Australian Government
Cotton Research and Development Corporation

# FINAL REPORT 2017

**Choose an item.**

## *Part 1 - Summary Details*

*Please use your TAB key to complete Parts 1 & 2.*

**CRDC Project Number:** **CRDC1501**

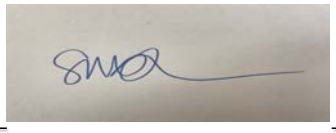
## Project Title: National NRM Technical Specialist

**Project Commencement Date:** **1/07/2014** **Project Completion Date:** **30/06/2017**

**CRDC Research Program:** Industry

## *Part 2 – Contact Details*


| | | | |
|---|---|---|---|
| **Administrator:** | Stacey Vogel | | |
| **Organisation:** | Vogel Consulting | | |
| **Postal Address:** | PO Box 318 Wee Waa NSW 2388 | | |
| **Ph:** 0428266712 | **Fax:** NA | **E-mail:** | staceyvogel.consulting@gmail.com |
| **Principal Researcher:** | Stacey Vogel | | |
| **Organisation:** | "As Above" | | |
| **Postal Address:** | | | |
| **Ph:** | **Fax:** | **E-mail:** | |
| **Supervisor:** | NA | | |
| **Organisation:** | | | |
| **Postal Address:** | | | |
| **Ph:** | **Fax:** | **E-mail:** | |


**Signature of Research Provider Representative:** 

**Date Submitted:** _____

## *Part 3 – Final Report*

(The points below are to be used as a guideline when completing your final report.)

***Background***

**1. Outline the background to the project.**

CRDC 2013-2018 Strategic R&D Plan under its Responsible Landscape Management theme, outlines the industries desire to lead in managing natural resources and be recognized for its leadership in environmental performance. This project built on the past decade of investment in NRM research by providing a National NRM technical specialist who helped the industry meet this strategic goal through:

- developing and implementing annual national NRM campaigns,
- continuously improving the industries best practice recommendations for NRM, and
- facilitating the capture of past and current NRM research into project activities, outputs and outcomes.

A key measure of success under this goal as outlined within the Strategic plan is 1000km of riparian land and one million hectares of floodplain vegetation managed under best practice.

This project contributed to meeting this measure of success through:

- Collaboration with CottonInfo's REO's, regional NRM bodies and industry groups (eg WINCOTT) to implement a innovative initiative which used social networks, especially women, as a method for improving growers engagement in NRM capacity building activities.
- Development of new tools and resources that engaged growers in NRM awareness, monitoring and best management practice, and
- Capturing current practice's and condition information for biodiversity and riparian areas within the cotton industry.

The projects progress over the past 3 years has been reported in the bi-annual progress reports. This final report outlines how the project has met the strategic goals mentioned above as well as highlights some of the key outputs & outcomes of the project. This final report also summarises project activities for the last reporting period.

*Objectives*

**2. List the project objectives and the extent to which these have been achieved, with reference to the Milestones and Performance indicators.**

## Lead the continuous improvement of the industry's best practice recommendations for NRM

### 1.1 Participate and assist the exchange of research results/activities amongst researchers and advisors working within NRM

Over the three years of the project I worked with CRDC researchers funded under the Responsible landscape program to assist them develop and implement their research activities and extend their research outcomes to the cotton industry, other relevant CRDC researchers and NRM advisors.

In addition I have worked with the CRDC Responsible Landscapes Program leader and the CottonInfo manager, to review the progress of individual research projects, identify R&D gaps and opportunities and identify adoption pathways for the outcomes of their research.

A highlight from the past 3 years was the Responsible landscape Management Forum held in Brisbane in May 2016. This forum organised by Jane Trindall (CRDC), Nicola Cottee (CA) and myself, saw thirty three researchers, growers and cotton industry stakeholders attended the 2 day forum to discuss the industries R&D needs and future challenges under the responsible landscape theme. A Sustainability Panel session held during the forum brought together cotton growers, leading cotton community leaders and other industry stakeholders to discuss what sustainability meant to their business and how to create sustainability value in a cotton business. The outcomes from the forum where used to advise the Grower panel strategy meeting and the sustainability stakeholder forum held later that year.

Other achievements, which saw the exchange of R&D among researchers and NRM advisors as a result of this project, include:

- Participation by relevant researchers and myself (including presentations) in the 2014 & 2016 Australian Cotton Conference and the 2015 Australia Cotton Science Conference
- Presentation and participation at the 2015 International River Symposium in Brisbane

- 2015 Mini Riparian researcher Forum- Moree in March- 5 industry Researchers undertook a tour of local cotton farms near Moree and met to discuss riparian R&D and monitoring and the implementation of project activities under the 25th Landcare Anniversary grant.
- 2015 Pathways to NRM collaboration – Twenty-five advisors participated in myBMP workshops extending the standards and resources within the Natural assets module as well as hearing presentations from CRDC researchers whose work underpins some of those BMP's.
- 2015 Advisor Spray Drift and Buffer Zone management workshop, Narrabri 28th & 29th April
- 2017 "Cottoning onto the Murrumbidgee field days" – collaboration between CottonInfo and the Southern NSW Landcare Irrigation Collective to extend cotton riparian R&D down south. The collective, which CottonInfo is a member since 2016, is made up of NRM NGO's, industry groups and local councils.
- GRDC & CSIRO Linkage project NRM tools for engagement- collaborated with CSIRO researchers Cate Paull and Nancy Schellhorn to establish linkages to cotton industry regional staff and develop a native vegetation planting guide for southern QLD.
- As a result of attending the NRM Regions workshop in Canberra in June 2017, I am involved in collaborative discussions between Cotton Australia, CottonInfo team manager and southern REO, Riverine LLS & the Murray LLS, on spray drift management RD&E.

In addition within this reporting period I have worked with CRDC funded researchers to assist them implement and extend their research, such as:

- Dr Kath Korbel (Macquarie University) – Co-ordinated Namoi groundwater health tool trial with growers.
- Dr Erin Peterson (University Queensland Technology) – Co-ordinated grower/site selection in Namoi for Honors project- Namoi microbat survey using acoustic monitoring
- Participation with other CRDC NRM researchers at the 2017 Restore, Regenerate & Revegetate Conference at UNE

**1.2 Undertake annual review of practices in myBMP natural assets module and the water modules NRM components (e.g. groundwater management)**

Annual reviews of the practices and supporting resources within the Sustainable Landscapes (natural assets) module have been undertaken and provided to Cotton Australia's myBMP team. In addition I worked closely with consultant Rachel Holloway to align the natural assets module with other modules whose practices overlapped (e.g water & pesticides) with those within the natural assets module. The natural assets module was used as a test case/benchmark to align other modules. The Natural assets module was also align with the structural changes made to the myBMP program as part of Rachel Holloways project. Key structural changes made to the module include, reduction of the number of standards, implementation of common language across all modules and the use of a standardised format for supporting resource sheets, based on the format previously developed for the natural assets. A document summarising the latest standards as of June 2017, for the myBMP program, including the natural assets module is outlined in Appendix 1.

### 1.3 Develop tools and resources (from research) for cotton growers and consultants that assist their adoption of NRM best practice.

The past 3 years has seen a large growth in NRM specific resources for growers and consultants. The development of a CottonInfo webpage by the CRDC/CottonInfo Communications Manager, has provided a platform on which many different types of NRM extension materials can be developed and extended to the industry. These include NRM research summary sheets, case studies, factsheets as well as links to YouTube videos, Smart phone App and social media sites. For a comprehensive list of material developed over the past 3 years for the CottonInfo NRM webpage refer to Appendix 2.

A highlight of the project was the development of the "Birds on Cotton Farm App" for smartphones released in early 2016 (further details in 4.3).

Another highlight of the project was the launch in 2016 of the National Cotton RiverCare Champion project. In late 2015 Mark Palfreyman, cotton farmer and zoologist, was appointed by CRDC to the role of Nation Cotton RiverCare Champion. In this 2 year role Mark is working with CottonInfo to demonstrate to cotton growers and the general public how best management practice maintains and or improves the good condition of riparian areas. The project is being developed and managed by myself. The aim of the project is to:

- Increase the industries awareness of the value of riparian land and engage them in the concept of Rivercare ie good riparian stewardship.
- Demonstrate to the cotton industry and the general public an example of a cotton growers "good stewardship" of riparian land, and
- Establish a long term riparian monitoring site looking at the impact of land management practice on riparian condition

Achievements to date under the project include:

- Establishment of 2 long term vegetation condition monitoring sites (one looking at impact of land practice change to non-grazing)
- Contracted professional ecologist, Phil Spark (North West Ecological) in October 2016 to undertake a four day fauna survey of "Taraba", results outlined in 5.1.
- Participation of Mark Palfreyman in his role as the National Cotton RiverCare Champion in the 2016 Australian Cotton Conference and the 2017 Restore, Regenerate and Revegetate Conference at UNE.
- Establishment of 2 "Cotton RiverCare" social media sites, one on facebook and twitter.
- We post to these sites twice a week using a combination of photos, info-graphics and videos. Our facebook site has almost 1100 followers and twitter has around 70. Facebook being a much more community and social interface receives a lot more comments and questions about the content compared to our twitter site. According to facebook analytics our followers are from across Australia, regional and metropolitan areas, with a few from overseas.

They are mainly women, 67% and almost 50% of total followers are over 55.

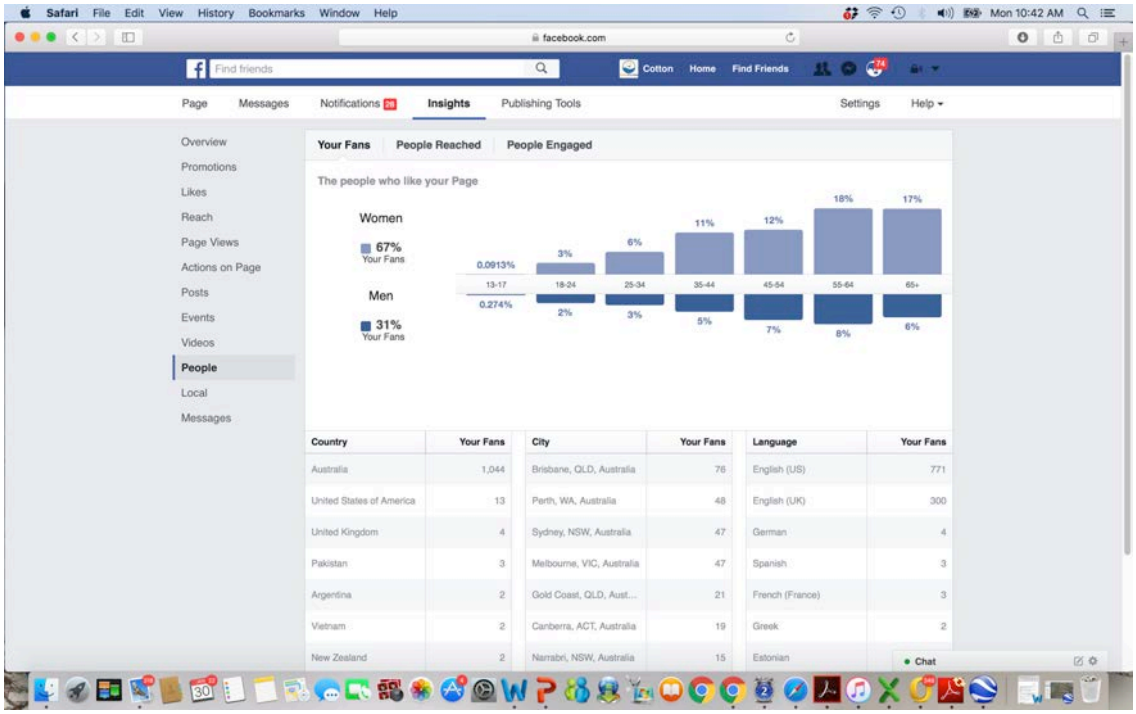



**Figure 1: Facebook analytics for the Australian Cotton RiverCare page**

- Our twitter site has around 70 followers and is a much more professional network with most followers being a combination of cotton growers, national and international cotton industry groups as well as, NGO's and NRM organizations and advisors. The content is re-tweeted often, particularly by other cotton industry groups providing a much greater reach then the 70 registered followers which can be seen in figure 2 in the top right hand corner which recorded 1700 impressions or views of the 2 tweets for that week. Good outcome for NRM extension.

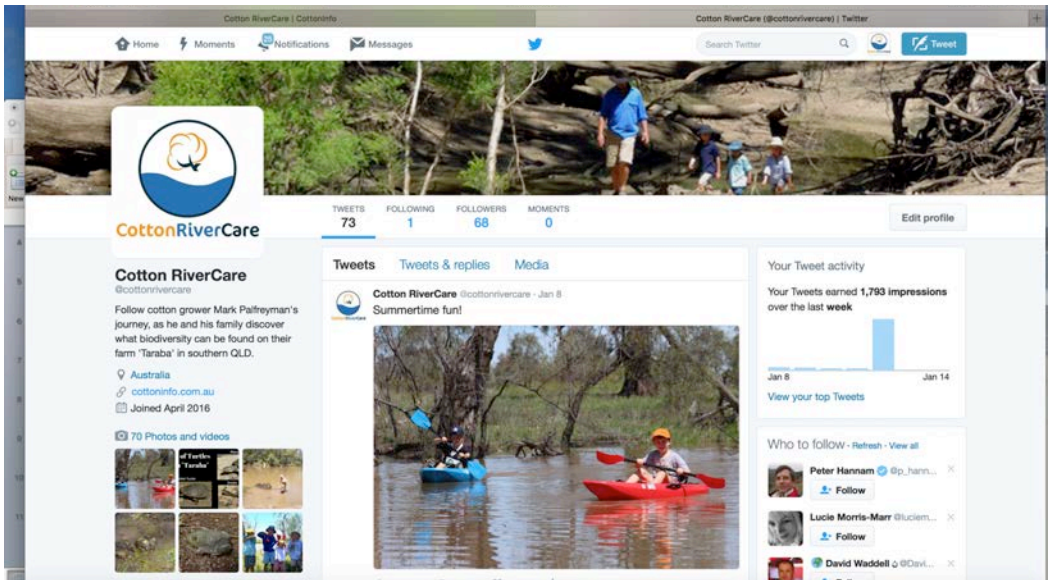



**Figure 2: Australian Cotton RiverCare Twitter site**

- In addition to the social media sites we also have a page on our CottonInfo website where we have a regular blog which enables us to go into more detail about the content in particular our best management practices. We have produced a number of YouTube videos about the project including Instructional videos such as how to establish permanent photo points for native vegetation monitoring. We also link these sites through to the cotton industries best management practice program, myBMP, providing cotton grower followers with more detailed information and resources for riparian and biodiversity management on farm.

Unfortunately a civil case being brought against Mr Palfreyman by his neighbour is threatening the continuation of this project. The details of this have been reported to CRDC program leader and a decision was recently made to cease all communication from the project until the matter is resolved.

In the last reporting period I co-ordinated the development of a project application under the Australian Governments "New and improved control technologies and tools for established weeds and pests" program. The application was successful. The 2 year project, starting in July 2017, seeks to develop a bio-herbicide for species and/or hybrids within the noogoora burr species complex from an existing, naturally occurring fungal pathogen agent (*Alternaria zinniae*). Sampling and testing will also determine if all Noogoora burr complexes are hosts of *Verticillium dahlia* – currently a pathogen of great concern to the cotton industry. Bio-herbicide development is currently constrained by taxonomic confusion within the complex. DNA sequencing will help clarify the current recognised distinctions between the complex and hybrids found in the field to ensure the efficacy of the agent against the species. The 2 year project led by NSW DPI is supported by CRDC, University of Queensland and Murrumbidgee Irrigation Association. The project has received $559,784 in funding from the Federal Government.

### 1.4 Participate in industry monitoring and benchmarking and survey metrics in understanding current NRM practice

Collaborated with industry riparian researchers and survey consultants to develop riparian practice questions for the 2014 & 2017 Cotton grower practices survey. Information collated from the 2014 survey was used in developing the annual CottonInfo NRM campaign and was extended to industry and the general public via

industry publications and conferences such as the International River Symposium. Information collected from the 2017 survey will be used as part of CRDC funded grower practice and attitudes research currently being undertaken by Dr Sam Capon from the University of Griffith.

Project activities and outputs have been reported in the CottonInfo YourDATA evaluation program. Information collated here was used by the CottonInfo JVC to assess progress against CottonInfo's Anuual Operating Plan (AOP) as well as development of new AOP's.

A comprehensive evaluation has been conducted of attendees of the "Cottoning onto the great outdoors" field days series (2015-2017) to provide evidence of changes in KASA (Knowledge, aspirations, skills and attitudes) as a result of attending the field days. All of the two hundred and eighty eight participants who attended theses field days recorded an improvement in their knowledge and capacity to implement riparian BMP as a result of their attendance. More information can be found in the following reports

- *Cottoning onto the Great Outdoors – river and riparian field days, 13-15 November 2015* (May 2016 progress report)
- *Cottoning onto the Great Outdoors – Emerald, November 2015* (May 2016 progress report)
- *Cotton RiverCare Champion Field day (wildlife spotlighting evening), October 2016* (November 2016 progress report)
- *Cottoning onto the Murrumbidgee River – river and riparian field days, 18-19 February 2017* Appendix 3
- *Cottoning onto the Macquarie River – river and riparian field days, 4 March 2017* Appendix 4

## Develop the issue messaging for the delivery of NRM best practice through the CottonInfo" in it together" campaign

**2.1 Demonstrate link between issue messaging and research outputs.**

NRM Research outputs, both CRDC and other, were captured in the annual CottonInfo NRM "In it together" Campaigns, see Appendix 5, 6 & 7. These campaigns were developed in collaboration with researchers and the CottonInfo team members.

The implementation of the annual campaigns was successful with researchers and other NRM organisations working along side the CottonInfo team to extend and implement the campaign messages and activities.

NRM research outputs are also reflected in the annual review of the industries key guidebooks the Cotton Pest Management Guide and Cotton Production Manual.

### 2.2 Demonstrate link between issue messaging and grower/consultant information needs

Over the past 3 years a number of activities, reported in the bi-annual progress reports, where undertaken as a result of grower/consultant needs. Below are examples of some of these.

As a result of a 2016 grower panel request for more on-ground action in NRM I co-ordinated the development of a collaborative research project between CRDC, NSW DPI, University of Queensland and Murrumbidgee Irrigation to develop a bioherbicide for the Noogoora Bur complex. Noogoora Bur is a significant environmental weed in riparian and wetland environments across Australia. It also poses a threat to the cotton industry, as it is a known host of Verticillium Wilt. The 2 year project commencing in July 2017 is funded through the Australian Governments' Department of Agriculture and Water Resources grant program "New and improved control technologies for established pests and weeds".

Smith R, Capon S, Trindall J & Vogel S (2014) Internal discussion paper on causes of Gwydir valley tree dieback for the Gwydir Valley Irrigators Association Board member.

Provided the Crop Consultants Australia network & REO's with information about the NSW Native vegetation legislation as a result of a request from consultants for more information about the changes in NSW Native vegetation legislation.

Collaborated with Cotton Australia to review and provide policy officers with industry feedback on the:

- Draft 2015 QLD & NSW Pest and weed strategy
- NSW Biodiversity conservation reforms
- APVMA guidelines for buffer zones – native vegetation.

Worked with Bill Gordon to update and improve consistency of messages in our industry guidelines as well as review consistency of product label guidelines with industry guidelines for minimising spray drift impacts on native vegetation. Developed supporting resources in collaboration with Bill Gordon including delivering a Spray Drift Management workshop in 2015.

Recently I worked with CottonInfo team members and entomologists to collate R&D outputs on management of natural pests and their habitats for IPM as a result of

consultants request to Cottoninfo team for improved understanding of non-chemical practices in IPM.

### 2.3 Demonstrate the linkage between issue messaging for NRM best practice and CRDC measure of success "1000km of riparian land managed under best practice & 1 million hectares of floodplain vegetation managed under best practice"

It is difficult to make direct linkages between "issue messaging" and implementation of BMP of ground. In 2014 we developed a series of riparian land practices questions for the 2014 Cotton grower Survey to help provide the industry with information on the number of kilometres currently under best practice. According to the survey 91% of the 116 respondents who said they had a riparian area on their farm, averaging 8km in length, implemented at least one of the listed best management practices for riparian lands. This suggests that in 2014 957km of riparian land was managed under a BMP.

Since 2014 as outlined in this report there has been many different activities that have been undertaken as part of this project to extend BMP R&D for riparian lands. One of these activities was the delivery of a series of riparian BMP awareness field days across NSW & QLD targeting social networks of women in cotton. Evaluations undertaken at the field days showed that participants who were not already doing so were more likely to implement BMP as a result of attending the field days and had gained a greater level of confidence to implement what they had learned as a result of attending the field days.

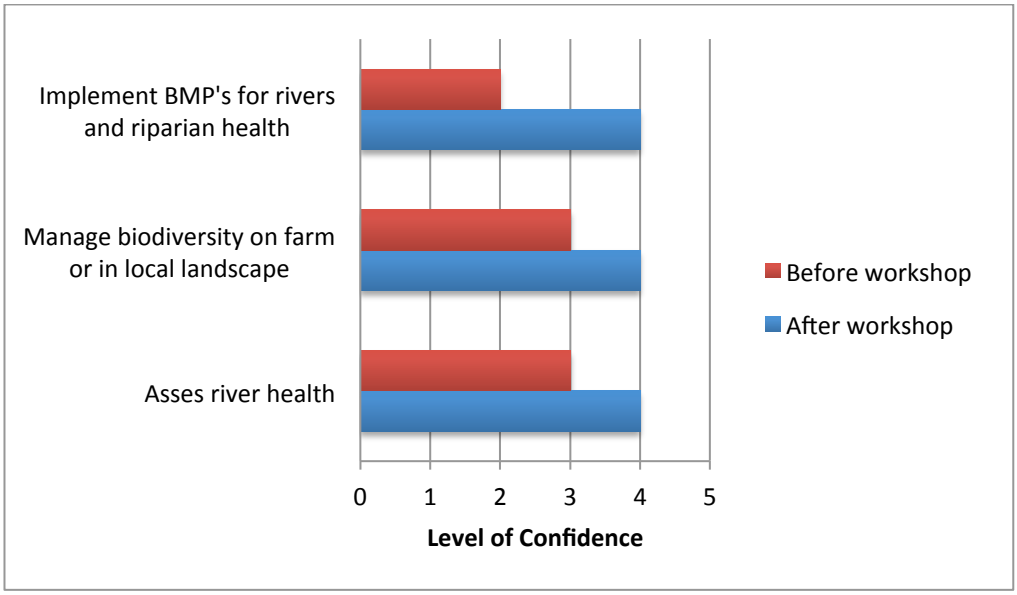



**Figure 3** Summary from the 25th Anniversary grant landcare grant field day series (Moree, Boggabilla & Mungindi) of average level of confidence to implement practices in the 3 key areas before and after the field days, total of 4 field days, where 1 is very basic and 5 is very good.

In collaboration with CRDC researcher Dr Sam Capon from the University of Griffith, a series of questions that look at riparian values and best management practice have been submitted in the 2017 grower practice survey due for release in late June 2017. The results from this survey will help increase our knowledge of how much riparian areas is under BMP and what type of BMP's they are implementing in these areas.

**Demonstrate awareness, understanding and utilisation of past and current NRM research findings in project activities**

### 3.1 Relevant research findings (past and recent) are incorporated into communication product development

Incorporation of Dr Smith UNE riparian vegetation carbon storage and sequestration research outputs into

- 2014 Carbon neutral cotton farms paper and cotton conference presentation
- 2015 International River Symposium presentation
- 2015 Cotton Grower Production Manual
- Anthony Barlows Sustainability Case study – 25th Landcare Anniversary Grant
- Level 3 standard within the Sustainable Landscapes (natural assets) module of myBMP
- Biodiversity booklet- natures workforce
- 2015-2017 Cottoning onto the great outdoors series of field days (Emerald, Border Rivers Gwydir, Murrumbidgee & Macquarie Rivers)

Development of a Birds on Cotton farm App which captured Dr Adam Smith's & Rhiannon Smiths bird research data to update species list and habitat management principles within the App. Also collaborated with BirdLife Australia to update the checklist of birds found in cotton landscapes.

