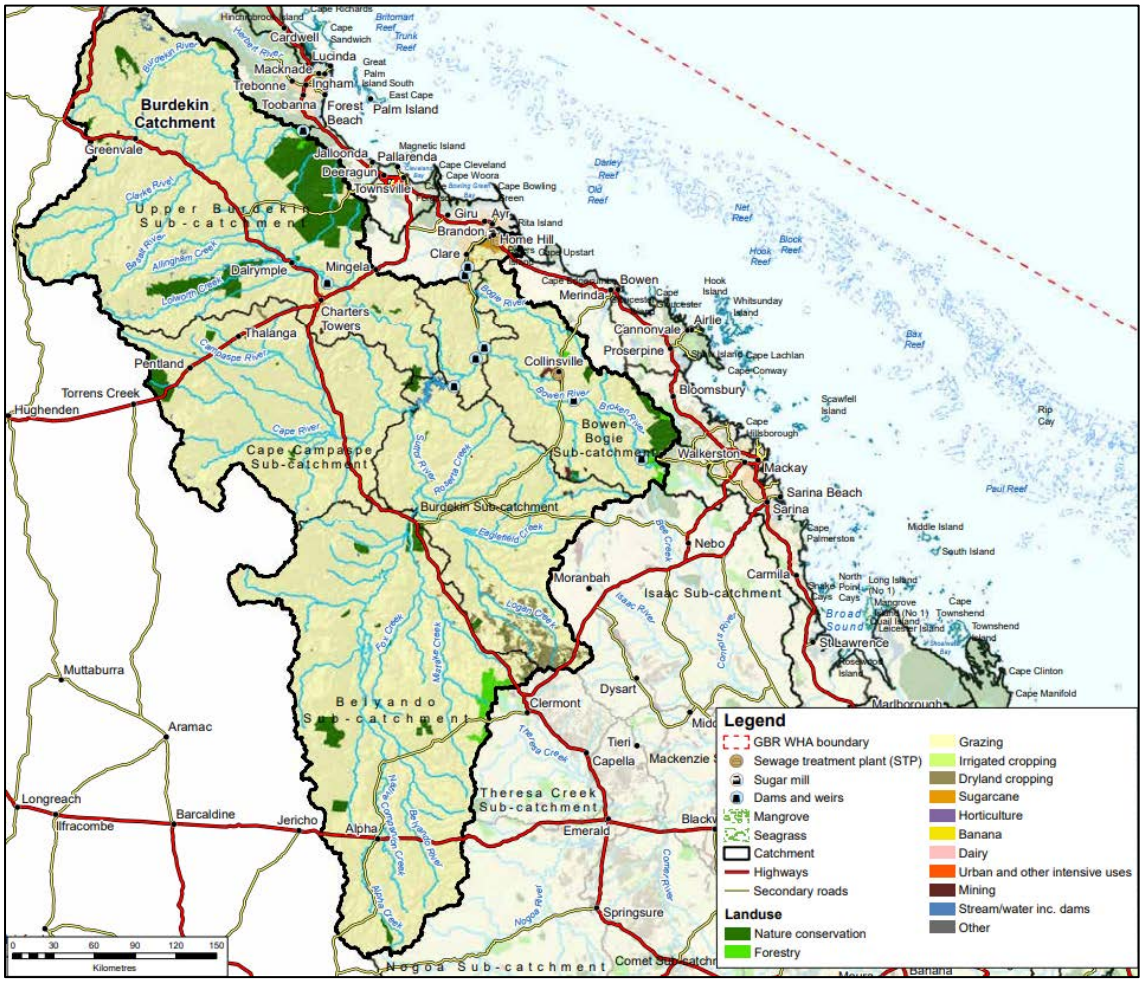


Figure 6: *Map of the boundaries used for setting Burdekin catchment specific targets in the Reef Plan 2050 Water Quality Improvement Plan. Source: DES (2018).*

Both the Haughton and Burdekin basin targets are relevant to this REP, but this REP is focused on supporting improved practices in the sugar growing areas, so does not consider areas in the Upper Burdekin. **The Upper Burdekin grazing areas are outside the scope of this REP and are being addressed by the *Burdekin – Grazing Regional Extension Plan*.**

The 2025 end-of-catchment water quality targets and priorities for the Haughton and Burdekin catchments are shown in **Figure 7**. These identify that reducing DIN loads from the Haughton catchment is a Very High Priority. Whereas in the Burdekin catchment reducing DIN load is a Moderate Priority. There are also differences in the targets for fine sediment, particulate phosphorus and particulate nitrogen. These are Very High Priority in the Burdekin catchment, but this is primarily related to soil erosion, from eroding gullies in grazing lands in the upper Burdekin catchment. Pesticides are also prioritized differently in the two catchments and are a High Priority in the Haughton catchment, mainly related to sugar growing.

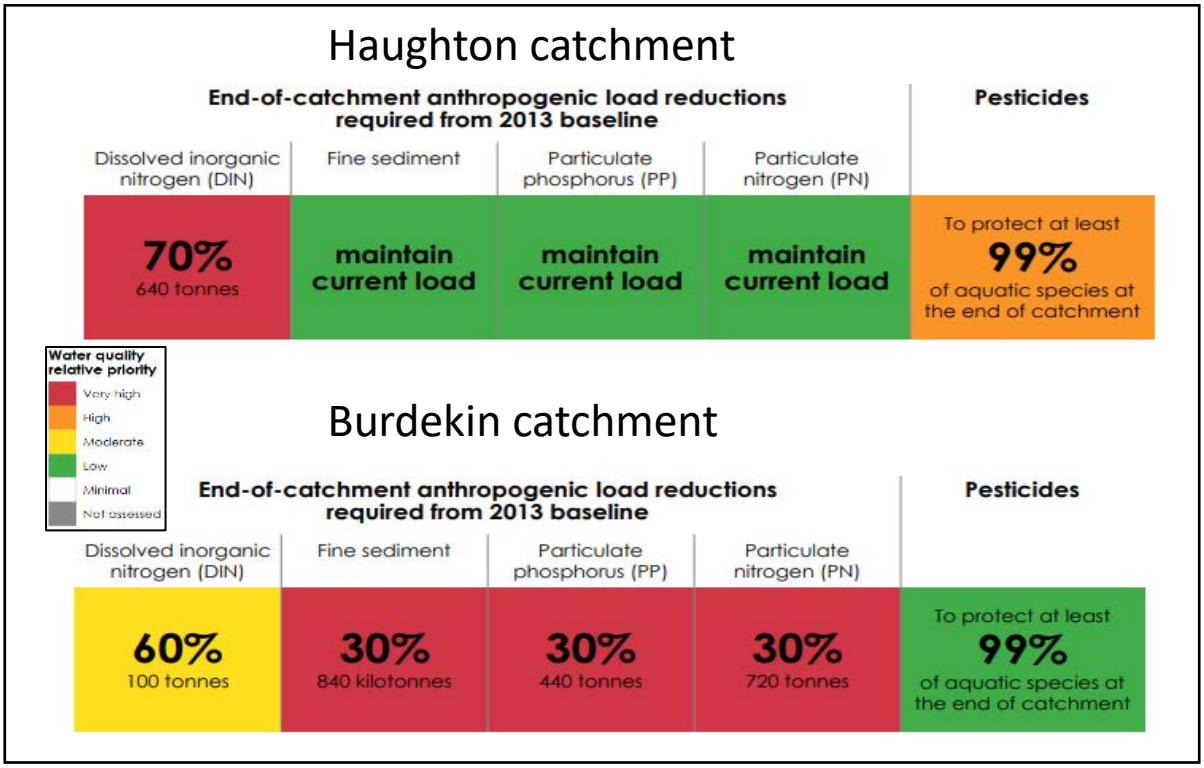


***Figure 7**: 2025 water quality targets and priorities for the Haughton and Burdekin Basins (containing the Lower Burdekin catchment). The relative water quality priority across the 35 Great Barrier Reef Basins is shown by colouration of the boxes. Source: DES (2019a).*

BCEG partners have highlighted that the delineation of the Burdekin and Haughton catchments, splitting both the BRIA and Delta sugar growing areas, is confusing to extension practitioners and sugarcane farmers. Further, two different sets of targets for the contiguous sugarcane growing areas of the Lower Burdekin, particularly the DIN targets, with one a very high priority and the other a moderate priority, makes local project prioritisation difficult also.

The BCEG will seek further advice from the Office of the Great Barrier Reef (OGBR) to determine a workable solution to reduce this confusion. But until clarified, since the BRIA and Delta sugar growing areas occupy approximately equivalent proportions of the cane producing area and contribute approximately equal loads of DIN, estimated at 460 tonnes/year (44 percent) and 586 tonnes/year (56 percent) respectively (Waterhouse et al. 2018, p.11), **this REP will treat the Lower Burdekin as a combined, conglomerate sugar growing area. The REP will aim to maximize the adoption of improved farm practices equally across the entire area, focusing on actions to reduce DIN and pesticide losses consistent with the Haughton catchment targets** (as these are not confounded by the large area of catchment in the Upper Burdekin that is not used for sugar growing).

CHARACTERISTICS OF THE LOWER BURDEKIN INFLUENCING LOSS PATHWAYS

Although the BRIA and Delta sugar growing areas are contiguous and both span the Haughton and Burdekin catchment boundaries described above, their irrigation schemes are managed separately, the BRIA by Sunwater and the Delta by Lower Burdekin Water, and there are variations across this landscape that affect farm management practices and pollutant loss pathways. For example, the BRIA and Delta areas have significant differences in soil characteristics. The BRIA has predominantly sodic duplex and light to medium and heavy clays, while the Delta area has predominantly course sands, sandy loams and light to medium clays (Schroeder et al., 2010).

Understanding local variations in the landscape, management practices and loss pathways and integrating this knowledge into prioritisation and project planning is a major contribution of this REP. These differences need to be considered in projects designed to influence farm practices and manage DIN and pesticide losses in the Lower Burdekin. For example, the opportunity for the construction of water recycle pits is generally more limited in the Delta, due to less suitable soil types (low clay content soils will need to be lined which becomes uneconomic for most farmers). In addition, the higher infiltration soils common in the Delta often results in less surface runoff. Generally, there are more opportunities for water recycle pits in the BRIA because the heavier soil types (high clay content to reduce leaking into the aquifer) and due to the larger farm size there is usually more land available (Rickert & Kenniff, 2018).

The Lower Burdekin is also faced with challenges unique from other sugar growing regions in the GBR catchment. With the completion of the Burdekin Falls dam in 1987, there was a dramatic increase in surface water irrigation in the Lower Burdekin, leading to increased groundwater recharge and rising groundwater tables, with some parts of the BRIA experiencing a rise in groundwater levels of up to 10 m. Groundwater levels are now less than 3 m below the ground surface across approximately 15 per cent of the irrigated area, with some areas measured at only 0.5 m below the surface (DNRM, 2017, p.3). A high water table has resulted in water logging of the soil profile and mobilised salts from the underlying bedrock, which has increased salinity levels. Both of these factors affects the productivity of agricultural land and limits opportunities for future development. High groundwater levels also results in higher rates run-off, increasing the potential for nutrient and sediment contaminants adversely affecting water quality (DNRM, 2017).

Below is a brief summary explaining some factors to consider in managing the priority DIN and pesticide losses in the Lower Burdekin.

DISSOLVED INORGANIC NITROGEN

The estimated annual average anthropogenic load of DIN exported from the Lower Burdekin using the Source Catchments model (2013 baseline), combining source areas within both the Haughton and Burdekin catchments, is 1,046 tonnes per year, or 87 percent of the regional anthropogenic load. These estimates correlate well with recent monitoring data

(Waterhouse et al. 2018, p.11). The BRIA and Delta sugar growing areas contribute approximately equal loads of DIN (accounting for uncertainties in some of the model input data such as current management adoption), further justifying treating the entire Lower Burdekin equally for the purpose of this REP. This is estimated at 460 tonnes/year (44 percent) and 586 tonnes/year (56 percent) respectively, with both areas occupying approximately equivalent proportions of the cane producing area in the Lower Burdekin catchment (Waterhouse et al. 2018, p.11).

However, nitrogen losses in surface runoff and deep drainage vary according to soil type in both BRIA and Delta regions. The dominant loss pathway in the largely clay based soils of the BRIA is through surface water runoff, whereas, in the highly permeable light soils of the Delta the dominant loss pathway is through deep drainage (Thorburn et al., 2011).

The highest risk from DIN losses are to freshwater systems in the dry season, from irrigation runoff and first flush events, and to coastal and inner shelf marine ecosystems in periods of high flow. Mid and outer shelf reefs can also be influenced by DIN runoff from the Lower Burdekin during large wet season events, when the discharge combines with river plumes from the larger Burdekin River and can extend hundreds of kilometers north (Waterhouse et al., 2018, p.12).

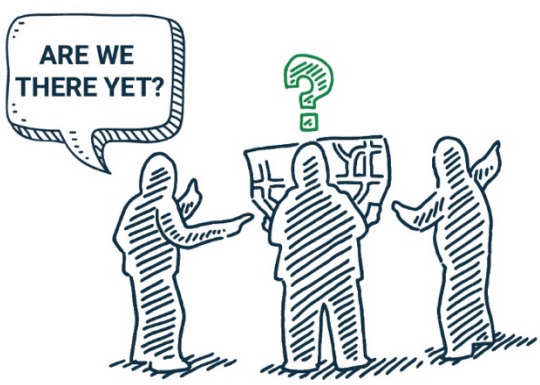
PSII HERBICIDES

The pesticide target aims to ensure that concentrations of pesticides at the end of each catchment are low enough that 99% of aquatic species are protected. This approach is consistent with assigning the level of protection when applying the Australian and New Zealand Guidelines for Marine and Freshwater Quality (ANZECC 2000), (Department of Agriculture, 2019). The target concentrations are not provided, but refer to the ANZECC (2000) guidelines, or subsequent revisions, which list water quality objectives for specific toxicants.