In collaboration with Bill Gordon updated spray drift management BMP recommendations for native vegetation through:

- Development of a factsheet on permanent vegetation barriers for spray drift management
- Updated spray drift management section in the 2015 Cotton Production Manual
- 2015 Spray Drift Management workshop Narrabri
- Updated spray drift standard and resources within the Sustainable Landscapes (Natural Assets) module of myBMP

Synthesis of R&D on dieback in the Gwydir valley into a paper by Dr R Smith UNE for GVIA board members

Dr Sam Capon and Dr Harry Balcombe's (GU) research findings on the role litter plays in reducing weed recruitment in riparian environments incorporated into

- "Auscott Midkin – "valuing riparian assets" case study 25th Landcare Anniversary Grant
- Managing riparian areas YouTube video.
- 2017 Cotton RiverCare Grazing management CottonInfo newsletter (DRAFT) see Appendix 8
- Biodiversity booklet- natures workforce
- Updates to the 2016 Cotton Grower production Manual
- 2015-2017 Cottoning onto the great outdoors series of field days (Emerald, Border Rivers Gwydir, Murrumbidgee & Macquarie Rivers)

Cotton RiverCare programs techniques for monitoring native vegetation condition incorporated into the instructional YouTube video - Monitoring vegetation changes over time (permanent photo points)

Dr Vesna Gagic's (CSIRO) initial research findings on pollinators contributing to the reduction of yield losses at high pressure for some insects incorporated into

- 2017 Cotton Pest Management Guide
- Currently being drafted into a Spotlight article, CottonInfo newsletter and NRM Research summary

In addition a summary of all CRDC NRM research projects goals and outputs are available on the Cottoninfo websites NRM page, see Appendix 2.

### 3.2 Attend/participate in at least one NRM conference each year

***2014***

- 2014 CSIRO & OECD international workshop on "Strategies to support both biodiversity and production in agricultural landscapes"

***2015***

- 2015 International River Symposium in Brisbane, 21– 23 September 2015. Presented "Carbon neutral cotton farms: valuing riparian vegetation"

***2016***

- 2016 CRDC R&D Review: Responsible Landscape Management 5-6th May Brisbane. Organising committee.

***2017***

- 2017 "Restore, Regenerate & Revegetate Conference UNE 5th-9th Feb 2017 – Presented – "Cotton RiverCare Champion project"

### 3.3 Provide technical NRM training opportunities to the CottonInfo team

- 2015 Pathways to NRM collaboration – myBMP workshops

- 2015 Spray drift management workshops
- 2015 Gwydir/Border Rivers Riparian Management Field days
- 2015 Emerald water quality monitoring and riparian management field day
- 2016 CRDC R&D Review: Responsible Landscape Management Forum
- 2017 Murrumbidgee River Riparian Management Field day
- 2017 Macquarie River Riparian management Field day

In addition to above workshops attended bi-annual National CottonInfo workshops where the annual NRM campaign messages where extended.

### Increase grower capacity using 'social networks 'to engage in riparian and floodplain vegetation management

#### 4.1 Support REO's in the development of regional riparian workshops in 7 cotton growing valleys

*Gwydir (Alice Devlin)*

***November 2015, Cottoning onto the Great outdoors field day series*** – CottonInfo, North West Local Land Services and the Gwydir Valley Irrigators Association in partnership with the National Landcare program ran a series of riparian management field days at Boggabilla, Mungindi and Moree in the Gwydir valley. The aim of the field days was to extend the latest cotton industry riparian vegetation research outcomes as well as increase participant's awareness of the value of riparian vegetation on farms and educate them on the latest best management practices for riparian areas on cotton farms. 108 people participated in the field days with approximately 1500 cotton industry stakeholders across NSW and QLD being exposed to extension material directly related to the project. As part of the development and delivery of the field days 3 extension products were also developed, 2 case studies and 1 biodiversity booklet showcasing local River Red Gum Communities. The case studies currently provide supporting resource material for the Sustainable Cotton Landscapes (natural assets) module of the cotton industries myBMP program.

*Emerald (Ngaire Roughly/Sharna Holm)*

- ***October 2015 community Water quality monitoring***. Co-ordinated the Central Highlands Cotton Growers and Irrigators Association (CHCG&IA) successful application for the "Care for Creek" bursary through the Fitzroy Partnership for River Health (FPRH) to undertake water quality monitoring of the Nogoa river at Emerald. The data collected, using the bursary water monitoring kit, contributes to the Fitzroy Basin Reef Plan Report Cards, which underpin the

Reef Water Quality Protection Plan. The first data collection undertaken on the Nogoa River in October 2015 as part of CottonInfo field day "Family fun on the Nogoa River". The monitoring kit is shared with the Central Highlands Science Centre (CHSC).

- ***October 2015 Family fun on the Nogoa River field day.*** Development of a NRM "social networks" engagement activity to monitor water quality within the Nogoa River at Emerald on the 24th October 2015 in collaboration with CHRRUP, CHCGI, CA & FBA and the Fitzroy Partnership for River Health. 35 people attended and learnt about riverine health and management and contributed water quality data towards the Fitzroy Basin reef plan report card.

***Namoi (Geoff Hunter)***

- ***2015 Narrabri & Burren Junction Carp Muster.*** CottonInfo partnered with Namoi Water, NWLLS & Narrabri Fishing Club through sponsorship of the event, which saw over 500 people register across the weekend removing a significant amount of carp from the Namoi river.
- ***2015 Wee Waa recycled art metal sculpture workshop.*** CottonInfo partnered with Wincott, NWLLS, North West Landcare Chairs Network & Wee Waa Agricultural show society to hold a weekend workshop highlighting the importance of recycling. The workshop targeted local cotton women and their families.

***Darling Downs (Jon Smith/Annabel twine)***

- ***2015 Focus on Feathers -*** While this event did not progress due to low numbers the pre-event media including a launch in Millmerran of the event by the Mayor and a ABC radio interview helped advertise the recent release of the Birds On Cotton farm App for smart phones.

***Border Rivers (Sally Dickinson)***

- ***February 2016 "Farming with Birds, Bats and Beneficials" workshop and "Birds on Cotton Farm App' launch.*** The App was launched by local Cotton grower Association president and Nuffield scholar Nigel Corish.10 people attended.
- ***October 2017 Cotton RiverCare Champion wildlife spotlight evening.*** CottonInfo in partnership with the QMDC to run a field day to increase the

local communities awareness of eth Cotton riverCare Champion project and extend the findings of the Fauna Survey undertaken by Northwest ecological on "taraba". 29 people attended the field day with all participants recording an improved knowledge of the program and biodiversity in their local landscape as a result of attending the field day,

- ***March 2017 Science update – Lower Balonne Floodplain (fish, waterholes and trees)*** CottonInfo partnered with MDBA, University of Queensland, QMDC, Griffith University, DNRM & DSITI to hold a science update for growers in the Dirranbandi areas. Approximately 10 people attended.

*Murrumbidgee (Kieran Okeaff)*

- ***February 2017, Cottoning onto the Murrumbidgee River field days.*** CottonInfo, partnered with Murrumbidgee Landcare Incorporated (MLI), Murrumbidgee Irrigation (MI), Riverina Local Land Services (RLLS) and the Australia Government ran two field days in the Murrumbidgee valley. The aim of the field days was to extend the latest cotton industry riparian vegetation research outcomes, increase participants awareness of the value of riparian vegetation on farms and educate them on the latest best management practices for riparian areas on cotton farms. 71 people participated in the field days.

  As part of the development and delivery of the field days a biodiversity booklet showcasing local River Red Gum Communities was produced and distributed to participants. A key outcome for the field day was the collaboration between CottonInfo, MLI, MI and RLLS, as part of the newly formed Landcare Irrigation Area Collective (LIAC), to deliver the field day. This collaboration established new local networks between cotton growers and local natural resource management advisors.

*Macquarie (Amanda Thomas)*

- ***March 2017, Cottoning onto the Macquarie River field day.*** CottonInfo and Central West Local Land Services (CWLLS) in partnership with the Australian Government ran a riparian management field day at Warren in the Macquarie valley. The aim of the field day was to; extend the latest cotton industry riparian vegetation research outcomes, increase participants awareness of the value of riparian vegetation on farms and educate them on the latest best management practices for riparian areas on cotton farms. 45

people representing 10 cotton farms and 2 cotton industry service organisations participated in the field day.

As part of the development and delivery of the field day a biodiversity booklet showcasing local River Red Gum Communities was developed. A key outcome for the field day was the collaboration between CottonInfo and the Central West Local Land Service to deliver the field day. This collaboration established new local networks between cotton growers/advisors and the local natural resource advisor for the CWLLS.

**4.2 Co-ordinate the development of a NRM ID guide for growers**

***Cottoning onto the great outdoors – biodiversity booklet***

An A5 size booklet was produced which provided descriptions of some of the native plants and animals found within riparian areas in cotton landscapes, in particular those found within River Red gum woodlands. The booklet also provides BMP guidelines for riparian areas on cotton farms. The "Murrumbidgee" and generic biodiversity booklets also have a strong focus on ecosystem services provided by individual plants and animals and what the latest CRDC funded research is telling us regarding these services and BMP's.

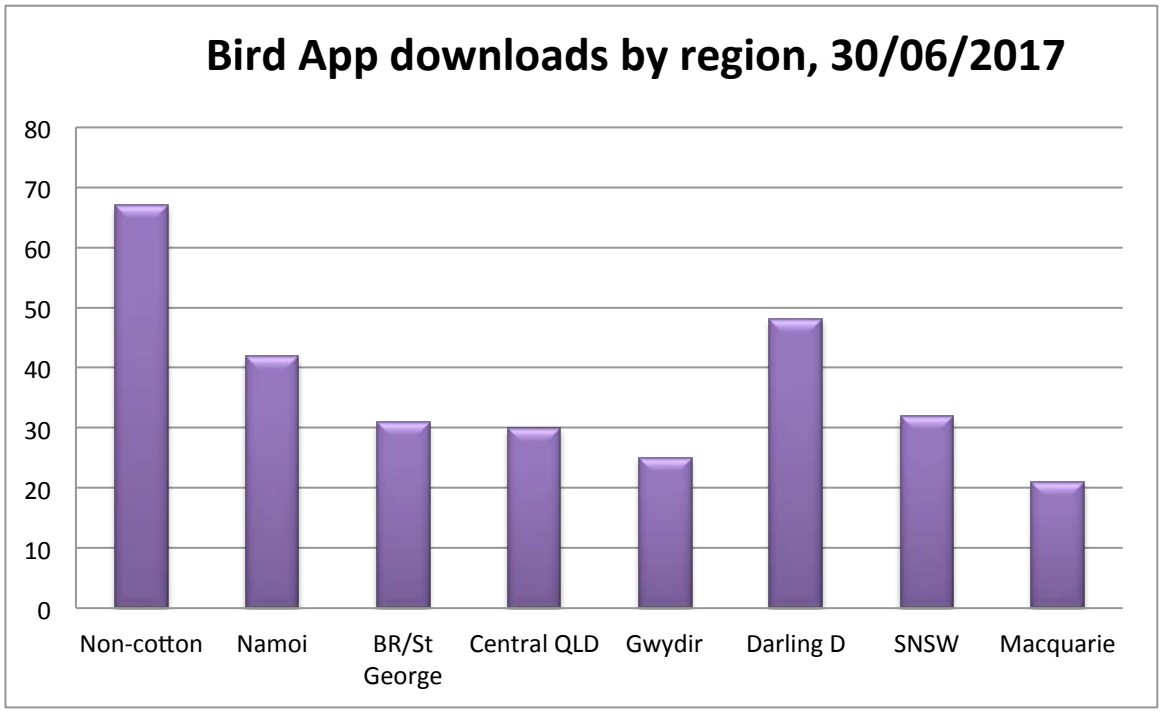
- Gwydir/Border Rivers – *distributed to 360 landholders within 100km of Moree and attendees of the 2015 "Gwydir Cottoning onto the great Outdoors" field day series and the 2016 Cotton RiverCare Champion project wildlife spotlight evening*
- Murrumbidgee – distributed to 71 attendees of field days as well as an extra 100 copies left in Murrumbidgee Landcare office in Griffith for use in upcoming field days.
- Generic industry- distributed to attendees of "Cottoning onto the Macquarie River" field day. Booklet also available for download from the CottonInfo websites's NRM page.

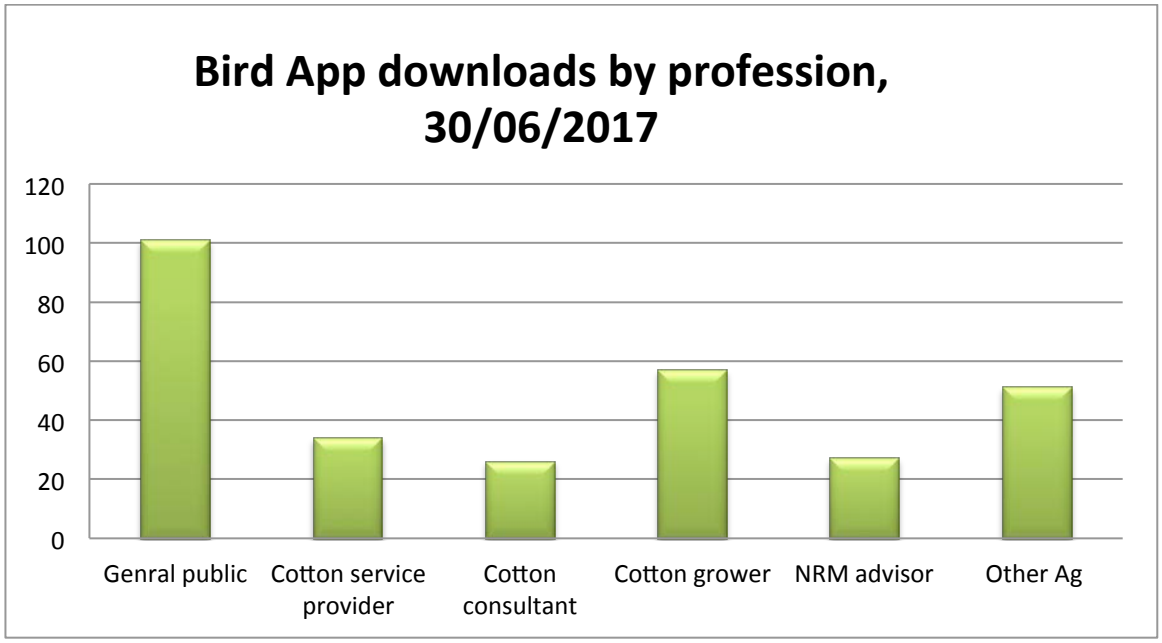
In the original contract twenty thousand dollars was allocated to the development of an NRM ID guide. Due to collaborative dollars and in-kind from organisations partnering in the delivery of the "Cottoning onto the….." series only minimal dollars where required to produce the biodiversity booklet. Therefore this twenty thousand dollars remains unspent.

**4.3 Co-ordinate the development of a Birds on Cotton Farm App for smart phones.**

The birds on Cotton farm App was launched on the 17th January 2016. The App provides another platform for growers to access information on bird identification and habitat management as well as allowing users to monitor and collate bird richness and abundance information on their farms. The region covered by the original book (southern QLD & northern NSW) has been expanded in the App to include southern NSW and central QLD cotton growing regions. Eleven new species of birds have been added to the App based on Dr Rhiannon Smiths CRDC funded bird survey and technical advice from CRDC funded bird researcher Adam Smith. The Checklist of birds found on cotton farms has also been updated by BirdLife Australia based on the Australian Bird Atlas data.

The App released in early 2016 incorporated the latest relevant research and a bird-monitoring tool. The App is a collaboration with many of the industries Cotton Grower Associations, Ginning companies as well as local natural resource organisations. The 2016 & 2017 CottonInfo NRM campaigns had a combined target of 200 unique users downloads of the Bird App and 40 unique users monitoring birds in cotton landscapes by June 2017, appendix 2. To date the App has had 296 downloads of which over 200 were in cotton growing regions. There has been 193 individual bird sighting recorded using the App's monitoring tool by 60 unique users. These results exceed the NRM CottonInfo NRM campaign targets. Below are two graphs showing some demographic data on who is downloading the App and where.


Bird App downloads by region, 30/06/2017
80
70
60
50
40
30
20
10
0
Non-cotton
Namoi
BR/St George
Central QLD
Gwydir
Darling D
SNSW
Macquarie


Bird App downloads by profession, 30/06/2017
120
100
80
60
40
20
0
Genral public
Cotton service provider
Cotton consultant
Cotton grower
NRM advisor
Other Ag

## Benchmark and monitor riparian land condition and practice within the cotton industry

### 5.1 Establish a long term monitoring framework for riparian land condition with riparian researchers and establish monitoring sites

Two long-term vegetation condition monitoring sites have been established within riparian areas on the cotton farm "Taraba" near Toobeah in southern Queensland. These sites have been established as part of the Cotton RiverCare Champion project. The sites were established in April 2016 with benchmarking undertaken by myself, UNE researcher Dr Rhiannon Smith and Cotton RiverCare Champion, Mark Palfreyman. The sites were selected based on their different history of landuse and the owner's intention to change management practice from grazing to non-grazing on one of the sites. The original intension was to work with CRDC funded researcher Dr Sam Capon's team from the University of Griffith during 2017-2018 to develop a case study looking at grazing intervention on weed establishment at the sites. Unfortunately due to unforseen circumstances, previously discussed, we may not have access to these sites in the future and are therefore considering the use of a different site to undertake the land practice intervention case studies.

**Site 1** is on the junction of Coomonga Creek and the McIntyre River. The site has had very little grazing. Even though it was extremely dry at the time of the vegetation survey, rainfalls had been well below average, the site had a very good cover of litter and diversity of groundcover species. Overall the site was in a very good condition with no dieback present at the site and regeneration of all age structures present. 3 canopy, 8 mid-low storey and 27 groundcover species where recorded at the site.

Site 04/02/2016 Site 2: 1: 05/03/2017

**Site 2** is a north/south transect out from the ephemeral creek, Coomonga creek. This site has been opportunistically grazed since the 60's. It has a large infestation of Lippia along the banks, which is not evident in site 1. On average 40% of the site was covered in lippia with the % of lippia cover decreasing as you moved away from the riverbank. Again considering the dry conditions and the level of lippia infestation present, the site was in a good condition

with a slightly lower diversity of species present at site 2 compared to site 1. No dieback was present at the site and regeneration of all age classes was recorded at site 2. 3 canopy, 4 mid-low storey and 21 groundcover species where present at site 2.

Site 2: 04/02/2016

Site 2: 05/03/2017

In addition, a fauna survey was undertaken on the farm by a professional ecologist, Phil Spark (North West ecological) in October 2016. The survey was undertaken over four days and endeavoured to get a snap shot of species diversity across the farm. The survey was not repeated overtime and across different seasons therefore it is not a true representation of the full diversity of species that exist on "Taraba". The survey found a good diversity of native reptiles (23), birds (75), amphibians (28) and mammal (11) species however abundance for some of the species, such as microbats, was low which is a trend being observed across Australia. While the survey found a good diversity of species the expected trend, due to continued fragmentation of habitat in the local landscape, is for species diversity to decline over the coming decades. In the final report the ecologist identified riparian weeds as one of the biggest threats to biodiversity on the farm. "Weeds displace native plants and seriously modify the habitat for native fauna by removing important sources of seeds, fruits, and nesting materials, increase shading and ground cover that affects reptiles, and reducing litter foraging area for birds and reptiles". Appendix 9 contains the results from the vegetation, fauna and water quality monitoring.

### 5.1.1 Indicators of riparian health identified

CRDC research undertaken over the past 3 years by Dr Sam Capon (GU) and Dr Rhiannon Smith (UNE) identified 3 key indicators of riparian health; litter cover, canopy cover and presence of a shrub layer. A cotton industry resilience project by Bel Tempo NRM, also funded by CRDC, identified a number of key parameters for native vegetation condition for the cotton industry - 'proximity to habitat', 'patch size', 'connectivity' and 'vegetation cover'. Theses results have been incorporated

into communication tools and products developed for CottonInfo as well as used to develop the framework for Dr Sam Capon's intervention case studies.

The results from this research is also currently being collated by Erin Peterson from QUT who is looking at all these indicators, including non-cotton specific indicators identified by other research, to determine if an achievable, measurable and meaningful biodiversity sustainability target can be identified for the cotton industry.

**5.2 Co-ordinate the update of industry guidelines for the best practice management of riparian lands within the Australian cotton industry**

In collaboration with industry and non-industry riparian researchers and NRM advisors the guidelines for Best management practice of riparian lands within the Australian Cotton Industry have been updated and collated in key industry publications such as:

- 2017 Australian Cotton production Manual & the 2017 Australian Cotton Pest Management Guide.
- Sustainable Landscapes Module (Natural Assets) myBMP standards and supporting resource sheets
- CottonInfo website resource sheets, case studies and YouTube videos.
- Birds on Cotton Farms App for Smart phones, and
- Cottoning onto natures workforce biodiversity booklet

Currently working with Dr Sam Capon's team from the University of Griffith to develop 2 detailed case studies around riparian land practice interventions ( vegetation planting/regeneration & grazing/weed management) as part of a new CRDC funded project.

**Benchmark the current condition and land management practices of riparian land in cotton growing areas**

The aim of this milestone was to provide the industry with improved knowledge regarding riparian condition and practice at a farm and landscape scale. The initial

intension was to collate and present the research outputs from Dr Rhiannon Smith's vegetation condition and grower practice data and Dr Sam Capons CRDC vegetation condition data in a joint riparian land practice research paper. However due to ill health, changes to research project deliverables ie no link to land practice data, and late delivery of condition data, the paper was not completed.

This project then investigated the feasibility of undertaking a more detailed grower practice and attitudinal survey of the cotton industry using a qualified social researcher, and linking this survey to the vegetation condition data collated by Dr Rhiannon Smith.

As reported in the November 2016 progress report, the outcomes of this investigation are summarised below.

- Dr Rhiannon Smith's vegetation condition dataset has over 200 sites across NSW & QLD and is variable enough that a range of vegetation conditions is present therefore potentially providing useful information in-terms of linking condition to practice and attitudes. *The dataset wasn't supplied to this project until early 2016.*
- The dataset would require additional work to stratify it eg NSW verse QLD, growing regions and enterprises (ie grazing or not) etc. Reference sites for condition based on NSW biometrics and QLD biodiversity condition would need to be determined.
- Collaboration with a social researcher to develop and implement the survey would be essential to the success of the project. The cotton industry would benefit from the development 2 separate surveys.
    - Industry Grower practice survey - series of land practice and attitude questions developed by social researchers which could be repeated in the grower practice surveys overtime to benchmark and evaluate changes in NRM practices and attitudes.
    - Vegetation condition and practice survey – linking vegetation condition data to practice and attitudes
- The time and cost associated with developing and implementing these surveys and stratifying/extrapolating Dr Rhiannon's dataset for use in the survey would cost well beyond the current budget of $20,000.

It was therefore determined that an industry grower practice survey linked to condition could not be achieved within this, the NRM Technical Specialist project. This was identified in the May & November 2016 progress report as a

research gap with discussions between myself and CRDC Program Leader Jane Trindall identifying two future research opportunities:

- Tender to an external group with GIS capabilities and an ecological background to capture vegetation condition data for the cotton industry at a landscape and farm scale using Dr Smiths data as well as other available datasets
- Tender to an external social researcher to undertake a detailed survey of growers current riparian land management practices and their values and attitudes which underpin their long term commitment to management practices.

In the 2017 CRDC FRP round EcoLogical were contracted by CRDC, as part of a larger Rural Research and Development for Profit Natural Capital accounting project, to provide a comprehensive database that documents the extent and condition of natural assets that the cotton industry utilises, and sets a foundation from which industry can develop and report against ecological sustainability targets under *Theme 2.2 Responsible Landscape Management*. The project will greatly assist in the definition of values and drivers relating to management of natural landscapes in cotton growing regions.

In Collaboration with Dr Sam Capon, a series of questions that look at grower riparian values and land practices were developed for inclusion in the 2017 Cotton Grower Survey. Dr Sam Capon as part of her current CRDC project will evaluate the results of this survey. However their are limitations in-terms of numbers of questions and format of this specific survey which may impact on how meaningful these results will be for the industry.

***Methods***

**3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.**

This project provided the cotton industry with a National NRM technical specialist 3 days a week who provided an important role within the cotton industries National extension team, CottonInfo. In this role the NRM Technical specialist over the past three years lead the continuous improvement of the best practice recommendations for NRM by:

- Being the technical lead for NRM and working with relevant NRM researchers & advisors (CRDC funded and others) to identify NRM R&D

opportunities and gaps, capturing key research messages and identifying and raising awareness of emerging issues

- In consultation with CottonInfo's Communication Manager and Team leader leading the capture and extension campaigns for NRM BMP, and
- In consultation with the myBMP team leading the continuous improvement of the BMP's recommendations and supporting resources within the Sustainable Landscapes Module (natural assets) of myBMP.