For pesticides, the highest risk is to freshwater systems in the dry season from irrigation runoff and first flush events. For coastal and marine ecosystems, the potential influence is highly variable depending on timing and location, but is typically only linked to periods of high flow and constrained to inner shelf systems.

The Lower Burdekin contributes 99 percent of the regional PSII herbicide exported load from the Burdekin region, which is estimated to be 2,295 kg per year (Waterhouse et al. 2018, p.11). This equates to a Diuron Toxic Equivalent load of approximately 2,100 kg per year.

The modelled PSII herbicide toxic equivalent load data for the region also shows that the modelled contributions from the BRIA and Delta are roughly equivalent (within the level of accuracy of the model), estimated at 693 kg/year (55 percent) and 564 kg/year (45 percent) respectively (Waterhouse et al. 2018, p.11).



LAND AND CATCHMENT MANAGEMENT TARGETS

To achieve end of catchment targets will require the adoption of improved management practices in the GBR catchments and these are the focus of this REP.

The Reef 2050 WQIP includes revised land and catchment management targets that address improved agricultural practices and the protection of natural wetlands and riparian areas. These targets recognise the important role of improved land management practices and catchment condition in meeting the end of catchment pollutant load reduction targets and are based on the conceptual understanding of the link between land condition, management practice standards and water quality outcomes. The relevant land and catchment management targets and human dimensions targets to be achieved by 2025 are shown in **Table 3**. **Table 3** also provides a summary of current progress towards these targets in the Lower Burdekin as recorded in the Reef Water Quality Report Card 2017-2018 results (DES, 2019a).

The Burdekin WQIP 2016 also defined several management action targets that are more specific to the region and current practices. These are also described in **Table 3**, but were based on the now superseded Reef Plan Sugarcane Water Quality Risk Framework 2013 and need to be updated to align with the revised Reef 2050 WQIP targets, and current knowledge. The 2016 proportion adoption reported under these targets is sourced from Reef Water Quality Report Card 2015-2016 results (DES, 2019a).

***Table 3**: Reef 2050 WQIP land and catchment management targets and Burdekin WQIP 2016 management action targets and progress in the Lower Burdekin as reported in the Reef Water Quality Report Card 2017-2018. The 2016 proportion adoption reported under the Burdekin WQIP 2016 management action targets was sourced from Reef Water Quality Report Card 2013-2016 results and cannot be compared directly to the 2017-2018 results due to a revision of the baselines used in the 2017-2018 report card.*

Reef 2050 WQIP

Target : 90 per cent of priority areas under grazing, horticulture, bananas, sugarcane and other broad-acre cropping are managed using best management practice systems for water quality outcomes (soil, nutrient and pesticides)

Situation:

Reef Water Quality Report Card 2017 and 2018 Burdekin sugarcane area managed under best management practice systems:

	Area managed under best practice (ha)		
	2016 Benchmark	Report Card 2017 and 2018 (%)	Report Card 2017 and 2018
Soil	0.0%	0.3%	347 ha
Nutrient	16.4%	19.6%	19,955 ha
Pesticide	11.5%	11.8%	11,941 ha
Irrigation	0.0%	3.2%	3,204 ha

Source: Australian Government & Queensland Government (2019).

In June 2018, 19.6% of land was managed using best management practice systems for nutrients (19,955ha), 11.8% for pesticides (11,941ha) and 3.2% for irrigation (3,204ha). Currently only 0.3% of land is managed under best practice systems for soil (347ha). On average, 10.6% of sugarcane is managed under best practice systems (for soil, nutrient and pesticides) in this region.

Although the following are Reef 2050 WQIP land and catchment management targets these are not discussed in detail in this REP. Groups and organisations other than the BCEG are addressing these targets:

1. The extent of riparian vegetation is increased
2. No loss of the extent of natural wetlands (natural wetlands include lakes, swamps and estuarine wetlands
3. Active engagement of communities and land managers in programs to improve water quality outcomes is increased.

Burdekin WQIP 2016	**Target:** By 2020, at least 75% of sugarcane areas are managed using SIX EASY STEPS® Guidelines for management zone yield potential for determining fertiliser rates, or other innovative management regimes **Target:** By 2025, 90% of sugarcane areas are managed using SIX EASY STEPS® Guidelines for management zone yield potential for determining fertiliser rates, or other innovative management regimes. Situation - Reported progress towards target 2016 adoption of these practices in the Lower Burdekin is ~17%
	Target: By 2020, less than 20% of sugarcane areas use low efficiency irrigation techniques (current D class irrigation practices). **Target:** By 2025, at least 60% of sugarcane areas are managed using high efficiency irrigation techniques (B irrigation practices) Situation- Reported progress towards target: 2016 adoption of these practices in the Lower Burdekin is less than 10%
	Target: By 2020, at least 60% of sugarcane areas are managed using best practice herbicide management **Target:** By 2025, 90% of sugarcane areas are managed using best practice pesticide management. Situation - Reported progress towards target 2016 adoption of these practices is ~30-35%

Source: Waterhouse et al. (2018).

WATER QUALITY RISK FRAMEWORKS

To achieve the Land and Catchment Management targets and end-of-catchment water quality targets described above requires an understanding of the specific practices to be encouraged to guide and prioritise on-ground activities and development of an implementation plan.

The industry and regional specific management practice frameworks Water Quality Risk Frameworks (DES 2019b), identify the management practice level for individual farm practices, which can be expected to result in a high, moderate, moderate-low and lowest water quality risk. Not all practices are considered equal and the frameworks allocate a percentage weighting to each practice depending upon its relative potential influence on off-farm water quality.

Multiple terminology for risk frameworks and best management programs has created unnecessary confusion in understanding the risk frameworks and setting regional adoption objectives. To clarify some of this confusion the alignment of the risk frameworks with related terminology, including the previously used 'ABCD" management practice frameworks and industry BMP programs is provided in **Table 4**.

Table 4: *Water Quality Risk Frameworks for the Reef 2050 Water Quality Improvement Plan and alignment with the 'ABCD' terminology and industry BMP programs (generalised).*

Terminology	Practice Standard			
ABCD	A	B	C	D
Water Quality Risk Framework	Lowest risk, commercial feasibility may be unproven	Moderate-low risk	Moderate risk	High risk
	Innovative	Best practice	Minimum Standard	Superseded
Industry BMP (generalised)	Above industry standard (typically aligns with Moderate-Low risk but in some instances aligns with Lowest risk state)		Industry Standard	Below Industry Standard

Source: Waterhouse et al. (2018).

BCEG partners have also commented that the indicators to describe each practice level (or risk level) in these frameworks are often not sufficiently specific or measureable. This has made it problematic for practitioners to consistently benchmark practices and delineate practice levels using these frameworks. A lack of consistent interpretation of these indicators will affect the design of projects to shift farmers to lower risk levels and the accuracy of monitoring rates of adoption.

The Enhanced Extension Coordination in GBR project is currently instigating a project with the Paddock to Reef team to improve the utility of these frameworks and develop methodology for how they can be used to plan and prioritise on-ground activities in the REPs.

The following **Table 5**, **Table 6**, **Table 7** and **Table 8** set out the current Water Quality Risk Frameworks for management practices relevant to sugar cane production for soil, nutrient, pesticide and irrigation management respectively (DES, 2019b). Included in these tables as part of this Situation Analysis is the Reef Report Card results for 2016 and 2017-2018 to indicate progress in shifting farm practices to lower risk levels. BCEG partners have also provided some interpretation of the reported progress for each practice.

However, because the latest Report Card 2017-2018 was released when the revision of this plan was nearly completed there are only limited interpretations at this stage. These will be explored further by the BCEG as part of implementing this REP and be included in future revisions.

Reef Report Card colour-coded system - Legend for Tables, 5, 6, 7 and 8

🔴	0-22% Adoption progress	E – red	Very poor
🟠	23-45% Adoption progress	D – Orange	Poor
🟡	46-67% Adoption progress	C- Yellow	Moderate
🟢	68-89% Adoption progress	B – Light green	Good
🟢	90-100% Adoption progress	A – Dark green	Very good

Table 5: *Water Quality Risk Frameworks 2017-22 for the Reef 2050 Water Quality Improvement Plan, Burdekin adoption of sugarcane key management practices since 2016 (adapted from Australian Government & Queensland Government (2019) for the Haughton Catchment, and alignment with the 'ABCD' terminology and industry BMP programs (generalised) -* ***Soil management****.*

Soil management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	By June 2018, 0.3% of land is managed under best practice systems for soil (347 ha).			
Crop residue cover (40%)	Cane trash blanket is retained, including as fallow cover after final ratoon.		Cane trash blanket is retained on ratoons.	Cane trash blanket is not retained.
	Report Card 2016 Benchmark 2.4%, Report Card 2017 & 2018 2.7% representing a 0.3% improvement. Adoption progress - Very poor			

Situation:
An industry wide commitment and approach would be required to convert the Burdekin to a green trash blanketing (GBT):

- The Burdekin cane crop is larger than other regions e.g. 8.7 M tonnes in 2016. The large amount of extraneous matter from larger crops would affect transport infrastructure required to send the harvested product to the mills. Without large capital investment in infrastructure, e.g. cane bins and milling equipment this could affect the length of the crush and push other critical tasks such as fertilizing into a period with higher risk of rainfall, could impact growers profitability through reduced CCS due to extended season length.
- On certain soil types, large amounts of cane trash laying on the ground, can impede the flow of irrigation water down furrows resulting deep drainage losses and potential loss of productivity due to irrigation water not reaching parts of the block.
- Harvester operators have to slow harvesting speeds down to compensate for the additional biomass, the current payment system works on tonnage as opposed to time so there is no monetary incentive to cut cane green at a slower speed.
- The Burdekin has a very small amount of harvester contractors with most groups cutting about 100,000 T. Slowing down the rate of the crush would push season length out as previously stated.
- Burning cane is part of the culture in the Burdekin with the first cane fire marked as a significant event that is celebrated by the community. Attitudes towards changing farming practice to cut green is another major barrier to widespread change.

Soil management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
Controlled machinery traffic (20%)	Less than 36% of the field is trafficked by machinery every year.		Between 37% and 60% of the field is trafficked by machinery every year.	At least 60% of field is trafficked by machinery every year.
	All machinery wheel spacing is matched to row spacing for all operations including harvesters and haul-outs. GPS guidance is used for **all** field operations, i**ncluding** harvesters and haul-outs.	All machinery wheel spacing is matched to row spacing for all operations including harvesters and haul-outs. GPS guidance is used for all operations **except** harvesters and haul-outs.	Most machinery operates on the same wheel spacing and is matched to row spacing. Harvesters and haul-outs are on difference wheel spacing's.	Machinery operates on different wheel spacing's
	Report Card 2016 Benchmark 7.9%, Report Card 2017 & 2018 8%, representing a 0.1% improvement. Adoption progress - Very Poor			

Situation:

- A successful controlled traffic system requires capital transition costs for the grower, with potentially several years of farming equipment being modified continuously until the entire farm has been transitioned across to wider rows.
- The SRDC program *Sugar Yield Joint Decline Venture*, did not have an extension component therefore; many growers remain sceptical about the benefits of a controlled traffic system.
- Controlled traffic has an impact on harvesting operations. There is a culture of negativity towards controlled traffic in the harvesting community, which has been a major roadblock to having growers change their farming system.
- Any improvements can take up to a decade or more to be realised.

Soil management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
• There has been a slight improvement in adoption in recent times; however, growers are still waiting for data from recent trials before committing.				
Land management during sugarcane fallow (20%)	Legume or cover crops are planted on **all** fallow land, without tillage. Crop residues are maintained.	Legume or cover crops grown on **all** fallow land, and crop residues are maintained.	Soil cover maintained during the fallow phase. Trash blanket and sprayed cane or growth of a legume/cover crop **when opportunity arises**. Weeds are controlled with knockdown herbicides.	Bare fallow or no fallow.
	Report Card 2016 Benchmark 17.1%, Report Card 2017 & 2018 17.8%, representing a 0.7% improvement. Adoption progress - Very Poor			
Situation: • DAF's Coastal Farming team, has recently held a series of workshops to encourage planting of alternative crops including grain storage solutions, inoculating legumes, pesticide management and benefits to soil health from legume crops. DAF provides agronomic and economic advice to growers wanting to grow legumes. • Local extension providers believe legume or cover crops in the region could be higher than reported above. Historically farmers will plant legumes in times of low sugar prices. It is not known if the sugar prices increases whether farmers will revert to a monoculture of sugar cane.				
Preparing land for planting (20%)	Minimum tillage.	Zonal tillage only, less than 60% of area is cultivated.	Up to 5 passes of tillage equipment.	Six or more passes of tillage equipment.
	Plant cane is established after fallow using 1 tillage operation or less.	Zonal tillage after a fallow or break crop. Only the row area is cultivated, inter-rows are left uncultivated.	Plant cane is established after a fallow using zonal tillage or the minimum number of passes required for soil and conditions.	All plant cane blocks are prepared with a fine tilth.

Soil management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	Report Card 2016 Benchmark, 3.4%, Report Card 2017 & 2018 3.4%, representing 0% improvement. Adoption progress - Very Poor			

Situation:

- Projects to address soil management practices have not been priority projects for improving water quality i.e. focus has/is on reducing DIN. Currently, there is only one soil health project operating in the Lower Burdekin '*Which is verifying and demonstrating the impact of moving to an improved farming system upon soil health, productivity and profitability in the Herbert and Burdekin regions'*. When a grower is asked the P2R questions, the questions relating to soil health would therefore be answered poorly, resulting in a poor report card rating.

Table 6: *Water Quality Risk Frameworks 2017-22 for the Reef 2050 Water Quality Improvement Plan, Burdekin adoption of sugarcane key management practices since 2016 (adapted from Australian Government & Queensland Government (2019) for the Haughton Catchment, and alignment with the 'ABCD' terminology and industry BMP programs (generalised)* - ***Nutrient management.***

Nutrient management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	A 3.2% increase in the area managed using best practice nutrient management was observed, taking the total area to 19.6% (19,955 ha) in June 2018.			
Matching nitrogen (N) supply to crop nitrogen requirements (70%)	SIX EASY STEPS® Nutrient Management program is employed, which includes developing a whole of farm nutrient management plan. Nutrient management plans include consideration of yield history and trends in order to estimate optimal amounts of nitrogen required for each major soil type and/or management zone.		Nitrogen fertiliser rate for each plant crop and its subsequent ratoons are derived from soil tests and the SIX EASY STEPS® method. Rates are based on district yield potential with adjustments made according to the soil N mineralisation index (based on organic carbon percentage). Deductions are made for other significant sources of N including from irrigation water, mill mud and legumes.	N fertiliser rate typically exceeds the SIX EASY STEPS® baseline application rate. Non-compliant with regulated method for calculating optimum N rate.
	Report Card 2016 Benchmark, 16.8%, Report Card 2017 & 2018 19.3%, representing 2.5% improvement. ● Adoption progress - Very Poor			
Situation:				

Nutrient management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
• BCEG partners have identified a holistic farming system is required to achieve real change in water quality and argue that a focus on individual water quality risks in isolation e.g. matching N to crop requirements will not achieve long term and sustainable changes. • Given that irrigation losses can be controlled by managing the amount and timing of irrigation application, there is scope to reduce nutrient losses through surface runoff and deep drainage by increasing irrigation efficiency. • The current RAP project has a focus on DIN reduction (15-20 kg) through irrigation practice change to reduce runoff and deep drainage risks, irrigation scheduling, irrigation efficiency (amount applied per watering), reduced irrigation runoff. Includes 750 hours of one on one extension, 30 landholders engaged, 1250 Ha of practice change, 15 enterprises moving to best management practice. • It is anticipated project RP161C and RAP projects will gain in relation to the adoption of improved N applications. • Reef Protection Regulations (Queensland Government, 2019b) current as of December 1st 2019 are anticipated to assist in bringing people up to industry standard.				
Matching phosphorus (P) supply to crop P requirements (15%)	P fertiliser requirements are determined through soil testing and consideration of extractable phosphorus and the P buffer index. P is not applied unless testing indicates it is necessary.		Phosphorus is regularly or routinely applied as part of plant or ratoon cane blends.	
	Report Card 2016 Benchmark, 14.1%, Report Card 2017 & 2018 14.1%, representing 0% improvement. Adoption progress - Very Poor			
Situation: • Compulsory N,P,K,S budgets will be introduced through Reef Protection Regulations in 2 years' time which will bring more attention to P application. • With a key focus on N in recent times P has not been a major element of concern, awareness around P has not been as public as that of N which may be the reason as to why there is not much adoption in this space.				

Nutrient management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
Application of mill mud or mud/ash (15%)	Do not apply mill mud or ash. OR Mill mud/ash is deep banded at <50 wet tonnes per hectare.	Mill mud is not applied where soil testing indicates P levels are adequate. Mill mud/ash is applied in a band over the crop row at <70 wet tonnes per hectare.	Broadcast application at rates up to 100 wet tonnes per hectare. For follow applications, mill mud/ash is incorporated soon after application.	Broadcast application rates over 100 wet tonnes per hectare.
	Report Card 2016 Benchmark, 65.9%, Report Card 2017 & 2018 65.9%, representing a 0% improvement. Adoption progress - Moderate			

Situation:

- Several trials are occurring around the application of mill mud. Results will be communicated to growers/industry at trial conclusion.
- There has been a significant effort to reduce DIN losses through Reef Trust III and IV and RP161C, where extension providers have engaged sugarcane farmers to adjust their fertiliser rates and implement on-farm trials of enhanced efficiency fertilisers and mill mud application methods.
- Reef Report card reporting periods do not reflect any recent progress in projects e.g. RP161, due to reporting being at least 12 months behind.

Table 7: *Water Quality Risk Frameworks 2017-22 for the Reef 2050 Water Quality Improvement Plan, Burdekin adoption of sugarcane key management practices since 2016 (adapted from Australian Government & Queensland Government (2019) for the Haughton Catchment, and alignment with the 'ABCD' terminology and industry BMP programs (generalised)* - ***Pesticide management.***

Pesticide management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	By June 2018, 11.8% of land was managed using best management practice systems for pesticides (11,941 ha)			
Use of residual herbicides in ratoons (30%)	Do not use residual herbicides in ratoons.	Overall strategy based on use of knockdown products only in ratoons. Residual herbicide use in ratoons only occurs as strategic response to problem situations.	Residual herbicides are routinely used in ratoon crops, both in response to known weed problems and as a preventative measure.	
	Pesticide application plant cane: **Report Card 2016 Benchmark 20%, Report Card 2017 & 2018 20.3%, representing a 0.3% improvement** Adoption progress - Very Poor **Pesticide application in ratoons:** **Report Card 2016 Benchmark 30%, Report Card 2017 & 2018 30%, representing 0% improvement.** Adoption progress - Poor			
Targeting herbicide application (30%)	Residual herbicides are applied in a directed band over the row only.	Residual herbicides are applied in a directed band over the row only.	Residual herbicides are applied through 100% coverage with conventional boom spray.	

Pesticide management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	Inter-row spaces are managed with knockdown herbicides. AND Precise weed mapping informs zonal residual herbicide applications. Application occurs only where weed pressure is expected.	Inter-row spaces are managed with knockdown herbicides.		
	Adoption of use of residuals: **Report Card 2016 Benchmark 64.1%, Report Card 2017 & 2018 64.5%, representing 0.4% improvement.** Adoption progress - Poor			
Timing of application (20%)	Residual herbicides are applied more than 3 weeks prior to significant runoff event.		Residual herbicides applied as soon as practical after harvest, with due consideration to current weather conditions and 4 day rainfall forecast.	
	Adoption of timing not provided in Report Card			
Pesticide selection (10%)	Pesticide choice is informed by assessment of control efficacy AND environmental risk, with lower toxicity products selected wherever feasible. Product choice considers the amount of active ingredient applied, its relative toxicity, half-life, solubility, and soil		Pesticide produce choice is based on efficacy and cost effectiveness of control.	

Pesticide management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	adsorption properties and their interaction with the soils on the farm.			
	Adoption of pesticide selection: **Report Card 2016 Benchmark 5%, Report Card 2017 & 2018 5%, representing a 0% improvement.** Adoption progress – Very Poor			
Managing canegrub (10%)	Control of canegrub is based on monitoring plant damage and risk assessments of likely pressure. An integrated pest management approach and participation in a district monitoring program informs grub management plans. No more than one application per crop cycle unless monitoring indicates economic thresholds are likely to be exceeded. For liquid formulations, coulter slots are completely closed or covered in.		Control of canegrub is based on monitoring plant damage and risk assessments of likely pressure. No more than one application per crop cycle unless monitoring indicates economic thresholds are likely to be exceeded. For liquid formulations, coulter slots are completely closed or covered in.	Insecticides are routinely applied to plant or ratoon crops. Often more than one application to a block over a crop cycle.

Pesticide management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	Adoption of cane grub pesticides: **Report Card 2016 Benchmark 50.6%, Report Card 2017 & 2018, 50.6%, representing a 0% improvement** Adoption progress - Poor			

Situation Pesticide Management:

Projects to improve pesticide management have been limited; however, the GBRF has recently funded Project Bluewater to reduce the loss of pesticides off-farm. Other projects that focus on pesticide management include the Smartcane BMP program and DAF's programs to increase the use of the Dual Herbicide Spray rig and the StoolZippa.

Table 8: *Water Quality Risk Frameworks 2017-22 for the Reef 2050 Water Quality Improvement Plan, Burdekin adoption of sugarcane key management practices since 2016 (adapted from Australian Government & Queensland Government (2019) for the Haughton Catchment, and alignment with the 'ABCD' terminology and industry BMP programs (generalised))* - ***Irrigation management.***

Irrigation management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
	By June 2018, 3.2% of land was managed using best management practice systems for irrigation (3,204 ha).			
Calculating the timing of irrigation (20%)	Irrigation schedule is informed by the use of in-field indicator tools in the *majority* of blocks, and the use of crop growth models to optimise timing.	Irrigation schedule is informed by in-field indicator tools such as gypsum blocks, mini pans or capacitance probes in the *majority* of blocks.	Irrigation schedule is informed by in-field indicator tools such as gypsum blocks, mini pans or capacitance probes in *some* blocks.	Irrigation scheduled on a set cycle.
	Adoption of timing of irrigation scheduling: **Report Card 2016 Benchmark 3.4%, Report Card 2017 & 2018 3.7%, representing a 0.3% improvement.** Adoption progress – very poor			
Calculating the volume of irrigation to apply (35%)	Irrigation applications aim to replace a measured or modelled soil water deficit.		Efforts made to adjust irrigation volume to match estimated crop water requirements at the time.	Fixed cycle and/or fixed duration irrigation events.
	Adoption of calculating irrigation volume: **Report Card 2016 Benchmark 5%, Report Card 2017 & 2018 5%, representing a 0% improvement** Adoption progress – very poor			

Irrigation management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
Minimising irrigation losses (20%)	Irrigation monitored closely (manual or with in-field advance sensors) and furrows are turned off as they reach completion. Inflow rates are increased in remaining furrows to ensure all/majority of furrows get through.		Irrigation sets are allowed to run until all/majority of furrows are competed.	
	Adoption of irrigation run-off: **Report Card 2016 Benchmark 4.7%, Report Card 2017 & 2018 5%, representing a 0.3% improvement** Adoption progress – very poor			
Irrigation tailwater capture and re-use (25%)	No irrigation tailwater leaves the farm (tailwater from 100% of farm area is captured). Storages are equipped with adequate pumping capacity and captured tailwater is rapidly re-used in the short term (days/weeks).		The majority of irrigation tailwater is retained on-farm (tailwater from 50-90% of farm is captured).	The majority of irrigation tailwater is not retained on-farm (less than 50% of farm area is captured).
	Adoption of irrigation tailwater capture not provided in Report Card.			

Situation Irrigation Management:

- Improved irrigation management is expected to incur a cost to growers, and this can be significant when reaching 'B class' or Moderate to Low risk irrigation efficiencies. Investment is likely to be required to redesign the existing irrigation system, and in many cases aging infrastructure (pumps and pipeline) requires replacement to deliver the appropriate volume for improved irrigation (Waterhouse et al. 2018)
- While projects such as the Climate Smart Sugarcane Irrigation Partnerships (CSSIP) will incorporate BOM's new high resolution climate model into an Irrigation Support Tool, BCEG partners acknowledge not all farmers want or need a high tech solution to irrigation management. The

Irrigation management (Key management practice and weighting)	**Relative water quality risk**			
	Lowest risk (A)	**Moderate – Low risk (B)**	**Moderate risk (C)**	**High risk (D)**
	Innovative	Best practice	Minimum standard	Superseded
Engagement Plan for Irrigation will outline the engagement activities required to ensure farmers on all levels of the adoption continuum can achieve the changes they want to make on their individual farms. • Training and capacity building programs aimed at irrigators, advisors and services providers will lift the capability of growers and advisors through a program of irrigation system data collection, analysis, benchmarking, discussion, reflection and evaluation.				
Production indicator: Estimated Crop Water Use Efficiency CQUE = TCH /(gross irrigation + effective* rainfall) – not included in calculations Assumes 450mm average effective rainfall	More than 9 tonnes of cane per mega litre per hectare.	7-9 tonnes of cane per mega litre per hectare.	5-7 tonnes of cane per mega litre per hectare.	Less than 5 tonnes of cane per mega litre per hectare.

Source: DES (2019b) & Australian Government & Queensland Government (2019).

Although extension practitioners have raised some issues around the use of these frameworks and there remains some reticence, the frameworks do currently provide the best means to guide the adoption of practices to work towards achieving Reef 2050 water quality targets. To that effect, **Sugarcane Water Quality Risk Frameworks 2017-2022 have been used to guide and prioritise project work in this REP** and have contributed to identifying and prioritisation of the activities identified in the Burdekin Sugar Recommendations and Actions described in **Table 11**.

LOWER BURDEKIN REGIONAL PROJECT/PROGRAM SCAN

Through consultation with extension providers and relevant stakeholders, and in a collaborative effort between DAF and SRA, current water quality, farming practice and extension projects and programs operating in the Lower Burdekin sugar growing areas have been identified and described. This information has been combined with data compiled by Waterhouse et al. (2018) to develop a Lower Burdekin Regional Project/Program Regional Scan (Regional Scan). Current projects and programs (sorted by P2R Water Quality Risk Framework categories where relevant) are presented in **Table 9** and completed projects and programs are presented in **Table 10**.

The Regional Scan provides an overview of the current extension effort and associated projects in the Lower Burdekin. Where possible, the Regional Scan aligns local initiatives to the P2R Water Quality Risk Framework categories: soil, nutrient, pesticide and irrigation management. Where initiatives fall outside those categories, for instance water quality monitoring and capacity building projects, these have been grouped into the following themes: All-of-farm projects and programs, Peer-to-Peer, Water quality monitoring; On-farm trials; and System repair/Treatment systems.

The Regional Scan was used by extension providers in conjunction with the P2R Water Quality Risk Framework to identify any gaps in extension delivery as part of the Situation Analysis to inform the recommendations set out in the **Burdekin Sugar Recommendations and Actions** (**Table 11**) below.