The challenge of increasing grower's capacity to engage in natural resource management was successfully addressed through this project by using an innovative methodology that targeted social networks of women, in particular families. With over 300 people attending field days on 'riparian management' across six valleys it is clear that attaining high level of attendance at non-production focused event is achievable if the right framework to engage them is used. The field day evaluations clearly show that the fact that these were family based events is the reason we had such high attendance. However the success we achieved in engaging families in each valley was dependent on how effective we were in engaging social networks of families. In reflection this often came down to having the right contact person (social connected) in a region when first planning and developing the field day. To provide a comparison, the field day held at Hay was organised via a committee based in Griffith with limited local contact had around 25 people attend. The field day held at Warren where a local contact with strong social networks was used had 45 people attend. Finally it is in my opinion based on my observations of these events that field days, which are tactile and require physical movement, are more engaging for families, generating more discussion and participant involvement.

In consultation with riparian researchers the Namoi Regional Vegetation (RVC) condition assessment methodology and condition benchmarks were used as the monitoring framework for the establishment of the two long-term monitoring sites. This framework is based on the Namoi riverine condition framework developed by Ecological for the Cotton CRC and Namoi CMA in 2009.

This framework was chosen as it captured condition indicators identified by CRDC researchers, could be undertaken by non-researchers (Cotton RiverCare Champion) and provided bio-condition benchmarks for the 2 vegetation communities identified at the site.

Note one site (Coomonga creek/land practice intervention) has been assessed using the QLD bio-assessment methodology, however neither of the monitoring sites under this methodology has a reference condition site under the QLD regional ecosystems framework. According to a report undertaken by EcoLogical for the MDBA & SRA (Sustainable Rivers Audit) in May 2010 "Preparation of a reference condition dataset" assigned RVC equivalents for QLD regional ecosystems where no benchmark data existed. (Site 1- 11.3.15:RVC 78) & (Site 2 - 13.3.5:RVC 73).

***Results***

**4. Detail and discuss the results for each objective including the statistical analysis of results.**

The results of the project are explained in detail in section 1.

***Outcomes***

**5. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.**

Workshops/activities that target "social networks" of growers and their families delivered across 7 valleys - *Increased numbers of growers participating in NRM activities with improved knowledge of best practice for riparian management*

- As described in the methodology using 'social networks" clearly increased grower participation in NRM activities with 288 people attending the events. Evaluations undertaken after the events showed that respondents felt that they had improved knowledge and confidence to implement BMP as a result of attending the events.

Industry relevant indicators of riparian health in cotton growing areas identified - *Industry has gained knowledge on BMP that it can be undertaken to maintain or improve riparian condition*

- Key industry indicators of riparian health identified through R&D over the past 3 years were linked to known land practices that impact on these indicators and 'packaged' into CottonInfo extension messages, tools and products, including extension at the above mention field days.

A methodology for capturing riparian health in cotton growing areas developed and implemented - *Improved understanding of industries impact on riparian health and its ability to implement BMP to improve maintain riparian health in cotton landscapes*

- A YouTube video on using permanent photo monitoring points as a simple grower friendly method for assessing vegetation change overtime was developed using the National Cotton RiverCare Champion and resides on the CottonInfo website.
- In consultation with riparian researchers the Namoi Regional Vegetation (RVC) condition assessment methodology and condition benchmarks were used as the monitoring framework for the establishment of the two long-term vegetation condition monitoring sites.

Reports and recommendations made to CRDC from attendance at NRM research forums, meetings and conferences - *Industry able to identify gaps in knowledge as well as opportunities for future NRM research*

- NRM R&D gaps and opportunities were identified through developing and running forums such as the 2015 Mini Riparian researcher forum in Moree and the 2016 Responsible Landscape Management forum in Brisbane
- Attendance and participation at NRM and industry conference such as the Australian Cotton Conferences, International River Symposium, CSIRO & OECD international workshop, UNE Restore, Regenerate & Revegetate Conference
- Keeping abreast of grower and consultant issues through attendance and participation at CottonInfo bi-annual meetings and fortnightly teleconferences
- Participation in the 2017 NRM regions committee meeting in Canberra and the identification and initial discussions of a potential collaboration on spray drift management with Riverina LLS and Murray LLS.

Provide an Industry NRM lead for NRM best practice - *The CottonInfo Team has technical NRM support*

- For the past 3 years CottonInfo has had a NRM Technical Specialist 3 days a week that has lead the continuous improvement of NRM BMP recommendations and lead the NRM extension program for CottonInfo.

Annually recommendations for the improvement of the natural assets module made to Cotton Australia - *Growers and industry members using the latest NRM best practice knowledge to manage natural assets on farm*

- Sustainable Landscape Module (natural assets) annually reviewed and updated and inline with other modules with myBMP. Links provided from CottonInfo NRM webpage to myBMP.

Development of the 2 NRM knowledge products with CottonInfo Team management and relevant NRM researchers- *Growers and industry gain knowledge and tools for managing natural assets on farm*

- Birds on Cotton Farm identification and monitoring App developed and released. 296 downloads and 129 unique monitoring entries
- Cottoning onto biodiversity booklet series (3 editions)
- Using vegetative barriers to minimise spray drift on cotton farms factsheet
- Case studies: Demonstrating whole farm sustainability – Anthony Barlow
- Case studies: Valuing our riparian assets – Auscott's Midkin
- YouTube video – permanent photo pints

NRM campaign "in it together" messages, activities, and targets developed and described to CottonInfo Team- *Increased NRM knowledge of REO's and growers better supported on NRM issues*

- Development of 3 annual NRM Campaigns in collaboration with CottonInfo team member and assistance of team members in implementing and meeting campaign targets. All campaign targets met with assistance of team members.
- Seven NRM knowledge improvement and training opportunities provided to REO's
- NRM research updates given to CottonInfo team members at bi-annual national team meetings and fortnightly teleconferences.

Assist REO's develop and deliver NRM activities on regional issues as identified by REO's or research - *RDO's and growers gain knowledge on local NRM issues*

- 9 extension activities held across 7 valleys with around 320 people attending
- Regional issues covered include, water quality monitoring, riparian BMP, biodiversity BMP, Managing beneficials and floodplain management.
- Groundwater health tool trials undertaken in Namoi valley with 5 growers and REO.
- Microbat habitat requirements research undertaken with 5 growers in Namoi catchment.

Development of NRM communication products, articles etc. - *Growers and industry gain knowledge on current and regional NRM issues*

- Industry grower and consultant surveys are showing an increasing impact by CottonInfo on their awareness and knowledge, this includes NRM based products, publications, websites etc around issues such as, spray drift management, bird identification, management and monitoring and riparian management and monitoring.
- "KASA" Evaluations from 'social network' field days reported an increased in both awareness and confidence of participants to implement riparian BMP.

CRDC research program reflects regional NRM issues and NRM knowledge gaps - *Growers and industry have upto date NRM best practice information*

Research opportunities and gaps identified through this project currently being addressed through CRDC funded projects include:

- Through forums (Riparian research mini forum, NRM Responsible Landscape Management Forum) and internal and external discussions a knowledge gap was identified around the industry wide understanding of native vegetation condition and extent and what/where areas where of key conservation value for the industry. A new 3 year CRDC project with EcoLogical, as part of a larger Natural Capital Accounting project, will address this knowledge gap.
- As a result of a 2016 grower panel request for more on-ground action in NRM I coordinated the development of a collaborative research project between CRDC, NSW DPI, University of Queensland and Murrumbidgee Irrigation to develop a bio-herbicide for the Noogoora Bur complex. Noogoora Bur is a significant environmental weed in riparian and wetland environments across Australia. It also poses a threat to the cotton industry, as it is a known host of Verticillium Wilt. The 2 year project commencing in July 2017 is funded through the Australian Governments' Department of Agriculture and Water Resources grant program "New and improved control technologies for established pests and weeds".
- Off-site impacts from spray drift management continues to be an industry and community high profile issue. The provision of technical spray drift training, information and advice provided through this project (Spray drift management workshop, vegetation barrier factsheet) and other industry projects, has failed to achieve practice change. Further R&D in this area including a new 3 year CRDC project under the Responsible Landscape management theme, "Quantifying the potential for off-farm impacts from pesticides (from cotton)", aims to better understand the industries risk and identify new innovative practice change methods. I am currently leading discussion between a number of NSW LLS's, CottonInfo and Cotton Australia about collaboration to address spray drift management at a regional level.
- Over the past two years I have held a number of conversations with fish ecologists in the QLD state government, regional NRM bodies, NSW DPI fish ecologists and cotton industry groups around the impact of pumping on fish

health. Fish screens may be a potential management strategy for the cotton industry. Further R&D on implementation of fish screens in-line with the National Carp Control Strategy was proposed to my program manager as a worthwhile future investment for CRDC's 2018-19 procurement round.

6. **Please describe any:-**
   a) **technical advances achieved (eg commercially significant developments, patents applied for or granted licenses, etc.);**
   b) **other information developed from research (eg discoveries in methodology, equipment design, etc.); and**
   c) **required changes to the Intellectual Property register.**

NA

***Conclusion***

7. **Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?**

Over the past 3 years there have been a number of achievements have been made as well as the identification of areas for future R&D investment.

Using social networks of women and their families to increase engagement of the cotton industry in NRM capacity building events is a very effective tool with over 300 people from cotton landscapes attending riparian management events over the past 3 years.

The drivers of riparian land management practice change on cotton farms ie the values and attitudes which underpin cotton growers long-term commitment to management practices, is very complex. To date the cotton industry has undertaken a fairly adhoc approach to NRM social research often incorporating social research outcomes into ecological research projects being undertaken by ecologists not social researchers. Also, the investment in these social research outcomes is often a minimal part of the overall project budget. Research to better understand the drivers of NRM change needs to be undertaken by qualified social researchers with allocation of appropriate budgets.

At a riparian monitoring meeting in 2014 at CRDC with industry and non-industry riparian researchers and ecologists, participants were asked to identify which of 4 higher level indicators of riparian health (vegetation, in-stream, geomorphology & water quality) best informs and evaluates land management practices on cotton farm. Riparian vegetation was ranked the second highest with in-stream health the highest. The milestones of this project, inline with CRDC 2013-2018 Strategic R&D

Plan, focused on identifying and extending the key indicators of riparian vegetation health that cotton growers influenced through their land practices. Discussion at the above mentioned workshop ranked extent (width & connectivity) as the most important. Over the past three years CRDC funded research undertaken by Dr Rhiannon smith and Dr Sam Capons group found that in addition to extent, canopy cover, litter Cover and shrubbiness within riparian vegetation where key indicators of riparian health that cotton growers influenced. Over the next two years through Dr Sam Capons CRDC project and the continuation of the NRM technical specialist project, case studies looking at land practice interventions for these key industry indicators, will be developed and extended to the industry.

CottonInfo's Cotton RiverCare program, in particular the Cotton RiverCare Champion project, has successfully increased the industry and non-industry communities awareness of good riparian stewardship on cotton farms. With almost 1200 followers on social media and one of the highest viewed CottonInfo YouTube videos 21/121, the use of growers themselves as the industries story tellers of good stewardship appears to be in effective engagement strategy. In the future the program would benefit from broadening its 'representative' stewards to include other cotton growers implement good practices on farm.

2016 Responsible Landscape Management forum was held to discuss the cotton industries R&D needs under this theme and to refine the direction of investment to meet future challenges and make a difference. A focus of the workshop was sustainability and how to create sustainable value to cotton businesses and identifying the pathways to impact. Participants of the workshop identified that sustainability means different things to different people, industries, organisations and sectors. For a cotton grower it means surviving economically, having a reasonable lifestyle and passing the farm onto your kids in a better shape without impacting on anyone else. However to achieve this and maintain the industries social licence to farm, inclusivity is essential. Industry needs to be working over the long-term with local communities and forging alliances with environmental groups so that there is real ownership of targets and less chance changing governments, CEO's etc. can derail these. A project currently being contracted by CRDC with EcoLogical will help the industry identify what is the extent and condition of the natural assets cotton communities utilise. The project will set the foundation for not only developing and reporting against ecological sustainability targets but also developing new collaborations with regional cotton communities and environmental groups that incorporate these ecological sustainability targets with regional social

and economic targets. A focus of the next 3 years for the NRM Technical & Extension specialist will be building these collaborations.

***Extension Opportunities***

**8. Detail a plan for the activities or other steps that may be taken:**
**(a) to further develop or to exploit the project technology.**
**(b) for the future presentation and dissemination of the project outcomes.**
**(c) for future research.**

The continuous improvement of best practice recommendations for natural resource management will be continued in a new project funded by CRDC. The new project provides the cotton industry with a Cotton NRM and extension specialist within the CottonInfo team for another 3 years (2017-2020). The new project will build on the outcomes achieved in this project, improve collaboration between the cotton industry and NRM organisations and lead the minimisation of off-site impacts within the cotton industry.

**9. A. List the publications arising from the research project and/or a publication plan. (NB: Where possible, please provide a copy of any publication/s)**

A list of all publications produced as part of this project are

**B. Have you developed any online resources and what is the website address?**

Yes online resources have been developed as part of this project. All reside either on the CottonInfo website's NRM page or within the supporting resources area of the Sustainable landscapes (natural assets) module of myBMP. A list of al publications is provided in Appendix 2. All publications have been uploaded to Centric.

## *Part 4 – Final Report Executive Summary*

Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.

This project built on the past decade of investment in NRM research by providing a National NRM technical specialist who lead and assisted the industry develop and implement annual national CottonInfo NRM campaigns, identify NRM R&D gaps and opportunities and facilitate the capture of NRM R&D into the cotton industries myBMP program, industry guidelines, tools and products.

Industry NRM research workshops such as the 2015 Riparian Researcher and the 2016 Responsible landscape Management forum provided important opportunities for researchers and industry leaders to discuss NRM research outcomes and workshop NRM R&D gaps and opportunities for CRDC investment.

The establishment of two long-term riparian vegetation condition/land management practice monitoring sites on a cotton property in southern QLD, provides an important longitudinal dataset on practice change as well as impacts on key riparian condition indicators identified for the cotton industry by CRDC riparian researchers.

Through Collaboration with CottonInfo's REO's, regional NRM bodies and industry groups (eg WINCOTT) an innovative initiative focusing on 'social network of women' implemented across 7 cotton valleys has resulted in over 300 people with improved knowledge of riparian BMP and the confidence to implement these practices.

The development and release in 2016 of a Birds on Cotton Farm App, provided the industry with an important tool for the identification, management and monitoring of birds in cotton landscapes, with almost 200 sightings of birds across cotton landscapes recorded to date by users.

The launch of the Cotton RiverCare program and appointment in 2016 of a National Cotton RiverCare champion has enabled the industry to extend 'good riparian stewardship' to industry and non-industry including 1200 followers on social media.

Extension of Cotton NRM R&D at CottonInfo industry meetings, forums and national and international conferences including the International River Symposium in Brisbane in 2016.

Over 50 CottonInfo extension tools and products on NRM BMP produced and residing on the NRM page of CottonInfo.

| | | | |
|---|---|---|---|
| **Module 1: Biosecurity** | | | |
| **Key Area: People** | | | |
| **Standard: People are made aware of biosecurity** | | | |
| | AA101 | Level 2 | All farm personnel, consultants, contractors and visitors are made aware of farm biosecurity requirements (e.g. signage, staff communication) |
| | AA102 | Level 2 | All farm personnel, consultants, contractors are briefed on action to be taken in the event of identifying unusual pests or plant symptoms or a potential exotic pest / disease / weed |
| | AA103 | Level 3 | A documented biosecurity plan has been prepared for the farm which assesses the risk of insect, weeds and diseases entering the farm, and how these risks are minimised / managed |
| | AA104 | Level 3 | The farms biosecurity plan is communicated to all staff |
| **Key Area: Crops** | | | |
| **Standard: All crops and farm inputs are monitored** | | | |
| | AB101 | Level 1 | All crops are regularly monitored and unusual symptoms or pests must be reported to the relevant industry expert or state department officer. Pests include: insects, mites, snails, nematodes, pathogens (diseases) and weeds |
| | AB102 | Level 3 | Ensure all farm inputs (seed, fertiliser, stock fodder) that are brought onto farm are pest free. Records are kept of farm inputs and where they came from |
| **Key Area: Vehicle, machinery and equipment** | | | |
| **Standard: Manage movement and cleanliness of vehicles, machinery and equipment** | | | |
| | AC101 | Level 2 | A wash down facility is available |
| | AC102 | Level 2 | All machinery, vehicles and equipment entering cotton production areas are inspected for any soil and plant debris and, if found, cleaned in the wash down facility before they are moved both on and off your property |
| | AC103 | Level 3 | A sign posted designated parking area is provided for visiting vehicles and contractor equipment that is away from paddocks or production areas. A record of visitors is kept |
| | AC104 | Level 3 | Farm vehicles are used to transport visiting people around the farm |

| | | | |
|---|---|---|---|
| **Module 2: Energy and Input Efficiency** | | | |
| **Key Area: Farm energy inputs** | | | |
| **Standard: Monitoring farm energy usage** | | | |
| | BA101 | Level 2 | Electricity bills and meter readings are reviewed to ensure readings are correct and tariffs are appropriate for your farm situation |
| | BA102 | Level 2 | When purchasing liquid fuels consideration is given to:<br>• buying strategy,<br>• storage life of fuel (e.g. old fuel),<br>• fuel quality |
| | BA103 | Level 2 | Energy inputs for the cotton season are kept for diesel, electricity, petrol, fertiliser and gas to coarsely monitor high energy use (e.g. total diesel usage per season) |
| | BA104 | Level 3 | Alternative energy sources are being used on the farm (e.g. wind, solar, solar-thermal, waste to energy fuels – biofuels) |
| | BA105 | Level 3 | Seasonal forecasting and multi-week weather models are used to prepare the farm for high energy demands (e.g. flood harvestable rain, heat waves resulting in periods of high energy use) |

| | | | |
|---|---|---|---|
| **Key Area: Energy efficient practices have been implemented on farm** | | | |
| **Standard: Irrigation pump stations are well designed** | | | |
| | BB101 | Level 2 | New pump stations (pump and engine) are the best design and type for the farming system and where possible are overseen by a qualified person |
| | BB102 | Level 2 | New irrigation pumps are placed at an appropriate height, ensuring there is no high suction pressure which can lead to cavitation and impeller damage |
| | BB103 | Level 2 | Well-designed pipelines in system upgrades:<br>• suction pipe entries are properly designed (e.g. large and smooth) and screens are appropriately sized for debris<br>• suction pipe diameters are sufficient in diameter (e.g. larger than discharge diameter)<br>• discharge pipe is appropriately sized |
| | BB104 | Level 3 | All new and upgraded pump stations have been designed by a qualified person |
| **Key Area: Energy efficient practices have been implemented on farm** | | | |
| **Standard: Irrigation pump performance is measured** | | | |
| | BC101 | Level 2 | Regular pump maintenance is undertaken |
| | BC102 | Level 2 | Energy use (fuel or electricity) is measured for each irrigation pump |
| | BC103 | Level 3 | An independent pump test is performed by a qualified consultant and recommendations are implemented |
| | BC104 | Level 3 | Water pumped is estimated for each irrigation pump |
| **Key Area: Energy efficient practices have been implemented on farm** | | | |
| **Standard: Optimising energy usage in tractors** | | | |
| | BD101 | Level 2 | Tractor operations take in account:<br>• working depth to ensure optimum energy efficiency,<br>• optimising the number of farming operations |
| | BD102 | Level 2 | Tractor tyre pressure is adjusted for tractor activity |
| | BD103 | Level 2 | Tractors are monitored for fuel usage (e.g. fuel records are used to monitor fuel consumption) |
| | BD104 | Level 2 | Tractor drivers are aware of the farms fuel efficiency gains through adaptive driving (e.g. adaptive driving to suit field conditions) |
| | BD105 | Level 2 | Tractor ballasting is adjusted for tractor activity |

| | | | |
|---|---|---|---|
| **Module 3: Fibre Quality** | | | |
| **Key Area: Crop management** | | | |
| **Standard: Practices were implemented during crop growth to preserve the high fibre quality of Australian varieties** | | | |
| | CA101 | Level 2 | An appropriate variety for this region was selected using comparative data on fibre properties from seed company |
| | CA102 | Level 2 | Measures were taken to ensure a uniformly spaced plant stand |
| | CA103 | Level 2 | An optimal sowing date is identified and measures are taken to ensure a uniform plant stand |
| | CA104 | Level 2 | Weeds were effectively controlled throughout the season to optimise plant growth and reduce the risk of lint contamination |
| | CA105 | Level 2 | The progression towards cut-out (NAWF) was monitored and strategies were engaged to avoid early crop cessation or delays in crop maturity / harvest |
| **Key Area: Crop preparation** | | | |
| **Standard: Practices prepare the crop for harvest to ensure clean white cotton** | | | |
| | CB101 | Level 2 | Irrigations were planned to finish the crop and to limit regrowth by having soil moisture levels to refill points by defoliation |
| | CB102 | Level 2 | Whitefly and aphid infestations are monitored and managed to avoid sticky cotton |
| | CB103 | Level 2 | Irrigations during early flowering were carefully scheduled to minimise crop stress to optimise fibre length |

| | | | |
|---|---|---|---|
| **Key Area: Harvest** | | | |
| **Standard: Uncontaminated cotton is delivered to the gin** | | | |
| | CC101 | Level 2 | Harvesters are regularly maintained and correctly set up |
| | CC102 | Level 2 | Cotton moisture was frequently checked and measured during harvest, specifically in the morning, and towards the end of each day to avoid moisture content above 12% |
| | CC103 | Level 2 | Well-constructed modules are correctly placed or staged for easy access on clean, even and well drained sites |
| | CC104 | Level 2 | High quality tarpaulins are used on conventional modules and were handled to avoid tearing or puncturing |
| | CC105 | Level 2 | Module information is effectively recorded |
| | CC106 | Level 2 | Farm hygiene practices are in place to avoid contamination, especially when constructing modules |

| | | | |
|---|---|---|---|
| **Module 4: Human Resources and Work Health & Safety** | | | |
| **Key Area: Human Resources** | | | |
| **Standard: A recruitment process is used to employ people** | | | |
| | DA101 | Level 1 | New employees are informed of any probationary periods |
| | DA102 | Level 2 | Position descriptions are written for all levels of employee positions |
| | DA103 | Level 2 | An offer of employment is initiated |
| | DA104 | Level 2 | A review of employment is conducted before the end of the probation period |
| | DA105 | Level 3 | A formalised recruitment strategy is in place that includes: position advertisement, job application forms, reference checks, preparing for interviews, offer of employment, letter of engagement, the probationary period and end of probationary period, unsuccessful candidate letter |
| **Key Area: Human Resources** | | | |
| **Standard: Contractors are managed appropriately** | | | |
| | DB101 | Level 1 | A contractor agreement is in place and signed including terms and conditions applicable to any employees of the contractor. The 'terms of service' has been confirmed (e.g. timing, costs, conditions, workers compensation insurance) |
| | DB102 | Level 1 | The difference between an employee and a contractor has been established |
| **Key Area: Human Resources** | | | |
| **Standard: Training, career development and farm succession planning** | | | |
| | DC101 | Level 1 | All staff members hold the relevant training / qualifications required to perform the tasks they are employed to do |
| | DC102 | Level 3 | The transfer of ownership and management of the farm is planned |
| | DC103 | Level 3 | A mentoring process is in place |
| | DC104 | Level 3 | A skills audit has been conducted and staff are provided flexibility to undertake "in house" and or external training |
| | DC105 | Level 3 | An opportunity for career path development is provided for staff |
| **Key Area: Human Resources** | | | |
| **Standard: Inductions for new employees and contractors are provided by the employer** | | | |
| | DD101 | Level 1 | All new employees and contractors receive an induction at the start of employment. A record should be kept |