It is anticipated that the Regional Scan will be updated annually.

Table 9: *Lower Burdekin Regional Project/Program Scan. Current Projects and Programs (Sorted by P2R Water Quality Risk Framework practice categories where relevant).*

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Soil Management					
Measuring soil health benchmarks and supporting practice change in the sugar industry project (soil health project)	SRA, BPS, HCPSL and DAF	SRA	Herbert, Lower Burdekin	2017 - 2022	Verifying and demonstrating the impact of moving to an improved farming system (IFS) upon soil health, productivity and profitability in the Herbert and Burdekin regions. It is using local extension support to assist growers who are seeking to transition, giving them the confidence to identify their soil constraints and adopt practices which will result in healthier soils
Nutrient Management					
Reef Trust IV: Repeated Tenders Burdekin	DoEE $6.1 million	NQDT	Lower Burdekin	2018-2022	Offers financial incentives to sugarcane farmers to reduce the amount of nitrogen applied to their farms and improve their water management practices through a two stage Competitive Tender process. Increase engagement and uptake of improved N management practices, promotion of nutrient rates below SIX EASY STEPS®, cost effective DIN reduction and mitigation of perceived risk of reduced N rates.
Reef Trust IV: Complete Nutrient Management	DoEE $3.38 million	DES	All cane growing regions focussing on Burdekin	2017-2022	Provision of agronomy advice and recommendations to 425 cane farmers to support improved nutrient management planning on their farms, tailored to their specific circumstances.
Reef Trust IV: Support of cane farmer trials of enhanced efficiency fertiliser	DoEE	Canegrowers	Lower Burdekin sugarcane (also in Wet Tropics and Mackay)	2016-2021	

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
RP161C: Burdekin cane farmer engagement	QG OGBR, SRA $1.6 million	Farmacist, SRA, a grower	Lower Burdekin	2018-2020	Further support for the Complete Nutrient Planning for Cane Farming project will provide practical assistance to cane farmers in the Burdekin to adjust their fertiliser application rates to industry standard (SIX EASY STEPS®). Farmacist provides extension services to assist growers develop and understand nutrient management planning and how to implement new practices on their farms. As of October 2018, over 150 growers in the Lower Burdekin had been engaged, with Farmacist reporting a 135 tonne reduction in nitrogen application to farms. The project has been extended to December 2020 with another 120 growers expected to be engaged over that period
Improved water quality outcomes from on-farm nitrogen management (EEF)	QG OGBR $300,000	UQ, CSIRO, DES	Wet Tropics, Burdekin, Mackay	2016-2018	Utilises existing farm trials at identified N loss 'hot spots' to test PUYP as the basis for determining fertiliser N rates and compare EEFs with standard N fertilisers for minimising N losses, and to examine the water quality benefits that derive from such practice changes. Productivity, economic and environmental indicators will validate these strategies for reducing surplus N and provide recommendations for enhanced BMP's.
Pesticide Management					
Project Bluewater	GBRF $1.2 million	Farmacist	Haughton Catchment	2019 - 2022	The aim of this project is to reduce the runoff of pesticides into the GBR through the adoption of improved cane farming practices. Includes; farm tailored, spatially mapped, pesticide management plan, Spray rig assessment and calibration, spray application and pesticide workshops, pesticide application data recorded in line with label requirements, farmer driven field trials. Target 1 – 2 kg reductions in pesticides

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Irrigation Management					
Reef Trust III: Reef Alliance – Growing a Great Barrier Reef	DoEE $6.6 million (Cane)	NQDT	Whole of Burdekin including Lower Burdekin	2016-2019	Targeted extension and training program that aims to improve water quality by enabling landholders to change practices. Delivered by an integrated Great Barrier Reef wide consortium of farmers, graziers, Natural Resource Management organisations and industry groups. Lower Burdekin - 313 farming enterprises engaged and benchmarked against water quality risk assessment.
Reef Alliance Stage 2	GBRF $915,000	NQDT	Lower Burdekin	2019 – 2020	DIN reduction (15-20 kg) through irrigation practice change to reduce runoff and deep drainage risks, irrigation Scheduling, irrigation efficiency (amount applied per watering), reduced irrigation runoff. Includes 750 hours of one on one extension, 30 landholders engaged, 1250 Ha of practice change, 15 enterprises moving to best management practice.
Improved Irrigation and System Selection for Increased Sugarcane Productivity and Profitability	SRA/USQ	SRA	Lower Burdekin	2019 - 2022	Training and capacity building programs aimed at irrigators, advisors and services providers Lifting the capability of growers and advisors through a program of irrigation system data collection, analysis, benchmarking, discussion, reflection and evaluation. Developing resources to support ongoing technical and profitable irrigation decision making, through development of case studies, information sheets, a handbook and ready-reckoner tools to support irrigation system selection, design and operation.

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Climate Smart Sugarcane Irrigation Partnerships (CSSIP)	National Landcare Program Smart Farming Partnerships $1.5 million	JCU Consortium partners: Agritech Solutions BPS CSIRO DAF Wilmar SRA NQDT	Lower Burdekin		CSSIP will minimize nutrient runoff, improve soil health and increase wetlands water quality by facilitating the adoption of world-class irrigation practices in sugar cane farming systems. The project will incorporate BOM's new high-resolution climate model into an Irrigation Support Tool.
All of Farm Projects & Programs					
Smartcane BMP	QG OGBR	Canegrowers / BPS	Lower Burdekin sugarcane	2012-2022	An industry-led, Government supported best practice system for cane growing across Queensland provides for accreditation of growers at or above industry standard in a set of modules. Growers: to Oct 2019, 298 self-assessed and 44 accredited over 16,450 ha
Cane Changer 2	GBRF $1.4 million	Canegrowers	Lower Burdekin/Mackay	2019 - 2020	Design a program to elicit improved practices through accreditation in the SmartCane Best Management Program and other forms of 'commitment' towards improved practices
Various Farm Business Management	QG OGBR	DAF	Lower Burdekin	To Jun 2022	Validation of Management Practice - Project Catalyst, Sugarcane BMP Harvesting project, Irrigation BMP in Burdekin and Mackay, Soil Health project, EEF project Development and Provision of Decision Support Tools (DST) for Sugarcane Industry (e.g. Farm Economic Analysis Tool (FEAT) Provide expert economic support to DAF and industry extension delivery P2R Economic evaluation/M&E (RP150) across all relevant commodities

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Peer-to-Peer Projects					
Project Catalyst	Queensland cane growers, NRM groups, the Australian Government, WWF, and The Coca-Cola Foundation. $634,500	Reef Catchments	Lower Burdekin sugarcane	Completed (some trials continuing) 2010-2020	Supports innovative farmers cane farmers to develop and test management practices that improve the quality of the water leaving sugarcane crops
Project Catalyst Extension	GBRF $2.4 million	Reef Catchments	Wet Tropics, Burdekin and Mackay/Whitsunday regions	2019 - 2021	Supports a network of cane farmers in the Reef catchments to improve farming practices to reduce nutrient run off to the Reef. Expression of interest open to growers to establish trials with any service provider in region, Ten categories of projects, 20 per year per site for two years
NextGen 2019 Tour	DAF (Peer-to-Peer Funding) $20,000	BPS	Lower Burdekin	Completed pending final report 2018 - 2019	11 younger growers and two extension officers (BPS and SRA) participated in the study trip to southern Queensland and northern New South Wales from the 11th to 14th March 2019. Attendees visited six farms and three industry/research facilities including USQ Toowoomba Campus, PB Agrifoods, Taylor's Family Produce Farms (Stanthorpe), NSW Farming and Husk Distillers (Tumbulgum).
Championing Water Quality Improvement in the Burdekin Region	DAF (Peer-to-Peer Funding) $15,000	Farmacist	Lower Burdekin	Completed pending final report 2018 - 2019	A study trip to New Zealand took place from the 23 to 31/3/19. Eight Burdekin growers, nine Mackay growers participated, along with four extension officers from Farmacist. The study trip visited, Christchurch (Environment Canterbury), Waimakariri Irrigation Scheme, Lincoln University, South Island Agricultural Field Day (Kirwee) and the Ashburton and surrounding farming area.

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Empowering and Upskilling Women in the Burdekin Sugar Industry to Address Reef Water Quality Issues.	DAF (Peer-to-Peer Funding) $48,500	BBIFMAC	Lower Burdekin	Completed pending final report 2018 - 2019	The project has involved working with Behaviour Innovation to develop two workshops targeted at women in the sugar industry. The first workshop explored ways in which the Women in Sugar Burdekin group could support the learning and development of other women in the industry. The workshop encouraged participation in the Smartcane BMP program. The second workshop held in October was opened up to other women in the industry and focused on understanding change management and strategies to embrace rather than reject change.
Burdekin Field Walk Group	DAF (Peer-to-Peer Funding) $15,000	DAF	Lower Burdekin	Completed pending final report 2018 - 2019	The project has included several activities, for the Peer-to-Peer group, including a study tour where nine growers visited Toowoomba to visit the Darling Downs, PB agrifoods and Farm Fest. Growers were able to look at new equipment and meet manufacturers.
Water Quality Monitoring/On-farm Trials					
Cane to Creek, 2.0	GBRF $2.2 million	SRA	Haughton Catchment	2019 - 2021	Bridge the gap between growers, community and water quality science through sub-catchment monitoring and in-paddock demonstrations of nutrient practices. Includes, on farm water sampling Training - 6 Easy Steps, water collection procedures, accounting for legumes Water quality focused field days
An Evidence Based Approach to Improving Water Quality in the Barratta Creek Catchment (Stage 2)	GBRF $900,520	BRIA Irrigators	Upper Barratta Creek Sub-catchment	2019 - 2021	Work with eight Barratta Creek Catchment irrigators on practices the farmers and experienced local extension providers believe could improve water quality. Communication through one on one extension and shed meetings.

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
System Repair/Treatment Systems					
Reef Trust V: Repair and Restoration of Priority Coastal Habitat and Wetlands	DoEE $5 million	Greening Australia	Across GBR regions	2017-2021	Addresses the loss and modification of coastal habitat and wetlands, which provide vital ecosystem services important to the health of the Great Barrier Reef, through the rehabilitation of priority wetland areas in Reef catchments.
Bioreactors for the GBR	QG OGBR $465,000	DAF	Burdekin and Wet Tropics	2017-2020	Implementation and monitoring of a mix of denitrification bioreactor systems (examples are denitrification walls and denitrification beds) in Burdekin cane systems to establish efficiency at reducing pollutants in shallow groundwater.
Proof of Concept – determining the role of a constructed surface-flow wetland system in improving water quality in Barratta Creek	QG OGBR $216,132	BBIFMAC, DAF	Barratta Creek	2017-2020	Constructed wetland treatment system in a disused borrow pit. The treatment system involves a sediment basin, berms and an outlet system, all designed to slow water down to provide time for bacteria in the wetland to treat the pollutants. Although the target pollutant will primarily be nitrate-nitrogen, the system will also monitored to understand the effectiveness in removing pesticides. Rigorous water quality monitoring will determine the effectiveness of the system.
Monitoring the effectiveness of a constructed wetland treatment system. Project Proponent: BBIFMAC	DAF (Flexible Funding) $46,056	BBIFMAC	Upper Barratta Creek Sub-catchment	2018 - 2020	Expand the water quality monitoring program to assess all of the inlets and all of the potential pollutants. It is proposed that the frequency of sampling effort (to better match when farm runoff is occurring) be enhanced and to expand the analysis to include testing for pesticide levels at key times of the year when chemicals are being used on farm.

Project	Funding Body and $	Project lead	Geographic coverage	Timing	Brief description
Reducing fine sediment by maintaining and restoring Burdekin stream banks and coastal wetlands project	DNRME	NQDT	Lower Burdekin River	2018 - 2022	Repair streambank erosion issues in prioritised areas on the lower Burdekin River Repair prioritised coastal wetlands in the Lower Burdekin Delta Engage communities and land managers in programs to improve water quality Develop tools to better evaluate Reef water quality outcome Contribute new scientific knowledge
Joint collaboration, Intellidesign, Telstra, DES, DNRME to install and monitor a PoC	DNRME	BBIFMAC	Lower Burdekin	2019 - 2020	Deploying water quality monitoring devices in bores and surface water locations

Table 10: *Lower Burdekin Regional Project/Program Scan. Completed Projects and Programs.*

Project	Funding	Project lead	Geographic coverage	Timing	Brief description
2008 Lower Burdekin Water Quality Tender	DoEE, National Market Based Instruments program $600,000	NQDT	Lower Burdekin sugarcane	Completed 2007-2008	Funding for on-farm projects delivering water quality improvements (including sediment, nutrient, herbicide and pesticide losses) through a competitive tender process.
Reef Rescue	DoEE	NQDT	Whole of Burdekin including Lower Burdekin sugarcane	Completed 2008-2013	Grants to assist with practice changes aimed at reducing sediment, nutrients and pesticides leaving farms.
Reef Programme	DoEE $15 million	NQDT	Whole of Burdekin including Lower Burdekin sugarcane	Completed 2013-2016	Targeted extension and financial incentives program.
Queensland Government NRM Investment Strategy	QG DNRM $240,000	NQDT	Lower Burdekin sugrarcane	Completed 2013-2016	Target the improvement of landscape resilience in sugarcane in the Lower Burdekin Delta
	$1.5 million			2013-2018	Regional Delivery Project promoting sustainable soils management across the region
Extension of Burdekin Nutrient Trials (RP20C): Nitrogen fertiliser requirements for representative soils of the Lower Burdekin cane growing district	QG OGBR $1.33 million	SRA, DAF, DES	Lower Burdekin sugarcane	2014-2018	Continues the work initiated in RP20C and includes the harvesting of the remaining 11 trial sites in 2014. Following the harvest of the 11 sites in 2014 one 1st ratoon site, three 2nd ratoon sites and five 3rd ratoon sites will be fertilised, monitored and sampled as part of the new project (RP20/14C). Four new trial sites were established across the Lower Burdekin in March/April 2014 under perceived ideal conditions for establishing plant crops. Includes specialised soil and plant analyses to support the agronomic measurements (DES) and economic assessment of the profitability of various nitrogen application rate strategies (DAF).