| | | | |
|---|---|---|---|
| **Key Area: Human Resources** | | | |
| **Standard: Employers ensure employees are legally entitled to work in Australia** | | | |
| | DE101 | Level 1 | Employers must ensure all employees are legally entitled to work in Australia |
| | DE102 | Level 1 | The individual has freely chosen to be employed |
| | DE103 | Level 1 | Employers of working holiday makers are legally required to register with the ATO |
| **Key Area: Human Resources** | | | |
| **Standard: A process is in place for ending an employee's employment** | | | |
| | DF101 | Level 1 | Management is aware of minimum notice periods for ending employment |
| | DF102 | Level 1 | End of employment entitlements are calculated correctly |
| | DF103 | Level 1 | End of employment by the employer must be notified in writing |
| | DF104 | Level 1 | Ending employment (e.g. redundancy, termination, resignation) must be carried out according to the Fair Dismissal Code as a minimum standard |
| | DF105 | Level 2 | Exit interviews are conducted with staff upon leaving and documented (either by management or by a third party) to enable continuous improvement in staff management |
| **Key Area: Human Resources** | | | |
| **Standard: A process is in place to manage employee performance and ensure fair treatment of employees** | | | |
| | DG101 | Level 1 | Conflict and disputes are managed according to the dispute resolution process in relevant award |
| | DG102 | Level 2 | Employees performance is regularly reviewed |
| | DG103 | Level 2 | There is a process for employees to give suggestions and feedback |
| | DG104 | Level 3 | Employees are recognised through a reward system |
| **Key Area: Human Resources** | | | |
| **Standard: Wages and Conditions – awards, agreements and employee entitlements are in accordance with the *Fair Work Act 2009*** | | | |
| | DH101 | Level 1 | The farm business understands the National Employment Standards which outlines the minimum entitlements for employees in Australia |
| | DH102 | Level 1 | Employees are employed under:<br>• the relevant award; or<br>• a common law employment contract; or<br>• individual flexibility agreements; and<br>their employment is in accordance with the minimum employment entitlements as per National Employment Standards. A record should be kept |
| | DH103 | Level 1 | All new employees are provided with a copy of the Fair Work Information Statement |
| | DH104 | Level 1 | Employee information records are kept and maintained |
| | DH105 | Level 1 | Payslips must be provided to all employees and include all relevant information |
| **Key Area: Work Health and Safety** | | | |
| **Standard: A person conducting a business or undertaking (PCBU) must ensure the health, safety and welfare of workers (employees and contractors) under State Work Health and Safety law. All cotton growers have legal obligations and duties to ensure people are not injured or harmed whilst at work** | | | |
| | DI101 | Level 1 | All people in the farm business are aware of legal obligations and duties to ensure people are not injured or harmed whilst at work |
| | DI102 | Level 1 | A Work Health and Safety policy has been developed and is displayed in the workplace. The policy is supplied to all workers (employees and contractors) |
| | DI103 | Level 1 | Workers (employees and contractors) are consulted and participate in the businesses health and safety management. Records are kept of consultation with workers (e.g. safety meetings, tool box talk) |
| | DI104 | Level 1 | All workers (employees and contractors) receive a safety induction at the start of employment. A record should be kept |

| | | | |
|---|---|---|---|
| | DI105 | Level 1 | All workers (employees and contractors) are provided suitable training, instruction and supervision so they can operate machinery and equipment competently. Records are kept of training |
| | DI106 | Level 1 | All workers (employees and contractors) who operate High Risk Plant need a High Risk Work Licence |
| | DI107 | Level 1 | The farm business must provide and maintain facilities (e.g. toilets, drinking water, hand washing, eating facilities and providing first aid) |
| | DI108 | Level 1 | A farm emergency plan must be developed. The plan includes all types of farm emergencies, is available to workers and is on display in the workplace |
| | DI109 | Level 1 | There must be people trained to provide First Aid in the workplace |
| | DI110 | Level 1 | Records are kept of all workplace incidents (definition: serious injury or illness, death or dangerous incident and first aid treatment) |
| | DI111 | Level 2 | A work health and safety plan has been developed and communicated to staff |
| | DI112 | Level 3 | The farm business has a written farm health and safety plan that is based on Australian Standard AS 4801 - Occupational Health and Safety Management Systems |
| **Key Area: Work Health and Safety** | | | |
| **Standard: The workplace is regularly inspected to identify and eliminate hazards in the workplace** | | | |
| | DJ101 | Level 1 | All farm hazards and risks are regularly (at least annually) identified and recorded |
| | DJ102 | Level 1 | A work health and safety action plan is developed for all hazards with significant risk |
| | DJ103 | Level 1 | All new and second hand machinery purchased is inspected and hazards are assessed and controlled before being used on farm |
| | DJ104 | Level 1 | All machinery is regularly serviced and maintained so that it is safe. A record is kept of machinery maintenance (e.g. Rego checks, diary, WHS meetings) |
| | DJ105 | Level 1 | Portable electrical equipment (power tools) are regularly inspected and tested to ensure it is safe to use. Residual current devices are installed on all power boards to protect workers from electrocution. Records are kept for portable electrical equipment and RCD testing. (Note: NSW and QLD have different requirements) |
| | DJ106 | Level 1 | Fire extinguishers, smoke detectors and alarms are regularly inspected and tested. This information is recorded |
| | DJ107 | Level 1 | Personal Protective Equipment is provided, regularly checked and it is safe to use |
| | DJ108 | Level 1 | First Aid kits are available and accessible. They are regularly checked and a record is kept (e.g. diary, WHS meeting) |

| | | | |
|---|---|---|---|
| **Module 5: IPM - Insects, Weeds & Diseases** | | | |
| **Key Area: Integrated Disease Management** | | | |
| **Standard: Integrated disease management is carried out on farm** | | | |
| | EA101 | Level 2 | Crops are monitored for disease symptoms, the information is used to identify where the disease occurs on the farm and to monitor the disease over time |
| | EA102 | Level 2 | Disease resistant varieties are selected where possible to assist in controlling diseases |
| | EA103 | Level 2 | All farm personnel, contractors and visitors where possible are made aware of diseases on farm and unusual disease symptoms are reported |
| | EA104 | Level 2 | An integrated disease management strategy is implemented across the whole farm:<br>• optimal planting date and temperature<br>• optimise crop nutrition and irrigation<br>• crop residue management<br>• volunteer and ratoon cotton plants are controlled throughout the year to minimise disease carry over<br>• crop rotations |
| **Key Area: Integrated Weed Management** | | | |
| **Standard: Integrated weed management is carried out across the whole farm** | | | |
| | EB101 | Level 1 | Herbicide tolerant cotton is managed in accordance with license terms and conditions of the Technology User Agreement (TUA) |
| | EB102 | Level 2 | Crops are monitored for weeds including after each herbicide application. Weeds are correctly identified |
| | EB103 | Level 2 | Timing of herbicide applications is managed for weed species and growth stage to ensure effectiveness of the application. Records are kept |

| | | | |
|---|---|---|---|
| | EB104 | Level 2 | Herbicides are selected based on rotating herbicide modes of action, residues and re-cropping intervals |
| | EB105 | Level 2 | Two non-glyphosate tactics are used to manage weeds in cotton crops as per the industry's Herbicide Resistance Management Strategy |
| | EB106 | Level 2 | Weeds that survive a herbicide application are controlled using an alternative mode of action or other methods e.g. cultivation, chipping before seeds are set |
| | EB107 | Level 2 | An integrated weed management strategy is implemented on farm, multiple weed control methods are used in crop, fallow, rotation and non-crop areas to manage for weed burden and resistance:<br>• rotate herbicide modes of action<br>• cultivation<br>• rotation crops<br>• cover crops<br>• manual chipping |
| | EB108 | Level 2 | Good farm hygiene is practiced to minimise the entry of new weeds, diseases and pests onto the farm - 'Come Clean Go Clean' |
| | EB109 | Level 2 | Volunteer and ratoon cotton plants are controlled in crop and non-cropping areas |
| | EB110 | Level 3 | Good weed records are kept including: field history - crop rotation, weeds present and weed size, herbicide applications, use of non-herbicide weeds controls and other management practices influencing weed control |
| | EB111 | Level 3 | Weed control thresholds are used to determine the timing of in-crop applications |
| | EB112 | Level 3 | Precision spray technology is used to optimise weed control while reducing chemical inputs |
| **Key Area: Integrated Pest Management** | | | |
| **Standard: Integrated insect and mite management for Bt and non Bt cotton crops** | | | |
| | EC101 | Level 2 | Pest control decisions are based on industry thresholds for pest population and crop damage |
| | EC102 | Level 2 | Application of insecticides are selected based on:<br>• pest species present<br>• Insecticide Resistance Management Strategy (IRMS) for the region, and<br>• impact on beneficials and bees |
| | EC103 | Level 2 | In the event of a suspected spray failure ensure the same insecticide group alone or in a mixture is not sprayed again |
| | EC104 | Level 2 | Beneficial insects are conserved on farm |
| | EC105 | Level 2 | Integrated pest management tactics are implemented to minimise pests:<br>• field selection<br>• varietal selection<br>• seed treatments<br>• strategic planting time<br>• pest weed hosts including volunteer and ratoon cotton are controlled<br>• pupae busting<br>• trap cropping |
| | EC106 | Level 2 | Crops are regularly monitored at least twice a week using industry sampling techniques. Pests and beneficials are correctly sampled and identified, crop growth and damage are recorded |
| | EC107 | Level 3 | Beneficial insect populations are increased through the following management strategies e.g. planting native vegetation, trap crops, food sprays, releasing parasites or predators |
| | EC108 | Level 3 | Pre-season planning considered the influence of whole farm cropping strategies on pests and beneficial species |
| | EC109 | Level 3 | Participation in an area wide management group or similar group regarding integrated pest management (IPM) |

| | | | |
|---|---|---|---|
| | EC110 | Level 3 | A post-season analysis of insect management strategies was undertaken to help inform future pest management decisions |
| **Key Area: Integrated Pest Management** | | | |
| **Standard: Managing resistance in Bt cotton** | | | |
| | ED101 | Level 1 | Adhere to Resistance Management Practices (RMP) for Bollgard (II or 3) cotton to delay the development of Bt resistance:<br>• a defined planting window<br>• mandatory growing of refuges<br>• control of volunteer and ratoon cotton<br>• restrictions on the use of foliar Bt<br>• pupae busting as required (According to current industry guidelines for your region and field defoliation dates)<br>These RMP are in accordance with the terms and conditions of the Technology User Agreement (TUA) |
| | ED102 | Level 1 | Bt cotton is managed in accordance with the terms and conditions of the Technology User Agreement (TUA) |
| | ED103 | Level 2 | The refuge is managed to ensure healthy plants that attract Helicoverpa spp. for the entire growing season |
| | ED104 | Level 3 | Pupae busting of all Bt cotton fields regardless of defoliation date |

| | | | |
|---|---|---|---|
| **Module 6: Pesticide Management** | | | |
| **Key Area: Pre-Season Planning and Communication** | | | |
| **Standard: Develop a farm map to identify sensitive areas and potential hazards** | | | |
| | FA101 | Level 2 | A detailed farm map(s) has been developed that shows:<br>• North orientation arrow<br>• Accurate Scale<br>• Location of property boundaries<br>• Crop Area<br>• On-farm and neighbouring houses and buildings<br>• Neighbouring agricultural areas identified (e.g. crops, grazing, bees, dairy, tree crops)<br>• On-farm and neighbouring sensitive areas<br>• Aircraft and spray rig hazards e.g. powerlines<br>• Windsocks, weather stations, public roads, railway lines, stock routes and school bus routes<br>• Chemical and fuel storage areas |
| | FA102 | Level 2 | Contact details (phone, UHF) for the farm, relevant employees and neighbours are listed and kept with the farm maps |
| | FA103 | Level 2 | CottonMap is updated at the beginning of each season |
| **Key Area: Pre-Season Planning and Communication** | | | |
| **Standard: Workers are trained and provided information for the safe use of pesticides** | | | |
| | FB101 | Level 1 | Workers are instructed and trained in the safe use of pesticides (e.g. transport, storage, mixing, loading, application and emergency procedures) |
| | FB102 | Level 1 | **NSW** - All people involved in supervising, handling or the application of chemicals should have chemical user accreditation (including contractors)<br><br>**QLD** - Chemical users applying herbicides on properties other than their own have chemical user accreditation |
| | FB103 | Level 1 | Workers know emergency procedures and emergency contact details |
| | FB104 | Level 1 | All workers are informed about pesticide applications and crop re-entry periods prior to spraying |

| | | | |
|---|---|---|---|
| | FB105 | Level 1 | Personal Protective Equipment (PPE) is available and used as described on the label for mixing, loading and applying pesticides |
| | FB106 | Level 1 | Safety Data Sheets (SDS) are available to workers for all chemical products used on farm |
| | FB107 | Level 2 | Hazardous work that includes pesticide preparation and application is not carried out by people under 18 years of age, pregnant, or nursing |
| | FB108 | Level 3 | Details of sprayed fields with re-entry periods are clearly marked on a farm map and are displayed at a central location |
| **Key Area: Pre-Season Planning and Communication** | | | |
| **Standard: Discussion of application requirements with consultant** | | | |
| | FC101 | Level 2 | A pre-season discussion is held with the consultant and documented [e.g. Pesticide Application Management Plan (PAMP)] |
| | FC102 | Level 2 | Consultant is provided with a current farm map and contact details |
| | FC103 | Level 2 | Consultants provide all spray recommendations in writing |
| | FC104 | Level 2 | Communication for spray applications is clearly defined for:<br>• who makes the final decision on spraying<br>• product selection<br>• who orders the application<br>• notification of job completed |
| | FC105 | Level 2 | Consultants are requested to access CottonMap and BeeConnected, prior to making spray recommendations |
| | FC106 | Level 3 | Consultants are invited to participate in an Area Wide Management Group |
| **Key Area: Pre-Season Planning and Communication** | | | |
| **Standard: Discussion of application requirements with spray applicators (ground and aerial)** | | | |
| | FD101 | Level 1 | Spray contractors agree to comply with all label requirements |
| | FD102 | Level 1 | Spray contractors must maintain and supply a copy of all application records that are legally required by State requirements |
| | FD103 | Level 1 | All people in NSW (including spray contractors) supervising, handling or applying pesticides must have chemical user accreditation<br><br>Contractors in QLD applying herbicides must have chemical user accreditation |
| | FD104 | Level 2 | A pre-season discussion is held with all aerial and ground rig spray contractors and documented (e.g. PAMP) |
| | FD105 | Level 2 | Guidelines for acceptable spraying parameters are developed and provided to spray contractors (e.g. wind speed / direction, temperature, machine speed, water volumes, nozzles) |
| | FD106 | Level 2 | Spray contractors are provided a current farm map and contact details |
| | FD107 | Level 2 | All pesticide application orders are provided in writing to the spray contractor (ground and aerial) |
| | FD108 | Level 2 | Spray contractors provide written confirmation of job completed (e.g. pesticide application record) |
| **Key Area: Pre-Season Planning and Communication** | | | |
| **Standard: Discussion of application requirements with neighbours** | | | |
| | FE101 | Level 1 | Neighbours are notified of applications where legally required by the pesticide label |
| | FE102 | Level 2 | A pre-season discussion is held with all neighbours and documented (e.g. PAMP). Discussion includes:<br>• location of neighbouring houses<br>• location of neighbouring cropping, grazing and sensitive areas<br>• pesticides to be used and timing and method<br>• the method and timing of notification<br>• contact details for both parties |

| | | | |
|---|---|---|---|
| | | | • weather conditions to spray<br>• how complaints are handled |
| | FE103 | Level 2 | Neighbours are notified of applications according to their pre-season instructions / request |
| **Key Area: Product Selection and Use** | | | |
| **Standard: Careful consideration is given when selecting and applying pesticides** | | | |
| | FF101 | Level 1 | Only registered products or products with current permits are selected and used on farms |
| | FF102 | Level 1 | All product selections take into account potential for off-target damage (e.g. formulation type, adjuvant, odour, toxicity, effect on beneficial insects including bees) |
| | FF103 | Level 1 | Pesticide labels that state 'spray drift restraints and mandatory no spray zones' are adhered to and a record of the no spray zone must be kept (e.g. map or spray record) |
| | FF104 | Level 2 | The Insecticide Resistance Management Strategy (IRMS) for the region and Herbicide Resistance Management Strategy (HRMS) are followed for product selection and timing of application |
| | FF105 | Level 2 | In the event of an adverse pesticide application or experience, it is reported |
| **Key Area: Transport, Storage and Handling of Pesticides** | | | |
| **Standard: Safe transport of pesticides** | | | |
| | FG101 | Level 1 | Only legal quantities of pesticides are transported by farm vehicle |
| | FG102 | Level 1 | Pesticides are transported:<br>• securely in the back of an open vehicle<br>• isolated from people, food stuffs and other goods<br>• containers are checked for leaks and breakages before loading and unloading |
| **Key Area: Transport, Storage and Handling of Pesticides** | | | |
| **Standard: All pesticides are stored appropriately** | | | |
| | FH101 | Level 1 | All farm chemicals are stored securely e.g. prevent theft, not accessible by children |
| | FH102 | Level 1 | All farm chemicals are stored in their original, labelled containers |
| | FH103 | Level 1 | The pesticide store is located in appropriate location and a safe distance from:<br>• sensitive areas (water bodies, drains)<br>• houses<br>• the property boundary<br>• ignition sources e.g. fuel, corrosives, gas, free of vegetation<br>• risk of flooding is considered |
| | FH104 | Level 1 | The pesticide store is bunded to contain spills:<br>• storage facility floor is made of impermeable surface such as concrete or steel<br>• floor is bunded to contain spills (bunding is able to contain 100% of the largest container or 25% of the total volume stored whichever is greater) |
| | FH105 | Level 1 | The pesticide store has adequate ventilation for its size:<br>• one or more sides of the storage building is open; or<br>• vents are installed in walls or ceilings |
| | FH106 | Level 1 | Pesticides are stored in an appropriate shed / store:<br>• separate building, room or enclosure<br>• access to running water (e.g. eye wash, emergency shower) |

| | | | |
|---|---|---|---|
| | | | • large enough to store the largest amount of pesticide at one time<br>• constructed of fire resistant and chemical resistant materials |
| | FH107 | Level 1 | A register of hazardous chemicals (pesticides) stored is kept.<br>Note: If hazardous chemicals exceed Manifest Quantities (see table in resources), notification is required to NSW/QLD Worksafe agencies. A hazardous chemical manifest record, site plan and emergency plan will need to be provided |
| | FH108 | Level 1 | Chemical groups (e.g. flammables, poisons, herbicides, and insecticides) are separated from each other in the store |
| | FH109 | Level 2 | Wherever practical, only minimum quantities of pesticides are stored on farm with extra product sourced as required |
| **Key Area: Transport, Storage and Handling of Pesticides** | | | |
| **Standard: Emergency procedures for pesticides** | | | |
| | FI101 | Level 1 | Appropriate safety signs are clearly visible at the chemical store |
| | FI102 | Level 1 | An emergency plan has been written, is clearly displayed and employees must know the emergency plan and clean up procedures for chemical spills |
| | FI103 | Level 1 | Safety Data Sheets (SDS) are available for all chemicals and fuels stored on farm |
| | FI104 | Level 1 | Emergency equipment is available for use in the event of a spill, poisoning, fire and is kept at the storage facility:<br>• emergency spill kit<br>• first aid kit<br>• fire extinguisher<br>• ready access to clean water or an emergency eye wash / emergency shower |
| **Key Area: Transport, Storage and Handling of Pesticides** | | | |
| **Standard: Mixing and loading pesticides** | | | |
| | FJ101 | Level 1 | Label recommendations for correct mixing order are always followed |
| | FJ102 | Level 1 | Suitable equipment is available to accurately measure quantities of pesticides |
| | FJ103 | Level 1 | The mixing site / wash down bay is at an appropriate location |
| | FJ104 | Level 1 | Emergency equipment is available on the spray rig or at the mixing and loading site when mixing and loading pesticides |
| | FJ105 | Level 2 | Closed transfer systems are used where available, or alternatively, the filling point is easy to reach |
| | FJ106 | Level 2 | Mixing equipment is checked prior to use for breaks and leaks regularly and calibrated prior to use |
| | FJ107 | Level 2 | Water quality has been considered as poor water quality can affect product efficacy |
| **Key Area: Disposal of Pesticide Waste and Containers** | | | |
| **Standard: Disposal of chemical containers and unwanted chemical appropriately** | | | |
| | FK101 | Level 1 | Out of date, or products that are no longer registered are disposed of using Chemclear®, ChemCollect® or through an approved hazardous waste disposal centre |
| | FK102 | Level 1 | All containers are triple rinsed during mixing. The rinsate is added to the spray tank |
| | FK103 | Level 1 | Disposal of empty chemical containers is managed responsibly (e.g. drumMUSTER® program) |
| | FK104 | Level 2 | Empty containers are stored securely prior to disposal |
| | FK105 | Level 2 | Pesticides are purchased in recyclable or returnable containers where available |
| | FK106 | Level 2 | Intermediate Bulk Containers (IBC's) are recycled through drumMUSTER or returned to the local reseller |
| **Key Area: Weather Monitoring and Recording** | | | |
| **Standard: Apply pesticides during appropriate weather conditions** | | | |
| | FL101 | Level 1 | Weather conditions are monitored and recorded at the site of application at the start, during and completion of each spray job |

| | | | |
|---|---|---|---|
| | FL102 | Level 1 | The grower ensures pesticide application takes place only during appropriate weather conditions (i.e. field specific weather parameters are established) for the application method as stated on the label |
| | FL103 | Level 2 | Weather forecasts are used where possible to determine appropriate application windows |
| | FL104 | Level 2 | Regular maintenance of weather monitoring equipment |
| | FL105 | Level 3 | Meteorological conditions are continuously measured and recorded at the site of application |
| **Key Area: Pesticide Application Equipment** | | | |
| **Standard: The correct application equipment and techniques are used** | | | |
| | FM101 | Level 1 | Where a specific spray quality is a label requirement, nozzles are selected and operated at pressures, for both ground rig or aerial application, to satisfy this requirement |
| | FM102 | Level 2 | Nozzles to reduce drift are selected where possible (e.g. coarse output) |
| | FM103 | Level 2 | Nozzle flow rates are calibrated prior to seasonal spraying activities (winter and summer) |
| | FM104 | Level 2 | Automatic rate controller (where fitted) settings are checked and adjusted according to the application as required |
| | FM105 | Level 2 | Pressure gauges are checked for accuracy and spray lines are checked for even pressure |
| | FM106 | Level 2 | Travel speed is selected to ensure boom stability is maintained |
| | FM107 | Level 2 | Where banded applications are made, the boom / nozzle height is adjusted to match band width chosen |
| | FM108 | Level 2 | Plumbing and nozzle spacing are set to match row spacing and planting configurations |
| | FM109 | Level 2 | Shielded sprayers are used where appropriate and practical |
| | FM110 | Level 2 | Spray equipment is cleaned and decontaminated between different product applications |
| | FM111 | Level 3 | GPS guidance and auto-steer are used for spraying activities |
| | FM112 | Level 3 | Auto boom height control is fitted to the machine |
| | FM113 | Level 3 | Variable rate applications are used wherever appropriate |
| | FM114 | Level 3 | Recirculating booms are used where available and appropriate |

| | | | |
|---|---|---|---|
| **Module 7: Petrochemical Storage & Handling** | | | |
| **Key Area: On Farm Storage and handling of Fuel and Lubricants** | | | |
| **Standard: Fuels on farm are stored appropriately** | | | |
| | GA101 | Level 1 | Petrochemicals are stored in tanks designed and constructed for that purpose |
| | GA102 | Level 1 | Where more than one tank containing the same fuel is installed at the same site, they are separated appropriately |
| | GA103 | Level 1 | Where both petrol and diesel tanks are located at the same site, they are separated appropriately |
| | GA104 | Level 1 | Where tanks are located within a building there is sufficient ventilation |
| | GA105 | Level 1 | Tanks are pinned or bolted to the support structure. The support structure is rigid and braced if required |
| | GA106 | Level 1 | Tripod stands are not used for tanks greater than 2200 litres |
| | GA107 | Level 2 | Tanks and supports are generally free from corrosion and rust |
| | GA108 | Level 2 | Filling / dipping points are easy to reach, or can be accessed safely |
| | GA109 | Level 2 | For bottom fill tanks, the fill point has a Kamlock fitting (with cap) and a gate valve to eliminate backflow |
| | GA110 | Level 2 | The volume of liquid in the tank is able to be measured / monitored using manual dipping |
| | GA111 | Level 3 | Tanks are painted to protect against corrosion and reduce evaporation |
| | GA112 | Level 3 | Tanks are earthed to dissipate static electricity |

| | | | |
|---|---|---|---|
| | GA113 | Level 3 | Tanks are secured against unauthorised access |
| | GA114 | Level 3 | All tanks with a capacity of 10,000L or greater are bottom fill |
| | GA115 | Level 3 | Most tanks have a sight tube with maximum fill level marked in order to measure / monitor the volume of liquid in the tank |
| | GA116 | Level 3 | A record of fuel use is kept for all tanks on farm to assist in determining efficiency calculations or unauthorised access |
| | GA117 | Level 3 | Service tanks are as close to the engine as possible and are fitted with an over-fill shutoff device |
| | GA118 | Level 3 | Large tanks located in high traffic areas (e.g. around work sheds) are protected from impact by bollards, bunding walls or other structures |
| | GA119 | Level 3 | A risk assessment is conducted annually and documented on all tanks |
| | GA120 | Level 3 | An inline restrictor valve is installed to reduce the loss of fuel in the event of a broken line |
| **Key Area: On Farm Storage and handling of Fuel and Lubricants** | | | |
| **Standard: Bulk fuel tanks are appropriately located on farm** | | | |
| | GB101 | Level 1 | All petrochemical storage tanks are a safe distance from houses, the property boundary, workshops and offices |
| | GB102 | Level 1 | All petrochemical storage tanks are a safe distance from overhead power lines |
| | GB103 | Level 1 | All petrochemical storage tanks are a safe distance from other chemical storage areas including pesticides, fertilisers and domestic or industrial gas cylinders |
| | GB104 | Level 1 | Storage tanks used at or near bodies of water are set back where possible and / or potential spills are prevented from reaching the water |
| | GB105 | Level 2 | Tanks are located on level sites that allow safe access for delivery tankers, farm vehicles and machinery |
| | GB106 | Level 2 | Tanks are located on sites that are not prone to flooding, or are protected from flood waters (e.g. by height) |
| | GB107 | Level 2 | Petrochemical tanks are not sited on highly permeable sandy soils or where a high water table exists. If unavoidable, impermeable bunding is present |
| | GB108 | Level 3 | The location of all fixed fuel storage facilities has been recorded on a farm map |
| **Key Area: On Farm Storage and handling of Fuel and Lubricants** | | | |
| **Standard: Mobile fuel tanks are appropriately handled on farm** | | | |
| | GC101 | Level 1 | Mobile fuel tanks are free from defects and maintained in good condition to reduce the risk of an accident |
| | GC102 | Level 1 | Mobile fuel tanks are to be parked at least 15 metres from buildings, storage areas or amenities |
| | GC103 | Level 1 | Mobile tanks containing Flammable Liquid 3 (FL3) must be parked at least 8 metres from another mobile tank containing dangerous goods |
| | GC104 | Level 2 | Mobile fuel tanks are secured to the vehicle or trailer to prevent movement |
| **Key Area: On Farm Storage and handling of Fuel and Lubricants** | | | |
| **Standard: Lubricants are appropriately stored on farm** | | | |
| | GD101 | Level 1 | Lubricants are separated by distance from ignition sources such as hot work and other flammable and combustible materials |
| | GD102 | Level 2 | Lubricants are stored on bunded concrete or other impervious material floor to assist containment in the event of a spill |
| | GD103 | Level 2 | Storage location of lubricants allows for the safe manual handling of drums |
| | GD104 | Level 3 | Lubricants are stored in a separate bunded shed or structure |
| **Key Area: On Farm Storage and handling of Fuel and Lubricants** | | | |
| **Standard: Waste petrochemicals are appropriately stored and disposed** | | | |
| | GE101 | Level 1 | Most used / waste oil is stored for collection by a licensed waste oil collector |
| | GE102 | Level 1 | Waste oil is stored in an area located away from sensitive areas and ignition sources |
| | GE103 | Level 1 | Waste oil is stored in an area where spills can be contained |
| | GE104 | Level 1 | Empty oil drums are stored securely until they can be disposed of or recycled |
| | GE105 | Level 1 | Empty fuel tanks and drums are disposed of appropriately |
| | GE106 | Level 2 | Waste oil storage containers are checked regularly for leaks and replaced if required |

| | | | |
|---|---|---|---|
| | GE107 | Level 2 | Used oil filters are drained before being stored and disposed of appropriately |
| | GE108 | Level 3 | Waste oil is stored in a bunded or purpose built area |
| | GE109 | Level 3 | Reusable drums and or returnable containers are used to purchase oil |
| **Key Area: Workplace Safety** | | | |
| **Standard: Workplace safety is managed appropriately on farm** | | | |
| | GF101 | Level 1 | All workers are made aware of the hazards and safety precautions for handling petrochemicals |
| | GF102 | Level 1 | Where large tanks of petrol (greater than 5,000 L), diesel (greater than 10,000 L), or engine oil (greater than 10,000 L) exist, all personnel employed on the premises have been appropriately trained in safety, with records kept |
| | GF103 | Level 1 | Current Safety Data Sheets (SDS) are available for all fuel and lubricants stored |
| | GF104 | Level 1 | A register is kept of all fuels stored on farm |
| | GF105 | Level 1 | Fuel storage areas are kept free from ignition sources |
| | GF106 | Level 1 | Fuel storage areas are kept free of fire hazards |
| | GF107 | Level 2 | Access to fuel bowsers / pumps is controlled e.g. locked |
| | GF108 | Level 2 | Vehicle engines are switched off whenever a fuel storage tank or bowser is in use. Tanks and vehicles are attended during filling |
| | GF109 | Level 2 | Machinery is not serviced during filling |
| | GF110 | Level 2 | Appropriate containers with correct labelling and safety directions are used when decanting bulk fuel to carry or store fuel |
| | GF111 | Level 2 | Drums and shuttles are checked for leaks before transporting, are properly secured and are transported only in the back of an open vehicle or trailer |
| | GF112 | Level 3 | A Standard Operating Procedure for handling petrochemicals has been developed for the farm and all staff are aware of it |
| **Key Area: Workplace Safety** | | | |
| **Standard: There are appropriate petrochemical emergency procedures in place** | | | |
| | GG101 | Level 1 | A written emergency plan has been prepared and includes:<br>• Action to be taken in the event of a fire<br>• Action to be taken in the event of a large fuel spill<br>• Responsibilities for contacting emergency services<br>• Contact numbers for emergency services and farm management<br>• Directions to the storage facility for emergency services<br>• The location of emergency equipment |
| | GG102 | Level 1 | All staff are aware of the emergency plan and what to do in the event of a fire / spill |
| | GG103 | Level 1 | Personal Protective Equipment (PPE) is available for handling a petrochemical spill |
| | GG104 | Level 1 | A spill kit is available for use in the event of a spill |
| | GG105 | Level 1 | Powder-type fire extinguishers are accessible for each above ground fuel storage tank |
| | GG106 | Level 1 | Fire extinguishers are checked every 6 months to ensure they are in working order, with maintenance records kept |
| | GG107 | Level 1 | A maintenance / service register is kept for all fire extinguishers on farm |
| | GG108 | Level 1 | An emergency drill is conducted at least annually to raise staff awareness of what to do in the event of an emergency |
| | GG109 | Level 2 | The emergency plan is displayed in a prominent position which is accessible to all staff |
| | GG110 | Level 3 | Instruction on the correct use of fire extinguishers is included in the staff induction |

| | | | |
|---|---|---|---|
| **Key Area: Workplace Safety** | | | |
| **Standard: There is appropriate petrochemical signage on farm** | | | |
| | GH101 | Level 1 | All tanks are signed satisfying the relevant QLD or NSW Dangerous Goods Regulations |
| | GH102 | Level 2 | The waste oil storage area and / or drums are clearly labelled 'waste oil' |
| **Key Area: Workplace Safety** | | | |
| **Standard: Spills on farm are contained appropriately** | | | |
| | GI101 | Level 1 | Personal Protective Equipment (PPE) is available and accessible for handling a petrochemical spill |
| | GI102 | Level 1 | A spill kit is available and accessible for use in the event of a spill |
| | GI103 | Level 1 | All large tanks of petrol (greater than 5,000 L), diesel (greater than 10,000 L), or engine oil (greater than 10,000 L) are bunded to contain at least the volume of the tank, or the volume of the largest tank if more than one tank is kept at the site |
| | GI104 | Level 1 | For smaller tanks and mobile tanks, spills are controlled by the use of ground slope, diversion channels, low bunds, kerbing |
| | GI105 | Level 1 | Spills can be safely drained from the area |
| **Key Area: Workplace Safety** | | | |
| **Standard: All licensing and notification requirements are met** | | | |
| | GJ101 | Level 1 | In NSW the location and details of all major hazard facilities are reported to emergency services |

| | | | |
|---|---|---|---|
| **Module 8: Soil Health** | | | |
| **Key Area: Nutrition** | | | |
| **Standard: Crop nutrient requirements are managed efficiently and effectively** | | | |
| | HA101 | Level 2 | Crop nutrient requirements are assessed at the appropriate time (pre and in-crop) to determine a nutrient management program for a targeted yield |
| | HA102 | Level 2 | A nutrient budget is prepared based on an assessment of nutrient inputs and outputs (crop removal and losses) |
| | HA103 | Level 2 | Plant monitoring is undertaken during the season to assess crop nutrient status and used to adjust crop nutrient program |
| | HA104 | Level 2 | Nutrient monitoring and record keeping is undertaken on a regular basis to identify any long term trends in nutrient status |
| | HA105 | Level 3 | Farm trials are conducted to verify fertiliser management practices |
| | HA106 | Level 3 | Variable rate fertiliser application practices are adopted |
| **Key Area: Nitrogen** | | | |
| **Standard: Nitrogen use is effective and efficient** | | | |
| | HB101 | Level 1 | Ammonia gas (NH3) applications are applied by trained and accredited staff |
| | HB102 | Level 2 | Soil testing is undertaken at an appropriate time to assess nitrogen levels and fertiliser requirements |
| | HB103 | Level 2 | A Nitrogen Fertiliser Management Plan has been developed and implemented |
| | HB104 | Level 2 | Plant monitoring is undertaken during the season to assess crop nitrogen status and used to adjust crop nutrient program |
| | HB105 | Level 2 | Nitrogen Use Efficiency (NUE) is determined for each field using Nitrogen Fertiliser Use Efficiency (NUFE) calculation. This is recorded each year and monitored over time |
| | HB106 | Level 3 | Crop rotation systems that include legumes to fix nitrogen effectively are adopted when practical |
| | HB107 | Level 3 | Nitrogen Use Efficiency (NUE) is calculated and field performance is assessed against long term farm performance |

| | | | |
|---|---|---|---|
| **Key Area: Carbon** | | | |
| **Standard: Management decisions and practices take into consideration the impact on soil carbon levels** | | | |
| | HC101 | Level 2 | Soil carbon levels are monitored |
| | HC102 | Level 2 | Minimum tillage practices are adopted where appropriate |
| | HC103 | Level 2 | Crop residue should be conserved |
| | HC104 | Level 2 | Prolonged bare fallows should be avoided |
| | HC105 | Level 3 | Legume crops are included in rotations |
| | HC106 | Level 3 | Management practices which preserve or improve soil organic carbon levels are implemented |
| **Key Area: Soil Structure** | | | |
| **Standard: Soil structure is assessed, maintained and improved** | | | |
| | HD101 | Level 2 | The soil surface is monitored visually for any structure issues or changes such as compaction, dispersion or hard setting |
| | HD102 | Level 2 | Sub-surface structural issues, causes and potential structural problems are identified through assessing soil pits and appropriate laboratory, soil and water tests |
| | HD103 | Level 2 | Field equipment, practices and operations are adopted to minimise their impact on soil structure and remediate existing problems |
| | HD104 | Level 2 | Management practices are adopted which aim to maintain soil organic carbon levels |
| | HD105 | Level 3 | Field variability issues are recognised, causes are explored and where appropriate addressed |
| **Key Area: Soil Structure** | | | |
| **Standard: Soil salinity and dispersion risks are monitored and managed** | | | |
| | HE101 | Level 2 | The presence / risk of soil salinity, sodicity and dispersion is identified and monitored through the use of appropriate tests |
| | HE102 | Level 2 | Where required, appropriate strategies to reduce the presence / risk of salinity, sodicity and dispersion are implemented |
| | HE103 | Level 2 | The quality of irrigation water and its effect on the presence / risk of salinity, sodicity and dispersion is considered and managed |
| | HE104 | Level 3 | Where available, knowledge from local water table monitoring programs is used to assist farm management decisions |
| **Key Area: Soil Structure** | | | |
| **Standard: Erosion risks are monitored and managed** | | | |
| | HF101 | Level 2 | Areas at risk of erosion have been identified, assessed, recorded and regularly monitored |
| | HF102 | Level 2 | Farm layout accounts for field slope and susceptible soil types |
| | HF103 | Level 2 | Measures are in place to prevent or minimise erosion in susceptible areas |
| | HF104 | Level 2 | Where erosion events do occur, action is taken to prevent their re-occurrence |

| | | | |
|---|---|---|---|
| **Module 9: Sustainable Natural Landscape (Natural Assets)** | | | |
| **Key Area: Sustainable cotton landscapes and communities** | | | |
| **Standard: Natural resources are identified and recorded** | | | |
| | IA101 | Level 2 | Natural resources are identified and recorded on a farm map or whole farm plan (e.g. natural resources includes: riparian vegetation, native vegetation, rivers, creeks, wetlands) |
| | IA102 | Level 3 | A whole farm plan exists which consider the management of natural resources on farm and in the surrounding landscape as part of the overall management of the farm (includes TSRs, riparian corridors, neighbouring vegetation patches) |

| | | | |
|---|---|---|---|
| **Key Area: Good Native Vegetation Management** | | | |
| **Standard: Maintain and improve the diversity of native plants and animals in the cotton landscapes** | | | |
| | IB101 | Level 2 | Minimise removal of fallen trees, trees with hollows, rocks and dead standing timber as it provides habitat |
| | IB102 | Level 3 | Habitat condition for biodiversity is improved on farm through re-vegetation techniques (planting vegetation or natural regeneration) that increase the size, connectivity and diversity of native vegetation on farm |
| | IB103 | Level 3 | Assess and monitor the condition of native vegetation on your farm |
| **Key Area: Good Native Vegetation Management** | | | |
| **Standard: Carbon sequestration and emissions are considered and managed across the whole farm** | | | |
| | IC100 | Level 2 | Understand different sources of carbon sequestration and emissions across the whole farm |
| **Key Area: Good Native Vegetation Management** | | | |
| **Standard: Maintain Groundcover** | | | |
| | ID101 | Level 1 | Obtain relevant approval before modifying native groundcover |
| | ID102 | Level 2 | Areas of erosion risk (e.g. uncontrolled sediment and salt movement into waterways) have been assessed |
| | ID103 | Level 3 | Assess and monitor groundcover conditions |
| | ID104 | Level 3 | Areas of erosion (e.g. saline areas, sodic scalds) are remediated |
| **Key Area: Good Native Vegetation Management** | | | |
| **Standard: Maintain or improve native vegetation connectivity in cotton landscapes** | | | |
| | IE101 | Level 1 | Obtain approvals before removing or modifying native flora and fauna on farm |
| | IE102 | Level 2 | Awareness of corridors, patches and single trees and how they link across the farm |
| | IE103 | Level 2 | Awareness of native vegetation and the impact on integrated pest management |
| | IE104 | Level 2 | Practices are in place to protect remnant native vegetation from negative impacts such as spray drift |
| | IE105 | Level 3 | Maintain or create new native vegetation using revegetation or natural regeneration that connect existing patches of vegetation |
| | IE106 | Level 3 | Maintain or restore natural wetlands and billabongs and enhance artificial ones |
| **Key Area: Riparian Management** | | | |
| **Standard: Stock Management** | | | |
| | IF101 | Level 2 | Stock access is managed to minimise bank instability, loss of groundcover, damage to native vegetation and promote regeneration |
| | IF102 | Level 3 | Off stream or purpose built in-stream watering points for stock |
| | IF103 | Level 3 | Exclude stock from natural riverbanks and waterways |
| **Key Area: Riparian Management** | | | |
| **Standard: Maintaining habitat and vegetation in riparian areas** | | | |
| | IG101 | Level 2 | Maintaining habitat features in riparian areas for native wildlife (e.g. hollows in trees, large logs, soil cracks) |
| | IG102 | Level 3 | Maintain a range of vegetation structure (groundcover, shrubs, trees) to improve the value of services to the farming business (i.e. IPM, carbon sequestration, salinity mitigation) |
| **Key Area: Riparian Management** | | | |
| **Standard: Stabilise riverbanks and waterways to reduce erosion** | | | |
| | IH101 | Level 1 | Obtain technical advice and relevant approval before commencing any works in-stream or along banks including the removal of materials such as logs and gravel |
| | IH102 | Level 2 | Identify and manage bank instability and erosion along riverbanks (e.g. pump sites) |

| | | | |
|---|---|---|---|
| | IH103 | Level 2 | Native vegetation is retained (minimum of 30 metres along top of bank) and protected in riparian areas, natural regeneration is actively promoted |
| | IH104 | Level 2 | Leave native vegetation, logs, woody debris and rocks along banks to provide bank stability |
| **Key Area: Environmental Weeds and Feral Pests** | | | |
| **Standard: Control environmental weeds and feral pests (terrestrial and aquatic)** | | | |
| | II101 | Level 1 | Declared weeds and pests are controlled according to legislative requirements and control activities are undertaken in accordance with environmental protection legislation |
| | II102 | Level 2 | Action has been taken to manage non-declared environmental weeds and pests |
| | II103 | Level 3 | Co-ordinated and implemented weed and pest control with neighbours and relevant authorities |

| | | | |
|---|---|---|---|
| **Module 10: Water Management** | | | |
| **Key Area: Water Management (Irrigation)** | | | |
| **Standard: Information is recorded each season to help make better WHOLE FARM irrigation decisions** | | | |
| | JA101 | Level 1 | The volume of licensed water extracted is measured and recorded |
| | JA102 | Level 2 | A water budget for the farm is prepared |
| | JA103 | Level 2 | Water quality (pH, salinity and sodicity) is known and risks are identified and monitored for both ground and surface irrigation water |
| | JA104 | Level 2 | Plant Available Water Capacity (PAWC) and Readily Available Water (RAW) have been estimated for your soil types |
| | JA105 | Level 2 | Irrigation Water Use Index (IWUI) for the farm is estimated and recorded |
| | JA106 | Level 2 | Water requirements for typical crop rotations in your region are known |
| | JA107 | Level 3 | Gross Production Water Use Index (GPWUI) for the farm is calculated and recorded |
| | JA108 | Level 3 | Water Use Efficiency is estimated (using IWUI and GPWUI) and farm performance is benchmarked and compared overtime |
| **Key Area: Water Management** | | | |
| **Standard: Information is used each season to help make better FIELD irrigation decisions** | | | |
| | JB101 | Level 2 | Irrigation scheduling tools are used to determine when and how much to irrigate |
| | JB102 | Level 2 | Soil moisture probes are located in representative soil types determined by objective evaluation such as EM survey, aerial or satellite image |
| | JB103 | Level 2 | There is awareness of deep drainage as an issue and of the measures that can be taken to reduce its impact |
| | JB104 | Level 3 | In field soil variation and potential 'leaky areas' are identified |
| | JB105 | Level 3 | Irrigation Water Use Index ($IWUI_{field}$) and Gross Production Water Use Index ($GPWUI_{field}$) for each field is estimated and recorded |
| **Key Area: Water Storage and distribution systems** | | | |
| **Standard: Practices are used for efficient management of storage and distribution systems** | | | |
| | JC101 | Level 1 | Any planned new infrastructure which effects flow of water to or from a river complies with legislation |
| | JC102 | Level 1 | Aware of State legislation for the capture of overland flow and rainfall runoff |
| | JC103 | Level 2 | Storages are surveyed to determine accurate storage volumes |
| | JC104 | Level 2 | Regular monitoring and maintenance of storages and channels for leaks and seepage |
| | JC105 | Level 2 | Storages are managed to minimise evaporation and seepage losses |
| | JC106 | Level 2 | Storages and channels (new and reconfigured) are located, designed to minimise evaporation, seepage losses and constructed by a qualified person |
| | JC107 | Level 3 | Losses from storages and channels have been measured |

| | | | |
|---|---|---|---|
| **Key Area: Irrigation system design, installation and management** | | | |
| **Standard: Surface irrigation systems are designed, installed and managed appropriately** | | | |
| | JD101 | Level 2 | Use good field design (including field length, bay size, slope, drainage) |
| | JD102 | Level 2 | Aim for uniform applications (e.g. water in furrows comes out evenly) |
| | JD103 | Level 2 | Flow rates and cut off times are appropriate for the soil type, run length and slope to ensure that furrows come out evenly |
| | JD104 | Level 3 | A surface irrigation performance evaluation has been conducted to assess application efficiency and distribution uniformity |
| **Key Area: Irrigation system design, installation and management** | | | |
| **Standard: Drip irrigation systems are designed, installed and managed appropriately** | | | |
| | JE101 | Level 2 | The drip irrigation system has been planned, designed and installed by a qualified person |
| | JE102 | Level 2 | The system capacity can meet peak crop water requirements |
| | JE103 | Level 2 | The drip irrigation system takes into account your soil characteristics |
| | JE104 | Level 2 | Training provided to the operator to ensure appropriate skills to operate the drip irrigation system |
| | JE105 | Level 2 | Regular maintenance of the system is undertaken including flushing, monitoring pressure, fertigation (if used) and flow rates |
| | JE106 | Level 2 | Water quality is known and monitored according to risk |
| | JE107 | Level 3 | A system evaluation was undertaken after installation to check the system meets specifications |
| **Key Area: Irrigation system design, installation and management** | | | |
| **Standard: Centre Pivot (CP) and Lateral Move (LM) irrigation systems are designed, installed and managed appropriately** | | | |
| | JF101 | Level 2 | CPLM irrigation system has been planned, designed and installed by a qualified person |
| | JF102 | Level 2 | CPLM irrigation system capacity can meet peak crop water requirements |
| | JF103 | Level 2 | CPLM irrigation system takes into account the topography and soil characteristics of your site |
| | JF104 | Level 2 | Pre-season and in-season maintenance checks of the system are undertaken including flushing (fertigation), flow rates, filtration system and pressures |
| | JF105 | Level 2 | Training provided to the operator to ensure appropriate skills to operate the CPLM |
| | JF106 | Level 2 | Water quality is known and monitored according to risk |
| | JF107 | Level 3 | A system evaluation was undertaken after installation to check the system meets specifications |
| **Key Area: Irrigation system design, installation and management** | | | |
| **Standard: Irrigation bore systems are designed, installed and managed appropriately** | | | |
| | JG101 | Level 1 | New bore construction and decommissioning of old bores is performed in accordance with State legislation |
| | JG102 | Level 1 | New groundwater bores are constructed by licensed drillers |
| | JG103 | Level 1 | Groundwater license holders are familiar with their license conditions, and in particular any specific conditions that may apply |
| | JG104 | Level 2 | Irrigation bore water salinity (Electrical Conductivity – EC) is known and is mixed with alternative water source where appropriate and available |
| | JG105 | Level 2 | The groundwater level is measured at the start and end of each irrigation season using basic methods and recorded to detect potential trends over time |
| | JG106 | Level 2 | Regular bore maintenance is undertaken |
| | JG107 | Level 3 | Groundwater salinity and major ions have been measured at the start of each irrigation season with laboratory analysis using standard methods of collection |
| | JG108 | Level 3 | The groundwater level is continuously measured using an automated logger |
| **Key Area: Dryland Water Management (Rain grown)** | | | |
| **Standard: Practices are used to take advantage of rainfall** | | | |
| | JH101 | Level 2 | Where practical cereal crops are planted as cover crops |
| | JH102 | Level 2 | Standing stubble is maintained |

| | | | |
|---|---|---|---|
| | JH103 | Level 2 | Minimum tillage is practiced when soils are dry and tillage practices are used to minimise the impact on stubble cover |
| | JH104 | Level 2 | A controlled traffic system is in place with all tractors, boom sprays and implements following the same set of wheel tracks to minimise compaction |
| | JH105 | Level 2 | Plant Available Water Content (PAWC) has been estimated for fields and soil types |
| | JH106 | Level 2 | Pre-season stored soil moisture profiles are the key determinant of planting decisions including field history, soil type, row configuration, plant population and variety |
| | JH107 | Level 2 | Fertiliser inputs are matched to pre-season soil water status and reviewed during crop growth. Additional fertiliser is applied in-crop if needed while minimising soil moisture loss |
| | JH108 | Level 2 | Planting row configuration is considered |
| | JH109 | Level 2 | Weeds are controlled in a timely manner |
| | JH110 | Level 3 | Water use efficiency has been estimated using kg/mm or bales/ML, where the term water means stored water and effective rainfall |
| **Key Area: Tailwater and Stormwater Management (Irrigated and Dryland growers)** | | | |
| **Standard: Management strategies are implemented to prevent off-farm water quality impacts** | | | |
| | JI101 | Level 1 | All irrigation tailwater is contained either on-farm or in a shared group water supply scheme |
| | JI102 | Level 2 | Irrigation discharge points should direct tailwater away from sensitive areas |
| | JI103 | Level 2 | Where possible vegetative barriers at least 6 metres wide are maintained between cropping lands and sensitive areas |
| | JI104 | Level 3 | The grower is aware of any priority issues identified in catchment water quality improvement plans that are relevant to their farm |
| | JI105 | Level 3 | The grower participates in sub-catchment water quality sampling programmes where undertaken by a catchment group |
| | JI106 | Level 3 | Water quality sampling is undertaken to monitor the quality of run-off from the property |
| **Key Area: Tailwater and Stormwater Management (Irrigated and Dryland growers)** | | | |
| **Standard: Plans are developed and implemented to manage the impact of tailwater and stormwater runoff from farm** | | | |
| | JJ101 | Level 1 | The first flush of storm water runoff from treated areas is retained on-farm |
| | JJ102 | Level 1 | Any planned new infrastructure to contain tailwater and or stormwater storages complies with legislation |
| | JJ103 | Level 1 | An effective stormwater management system is in place for managing storm events (e.g. minor, moderate, severe events) |
| | JJ104 | Level 2 | A documented stormwater management plan exists to manage storm events |
| | JJ105 | Level 3 | Runoff from most moderate and severe storms is controlled on farm or in a shared group water supply scheme |

| Action Plans | | |
|---|---|---|
| **Code** | **Check List Item Notes** | **Action Plan Items** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Appendix 2. Tools and Resources developed for growers and consultants that assist adoption of NRM best practice.**

## CottonInfo website

### CottonInfo fact sheets

- Using vegetative barriers to minimise spray drift on cotton farms

### CottonInfo and myBMP best practice fact sheets:

- Flora and fauna legislation
- Whole farm planning
- Farm mapping
- Maintaining important habitat features
- Maintaining wetlands

### CottonInfo grower case studies

- Demonstrating whole farm sustainability – Anthony Barlow
- Valuing our riparian assets – Auscott's Midkin

### CottonInfo biodiversity booklet

- Nature's workforce booklet (3 Versions – Murrumbidgee, Border Rivers Gwydir & whole of industry)

### Focus on NRM research case studies (Research summaries)

- River red gums in cotton landscapes (R. Smith, UNE)
- Riparian vegetation and land management (Capon, GU)
- How can trees intercept salinity/ (Biggs, QDNRM)
- How quickly do floods recharge aquifers? (Anderson, UNSW)
- Groundwater ecosystems functions and impacts (Korbel, MU)
- Connecting farms and natural systems (Schellhorn, CSIRO)
- Evaluating the extent of hydraulic connectivity between the Condamine Alluvium, the Great Artesian Basin and the Walloon Coal Measures (Kelly, UNSW)
- Evaluating the extent of hydraulic connectivity between the Great Artesian Basin and the lower Namoi Alluvium (Kelly, UNSW)
- Microbiological communities in vertosol soils & aquifers (Beckmann, UNSW)

- Resilience of the Australian cotton industry (Andreoni, Bel Tempo NRM)
- Nitrogen losses & indirect nitrous oxide emissions (Chang, CSIRO)
- Water and woodland birds on cotton farms (A. Smith, UNE)

### YouTube videos

- National Cotton RiverCare Champion project – 369 views
- Monitoring vegetation changes over time (photo points) – 47 views
- Healthy Rivers – 278 views
- Maintaining healthy Riparian vegetation – 39 views
- DRAFT – Fauna monitoring "Taraba"

### Cotton RiverCare

- RiverCare Champion project summary and links to social media sites on twitter and facebook that provide bi-weekly feeds on project activities.