Project	Funding	Project lead	Geographic coverage	Timing	Brief description
Reef Trust II: Reverse Tenders	DoEE $2.6M	NQDT	Lower Burdekin sugarcane	2015-2018	Offers financial incentives to sugarcane farmers to reduce the amount of nitrogen applied to their farms and improve their water management practices through a two stage Competitive Tender process. Increase engagement and uptake of improved N management practices, promotion of nutrient rates below SIX EASY STEPS®, cost effective DIN reduction and mitigation of perceived risk of reduced N rates.
Reef Trust III: Project Catalyst Revamp	DoEE $875,000*	Catchment Solutions	Lower Burdekin sugarcane	Completed 2016-2018	Supports innovative farmers cane farmers to move beyond industry best practice for nutrient, irrigation, pesticide and soil management. Part of the integrated Phase III programme across all NRM regions to support adoption of improved agricultural land management practices.
Rural Water Use Efficiency – Irrigation Futures (RWUE-IF) program				Completed 1999 - 2018	Partnership between the Queensland Government and major rural industries where the government funds industry groups to deliver agreed services to irrigators to achieve water use efficiencies. Includes financial incentives to implement conjunctive use bores and to make irrigation system improvements; undertaking irrigation system evaluations and the installation of irrigation information management system sensors. Groundwater harvesting recently introduced.
RP169C Connecting cane farmers to local wetlands	QG OGBR $296,000	NQDT	Lower Burdekin sugarcane	Completed 2017-2019	Providing opportunities for cane farmers that adjoin two wetlands to reduce irrigation and nutrients to benefit the wetlands, without negatively affecting their profitability.

Project	Funding	Project lead	Geographic coverage	Timing	Brief description
(SRA Projects) WW001 Improved management practices of legume crop residues for maximal economic and environmental benefits	SRA $83,854/year for 3 years	QG OGBR	GBR sugarcane areas	2015-2018	This project aims to address N losses from legume residues. It will investigate a suite of N-efficient legume residue management strategies through manipulating legume N mineralisation (release), capturing excess mineral N, or inhibiting formation of the mobile and vulnerable nitrate N.
Wilmar demonstration trials assessing cane productivity and water quality impacts of mill by-products	QG OGBR $164,600	BBIFMAC, Wilmar	Burdekin and Herbert	Completed	Water quality monitoring for different mill by-product and application strategies on irrigated and rain-fed sugar cane farming systems to inform and assist in on-going development of mill by-product guidelines.
StoolZippa trial	DAF (Flexible Funding) $16,500	DAF	1 farm Delta	Completed July 2019	The StoolZippa was designed by DAF to address issues related to cover over Imidacloprid application. This project will validate the StoolZippa in the Burdekin region where the primary mode of loss is generally through irrigation tailwater. Funding will help to promote the StoolZippa with replicated scientific data, so that growers can make a decision about how to best manage the application of Imidacloprid.
Barratta Creek Action Group monitoring	DAF $70,000	Barratta Creek Action Group (BCAG) - BRIA Irrigators Ltd, BBIFMAC, Burdekin Productivity Services, Farmacist, DAF and Wilmar	Barratta Creek	Completed 2016-2017	Designed to identify where in the catchment nutrient, herbicide and pesticide loads were originating and identify which products were contributing to the highest loads to guide potential improvements in individual farm management practices. Provided a farmer/industry driven approach to water quality monitoring with industry partners. To-date the project has not been successful in obtaining further funding.

Project	Funding	Project lead	Geographic coverage	Timing	Brief description
RP143C Quantifying residual soil nitrogen in sugarcane beds in the Burdekin	QG OGBR		Lower Burdekin sugarcane	Completed	Farm trials to measure nitrate fluxes that moved off-farm via run-off from rainfall events assessing timing of losses after application.
Improving water quality for the GBR and wetlands by better managing irrigation in the sugarcane farming system	NESP	JCU/Agritech Solutions/BPS	Lower Burdekin	Concluded June 2019	Address barriers that impede the adoption of new practices and technologies related to irrigation efficiencies. Created a two-way communication pathway to improve irrigation information transfer between smart irrigation tools and make them 'smarter'.

Source: Waterhouse et al. (2018) and DAF/SRA Regional Scan (2019).

BURDEKIN SUGAR RECOMMENDATIONS AND ACTIONS

The Burdekin Sugar Recommendations and Actions aligns the Regional Scan and progress towards improved management practices outlined in the P2R Water Quality Risk Framework to develop recommendations and actions to improve the effectiveness of extension activities aimed at improving water quality outcomes in the Lower Burdekin sugar growing areas (Table 11). It sets out gaps and barriers identified by the BCEG and makes specific recommended actions to be implemented through this REP to improve rates of adoption or practices to improve water quality.

The intent is for the recommendations and actions to be updated annually as part of REP annual updates and for the Regional Gaps and Priorities to be prioritized to ensure funding is strategically targeted to initiatives of importance. Planning will be ongoing, for instance, items marked 'TBA' will require ongoing discussions with BCEG partners and other stakeholders to address.

A key focus for the Enhanced Extension Coordination in GBR project in moving forward is to encourage commitment to increase coordination and collaboration between extension providers. The Burdekin Sugar Recommendations and Actions aims to target activities to address regional priorities and support enhanced coordination and collaboration through sharing of information and resources and working together.

Table 11: *Burdekin Sugar Recommendations and Actions to be implemented through the Burdekin – Sugar Regional Extension Plan.*

Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
Farming Practices				
Soil Management	Adoption of fallow management	• Enhanced Extension Coordination in GBR project (Peer-to-Peer funding) • SRAs Industry Adoption Strategy	There is some work occurring around adoption of fallow management including; the Peer-to-Peer Burdekin Field Walk group who has interest in fallow management and alternative crops, SRA's *Measuring soil health benchmarks and supporting practice change in the sugar industry* project (soil health project) and Project Catalyst Extension and DAF's Burdekin extension program. BCEG also see value in the adoption of fallow management to minimise weed pressure and reliance on herbicide application.	All involved with these activities to share knowledge/outcomes and through project M&E identify gaps and develop new initiatives to address.
Nutrient Management*	Nutrient management plans - skills in applying the plans in a tactical and practical way Work on a broader range of practices	• RP161C • Reef Trust III • Reef Trust IV	The RP161 project designed to give sugarcane farmers the confidence to implement the SIX EASY STEPS® program on their farm by providing tailored agronomic services for a number of sugarcane farmers. The project provides agronomic support to help sugarcane farmers align nitrogen and phosphorous rates to the regulated amounts based on soil tests and soil types. Reef Trust projects offer: • Financial incentives for sugarcane farmers to reduce the amount of nitrogen applied to their farms and improve their water	Ongoing

Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
	– timing, placement, product selection, irrigation timing, spilling at end of rows, spread		management practices through a two-stage, Competitive Tender process. • Provision of agronomy advice and recommendations to 425 cane farmers to support improved nutrient management planning on their farms, tailored to their specific circumstances.	
Pesticide Management*	Increased adoption of best practice technology for application of herbicide e.g. banded spraying, nozzle selection, products and rates Timing of irrigation after herbicide / pesticide application	• Enhanced Extension Coordination in GBR project (Flexible funding) • Pesticide Working Group (PWG) • GBRF	Participants from the PWG have provided ideas around activities to address this priority. DAF is supporting a more local ownership approach to pesticide issues, planning and action around solutions. Resellers and their grower clients engaged. Project Bluewater will work with sugarcane farmers to develop pesticide management plans.	• By Mar 2020 – As an outcome of the Pesticide Working Group DAF to hold pesticides training targeting extension officers, contractors, resellers and sugarcane farmers. • By June 2020 –REC to facilitate exploring common ground and potential for collaboration i.e. develop area specific Rules of Thumb (common consistent messages to sugarcane farmers). • Ongoing - Results of trials such as *BSFF02 StoolZippa Imidacloprid Trial* and others on alternative herbicides communicated to sugarcane farmers at Industry Shed meetings and other opportunities.
	Sugarcane irrigation, N and	• Enhanced Extension Coordination in GBR	There has been little opportunity for this gap to be implemented as most funding/programs have	

Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
Irrigation Management*	pesticide management should be addressed in unison	project (Personnel and Expertise funds - Engagement Plan for Irrigation) • RP161 • Reef Trust IV • OGBR - Improved water quality outcomes from on-farm nitrogen management (EEF) • GBRF	focused primarily on reducing N rates without addressing irrigation efficiencies in unison. While the number of trials investigating irrigation management has been limited, trials that have occurred, have demonstrated that improved irrigation management could reduce N losses with no impact to yield (Thorburn et al., 2011). There are also new technologies available to improve irrigation efficiency, but are yet to be widely adopted.	• Feb 2020 – EOI submitted to GBRF for an irrigation efficiency project. • By May 2020 –- the Engagement Plan for Irrigation is developed in collaboration with all BCEG partners and other stakeholders.
	Irrigation management to minimise losses to runoff and deep drainage	• GBRF • SRAs Industry Adoption Strategy • Improved Irrigation and System Selection for Increased Sugarcane Productivity and Profitability • Joint collaboration, Intellidesign, Telstra, DES, DNRME to install and monitor a PoC • Climate Smart Sugarcane Irrigation Partnerships (CSSIP)	In sections of the Lower Burdekin, deep drainage due to flood irrigation has contributed to elevated water tables and high levels of soil salinity, that are detrimental to the region's sugar production. How irrigation practices are managed interacts with other farm practices to affect losses and loss pathways of applied nutrients and pesticides to influence off-farm water quality risks. The Engagement Plan for Irrigation, GBRF and SRA projects will provide trials, engagement of sugarcane farmers and provision of training for extension officers to progress improvements in irrigation efficiencies and management. The deployment of water quality monitoring devices in bores and surface water locations will enhance knowledge around loss pathways.	
	Strategic installation and management of recycle pits in the	• Enhanced Extension Coordination in GBR project (Personnel and Expertise Funds -	Recycling of irrigation tail water where possible is attractive in the Lower Burdekin where water is a highly valued commodity. While there have been several local studies conducted around the	By May 2020 the Engagement Plan for Irrigation identifies need to develop a plan for the strategic location, design considerations and

Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
	context of BRIA and Delta characteristics	Engagement Plan for Irrigation)	efficiencies of recycling pits there exists no strategy or plan around most efficient locations for placement, costs, design requirements or management of pits.	costs for the construction of further recycling pits to encourage more water recycling and reduce irrigation tailwater runoff.

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
People, Extension and Engagement				
Communication	• A coordinated and consistent message to sugarcane farmers and industry sectors • Consistent and timely communication between on-ground extension and research, science providers	Enhanced Extension Coordination in GBR project • REP • CEP • Engagement Plan for Irrigation • Max Hardy Consulting Collaboration Program Enhanced Extension Coordination in GBR project • REP • CEP SRAs Industry Adoption Strategy • Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019	• Consistent and timely communication between on-ground extension and research, science providers is required to ensure a consistent message to sugarcane farmers. This allows a collective understanding of industry issues and GBR Water Quality Targets. • The introduction of the SRA Regional Coordinator and DAFs REC roles provides a conduit to link industry with extension effort addressing environmental issues. • Rules of Thumb (RoT) – DAF engaged Townley's Environmental Services to develop industry-specific (with regional variations) common and consistent messages to sugarcane farmers (RoT). While a commitment for taking these messages to the next level has been expressed by stakeholders, it is recognised that understanding barriers, as well as drivers, to adoption will be an important part of reframing the RoT messages to drive uptake.	• Ongoing – REC in conjunction with BCEG to update REP annually. • Ongoing - REC to provide information to stakeholders in relation to webinars, events and provide opportunities for two-way communication between extension, research and science providers. • Ongoing - REC to invite guest presenters to BCEG meetings • By June 2020 – DAF to facilitate exploring common ground and potential for further developing area specific RoT

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
	Raise awareness of the collective Lower Burdekin extension effort	Enhanced Extension Coordination in GBR project • REP • CEP • SRA	The BCEG identified two main audiences to influence: - Sugarcane farmers - Policy and investors 1. Sugarcane farmers Sugarcane farmers need access to extension staff for opportunistic 'one on one' and small grower group engagement. It is important that sugarcane farmers understand who can provide extension services in their area and how those services can be accessed. Hardy (2019) recommended making more visible all services organisations are providing, and highlighting their expertise, as well as making it easy for sugarcane farmers to access these services. 2. Policy and investors Manager (Extension and Coordination) has developed a Terms of Reference that would see two representatives from each of the regional extension groups travel to Brisbane to meet with key people from DAF, OGBR and funders once per year. Such a group would make the regional extension providers feel part of the 'bigger GBR picture' and provide an opportunity to input into policy development around extension.	• By Mar 2020, REC develop a brochure or other communication product with BCEG partners, highlighting extension providers expertise and how sugarcane farmers and others can access their services. • Ongoing – REC continues to maintain and promote a shared calendar of events. • Manager (Extension and coordination) facilitates a cross-regional workshop in Feb 2020.

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
	Communication around trial results - local, regional, international	Enhanced Extension Coordination in GBR project • REP • CEP • Peer-to-Peer and Flexible Projects SRAs Industry Adoption Strategy • Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019 GBRF • Reef Water Quality Improvement Grant Program Stage 1 Projects	• BCEG partners have requested trial results be presented at BCEG meetings to enable questions and solutions around trial designs and results to be analysed via a group discussion. • Collaborative platforms, like Basecamp, could be established to house research papers, and other resources such as the Regional Scan attached to this plan, lists all projects and programs occurring in the region. • GBRF projects, Flexible and Peer-to-Peer and other projects have communication initiatives linked to the project activities e.g. communication of water quality results or trial results to sugarcane farmers through shed meetings, field days, bus trips etc..	• By Jun 2020 – REC to trial an online platform e.g. Basecamp, for sharing of information amongst BCEG partners. • All BCEG partners contribute annually to the updating of the Regional Scan (programs and projects underway in the area). This should be housed on a shared platform such as Basecamp. • Ongoing - REC to invite guest presenters including local project updates to BCEG meetings
Coordination	A collaborative, area wide, strategic and structured approach to extension	Enhanced Extension Coordination in GBR project • REP • Max Hardy Consulting Collaboration Program SRAs Industry Adoption Strategy	Hardy (2019) outlined overarching challenges around extension delivery and improved coordination and identified collaborative initiatives for implementation at the local level.	Ongoing – REC to organise quarterly BCEG meetings. By May 2020 –- SRA develops the Engagement Plan for Irrigation in collaboration with all BCEG partners. By June 2020, REC encourages and BCEG holds more networking events and

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
		• Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019		celebrate/report on progress made. By June 2020 – develop a BCEG Code of Conduct. By Mar 2020 – BCEG forms a cross-organisation committee to organise a collaborative event.
	Trials - A consultative approach in trial development, initiation, trial efficacy, rigour, consistency, measuring N coming off in runoff, deep drainage and volatilisation	Enhanced Extension Coordination in GBR project • REP SRAs Industry Adoption Strategy • Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019	Currently there is no planned/strategic approach to trial development. Organisations develop trials based on a reactive approach to funding or favourable issues of the time. Sugarcane farmers need more access to a coordinated and planned number of trials or demonstration sites, undertaken by sugarcane farmers in conjunction with extension providers. This engagement should include supporting data to reassure and provide confidence in changing or enhancing farming to ensure long-term viability.	By Jun 2020 – REC and SRA Regional Coordinator to work with industry stakeholders including sugarcane farmers to identify current and needed future trials and develop a collaborative/strategic approach to trial development and implementation.
Knowledge and technology transfer and adoption	Understanding and addressing barriers to adoption	Enhanced Extension Coordination in GBR project • Max Hardy Consulting Collaboration Program • Peer-to-Peer Funds • CEP Reef 2050 WQIP	While there have been and are several programs and projects addressing this priority through the Enhanced Extension Coordination in GBR project , Reef WQIP e.g. social indicator questions have been added to P2R, a collaborative way forward will require further consultation with the BCEG, policy and program advisors.	TBA

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
		• Implementation table A2: Culture of innovation and stewardship GBRF • Cane Changer 2 Project • Project Catalyst Extension		
	Involvement of sugarcane farmers/existing farming groups, including women's groups, in developing and running extension programs	Enhanced Extension Coordination in GBR project • REP • Peer-to-Peer Funds • Max Hardy Consulting Collaboration Program SRAs Industry Adoption Strategy • Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019	The Lower Burdekin Enhanced Extension Framework outlines a strategy to involve sugarcane farmers in decision making and extension activities related to water quality through the formation of focus groups. Peer-to-Peer Funds projects e.g. BSPTP02: Empowering and Upskilling Women in the Burdekin Sugar Industry to Address Reef Water Quality Issues, acknowledges women represent key change agents in the sugarcane industry. While there are several Peer-to-Peer groups operating in the Lower Burdekin, these groups could be evaluated to determine their success and if more support is needed.	By Jun 2020 – SRA, DAF and BCEG partners put into practice the Lower Burdekin Enhanced Extension Framework.

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
	Extension and support for adoption of technology and understanding of local water quality and business issues	Enhanced Extension Coordination in GBR project • Flexible projects • Personnel and Expertise projects GBRF Improved Irrigation & System Selection for Increased Sugarcane Productivity and Profitability (SRA) SRAs Industry Adoption Strategy • Burdekin Region Sugar Industry Adoption Strategic Action Plan 2019	• Current water quality monitoring projects and programs will provide a greater understanding of local water quality and build on current knowledge. • The Engagement Plan for Irrigation will provide a framework for extension and support around irrigation efficiencies and management.	Ongoing –ensure learnings from projects communicated to all stakeholders and future planning and implementation opportunities identified.
	Support existing programs e.g. Smartcane BMP, industry shed meetings	Enhanced Extension Coordination in GBR project • REP • Peer-to-Peer Funds	Current projects such as BSPTP02: Empowering and Upskilling Women in the Burdekin Sugar Industry to Address Reef Water Quality Issues are supporting increased uptake of Smartcane BMP. The Collaboration Program (Hardy, 2019) will build on opportunities for increased collaboration around industry events such as industry shed meetings.	Ongoing – REC continues to ensure learnings from projects are communicated to all stakeholders and future opportunities identified.

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
		• Max Hardy Consulting Collaboration Program SRAs Industry Adoption Strategy		
	Enhance the technical understanding and skills required of extension providers	Enhanced Extension Coordination in GBR project • Training Development Program SRAs Industry Adoption Strategy • Improved Irrigation and System Selection for Increased Sugarcane Productivity and Profitability	Training and capacity building programs targeted at irrigators, advisors and service providers is a component of SRA's Improved Irrigation & System Selection for Increased Sugarcane Productivity and Profitability. DAF's Training and Capacity Building program is providing opportunities for extension staff to participate in training.	Ongoing – REC will continue to collaborate with program managers in relation to training opportunities and ensure BCEG partners and other stakeholders are provided every opportunity to provide input to and participate in training programs.
Monitoring and evaluation	Farm benchmarking	Enhanced Extension Coordination in GBR project • Personnel and Expertise Funds SRAs Industry Adoption Strategy • Improved Irrigation and System Selection for Increased	Benchmarking can be either indirect — where sugarcane farmers calculate their own performance indicators and compare them against published industry benchmarks; or direct — where producers contribute their farm information into a service which generates the benchmarks for comparison with other sugarcane farmers. The Engagement Plan for Irrigation and SRA's Improved Irrigation and System Selection for Increased Sugarcane Productivity and Profitability projects aim to identify	• TBA • Work with P2P management practice adoption team to ensure that farm benchmarking aligns with P2R and practice changes are reported

BCEG Priority	Regional Gaps & Priorities	Existing Programs/Projects (From Regional Scan)	Situation	Recommendations & Action
		Sugarcane Productivity and Profitability	the most appropriate from of benchmarking and implement some form of benchmarking.	
	Measure capacity/attitudinal change, benefits of good extension	Enhanced Extension Coordination in GBR project • REP • Max Hardy Consulting Collaboration Program P2R Monitoring Program	To assess and track the social factors that influence management practice adoption, six questions have been included in the new P2R surveys. The REP Monitoring and Evaluation (M&E) Framework sets out the processes and methods for measuring the effectiveness of implementing the REP and the associated efforts to enhance the coordination of extension projects in the Lower Burdekin region.	• Ongoing – encourage more collaboration between BCEG and P2R program. • By Jun 2020 – Collaboration Matrix (Hardy 2019) has been used as a qualitative way to do benchmark how the Lower Burdekin sugar extension network is operating, or 'working together'.
	Water quality monitoring with a purpose, at scales ranging from on-farm, sub-catchment and Delta/BRIA	GBRF	GBRF projects will see on-ground action with cane farmers to reduce run-off of the highest priority pollutants nutrients and pesticides in the Lower Burdekin. On-farm and sub-catchment level water quality monitoring are a component of three projects recently funded by the GBRF.	By Jun 2020, presentations on project progress have been delivered to the BCEG, farmers and other stakeholders.

MONITORING AND EVALUATION FRAMEWORK

This Monitoring and Evaluation (M&E) Framework has been designed to monitor and evaluate the performance of the REP in coordinating the extension effort in the Lower Burdekin region and in facilitating collaboration amongst extension providers to implement the REP. It is based around Key Result Areas (KRAs) established in the Enhanced Extension Coordination in GBR project that were developed by DAF with input from the Department of Environment and Science and Coutts J&R. In addition, the M&E Framework includes objectives identified by the BCEG, associated with other projects, and funding sources that are being managed through the REP.

The M&E Framework sets out the processes and methods for measuring the effectiveness of implementing the Burdekin Sugar REP and the associated efforts to enhance the coordination of extension projects in the Lower Burdekin region. The purpose of the evaluation information can be summarised into the following categories:

- Reporting: justifying the investment
- Communication: increasing awareness of the outcomes, successes and lessons learnt
- Adaptive management: making improvements to project delivery
- Informing future work: evaluate outcomes to provide recommendations for future projects.

It is designed to streamline and clarify the M&E process around key elements set out in three tables:

- **Table 13:** Users and uses for the evaluation information. that describes who needs the evaluation information and what they need it for
- **Table 14** that sets out how progress towards each project objective will be measured in terms of effectiveness, efficiency, impact, legacy and project management
- **Table 15** outlines how the evaluation information will be collected including, the proposed timeframes and responsibilities.

By following this M&E framework the REP can be revised and updated and processes improved over time so that the extension projects it supports will be more effective in increasing the adoption of improved farm practices that result in better water quality outcomes. This monitoring and evaluation framework will be implemented by the REC with the BCEG and form part of the broader cycle of review, reporting and improvement of the REP and the Enhanced Extension Coordination in GBR project.

The M&E Framework is not a substitute for project level monitoring and evaluation and does not provide for the monitoring and evaluation of all the individual extension projects being coordinated by the REP or in the Lower Burdekin region. However, it does aim to build on project level evaluation and capture outcomes from such projects, as a measure of the effectiveness of enhanced coordination. To this end a Monitoring and Evaluation Template has been developed to guide the monitoring and evaluation of projects supported through the Burdekin Sugar REP.

Performance measures are based on the project objectives and will be measured through a combination of quantitative and qualitative data and analysis. **Table 15** outlines how the information in the Evaluation Methods described in **Table 14** will be collected including, the proposed timeframes and responsibilities.

The YourDATA data base platform has been chosen for each REC to record and report to the Manager (Extension Coordination) on activities coordinated through the Regional Coordination Groups and the implementation of the REPs. YourDATA is an online monitoring and evaluation database developed by Coutts J&R to assist programs and projects collect and report key evaluation data, including project activities, narratives, milestones, and feedback sheet responses. It provides a secure central data collection point with individual user accounts – allowing team partners to input, edit, and view their own M&E data (or all data for their assigned region/project) and managers to view, filter, analyse and export all project/program data for reporting.

M&E – COLLABORATION, COMMUNICATION AND ENGAGEMENT

To monitor and evaluate progress towards Key Result Area 1: *Improved effectiveness and efficiency through improved collaboration and coordination* it is important to monitor how the network is operating currently and use this to set objectives and plan for how they could operate in the future. This is quite complex as there are many ways in which people work together and interact and will require benchmarking where the network currently sits.

To achieve this indicators have been developed describing how people work together based on the *Collaboration Continuum* presented in Hardy (2019) (**Table 12**). These indicators have been developed into the Collaboration Matrix that describes examples and indicators for the different levels of working together set out in the Collaboration Continuum: Networking, Cooperation, Coordination, and Collaboration (**Figure 8**); with four levels to represent the maturity of the interactions and readiness to commit to more connected ways of working together.

The observed frequency of activities described by these indicators was then colour coded and presented as an overall assessment of group performance relative to the Collaboration Continuum (**Figure 9**). This assessment was then used to inform the Burdekin Sugar Regional Collaboration Strategy to guide how to encourage improved coordination and collaboration in extension activities.