### CottonInfo Blogs

- Kayak trips reinforce important message about river health
- Zoologist turned cotton grower embarks on journey to track river health
- Cotton RiverCare blog – Templeton the water rat
- Cotton RiverCare blog – the case of the curious echidna
- Cottoning onto cool critters at wildlife spotlight evening
- Cottoning onto the Macquarie River: NRM field day (4th March)

### CottonInfo Apps

- Birds on Cotton Farms identification and monitoring App

## CottonInfo E-newsletters

2015 – Why is riparian land important?
2015 – The value of native vegetation – Barlow case study
2015 – myBMP natural assets module
2016 – have you seen this Bustard? Bird App
2016 – Cotton Rivercare Champion
2017 – Drafted – Cotton RiverCare Champion - Grazing BMP for weed management

## Spotlight Articles

Spring 2014 edition – Carbon neutral Cotton Farms,

Summer 2014 edition - Building Future capacity, Pathways to NRM collaboration workshops

Spring 2015 edition – Have you seen this Bustard?

Autumn 2016 edition – Resource review – Bird on cotton farm App

Winter 2016 edition – The farmer zoologist

Autumn 2017 – Revealing native fauna on cotton farms

Autumn 2017 – Ringtank salinity management options

Winter 2017 – River and riparian zone research in focus

## Australian Cotton grower magazine

Collation and co-ordination of articles for the NRM Chapter of the 2016 Australian Cotton grower magazine year book on research outcomes/outputs for 2016.

## Industry products and tool review

- Reviewed and edited the "sustainable landscape" chapters within the 2015, 2016 & 2017 Cotton Production Manual and Cotton Pest Management Guide.
- Reviewed the 'Enviro stories' water themed resource booklet for the 2016 schools Enviro stories competition.
- Annually review and update CottonInfo's NRM page on the website

# Cottoning onto the Murrumbidgee River – river and riparian field days, 18-19 February 2017


## Abstract

In February 2017, CottonInfo, Murrumbidgee Landcare Incorporated (MLI), Murrumbidgee Irrigation (MI), Riverina Local Land Services (RLLS) and the Australia Government ran two field days in the Murrumbidgee valley. The aim of the field days was to extend the latest cotton industry riparian vegetation research outcomes, increase participants awareness of the value of riparian vegetation on farms and educate them on the latest best management practices for riparian areas on cotton farms. 71 people participated in the field days.

As part of the development and delivery of the field days a biodiversity booklet showcasing local River Red Gum Communities was produced and distributed to participants. A key outcome for the field day was the collaboration between CottonInfo, MLI, MI and RLLS, as part of the newly formed Landcare Irrigation Area Collective (LIAC), to deliver the field day. This collaboration established new local networks between cotton growers and local natural resource management advisors.

Stacey Vogel
National Cotton Natural Resources Technical Specialist, CottonInfo
March 2017

## Acknowledgements

The “Cottoning onto the Murrumbidgee River” river and riparian field days was undertaken by CottonInfo with support from Murrumbidgee Landcare Incorporated, Murrumbidgee Irrigation, Riverina Local Land Services and the Australian Government.

Thanks goes to:

- The organising committee of Kerri Keely (Murrumbidgee Landcare Incorporated), Annabel Lugsdin (Murrumbidgee landcare Incorporated), Bindi Vanzella (Riverina Landcare), and Cathy Semmler (Murrumbidgee Irrigation)
- Local helpers Stacey Lugsdin and Sally Ware (RLLS)
- Technical presenter, ecologist Dr Rhiannon Smith (University New England) and Michelle Durkan (Taronga Zoomobile)
- Ecologist Phil Spark (North West Ecological) for provision of photos for use in biodiversity booklet, and
- Out and About Adventure kayak instructors, Peter Vaughan and Andy Fraser.

*Photo overleaf: Hay cotton farmers Jenny Cleton and Paul Cleton with Doug Cleton, Hugh Cleton, Lucy Cleton, Maya Cashmere and Michelle Durkan from Taronga Zoomobile.*

This activity is part of the Local Landcare Coordinators Initiative

The Local Landcare Coordinators Initiative is funded by the NSW Government, and is supported through the partnership of Local Land Services and Landcare NSW.

Australian Government

## Contents

CottonInfo Information when you need it

# Field Day Information

## Background

The 2016-17 National Cotton NRM campaign identified a need to continually improve the extension of the cotton industries riparian ecosystem services research outcomes and increase growers knowledge of riparian BMP's.

To help achieve this, CottonInfo formed a partnership with Murrumbidgee Landcare Incorporated, Murrumbidgee Irrigation, Riverina Local Land Services (RLLS) and the Australia Government to:

- Extend the latest cotton industry riparian vegetation research outcomes within the Murrumbidgee valley
- Increase awareness of the value of riparian vegetation on farms within the Murrumbidgee valley and
- Extend best management practices for riparian areas on cotton farms.

Following on from the success of the "Gwydir Cottoning onto the great outdoors" field day series, a similar field day structure and program, which targeted farming families, was developed for the "Cottoning onto the Murrumbidgee River" field days. The program was developed based on the delivery of fun family based activities that engaged both decision makers (husband and wife) in the family farming business.

In May 2016 CottonInfo was invited by Murrumbidgee Irrigation to join the new Landcare Irrigation Area Collective, a group of various private and government organisations within the Murrumbidgee and Murray Irrigation areas actively improving and managing natural resources of the Riverina irrigation areas. From these initial meetings the "Cottoning onto the Murrumbidgee River" program was developed to deliver a series of riparian awareness and management field days.

The three day program which included a session kayaking on the river was developed originally for early November 2016 at Gogeldrie Weir Park (2 events- friday and saturday) and Maude Weir at Hay on the Sunday. Unfortunately due to widespread flooding the events had to be postponed with a new date set for the 17th, 18th & 19th February 2017. Owing to poor RSVP's the Friday event was cancelled. Initially the program included a fisheries technical expert from NSW DPI but unfortunately they withdrew from the event at late notice. A copy of the final agendas for all 3 field days can be found in Appendix 1.

At the 2 field days held the following topics where covered:

- Landscape principles for healthy rivers, why value riparian areas – Cathy Semmler (Murrumbidgee irrigation)
- Ecosystem services of native vegetation on cotton farms – Dr Rhiannon Smith (UNE – CRDC funded research)
- BMP's for rivers and riparian areas –Stacey Vogel (CottonInfo)
- What are the indicators of river health? - Kerri Keely/Annabel Lugsdin (Murrumbidge Irrigation Incorporated)

- What fauna is found here, food & habitat requirements – Michell Durkan (Taronga zoomobile)

The field days were promoted heavily through the CottonInfo extension network and local media. A booklet showcasing River Red gum communities, some of the local fauna that lived within them and BMP's for their management was also created and handed out to all participants of the field day.

## Participants Reponses

A comprehensive evaluation was conducted to provide evidence of changes in KASA (Knowledge, aspirations, skills and attitudes) as a result of attending the field days. Participants completed an anonymous feedback sheet at the end of each workshop. The evaluation template is provided in Appendix 3. A total of 29 evaluations were received over the two field days, where 71 people attended – a 41% percent response rate. Predominantly attendees were families. Approximately 57 of the attendees were adults with the remainder predominantly primary age children.

The results of the evaluations are summarised in this section.

### Demographics

There were a total of 71 participants at the field day. Of respondents 21% were growers or farm mangers, 45% identified themselves as a mixture of agronomists, teachers, consultants, contractors, students and environmental enthusiasts. The remaining respondents did not specify an occupation.

### Field day delivery

Most participants agreed that the field days had met their aims and expectations and information was presented at a level they could understand. All participants felt that the instruction received was at a high standard and the topics covered were useful. One participant made the comment that some of the younger kids found some of the information a little technical.

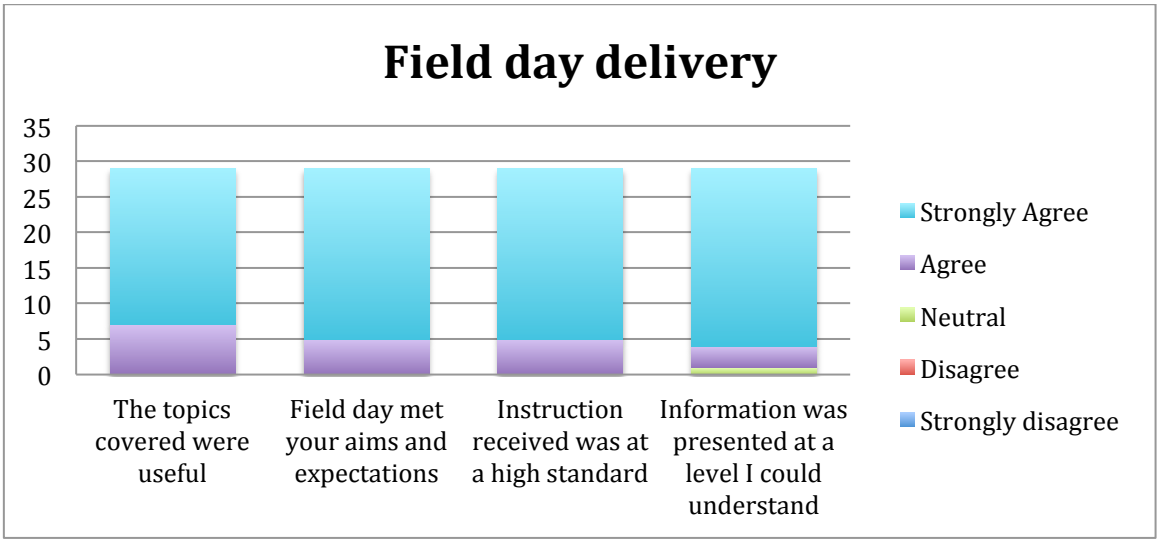


**Figure 1** Participants evaluations of field day delivery (Griffith and Hay combined)

## Changes in KASA (Knowledge, awareness, skills and aspirations)

### Gains in Understanding

A summary of KASA changes from both field days (Figure 2 & 3) indicated an overall increase in the level of understanding of the three key areas, indicators of river health, habitat requirements of local biodiversity and ecosystem services of native vegetation (carbon sequestration).

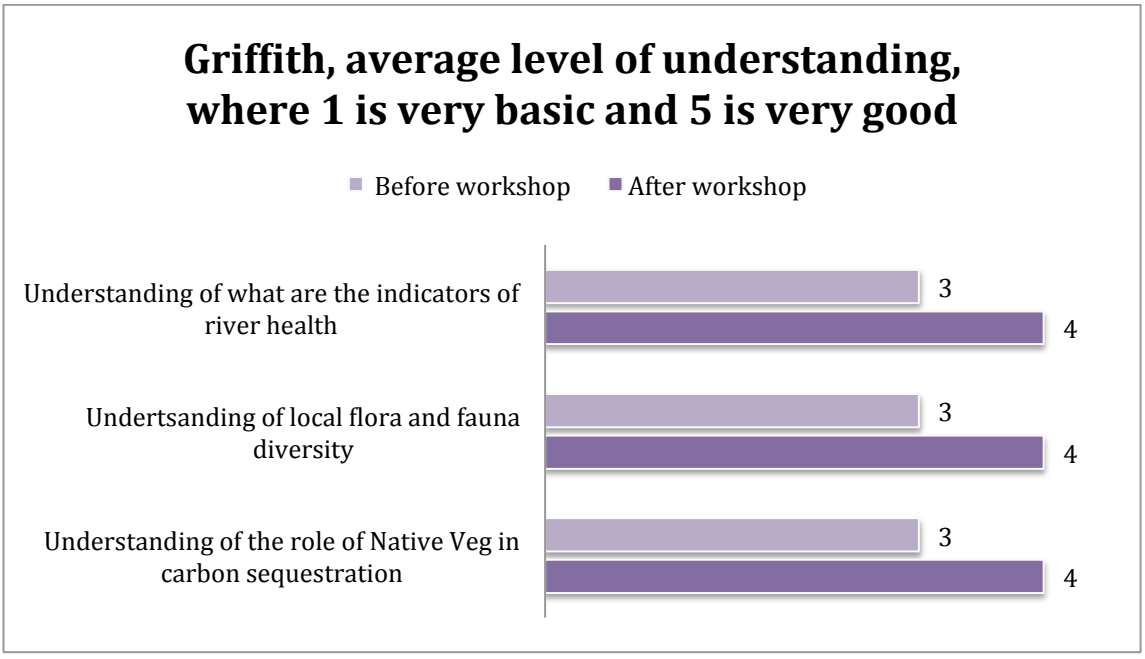



**Figure 2** Average level of understanding of the 3 key areas before and after the field day, where 1 is very basic and 5 is very good.

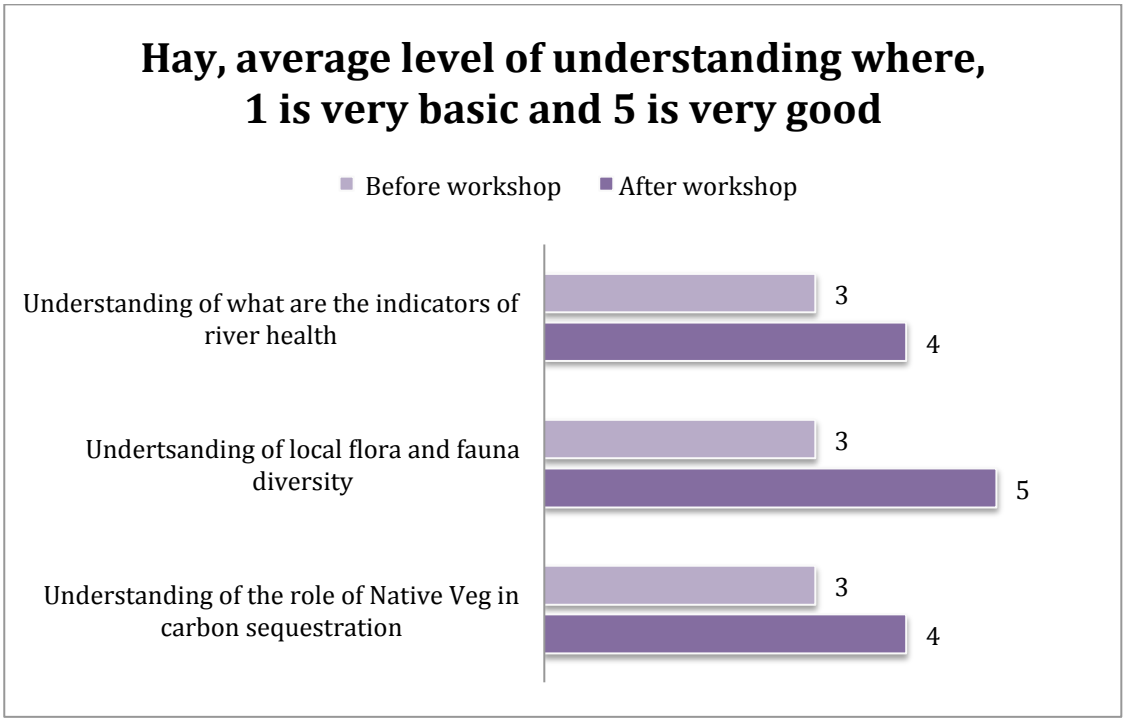



**Figure 3** Average level of understanding of the 3 key areas before and after the field day, where 1 is very basic and 5 is very good.

Participants also recorded an overall increase in their level of confidence to implement what they had learned at the workshop.

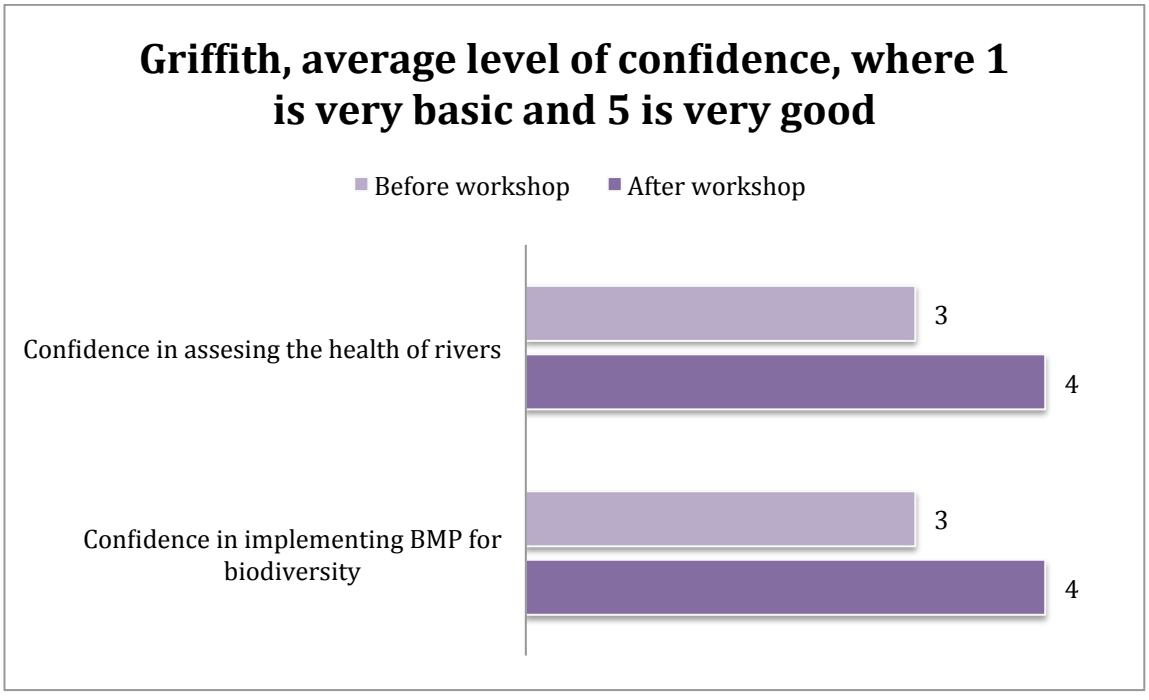



**Figure 4** Average level of confidence to implement practices in the 3 key areas before and after the field days, where 1 is very basic and 5 is very good.

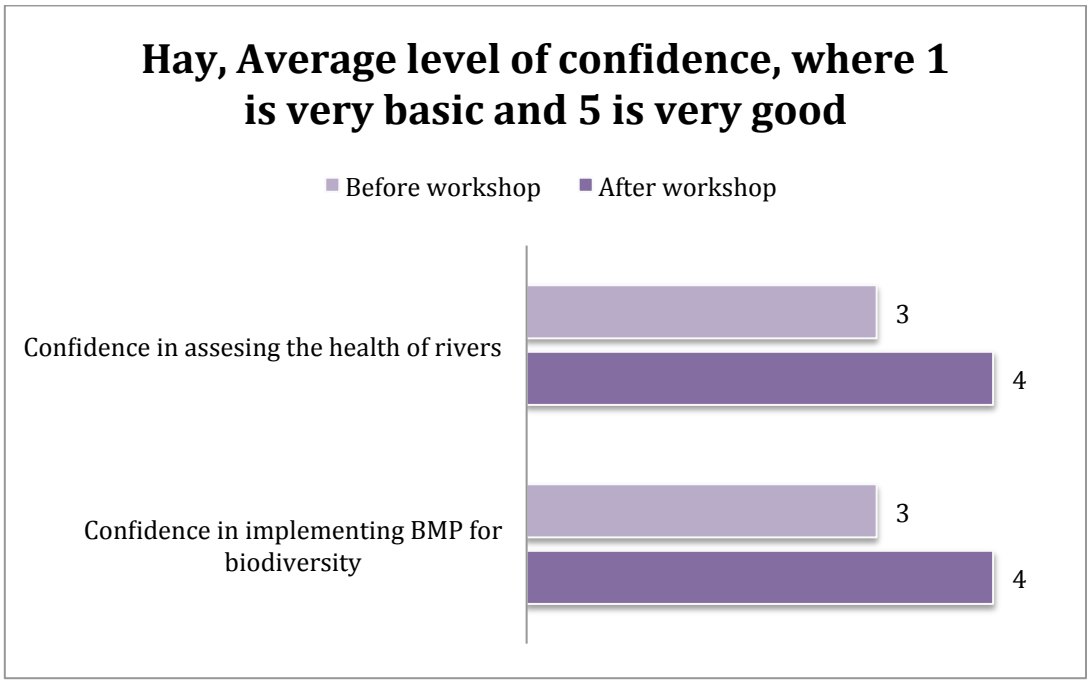



**Figure 5** Average level of confidence to implement practices in the 3 key areas before and after the field days, where 1 is very basic and 5 is very good.

Forty eight percent of respondents were more likely to adopt riparian BMP's on their farm as a result of attending the field days, 17% they were already adopting best practice, 10% said they would not and the remainder did not answer the question.

## Feedback responses from participants:

- Show more animals
- It was excellent couldn't be better
- BBQ lunch, simpler sandwiches for kids (Griffith)
- Go for longer with more information
- More animals
- More animals, maybe an echidna some fish and a baby kookaburra
- Good to see the child friendly level of info and their enthusiasm to participate
- Fantastic event would love to have involved the scouts but they operate during school term. Advertising over holidays reduced RSVP's

**Photo:** Presenters left to right, Annabel lugsdin (M. Landacre), Dr Rhiannon (UNE) Smith and Michelle Durkan (Taronga), Hay 2017

**Photo:** Participants Gogelderie weir, Feb 2017

## Communications

### Field day fauna Booklet

A field day booklet was developed as a follow-up educational tool, Appendix 4. The booklet contained information about River Red Gum Woodlands, local biodiversity occurring within the Riverina area and what management actions readers could do to preserve their habitat. Extra copies of the booklet were printed for use by Murrumbidgee Landcare Incorporated and other members of the LIAC in future relevant extension events.