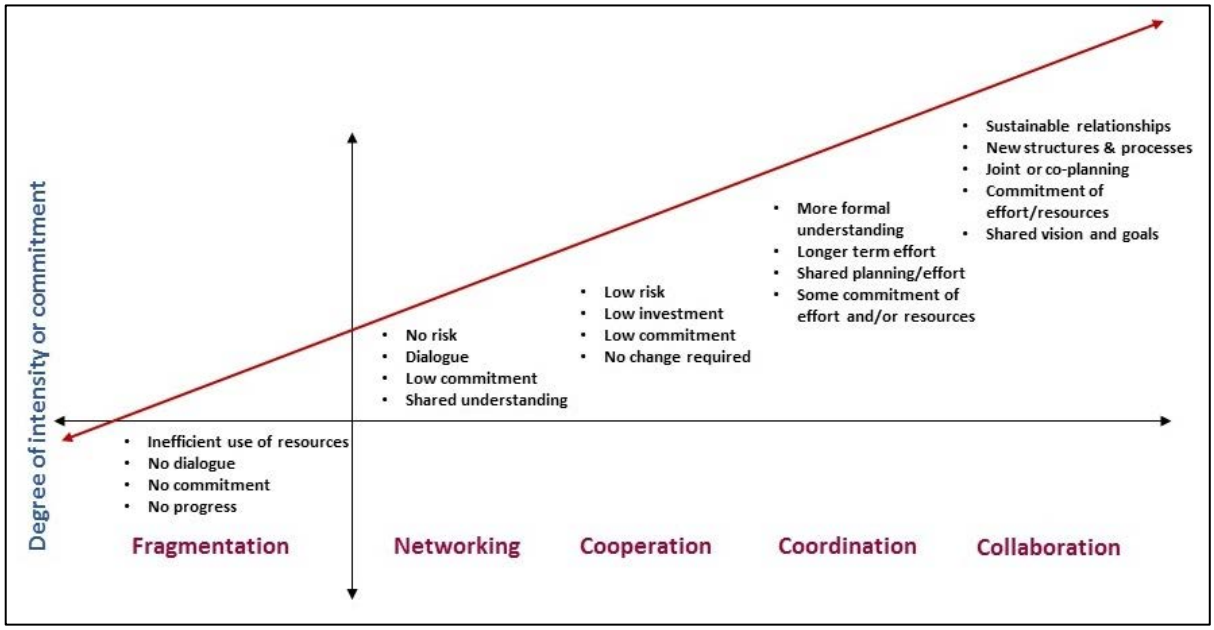


Figure 8: *Collaboration Continuum – Degree of intensity and commitment required at different levels of the collaboration continuum (Hardy, 2019).*

Table 12: *Examples of indicators for the different levels of working together in a Collaboration Continuum (Adapted from Hardy, 2019).*

	Fragmentation	Networking	Cooperation	Coordination	Collaboration
Level 1	Participants do not liaise or meet Participants may view other organisations as competitors Participants do not share resources or events	Participants come together socially or informally Participants exchange or are happy to exchange information or contact details	Participants attend a Regional Extension Coordination Network Meeting Participants attend a flexible funding or peer-to-peer learning event	Participants assist with the delivery of a network activity or event (organise catering, venue, take minutes etc) Participation in a shared planning activity Responsibility for meeting action list is shared by 2 or more partners	Participants are taking a lead or contributing to new activities (outside the meetings or funded activities) 2 or more partners that previously didn't work together are now working together on new projects or activities
Level 2		Participants happy to attend network meetings Participants interact with each other	Participants come along to meeting with a shared agenda Participation in the meeting	Participants share in a joint planning process (development of agenda or approval of projects for example) Participants contribute resources to planning meetings	Participants are working towards a shared goal Participants are volunteering suggestions Participants are offering to lead new activities
Level 3		Participants happy to come along to a second meeting Participants tell others about the benefits Participants invite others to the network	Follow up phone calls or emails from participants after meeting	Participants agree on a decision (or with the decision made) Participant(s) other than the REC take a lead on an action	Participants commit resources (time and/or funding) for joint activities Participants are starting to work with other network members on other initiatives
Level 4		A higher level of trust is reported among networkers. Evidence of networkers being willing to actively explore working at higher levels (ie, cooperation, coordination and collaboration). Evidence of organisations being more willing to share information about achieving practice improvements, or lessons learned.	Evidence of producers being referred to other extension services where more appropriate. Evidence of sharing resources between organisations providing extension services. Messaging about practice improvement is more consistent between different providers.	Feedback from producers of significantly less duplication of surveys and events. Feedback from producers of improved scheduling. Greater clarity about which services organisations are providing	Applications for funding jointly prepared by multiple organisations. Extension events jointly organised by multiple organisations. Producers express greater confidence in the relevance and effectiveness of the extension system. Evidence of more attempts at innovating through joint planning and delivery.

2018	Fragmentation	Networking	Cooperation	Coordination	Collaboration
Level 1					
Level 2					
Level 3					
Level 4					

2019	Fragmentation	Networking	Cooperation	Coordination	Collaboration
Level 1					
Level 2					
Level 3					
Level 4					

2020	Fragmentation	Networking	Cooperation	Coordination	Collaboration
Level 1					
Level 2					
Level 3					
Level 4					

Key to Colour Code:

2018	2019	2020	Extent of interaction
			Does not occur
			Occurs but infrequently
			Occurs more often
			Occurs frequently and regularly

Figure 9: *Benchmarking – where the Lower Burdekin extension network is placed, relative to the Collaboration Continuum. Orange 2018, Green 2019, Blue target for 2020 (Hardy, 2019).*

Communication and engagement activities will be guided by the Burdekin Sugar Extension C&E Plan and will be captured in a reporting template for the six monthly progress report submitted to the Manager (Extension Coordination) (DAF).The components of the framework, evaluation questions, performance indicators and evaluation methods are aligned to the MERI Plan for the Enhanced Extension Coordination in GBR project and have been influenced by the Stockwell et al. (2015) RP150 report, Coutts et al. (2017) report and Moore and Rinehart (2017). The information collated in the YourDATA platform will form part of the Evaluation Methods and be used to inform the Performance Indicators.

The aim of the evaluation will be to learn how to efficiently and effectively coordinate and prioritise extension effort in the Lower Burdekin region, but will also identify data needs and target the information required to improve the efficacy of Performance Indicators to implement in future iterations of the REP

Table 13: *Users and uses for the evaluation information.*

Who needs the information?	What do they want to know?	How will they use the information?
RECs & Regional Coordination Group (RCG) partners	• Is the RCG functioning effectively? • Is the REP & work plan implementation on track? • Is the work meeting needs?	• Report on progress to DAF towards milestones and objectives • Make improvements to the structure and functioning of the RCG • Make improvements to the REP & work plan • Make decisions about resourcing
Stakeholders (e.g. extension officers, industry, NRM, growers)	• What is the project doing? • How does the project impact their work? • Is the project improving the on-ground delivery?	• To inform their work program/determine whether to participate • To develop linkages with the project or others • To communicate to other stakeholders or peers
Department of Agriculture and Fisheries (DAF)	• Are RECs and RCGs functioning effectively? • Have REPs been developed and are they being implemented? • Are partnerships operating effectively? • Is there improved extension coordination & collaboration in each GBR region? • What results, expected and unexpected, and direct and indirect, are produced?	• Report on progress to OGBR (DES) towards milestones and objectives • Make improvements to the Enhanced Extension Coordination in GBR project • To facilitate learning and continuous improvement • Make recommendations about investment • Make decisions about staffing, resourcing • To justify program and continued support for REC positions
Office of the Great barrier Reef (OGBR)	• Are partnerships operating effectively? • Is the project meeting milestones and objectives? • Is the project worth the investment? • What results, expected and unexpected and unexpected; and direct and indirect are produced?	• To justify investment • Make decisions about investment • Report on Taskforce recommendations
External funders (including Australian Government and GBR Reef Foundation	• Is the Extension network functioning effectively and worth investing in?	• Make decisions about investment

Table 14: *Evaluation framework for project.*

Project objectives	Activities/deliverables	Evaluation questions	Performance indicators	Evaluation methods
Overall Reef Water Quality Outcomes	Reef 2050 : Queensland Reef Water Quality Program Goals Of which the REP and associated actions are contributing activities.	Impact • What measurable progress has been made towards meeting Reef 2050 WQIP 2025 land management and water • How has the REP and coordination added to the rate and quality of progress • What have been the positive and negative impacts that have resulted?	1. Extent of progress 2. Evidence of added value from the REP and coordination 3. Examples of positive and negative impacts	• Paddock to Reef Report Card • Scientific Consensus statements • Collated data from the evaluation of the coordination project below.
Key Result Area 1: *Improved effectiveness and efficiency through improved collaboration and coordination* • *Maintain, enhance and expand regional extension partnerships and collaboration across major agricultural industries and NRM groups, programs (e.g. MIPs) and projects (e.g. Reef Trust Phase 3 and future funding e.g. Reef Taskforce)* • *Strengthen links, collaboration and leverage of product development between researchers/ scientists (reef, industry etc.) and extension staff to maximise knowledge transfer*	Coordination Positions • REC • Regional Extension Group Resources • Flexible regional funding to support collaborative activities and fill regional gaps. • Peer-to-Peer Funds. • Skills/expertise gap program (DAF). • Training Development program (DAF). • *Other funding or extension provider's resources being provided* Platforms • Establish and maintain a Regional Extension Group and regional extension network –	Benefits derived • What cost efficiency, practice change, economic and environmental benefits have occurred from the extra coordination and funding in terms of improved efficiencies and effectiveness of extension. • Has the effectiveness of extension in the Lower Burdekin region improved through the implementation of the REP? Impact on organisations and people	4. Documented cases of newly initiated collaborative extension activities, projects or programs and linkages between related programs – at regional, cross-regional, state and national levels. 5. Increased formal linkages between extensions and capacity building programs and projects funded to improve water quality. 6. Evidence of impact of improved coordination	Secondary data • Documentation/progress reports of structures, positions, resources, activities and outputs put in place in the coordination program. • Partnership and activity details of the BCEG. • Regular extension practitioner workshops sessions about

Project objectives	Activities/deliverables	Evaluation questions	Performance indicators	Evaluation methods
• *Minimise the duplication of effort across Australian Government, State Government and industry programs which have extension activities associated with them* • *Enhance and support the increased extension effort being provided through and the increased urgency for this to lead to on ground practice change outcomes for reef water quality* Key Result Area 2: Improve the professional capacity of the extension network Key Result Area 3: Improve evaluation and review of extension effort and impact • *Identify gaps/opportunities and provide feedback to inform and support future allocation and targeting of on-ground resources* • *Provide strategic advice on regional gaps, needs and appropriate responses that meet the needs of Reef Plan and the Queensland Government Great Barrier Reef Water Quality program*	formally bringing deliverers together, facilitating collaboration and new initiatives to fill gaps and developing the REP. • Inclusion of other regional industry/NRM/Community groups in coordinated extension program e.g. SRA regional adoption coordinator. • Community of practice – on-line platform and face to face events. • Working with other regional groups and industry extension coordinators. Activities • Development of REP. • Identified regional extension gaps and barriers. • Identify extension practitioners influencing improved management practices in the Lower Burdekin region. • Identify opportunities to improve collaboration. • Undertaking agreed collaborative activities in line with the REPs, supported through Flexible Funds. • Facilitated Peer-to-Peer learning projects. • Undertaking regional Communication Activities – led or facilitated by RECs Coordinators Training	• To what extent has extension coordination improved across the Lower Burdekin region? • To what extent are extension and other programs being (better) strategically planned and targeted (with reduced overlap) at areas of greatest need and to achieve largest potential impact towards water quality targets? • What new initiatives have resulted from the coordination activities? • To what extent do extension personnel feel more connected, supported and valued and better able to undertake their extension activities? Effectiveness of process • Has the implementation of the REP been effective? • To what extent is communication and sharing of information/ experience (more effectively) occurring in the Lower Burdekin region and between	on practice changes on enterprises which have a known impact on economic and/or water quality benefits. 7. Improvements in the levels of stakeholder satisfaction re coordination, access and effectiveness of extension delivery. 8. Increases in the extent/type of interaction between extension staff within region and between regions and their awareness of other programs 9. Production and use of required REPs. 10. Extent of participation in extension capacity building activities and resulting improvement in the levels of understanding, skills, motivation, job satisfaction and commitment to extension in the reef regions. 11. Documented use of new science being used in extension	coordination, learning, issues and impacts. Primary data collection • Outputs of monitoring and evaluation from projects and programs being funded and/or supported through the REP. • Use of YourDATA to record extension coordination activities. • Narratives and detailed case studies of where extra coordination has resulted in collaboration and impacted on efficiency and impacts • Regional Landholder Engagement Project List updated annually • Updated E & E Spatial Database / Layers annually

Project objectives	Activities/deliverables	Evaluation questions	Performance indicators	Evaluation methods
	• Undertaking the training needs analysis, identifying professional capacity challenges, and working collaboratively to address them. • Raise awareness amongst network and facilitate training organised through Manager (Reef Training & Development). Skill/expertise gaps • Identify regional needs for skills and expertise to value add to extension activities and for support from DAF skills gap/expertise project. Evaluation • Record information in YourDATA and provide data for the E & E WebMap platform. • RECs to work with P2R and delivery organisations to increase spatial monitoring and evaluation of extension impact. • Document findings to provide policy makers with information and implications for extension policy, funding and operational activities. • Facilitate annual regional meetings to provide feedback to key stakeholders including Manager (Extension Coordination)	projects within and across regions and industries? • What extra capacity building activities have occurred and what were the participation, reaction and impact on participants? • To what extent is the communication and collaboration between researchers/scientists and extension officers increased? • To what extent does reporting of M&E meet the P2R needs and requirements? • To what extent is strategic advice being provided to investors on where extension effort should be targeted? • What barriers/ issues have impacted on the process and what changes are needed? • What were the expected/ unexpected results of coordination?	activities and their uptake by producers.	

Table 15: *Evaluation methods and timing.*

Evaluation Method	Focus	Timing	Responsibility
Secondary data capture and analysis	Using available reporting and data sets to capture trends, activities, changes in linkages and impacts. Includes analysis of capacity building/extension projects and linkages; progress reports of extension providers; P2R reports and Report card; Reef Extension Network data.	Annually	RECs Partner extension providers
Narratives	To qualitatively capture impacts and outcomes from projects and also barriers/issues.	Collected throughout projects and reported via six-monthly progress reports.	RECs
Case studies	To quantify where possible specific instances of change and resulting efficiencies and impact	Annually with an emphasis on final 6 months	RECs Partner extension providers
Interviews with informed stakeholders	To quantify and qualify benchmarks and changes in coordination, collaboration and extension delivery performance. Informed Producer input should also be sought in the final benchmark.	Annually	RECs Partner extension providers M&E Consultants
Workshop debrief of RECs	Capture observations, experiences and outcomes from RECs as well as opportunities for improvement.	Annual Regional Extension Coordinator workshop	Manager (Extension Coordination) to organise workshop M&E Consultants
Workshop evaluation – AG and QG	Capture feedback provided to AG and QG, actions planned and success of workshop, areas for improvement	Annual Regional Extension Coordinator workshop	Manager (Extension Coordination) to organise workshop M&E Consultants/ Independent facilitator to collect data
Extension personnel survey	To capture feedback, satisfaction, observations and experiences from stakeholders involved in the project and document examples of actions taken and how activity assisted.	Annual	Manager (Extension Coordination) M&E Consultants
Analysis of Communication activities	Show evidence of key messages being developed and used by extension officers. To share project outputs and outcomes.	Reported in six-monthly progress reports	RECs Communications officer Manager (Extension Coordination)
Capacity building evaluation	Show evidence of capacity building in extension network.	Reported in six-monthly progress reports	RECs Manager (Reef Training & Development)

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APPENDIX A: Pesticide Working Group

DAF established and administers the PWG that aims to facilitate communication between stakeholders and take actions to accelerate progress towards the Reef WQIP 2050 targets for pesticides. The PWG framework comprises a PWG secretariat (DAF) who oversee three sub-groups, Science and Monitoring, Policy and Extension Coordination (**Figure A1**).

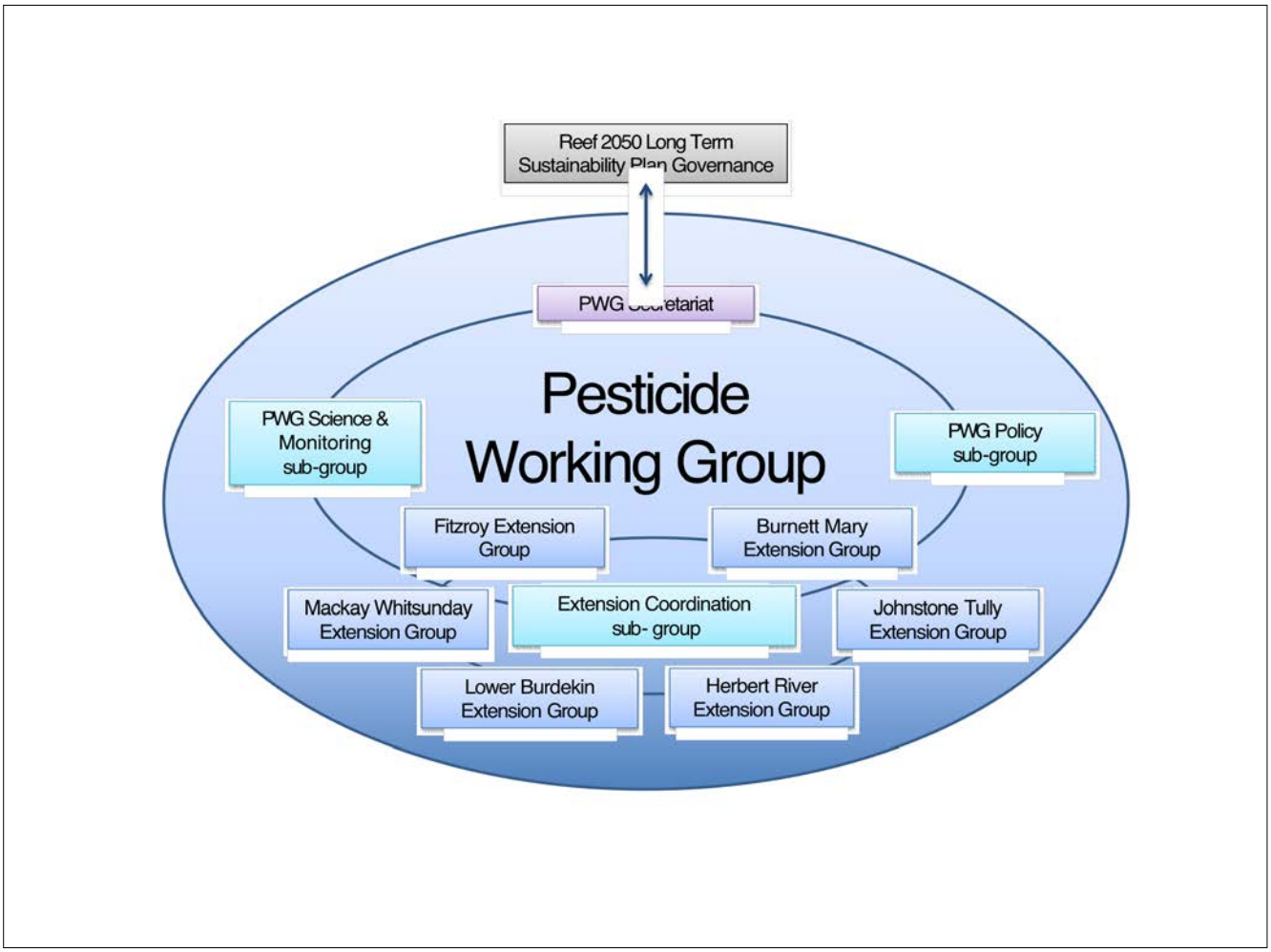

Figure A1: *Pesticide Working Group Framework. Source: DAF 2017.*

There have been two GBR wide PWG forums held in Townsville in 2017 and 2018. After the 2018 forum, it was recognised there was a need to develop local ownership of activities around pesticides. Regional and local strategies and networks were needed to accelerate adoption of Best Management Practices (BMPs) that support improved pesticide and weed management practices.

In response, earlier in 2019, the RECs from the Wet Tropics, Burdekin (Sugar) and Central Region organised PWG Forums in Cairns, Ayr and Mackay, where forum participants were encouraged to form local networks to:

- Develop regional and local strategies and networks to accelerate adoption of BMPs that support improved pesticide and weed management practices.

- Develop extension material and communication processes from research and monitoring based on producers/advisors/working group feedback and resource requirements.
- Review current BMPs and existing technology to identify opportunities for updating practices or developing new technology.
- Provide feedback between producers and the PWG on current research, monitoring and the prioritisation of future work.
- Extend research outcomes, monitoring results and improved management practice options to producers/advisors/working groups.

APPENDIX B: Devolvement of Flexible and Peer-to-Peer Funds

Table B1: *Timeline, actions and person responsible for auctioning the developed Flexible and Peer-to-Peer process.*

Date	Action	Who
To the 14/9/18	• Develop assessment criteria and weighting	REC
	• Developed Project Submission forms	REC
	• Obtain Collaborative Agreement template	REC
14/9/18	• Projects close • Send projects to Project Assessment Panel	REC
18/9/18	• Develop and provide scoring and ranking matrix for Project Assessment Panel • Read projects – compile any questions and provide to REC	REC Project Assessment Panel
19/9/18	• Contact project proponents with any questions/clarification required of the Project Assessment Panel	DAF
20/9/18	• Meet to assess projects – incudes discussion around improving or combining projects to better meet program priorities/objectives and developing a small statement on reasons Project Assessment Panel believe the project should or should not be funded.	Project Assessment Panel
21/9/18	• Discuss any changes with proponents and advise assessment panel of changes.	REC
24/9/18	• Send brief statement from Project Assessment Panel on merits of the projects to BCEG partners for endorsement by majority consensus.	REC
3/10/18	• BCEG endorsement confirmed • Successful project proponents notified	REC
3/10/18 31/10/18	• Collaborative Agreements and internal project templates prepared by DAF • Proponent signs and invoices DAF and proponents paid.	REC & Project proponent
Ongoing	• DAF supports project proponents as required e.g. develops reporting templates and M&E processes. • Milestone reporting monitored.	REC

APPENDIX C: Peer-to-Peer and Flexible Funding Criteria

Project Criteria

Peer to peer funding will support the following priority as identified in the Burdekin Regional Extension Plan Sugar

- Growers are involved in the design and deliver of extension programs and peer-to-peer projects are encouraged and supported.

The Coutts review outlined there needs to be an increased focus on long-term Peer-to-Peer group learning e.g. focus farms, whole-farm review groups, producer demonstration sites and/or producer learning groups. Funding should be directly available to producer groups who select their own facilitator or accessed by delivery organisations who then work to establish groups for this purpose.

Facilitated groups is a long-term strategy based on developing relationships, trust and respect for the skills and experience each person brings to the group. The extension person is usually the facilitator and it is helpful if they have some technical understanding of the farming context of the producers involved.

The aims of peer to peer groups is to share information, raise issues being faced and opportunities presented and together decide how best to address these. These could be addressed by inviting 'experts', undertaking on-farm trials, holding training workshops, accessing information or available tools and/or going on farm walks and tours.

A key element is to be able to share some of the outcomes from these groups to inform/encourage other producers with the successes. In the cane industry, there are groups/shed meetings that work in this fashion – others tend to be more open forums with technical updates/questions and answers. Each have their place, but it is important to make the distinction.

Peer-to-Peer groups should contribute in some way in meeting the 2025 Water Quality Targets:

Water Quality Priority	Water Quality Target by 2025
Dissolved Inorganic Nitrogen	**80 per cent reduction of DIN load entering the GBR from Lower Burdekin sugarcane***
Pesticides (PSII's, alternatives, Imidacloprid)	**To project at least 99% of aquatic species at the end of catchment**

*A reduction from approximately 1,088 t/y to 220 t/y (modelled on 2013 baseline estimates)

Figure C1: *Peer-to-Peer funding criteria. Source: DAF (2018).*

PROJECT CRITERIA

The flexible funds will support extension and education projects. Applications need to meet the following criteria:

CRITERIA 1

Outline how the proposed project supports one or more of the following:

- Supports cross-program/organisational collaboration
- Adds value to current activities
- Supports the use of innovative learning approaches and/or new tools and technologies to support on-farm learning.

CRITERIA 2

Describe how the project will contribute to meeting the 2025 Water Quality Targets:

Water Quality Priority	Water Quality Target by 2025
Dissolved Inorganic Nitrogen	80 per cent reduction of DIN load entering the GBR from Lower Burdekin sugarcane*
Pesticides (PSII's, alternatives, Imidacloprid)	To project at least 99% of aquatic species at the end of catchment

* A reduction from approximately 1,098 t/y to 220 t/y (modelled on 2013 baseline estimates)

CRITERIA 3

Address one or more of the following Lower Burdekin cane regional priorities, gaps as identified by the Burdekin Regional Extension Group:

Priorities:

- Measurable progress can be demonstrated towards meeting water quality targets relevant to Lower Burdekin sugar cane.
- Growers are involved in the design and delivery of extension programs and peer to peer projects are encouraged and supported.
- Develop an effective, coordinated, collaborative, transparent approach to communication and extension delivery in the Lower Burdekin.
- Maintain, enhance and expand regional partnerships, including researchers, reef scientists, extension providers, government agencies, NRM and industry groups.
- The professional capacity of Lower Burdekin extension providers and other industry stakeholders is enhanced through training and capacity building opportunities.
- Duplication of extension activities is reduced and there is clarity around key messages.

Figure C2: *Flexible funding criteria. Source (DAF 2018).*

	Regional GAPS - People and Extension
Communication	• A co-ordinated and consistent message to growers and industry sectors. • Consistent and timely communication between on-ground extension and research, science providers. • Raise awareness of the collective Lower Burdekin extension effort. • Communication around trial results - local, regional, international.
Co-ordination	• A collaborative, area wide, strategic and structured approach to extension. • Trials - A consultative approach in trial development, initiation, trial efficacy, rigour, consistency, measuring N coming off in runoff, deep drainage and volatilisation
Knowledge and technology transfer and adoption	• Understanding and addressing barriers to adoption. • Involvement of growers/existing farming groups in developing and running extension programs. • Extension and support for adoption of technology and understanding of local water quality and business issues. • Support existing programs e.g. Smartcane BMP, industry shed meetings. • Enhance the technical understanding and skills required of extension providers.
Monitoring and evaluation	• Farm benchmarking • Measure capacity/attitudinal change, benefits of good extension • Water quality monitoring with a purpose, at scales ranging from on-farm, sub-catchment and Delta/BRIA.

Regional GAPS - Farming Practices	
Irrigation/N	• Sugarcane irrigation, N and pesticide management should be addressed in unison. • Irrigation management to minimise losses to runoff and deep drainage. • Work on a broader range of practices – timing, placement, product selection, irrigation timing, spilling at end of rows, spread. • Nutrient management plans - skills in applying the plans in a tactical and practical way. • Strategic installation and management of recycle pits in the context of BRIA and Delta characteristics.
Pesticides including PSII's, alternative and insecticides	• Increased adoption of best practice technology for application of herbicide e.g. banded spraying, nozzle selection, products and rates. • Timing of irrigation after herbicide application. • Adoption of fallow management to minimise weed pressure and reliance on herbicide application.

Figure C3: *Regional Gaps as identified by the Burdekin Cane Extension Group. Source: DAF (2018).*

Eligible and Non-eligible Activities

What activities are eligible for flexible funding?	What activities are out of scope — not deemed appropriate for flexible funds expenditure?
• Targeted activities to increase uptake of key practices to address water quality priorities	• Activities that fall outside the Lower Burdekin region
• Targeted extension activities that address challenges and fill gaps in current delivery effort	• Vehicle purchase/lease/running expenses
• Building synergies within catchments and regions to add value to current programs	• Purchasing equipment for host organisation
• Supporting cross regional and cross organisational activities, learnings and information sharing (e.g. events such as field days/ workshops)	• Delivery of existing activities or projects (e.g. BMP programs which have ongoing support via other funding arrangements), or activities which duplicate others
• Innovative capacity building for producers and/or extension staff	• Water quality monitoring or research if there is not a major producer engagement component
• Piloting/demonstrating new technologies or platforms	• Purchasing equipment or providing funding to a particular producer (e.g. as per grants program)
• Multi-year projects, with funding provided annually upon demonstration of outcomes; in particular to support longer term peer-to-peer learning groups	• Activities that are not related to agricultural management (e.g. urban or industrial)
• demonstrations/applied research trials e.g. regional validation of existing improved management practices in new areas* * This may include on-ground works in limited situations where it is an essential component of an extension activity that facilitates learning in an area of identified need or as part of peer-to-peer learning via facilitated producer groups.	• Activities that do not contribute to improved water quality outcomes • Salary for existing staff / staff relocation costs • Activities which are retrospective—have commenced / are funded but not yet completed • Activities required as compliance or are part of an approval or funding contract under Commonwealth or state legislation or agreement

Figure C4: Eligible and non-eligible activities Flexible Funds.