### Event promotion

- Distribution of field day flyer through committee networks and local newsletters, newspapers and social media such as:
  - CottonInfo and MI website
  - Email to schools-Griffith High, Leeton High, St Francis in Leeton, Binya Public, Darlington Point Public, Whitton Public, Wamoon Public, Darlington Point Public, Coleambally Central School, Leeton Primary, Parkview Primary
  - Advertising in Murrumbidgee Field Naturalists newsletter
  - Email-Irrigation Area Collective
  - Distribute posters
  - Meeting with Kate O'Callagan from Southern Cotton re promoting the event
  - Posters at Southern Cotton, Whitton Shop, Pool and Post Office, Darlington Point Shop, Pool and Post Office, Griffith Supermarket,
  - Radio interviews-Triple M in Riverina, 2MIA FM ( twice) , , Anne Delaney ABC radio
  - Bindi-ABC radio advertising (twice)
  - Riverina Local Land Services e newsletter
  - Mli website, facebook and twitter accounts

### Social Media

During the events we used Twitter to publicise and promote the events. These tweets were re-tweeted or liked by CottonInfo, Murrumbidgee Landcare Incorporated, Murrumbidgee Irrigation, CEO Cotton Research Development Corporation, CEO for Murray Darling Wetlands Working group Ltd and field day participants

**https://twitter.com/vogelstacey**

### Post media

An article on the field day was published in the local Hay newspaper.

## Conclusion

The 2017 "Cottoning onto the Murrumbidgee River" riparian and river awareness and management field days were a successful capacity building activity. Ecologists, researchers and natural resource management technical staff provided 71 people from the Riverina area with the latest riparian management information.

Importantly, the evaluation material collected during the events found that field day participants increased their awareness and understanding of riparian management. The evaluations also indicated that 48% of respondents were more likely to adopt riparian BMP's on their farm as a result of attending the field days, 17% they were already adopting best practice, 10% said they would not and the remainder did not answer.

The field days were an example of how riparian management research outcomes can be successfully delivered to cotton communities in a fun and interactive way. The success of the field days was also a positive start to CottonInfo's inclusion in the Landcare Irrigation Area Collective.

# Appendices

## Appendix 1 Field day program

CottonInfo Information when you need it

| AGENDA<br>Friday 17th Feb 2017 – Gogeldrie Weir | |
|---|---|
| **9:30am start** | Participants arrive at starting point<br><br>Welcome & Introduction/Event facilitation–Stacey Vogel (CottonInfo) (5mins) -<br><br>Jimmy Ingram (5mins) - welcome to country<br><br>Erin Lenon (Commonwealth officer of water) – environmental flows (10mins)<br><br>Sky Wassen (CSU) –Wetland and riverine function, why value it what services providing farming community (10mins)<br><br>Facilitator Hand over to Guides for induction |
| **9:55am** | Kayaking Induction by kayak guides (Out & About Adventures) - Workplace Health & Safety outlined to group and Job Safety Assessment sheet handed around for signature |
| **10:15 – 11:30**<br>**Paddle** | Participants on river paddling by 10:15am (2hrs (6-8km) paddling +1/2 morning tea)<br><br>Technical experts to point out things of interest as paddle and answer questions.<br><br>Short talk on bank about what we can see as move kayaks around structure<br>Sky Wassens (CSU)<br>Kerri Anne (MI/Landcare) – facilitate discussion as paddle |
| **11:30-12:00**<br>**Morning tea** | Morning tea stop (simple morning tea can be packed by Guides). |
| **12:00 – 1:15**<br>**Paddle** | Technical experts point things of interest and answering questions |
| **1:15 – 2:00pm** | **Lunch** |

CottonInfo | PO Box 381, Wee Waa NSW 2388 | 0428 266 712 | staceyvogel.consulting@gmail.com

CottonInfo Information when you need it

CottonInfo Information when you need it

| | |
|---|---|
| **2:00 – 2:40** | Cathy Semmler (MI) Why are healthy riparian areas important? (10mins)<br><br>Dr Rhiannon Smith (UNE/CRDC) Ecosystem services of NV –Cotton research outcomes (15mins) |
| **2:40 – 2:50** | Management – what can I do? /, funding incentives etc TBC speaker Riverina LLS – 10mins |
| **2:50 – 3:00** | Wrap-up, Collection of workshop evaluation sheets<br>Workshop Close – (5mins) |



CottonInfo | PO Box 381, Wee Waa NSW 2388 | 0428 266 712 | staceyvogel.consulting@gmail.com

| Weekend Saturday 18th Feb 2017<br>Gogeldrie Weir -9:30– 2:30pm<br>Concurrent sessions | |
|---|---|
| **9:30am**<br>**Start** | Participants arrive at starting point<br>Welcome & Introduction –Facilitator / Stacey Vogel (CottonInfo) (5mins)<br>Landscape principles for healthy rivers (use satellite image) – Cathy Semmler environment officer Murrumbidgee Irrigation (10mins)<br>The value of River Red Gums- Dr Rhiannon Smith UNE/CRDC (5mins) |
| **10:00am** | Sessions begin. Group split into 2 concurrent sessions. |
| **Session 1**<br>**1hr & 45mins**<br>**10:00am – 11:45am** | **Activity 1 – Kayaking**<br>Kayaking Induction by kayak guides/grab some fruit/muslei bar (10mins)<br>1 ½ hr Paddling with NRM Technical experts , Dr Rhiannon Smith UNE, Cathy Semmler Murrumbidgee Irrigation)<br>**Activity 2 – Riverbank activities (can start morning tea early so ready to take off**<br>Morning tea – 15minutes<br>Waterwatch Activity –Kerri Keely Murrumbidgee Landcare /Annabel Lugsdin (45mins)<br>Fauna show & Tell- Taronga Zoo (45min) – 11:00am |
| **Session 2**<br>**1hr & 45mins**<br>**11:45am – 1:30pm** | **Activity 1 – Kayaking 1 1/2**<br>Kayaking Induction by kayak guides (10mins)<br>1 ½ hr Paddling with NRM Technical experts Dr Rhiannon Smith UNE, Annabel Lugsdin)<br>**Activity 2– Riverbank activities (can start morning tea early so ready to take off**<br>Morning Tea – 15minutes |

CottonInfo Information when you need it

| | |
|---|---|
| | Fauna show & Tell- Tooronga Zoo (45mins)<br><br>Waterwatch Activity – Kerri/Cathy(45mins) |
| **1:30pm – 2:00pm** | Lunch (wrap-up and close while people are grabbing something to eat.<br><br>Evaluation sheets |
| **2:00pm Lunch/close** | Wrap-up and Collection of workshop evaluation sheets – Stacey Vogel CottonInfo (5mins) |

CottonInfo Information when you need it

| Weekend Sun 19th Feb 2017<br>Hay -9:30– 2:30pm<br>Concurrent sessions | |
|---|---|
| **9:30am**<br>**Start** | Participants arrive at starting point<br>Welcome & Introduction –Facilitator / Stacey Vogel (CottonInfo) (5mins)<br>The value of River Red Gums and landscape principles for healthy riparian areas- Dr Rhiannon Smith UNE/CRDC (15mins) |
| **10:00am** | Sessions begin. Group split into 2 concurrent sessions. |
| **Session 1**<br>**1hr & 45mins**<br>**10:00am – 11:45am** | **Activity 1 – Kayaking**<br>Kayaking Induction by kayak guides/grab some fruit/muslei bar (10mins)<br>1 ½ hr Paddling with NRM Technical experts , Dr Rhiannon Smith UNE, Stacey Vogel ?<br>**Activity 2 – Riverbank activities (can start morning tea early so ready to take off**<br>Morning tea – 15minutes<br>Waterwatch Activity –Annabel /Stacey Vogel (45mins)<br>Fauna show & Tell- Taronga Zoo (45min) – 11:00am |
| **Session 2**<br>**1hr & 45mins**<br>**11:45am – 1:30pm** | **Activity 1 – Kayaking 1 1/2**<br>Kayaking Induction by kayak guides (10mins)<br>1 ½ hr Paddling with NRM Technical experts Dr Rhiannon Smith UNE,<br>**Activity 2– Riverbank activities (can start morning tea early so ready to take off**<br>Morning Tea – 15minutes<br>Fauna show & Tell- Tooronga Zoo (45mins)<br>Waterwatch Activity – Annabel/Stacey(45mins) |

CottonInfo **Information** when you need it

| | |
|---|---|
| **1:30pm – 2:00pm** | Lunch (wrap-up and close while people are grabbing something to eat. |
| **2:00pm Lunch/close** | Wrap-up and Collection of workshop evaluation sheets – Stacey Vogel CottonInfo (10mins) |

## Appendix 2 - Field day Flyer


# cottoning on to the Murrumbidgee River

**You are invited to three great events: free kayak trips and wildlife discovery adventures on the Murrumbidgee River!**

Join flora and fauna experts for these fun events at any of our great locations over three days!

**Gogeldrie Weir: Friday 17 Feb 2017**
9:30am-3:00pm
Join us for a relaxing morning cruising down the river on a free kayak trip while learning about your local river. **Over 18s only.** Kayaks and PFDs provided, along with a free morning tea and BBQ lunch.

**Gogeldrie Weir: Saturday 18 Feb 2017**
9:30am-2:30pm
Join us for a fun family day kayaking and exploring the local river and its wildlife. Come and see what special guests Taronga Zoo have brought for us to have a look at! Kayaks and PFDs provided, along with a free morning tea and BBQ lunch.

**Hay Weir: Sunday 19 Feb 2017**
9:30am-2:30pm
Join us for a fun family day kayaking and exploring the local river and its wildlife. Come and see what special guests Taronga Zoo have brought for us to have a look at! Kayaks and PFDs provided, along with a free morning tea and BBQ lunch.

**Please RSVP for all events by Friday 3 Feb.**
Contact Kerri Keely: 0428 396 826, kkeely@mli.org.au. Spaces are limited so get in quickly!

*This project is supported by funding from the Australian Government.*

MURRUMBIDGEE Landcare INCORPORATED · Murrumbidgee Irrigation · TARONGA ZOO · NSW Local Land Services · Landcare New South Wales

## Appendix 3 – Evaluation Form

CottonInfo Information when you need it

CottonInfo

## Evaluation form: Cottoning onto the Murrumbidgee Feb 2017

***Thank you for attending today's event. We value your time and would appreciate your feedback.***

| | | *Disagree* | | | | *Agree* | |
|---|---|---|---|---|---|---|---|
| 1. | The event met your aims & expectations: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |
| 2. | The instruction received was of a high standard: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |
| 3. | The event was presented at a level you could understand: | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | The topics covered were useful: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |

5. The pace of delivery of information was: ☐ Too slow ☐ About right ☐ Too fast
6. The amount of information was: ☐ Not enough ☐ About right ☐ Too much

7. How could we have improved the event to be more useful for you? _____

_____

_____

8. With regard to the river health please rate your:

a. level of understanding of what the indicators are for river and riparian health (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

b. level of confidence in being able to assess how healthy your local river is (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. With regard to biodiversity please rate your:

a. level of understanding of the diversity of native flora and fauna that live in your local landscape and what their habitat and food requirements are (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

b. level of confidence in managing native flora and fauna on your farm or in your local landscape (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

CottonInfo Information when you need it

CottonInfo

10. As a result of this event, are you (more) likely to adopt Best Management Practices for river and riparian areas or biodiversity on your farm or in your catchment; or if you are already adopting it, to do it more effectively?

☐ Yes ☐No ☐ Already adopted/using effectively

11. What would prevent you from adopting these BMP's and/or what else do you need to assist you in adopting them? _____

_____

12. As a result of this event, please rate your level of understanding of the role native vegetation such as River Red gums play in sequestrating carbon (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

14. How do you classify yourself?

☐ Grower/farm manager ☐ Farm staff ☐ Consultant/advisor ☐ Retailer

☐ Agency ☐ Other. Please specify: _____

15. Do you have a riparian area on your farm?

Yes No

16. Any further feedback? _____

_____

***Thank you.***

MI Murrumbidgee Irrigation

MURRUMBIDGEE Landcare INCORPORATED

## Appendix 4 – Fauna Book

CottonInfo Information when you need it


# cottoning on to the Murrumbidgee!
# Nature's workforce

CottonInfo and its partners Murrumbidgee Irrigation, Murrumbidgee Landcare Incorporated, NSW Landcare, the Riverina Local Land Services and the Australian Government are running a series of free, fun and informative kayak trips on the Murrumbidgee River in February 2017.

This booklet contains information about some of the amazing flora and fauna we hope to see while paddling on the river and how this natural workforce is providing benefits to our farms and rural communities.

One such 'natural worker' is Australia's iconic River Red Gum. River Red Gum communities, which are common along our rivers and creeks, provide habitat and food for a diversity of species such as microbats and sugar gliders, as well as a range of free environmental services such as habitat for crop pest predators, carbon sequestration and erosion control.

Join us to see and learn more about our natural workforce and what you can do to help protect them.

For more information visit www.cottoninfo.com.au.

STACEY VOGEL

MICHAEL SNEDIC

*This project is supported by funding from the Australian Government.*

MURRUMBIDGEE Landcare INCORPORATED · MI Murrumbidgee Irrigation · TARONGA ZOO · NSW Local Land Services · Landcare New South Wales

## River Red Gums

*Eucalyptus camaldelensis*

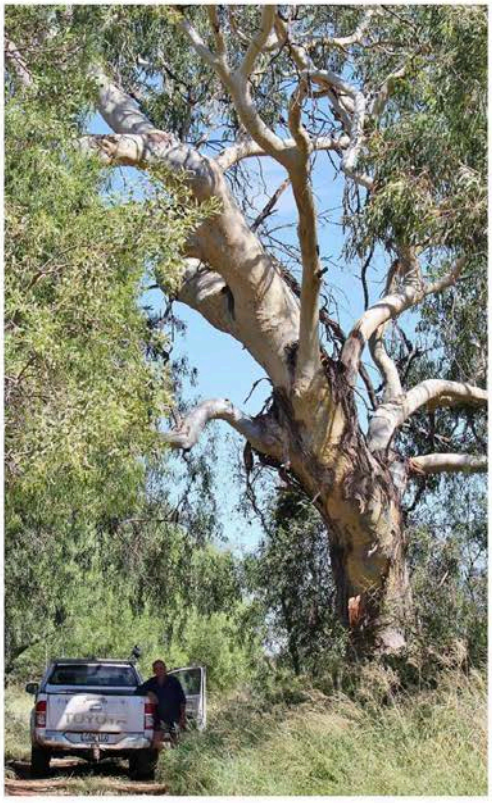
River Red Gums are a common tree along watercourses across Australia. They have adapted to survive periodic flooding (a necessity for their survival) and drought. They are fast growing, reaching heights of up to 45m and diameters of between 1-3m. They can reach ages of between 500-1000 years old.

They use water from three sources: rainfall, groundwater and flooding. They have an extensive root system consisting of many vertical and lateral roots. Their roots have a unique ability to move water at night from layers of wetter deeper soil to drier upper layers where it is stored for use during the day by roots near the surface.

Hollows form at around 120-180 years of age providing habitat for much of our natural workforce such as birds, microbats, snakes and mammals such as sugar gliders.

As part of our natural workforce they provide a range of services for us such as salinity mitigation, habitat for natural pest control, erosion control and carbon sequestration and storage.

They also contribute to healthy waterways by regulating water



MELANIE JENSON

temperature through shading, contribute nutrients through leaf and insect fall for aquatic animals, and provide snags as habitat and nurseries for species such as Murray Cod.

***Fast fact:*** *They store on average 200 tonnes of carbon per hectare, with totals found as high as 400 tonnes of carbon per hectare - the same amount of carbon as 290 Holden commodores emit in one year!*

## Common rush

*Juncus usitatus*

Common rush is a perennial semi aquatic plant species that grows upto 1.2m tall. It is native to eastern Australia and is commonly found along streams, riverbanks, irrigation supply channels and other periodically wet areas including wetlands. It is found along water edges or in shallow water often with other sedges, rushes and grasses.

Common rush is excellent habitat for frogs, fish, crustaceans and small birds. Yabbies' also eat the tender young stems. It can also be a good colonizing species in bank rehabilitation works and can out compete less desirable 'weedy' species. In addition it is also acts as a filter helping to up-take nutrients and filter suspended solids.

***Fast fact:*** *Common rush is a useful plant for controlling erosion along watercourses and around dams as its fibrous roots help bind the soil together and it is adapted to periodic wetting and drying.*

STACEY VOGEL

STACEY VOGEL

## Striated pardalote

*Pardalotus striatus*

The Striated pardalote is a very small short-tailed woodland bird species, which forages noisily for small insects in the tops of trees.

There is considerable variation in the plumage markings across the species but generally they are a grey bird with a black cap and have wide eyebrows that shade from yellow to white with a yellow spot in front of the eye.

Their wing edges are pattered in black and white and they have a distinctive rich yellow throat.

They feed singly, in pairs or small parties and move constantly. Pairs nest in a burrow in riverbanks, earth-mounds, road cuttings or similar spots.

Its presence is often first noticed by its call, you can listen to its call on the free Birds on Cotton Farm app (available from: www.cottoninfo.com.au/birds-cotton-farms-app).

***Fast fact:*** *Striated pardalotes are small insect eating birds and can contribute to natural pest control.*

MICHAEL SNEDIC

4

## Sugar glider

*Petaurus breviceps*

Sugar gliders are a common, small marsupial gliding possum found in woodlands such as riparian areas.

They have a skin membrane from their fifth finger to the ankle, which they use to glide from tree to tree using their tail for balance and steering.

They are nocturnal, sleeping by day in nests made of leaves in tree hollows. Groups of adults and their young may share a nest.

Sugar gliders eat crickets, Christmas beetles, mealworms, nectar, some fruit and sap.

They have grey body fur with a pale yellow/grey coloured belly. They have a dark stripe running from between their eyes and extending down the middle of their back towards the tail.

They look similar to squirrel gliders but are smaller, often with a white tip on their tail and a have more rounded face with a protruding nose. Their call is like a small dog "yip" "yip".

***Fast fact:*** *A single sugar glider can eat upto 3.25kg of insects in a year. They play an important role in controlling Christmas beetles, which defoliate trees.*

PHIL SPARK

## Yellow-bellied Sheathtail-bat

*Saccolaimus flaviventris*

The Yellow-bellied Sheathtail-bat is an insectivorous microbat that can be found across most of Australia however its numbers are declining and has a vulnerable status in NSW.

It is one of the largest microbats growing upto 87mm long. It has a very distinctive appearance with long narrow wings a glossy jet-black back and a white to yellow belly.

It gets its name from its naked tail, which is enclosed in a sheath flying membrane stretching between its legs.

They roost in tree hollows and are believed to migrate in winter to warmer northern areas.

***Fast fact:*** *It flies high above the tree canopy and can often be seen foraging for insects above rivers and water storages catching large insects. It eats up to half its body weight each night, including many agricultural pests.*

PHIL SPARK

7

## Ladybird beetles

*Coccinellinae family*

The Coccinellidae family is made of small beetles ranging from 0.8 to 18mm in length. They are commonly yellow, orange or red with black spots or stripes on their wing covers, they have black legs, heads and antennae.

Adults and larvae of ladybird beetles are important predatory insects in most crops with at least 9 species found in cotton landscapes that contribute to natural pest control.

According to legend crops in Europe during the Middle Ages were plagued by pests, farmers began praying to the Blessed Lady, the Virgin Mary. Soon they started seeing ladybirds in their fields and the crops were saved so they called the beetles 'Lady beetles' after the Virgin Mary.

More information on ladybird beetles can be found in the guide: Pests and Beneficials in Australia Cotton Landscapes (available at www.cottoninfo.com.au/publications).

***Fast fact:*** *They are voracious predators of aphids and under most conditions (along with lacewings and hover flies), stop aphid populations from increasingly explosively.*

D. MCCLENAGHAN

8

## Christmas spider

*Austracantha minax*

The Christmas spider, also called the jewel spider, is a harmless and relatively small spider growing upto 8mm in length.

They are predominately black with a bright yellow and white pattern on their abdomen. The abdomen has six distinctive spines, which combined with their bright coloring make them easily identifiable.

Christmas spiders are usually found in groups building overlapping communal webs with other Christmas spiders.

They feed on the small flying insects that get entangled in their webs.

More information on beneficial spiders can be found in the guide: Pests and Beneficials in Australia Cotton Landscapes (available at www.cottoninfo.com.au/publications).

***Fast fact:*** *Christmas spiders are common in cotton landscapes and contribute to natural pest control by building their webs between the cotton rows and amongst the plant leaves.*

STACEY VOGEL

## Murray-Darling carpet python

*Morelia spilota metcalfei*

The carpet python is a large non-venomous snake that can grow up to 4m long. While common in NSW it is endangered in Victoria and vulnerable in South Australia.

They vary in colour from dark brown to grey with a series of light and dark bands along their back. They have a large elongated head and slender neck.

The live in diverse habitats but are often found in areas with large hollow eucalypts along permanent and ephemeral watercourses.

They are night active and can be seen during daylight hours basking in the sun.

They kill their prey by constricting it with coils of their body so that the prey animal can no longer breathe. They do not crush their food because the resulting broken bones could cause injury when ingested.

***Fast fact:*** *They feed mostly on small mammals, bats, dunnarts, birds and eggs. They contribute to rodent control by also eating mice and rats and can often be seen in farm sheds helping keep rodent numbers down.*

STACEY VOGEL

## Freshwater mussels

*Hyriidae family*

There are thought to be around 21 species of freshwater mussels in Australia, five of which have been found along the Murrumbidgee River.

Mussels generally live between 10-40 years, one species, Velesunio, are thought to live up to 60 years.

Mussels live along stream beds using their muscular foot to drag their shell and burrow into the fine streambed sediments such as sand and mud. Adult shells vary in size from around 50-200mm. The shell colour ranges from brown to black and sometimes green in young shells.

Their unique reproductive cycle extends throughout most of the year. When mussel larva "glochidium" is released by the female they must attach themselves to the gills or fins of fish hosts such as gudgeons and smelt to complete its development.

Females produce large numbers but only a few find a host and even fewer survive to maturity.

***Fast fact:*** *Freshwater mussels are natural water filters, cleaning the water by removing pollutants, algae and zoo-plankton. They also promote nutrient cycling.*

PHIL SPARK

11

## What can you do?

Riparian woodlands of River Red Gums help keep our rivers healthy and provide habitat and food for many native animals. They also provide services such as habitat for beneficials (natural pest control), carbon storage and sequestration, erosion control and salinity mitigation.

What can you do to protect these great species?

- Improve riparian corridor connectivity and extend widths to at least 30m.
- Protect dead and living trees with hollows.
- Control invasive weeds and pests.
- Leave fallen logs, if you need to 'tidy' up consider putting them into piles and don't burn them.
- Manage grazing to maintain good groundcover (50-70 per cent) and allow natural regeneration of shrubs and trees.
- Avoid agricultural chemical spray drift onto these areas.
- Leave logs and 'snags' along riverbanks and riverbeds to provide bank stability, aquatic habitat and roughage to flow.

MILLY HOBSON

MILLY HOBSON

**For further information, please visit:**

- The *my*BMP natural assets module: www.mybmp.com.au
- The CottonInfo NRM page: www.cottoninfo.com.au/natural-resource-management
- Murrumbidgee Irrigation: www.mirrigation.com.au
- Murrumbidgee Landcare: www.mli.org.au
- Riverina Local Land Services: www.riverina.lls.nsw.gov.au
- The Australian River Restoration Centre: www.arrc.com.au

Best Practice

# Cottoning onto the Macquarie River – river and riparian field days, 4 March 2017


## Abstract

In Feburary 2017, CottonInfo and Central West Local Land Services (CWLLS) in partnership with the Australian Government ran a riparian management field day at Warren in the Macquarie valley. The aim of the field day was to; extend the latest cotton industry riparian vegetation research outcomes, increase participants awareness of the value of riparian vegetation on farms and educate them on the latest best management practices for riparian areas on cotton farms. 45 people representing 10 cotton farms and 2 cotton industry service organisations participated in the field day.

As part of the development and delivery of the field day a biodiversity booklet showcasing local River Red Gum Communities was developed. A key outcome for the field day was the collaboration between CottonInfo and the Central West Local Land Service to deliver the field day. This collaboration established new local networks between cotton growers/advisors and the local natural resource advisor for the CWLLS.



Stacey Vogel
National Cotton Natural Resources Technical Specialist, CottonInfo

20 March 2017

## Acknowledgements

The Macquarie river and riparian field day was undertaken by CottonInfo with support from Central West Local Land Services and the Australian Government.

Thanks goes to:

- Local organisers Amanda Thomas and Sally Ceeney (CottonInfo)
- The technical presenter, Terrestrial ecologist Phil Spark (North West Ecological) and Land Services Officer Cameron Downing (Central West Local Land Services), and
- Out and About Adventure kayak instructors, Peter Vaughan and Andy Fraser.

Contents

CottonInfo Information when you need it

# Field Day Information

## Background

The 2016-17 National Cotton NRM campaign identified a need to continually improve the extension of the cotton industries riparian ecosystem services research outcomes and increase growers knowledge of riparian BMP's.

To help achieve this, CottonInfo formed a partnership with Central West and the Australian Government to

- Extend the latest cotton industry riparian vegetation research outcomes
- Increase awareness of the value of riparian vegetation on farms,and
- Extend best management practices for riparian areas on cotton farms.

Following on from the success of the "Gwydir Cottoning onto the great outdoors" field day series, a similar field day structure and program, which targeted social networks of rural women was developed for the "Cottoning onto the Macquarie River" field day at Warren. The program was developed based on the delivery of fun family based capacity building activities that while targeting women engaged both decision makers (husband and wife) in the family farming business.

The field day format included 2 concurrent sessions, Appendix 1, a session kayaking on The Macquarie river looking at riverine processes and management with Cameron Downing and a session on the riverbank looking at local terrestrial and aquatic native flora and fauna with Terrestrial ecologist Phil Spark and CottonInfo NRM Technical Specialist Stacey Vogel.

At the field day the following topics where covered:

- Landscape principles for healthy rivers, why value riparian areas – Stacey Vogel (CottonInfo)
- Ecosystem services of Native vegetation, eg Carbon Sequestration – Stacey Vogel (CottonInfo)
- BMP's for rivers and riparian areas - Stacey Vogel (CottonInfo) & Cameron Downing (CWLLS)
- What are the indicators of river health? - - Stacey Vogel (CottonInfo) & Cameron Downing (CWLLS)
- What fauna is found here, food & habitat requirements - Mr Phil Spark, (North West Ecological)

The field days were promoted through the CottonInfo extension network, Appendix 3. A booklet showcasing fauna and flora species within River Red gum communities and BMP's for their management which was created for the 'Cottoning onto the Murrumbidgee River' field days was handed out to participants during the field day.

## Participants Reponses

A comprehensive evaluation was conducted to provide evidence of changes in KASA (Knowledge, aspirations, skills and attitudes) as a result of attending the field days. Participants completed an anonymous feedback sheet at the end of each workshop. The evaluation template is provided in Appendix 3. A total of 8 evaluations were received from the 45 people attending. A thunderstorm at the end of the field day during lunch impacted on people ability to complete the evaluation forms. All participating attendees were families. 17 of the attendees were adults with the remainder predominantly primary age children.

The results of the evaluations are summarised in this section. A copy of the evaluation form ca be found in Appendix 2.

### Demographics

There was a total of 45 participants at the field day. 17 of these were adults and the remaining 28 were children. All participants were linked to the local cotton industry, the 45 participants represented 10 local cotton farms and 2 cotton service industries (CottonInfo and Cotton Australia).

### Field day delivery

Most participants agreed that the field days had met their aims and expectations and information was presented at a level they could understand. All participants felt that the instruction received was at a high standard and the topics covered were useful. One participant made the comment that some of the younger kids found some of the information a little technical.

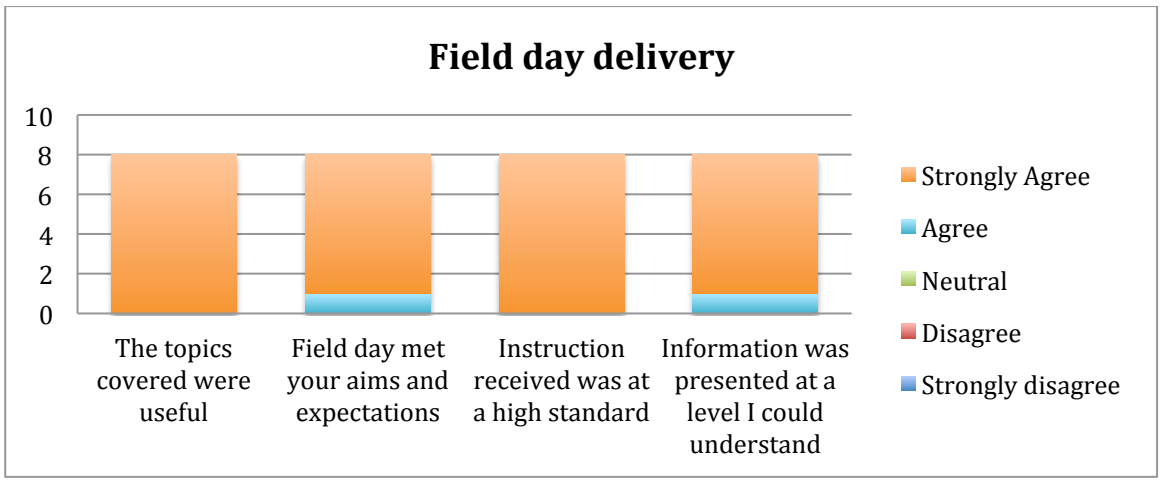



Figure 1 Participants evaluations of field day delivery

## Changes in KASA (Knowledge, awareness, skills and aspirations)

### Gains in Understanding

A summary of KASA changes as a result of the field day (Figure ?) indicated an overall increase in the level of understanding of the three key areas, indicators of river health, habitat requirements of local biodiversity and ecosystem services from native vegetation such as carbon sequestration.

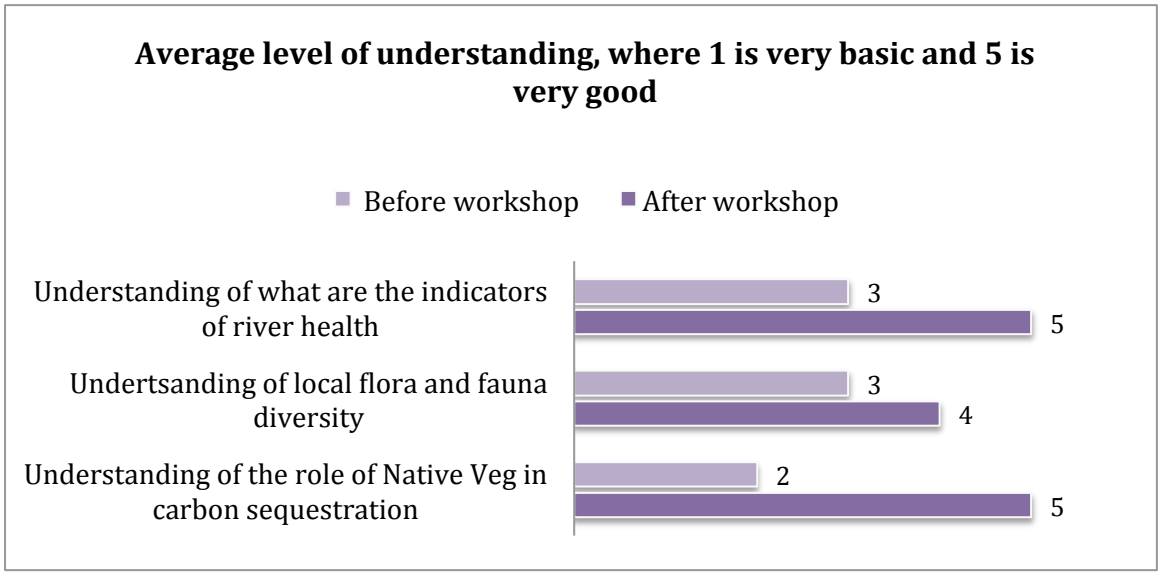



Figure 2 Average level of understanding of the 3 key areas before and after the field days, where 1 is very basic and 5 is very good.

Participants also recorded an overall increase in their level of confidence to implement what they had learned at the workshop.

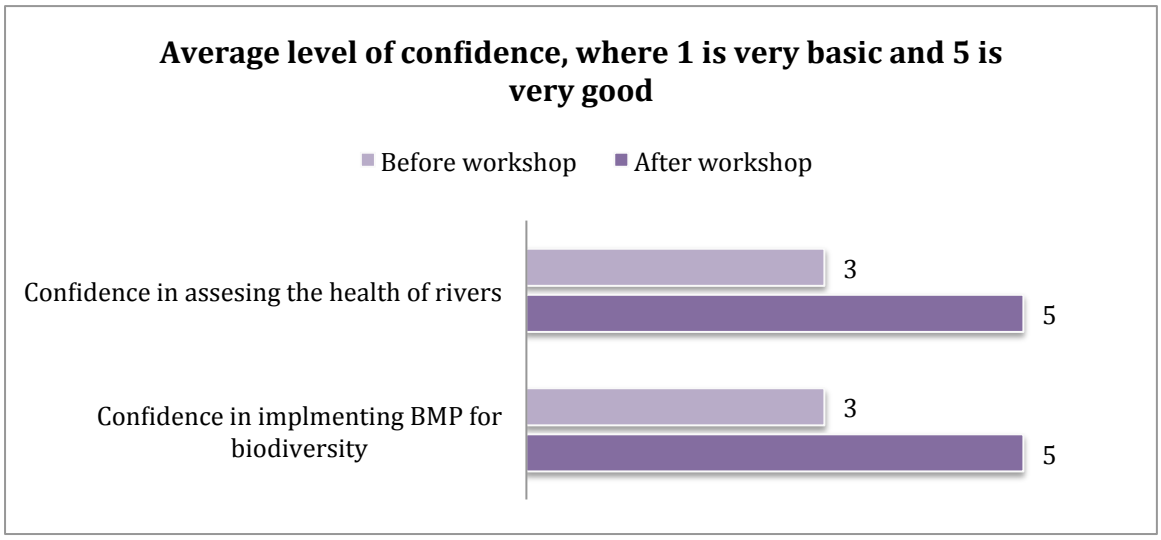



Figure 3 Average level of confidence to implement practices in 2 key areas before and after the field days, where 1 is very basic and 5 is very good.

Sixty two percent of respondents said that as a result of the field day they are more likely to adopt BMP's for biodiversity on their farm or in their local area. The remainder said they were already adopting BMP or did not answer the question. Fifty present of respondents said they had a riparian area on their farm.

### Feedback responses from participants:

- Thankyou very much for such a fun day. The 2 big kids have been talking and asking questions most of the way home. They want to do it again already.
- OMG the girls had the best day!! A big thankyou, Tony said he learnt so much about the wildlife. Great job.
- Great job well organized
- Keep doing all you are doing to educate the future generation
- Excellent day great for the kids and the whole family, everyone learnt something
- Really great job!

**Photo:** Macquarie River Warren, March 2017

**Photo:** Macquarie River warren, March 2017

## Communications

### Event promotion

- Distribution of field day flyer through committee networks and local newsletters and social media.

### Social Media

During the events Cotton research development Corporation, Murrumbidgee Landcare, Murrumbidgee Irrigation and participants of the events

**https://twitter.com/vogelstacey**

### Post media

A follow-up article was prepared by CottonInfo REO Amanda Thomas and submitted into the Warren Weekly newspaper, see Appendix 4.

## Conclusion

The 2017 "Cottoning onto the Macquarie River" riparian awareness and management field day was a successful capacity building activity. Terrestrial and aquatic researchers and natural resource management technical staff provided 45 people from the Macquarie valley with the latest riparian management information. Developing a fun and interactive extension activity that targeted farming families was very successful in gaining a high level of attendance at the field days.

Importantly, the evaluation material collected during the events found that field day participants increased their awareness and understanding of riparian management. The evaluations also indicated that 62% of respondents were more likely to adopt riparian BMP's on their farm as a result of attending the field days.

The field days were an example of how riparian management research outcomes can be successfully delivered to cotton communities in a fun and interactive way. As a result of the success of these field days CottonInfo has been approached by other cotton growers within the Macquarie Valley who would like a similar event held in there area.

# Appendices

## Appendix 1 - Field day Program

| Weekend Saturday 4th March 2017<br>Warren Top Weir :8:30– 1:00pm<br>Concurrent sessions | |
|---|---|
| **8:30am**<br>**Start** | Participants arrive at starting point<br>Welcome & Introduction –Facilitator / Stacey Vogel (CottonInfo) (20mins) |
| **9:00am** | Sessions begin. Group split into 2 concurrent sessions. |
| **Session 1**<br>**1hr & 45mins**<br>**9:00am – 10:45am** | **Activity 1 – Kayaking**<br>Kayaking Induction by kayak guides (15mins)<br>1 ½ hr Paddling with CWLLS (Cameron Dowling)<br>**Activity 2 – Fauna show and tell**<br>Fauna and habitats – NW Ecological – Phil Spark (1.5hrs)<br>Morning tea – 15minutes |
| **Session 2**<br>**1hr & 45mins**<br>**10:45am – 12:30pm** | **Activity 1 – Kayaking 1 1/2**<br>Kayaking Induction by kayak guides (15mins)<br>1 ½ hr Paddling with CWLLS (Cameron Dowling)<br>**Activity 2– Riverbank activities (can start morning tea early so ready to take off**<br>Morning Tea – 15minutes<br>Fauna and habitats – NW Ecological – Phil Spark (1.5hsrs) |
| **12:30pm – 1:00pm** | Lunch - Wrap-up and Collection of workshop evaluation sheets – Stacey Vogel CottonInfo (5mins)<br>Evaluation sheets |
| **1:00pm Lunch/close** | |



## Appendix 2 – Evaluation Form

CottonInfo Information when you need it

CottonInfo

## Evaluation form: Cottoning onto the Macquarie March 2017

***Thank you for attending today's event. We value your time and would appreciate your feedback.***

| | | *Disagree* | | | | *Agree* | |
|---|---|---|---|---|---|---|---|
| 1. | The event met your aims & expectations: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |
| 2. | The instruction received was of a high standard: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |
| 3. | The event was presented at a level you could understand: | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | The topics covered were useful: | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | |

5. The pace of delivery of information was: ☐ Too slow ☐ About right ☐ Too fast
6. The amount of information was: ☐ Not enough ☐ About right ☐ Too much

7. How could we have improved the event to be more useful for you? _____

_____

_____

8. With regard to the river health please rate your:

a. level of understanding of what the indicators are for river and riparian health (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

b. level of confidence in being able to assess how healthy your local river is (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. With regard to biodiversity please rate your:

a. level of understanding of the diversity of native flora and fauna that live in your local landscape and what their habitat and food requirements are (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

b. level of confidence in managing native flora and fauna on your farm or in your local landscape (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

**PTO**

CottonInfo Information when you need it

CottonInfo

10. As a result of this event, are you (more) likely to adopt Best Management Practices for river and riparian areas or biodiversity on your farm or in your catchment; or if you are already adopting it, to do it more effectively?

☐ Yes ☐No ☐ Already adopted/using effectively

11. What would prevent you from adopting these BMP's and/or what else do you need to assist you in adopting them? _____

_____

12. As a result of this event, please rate your level of understanding of the role native vegetation such as River Red gums play in sequestrating carbon (where 1 is very basic & 5 very good)

Before today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After today's event: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

14. How do you classify yourself?

☐ Grower/farm manager ☐ Farm staff ☐ Consultant/advisor ☐ Retailer

☐ Agency ☐ Other. Please specify: _____

15. Do you have a riparian area on your farm?

Yes No

16. Any further feedback? _____

_____

***Thank you.***

NSW GOVERNMENT | Local Land Services Central West

CottonInfo Information when you need it

## Appendix 3 – Event advert

# cottoning on to the Macquarie River

### Free family kayak adventure!

Join us for a fun family morning paddling along the Macquarie River on a free kayak trip while learning about your local river and all the creatures that call it home. A free morning tea and BBQ lunch will be provided, followed by an opportunity to see up close some of your local fauna with wildlife expert and ecologist Phil Spark.

**Date:** Saturday 4 March 2017.
**Time:** 8:30am-2:00pm.
**Location:** Warren Weir, further directions provided upon registration.
**RSVP:** Amanda Thomas, CottonInfo, by 24 Feb: 0417 226 411.

CottonInfo

The kayak trip is led by professional kayak guides: *Out and about Adventures*. Kayaks and personal floatation devices will be provided. Children must be accompanied by an adult.

## Appendix 4 – Post media article in Warren weekly

Page 8, WARREN WEEKLY, Wednesday, 15 March 2017

# CottonInfo and LLS host Macquarie River NRM Field Day

**On the first weekend in March, CottonInfo and Central West Local Land Services (LLS), in collaboration with the federal government, hosted a Natural Resource Management (NRM) field day where growers and their families had the opportunity to take a unique hands-on look at the importance of local fauna to the river environment.**

** Two very cool looking characters, brother and sister duo Fred and Mabel Ceeney, took to the river with their dad Matt (not pictured).*

CottonInfo Natural Resource Management Technical specialist Stacey Vogel was on hand to run the event and local growers were keen to take up the opportunity to participate, as Amanda Thomas from CottonInfo explained.

"The 40 spots available in the kayaks were snapped up by the cotton growers and their families. All I had to do was get the message out the growers who jumped at the opportunity."

Ecologist Phil Spark from North West Ecological camped out for the two nights preceding the event in order to collect a sample of local fauna and flora. He was able to gather eight species of Micro bat, including one albino, as well as many different types of frogs, lizards, fish, weeds and plants.

"Everyone, adults and children alike, was able to learn about the importance of these species in the riverine environments, as well as how useful they can be on cotton farms," said Amanda.

"For example, the micro bats are a great predator of some of the higher flying insects such as helicoverpa.

"We also learned about the importance of the habitat that supports these animals and plants on our farms and in our communities. Phil even played the calls of some of the animals while we were looking at them".

'Out and About Adventures' led a guided tour in the kayaks, showing the participants tree species beneficial to the river bank, such as river red gums, explaining how carbon is stored in these trees, some of which live to be a thousand years old.

"Cameron Downing from CWLLS provided info as we were paddling along.

"The children we fully engaged and asked questions throughout the wild life talks and paddle. They were able to hold many of the reptiles, of which a few were Phil's, and they learnt about invasive species such as the European carp.

"Given the grower participation and the great feedback we got from those who participated, we would like to run another one of these days in the Narromine or Trangie end of the Valley. I invite growers to get in touch with me if they have an ideal location in mind, so that we can get the ball rolling," she finished.

** Young Tom Wise looked very pleased to meet this particular lizard.*

** Airlie Thomas and Pollyanna Wass admiring a very handsome lizard.*

** Tom Williams was another 'Bubbles' fan.*

** Angela Ramsay showed no fear when she gave 'Bubbles' the snake a cuddle.*

| Campaign | Focus Area | myBMP Standard | Problem & opportunity | Practice Gaps | Benefits of change | Scope and Focus | Service Scan | Target Audience | Delivery methods | Lead | Working With | What | Specific Target | For what Outcome | By When | Indicators |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NRM "In it Together"** | Riparian Land Managment | Key Area: Healthy Biodiversity - all standards | There is significant areas of riparain vegetation on cotton farms. Recent research is showing that these areas can provide production benefits to farmers. Recent industry feedback through grower groups is also indicating that these areas hold high social values with growers and their families. | There is a lack of awareness of the role that riparian zones play in supporting sustainable production practice. | Increased condition of riparain land in cotton landscapes. | RiverComm- Hold a 2 day forum in the Border-gwydir valley in partnership with influencial industry and NRM groups that aims to increase awareness of riparain land BMP as well as capture the range of values growers place on these part of the landscape | Undertake a 2 day field tour and workshop in the border rivers area (Moree) extending industry riparian researcher and visiting 3 key cotton farms that are implmenting riparain land management best practice. As part of the two day forum we will also explore how we capture current 'good' practice on cotton farms and how to package our messages toincrease BMP. | Gwydir & Border rivers cotton growers, industry riparian researchers, RDO's other industry key stakeholders | Riparian management field trip and workshop within the Gwydir valley. | Stacey Vogel | Alice Devlin, GVIA, GCGA, NWLLS,Dr Rhiannon Smith | RiverCOMM - 1x 2 day riparian management tour & workshop in Moree | 60 industry people attend RiverComm forum | Increased industry knowledge of riparian research outcomes, development of a plan for capturing and increasing riparian stewardship. Increased industry knowledge of grower riaparin values. | Jun-15 | 80% of attendees respond in evaluation survey that they have increased knowledge of riparain land management best practice. |
| | | Key Area: Healthy Biodiversity - all standards | Non-cropped areas play an important role in providing ecosystem services to the whole farm and ensuring it's resilience into the future. Their exists an opportunity to raise awareness on the production benefits of native vegetation. | Extending recent ecosystem service research on carbon sequestration from riparian zones, NV as a refudge for benneficials, salinity mitigation na derosion mitigation | Create an awareness of the value of non-cropped areas in terms of its contribution to sustainability. A reduction of inputs i.e. more beneficial insects to protect crops (less chemical use), less erosion of causeways from better managed riparian zones | Using recent research outcomes on the production benefits of native vegetation management engage cotton gowers in southern QLD & North NSW to develop a native vegetation action plan for their area | Collaborating with Nancy Schellhorn under her GRDC project work with groups of growers to develop and implement landscape vegetation management plans around sustainable agriculture. | Cotton growers & consultants in northern NSW and southern QLD | focus group meetings, worksshops and collaboration with other organisations working to achive similar outcomes (eg NWLLS biodiversity strategy) | Stacey Vogel | Sally Dickinson, CSIRO - nancy Schellhorn, UNE Rhiannon smith, North West Local Land Services, CottonInfo & Warragamba landcare group | 2 workshops, 2 landcape vegetation plans | 2 landscape vegetation management plans developed and implemented | Increased condition of native vegetation in cotton landscaeps | Jun-17 | Best practice native vegetation management plans exist for 100km and/or 1000ha of riparain vegetation |
| | Natural Assets/ resources best practice | Key Area: Healthy Biodiversity. Practices are in place to protect remnant native vegetation from negative impacts such as spray drift | Increasing incidents of spray drift damage of remnant vegetation in cotton landscapes | Unclear and conflicting industry BMP's for native vegetationaround it use as a "buffer" for spray drift. | Increase condition of remnant vegetation and its capacity to provide other ecoservices. Increased spray efficency = increased profit/productivity. Improved community perception of industry practices. | Focus on reducing impact on remnant vegetation and effective native veg planted buffers. Extend to all industry | Working with Bill Gorodon review and update industries BMPs for NV and spray drift management | Growers, consultants and spray operators | Factsheets, myBMP, RiverComm, Spotlight Mag, e-newsletter | Stacey Vogel | Bill Gordon, Rhiannon Smith & Sam Capon | 2 factsheets. 1 - minimising spray drift onto existing remnant veg, 2 - design of effective planted veg buffers | Reduced reports of spray drift damage to remnant veg | Reduced reports of spray drift damage to remnant vegetation and improved condition of remnant veg | Jun-15 | Reducation in the reported incidents of spray drift in cotton landscapes. |
| | | myBMP natural assets module - all standards | Limited NRM knowledeg and skills exist within the industry to support growers to adopt natural resource best practice. Building collaborations with NRM bodies will help provide more regional on-ground support to growers & RDO's. | NRM bodies are using generic NRM information where there is specific cotton resources underpinned by industry research available for them. | Increased adoption of Best practices for natural resources. Other NRM bodies will be using cotton industry best practice when supporting grower awareness and decision making. | NSW LLS and regional NRM bodies have existing resources and programs to support sustainable land management and are looking for opportunities to engage with industry. myBMP provides a frameowrk for them to do this. | This is about creating awareness of cotton specific NRM resources and tools. | LLS, NRM staff & RDO's. | Workshops in the main cotton growing regions | Stacey Vogel | Jon Welsh, peter Verwey & sandra williams | 5 workshops targeting NRM advisors, RDO's & CA staff. | 30 NRM advisors attending workshops | NRM advisor awareness of myBMP natural aseets module | Jun-15 | 80% of attendees respond in evaluation survey that they have increased knowledge of myBMP |
| | NRM Capacity Building - social networks | myBMP natural assets module - all standards | How do you engage with growers on a topic that is not obviously linked to productivity and profitability? The objective is to link into existing social networks so social engagement around the issue is ongoing. | Capacity to implement NRM activities on-ground especially where there is no obvious production benefit | Improved knowledge and capacity of growers to implement NRM activities on farm | All cotton communities | Engage social networks of growers (women, schools, gym groups etc.) in NRM activities that are family based, fun and educational such as kayak trips, evening spotlight nights, environmental photography/art etc. | Cotton families in cotton growing communities | Fun, family, educational NRM activities | Stacey Vogel | All RDO's, Liz Alexander (Bluedog Agriculture), Wincott and existing social networks in cotton communities (eg fishing clubs ect) | "Cottoning onto the great outdoors" photo comp with AG show societies. Kayak/canoe trips, wildlife discovery tours, bird watching ect | 100 people attending and/or participating in 7 activities across 7 regions | Increased NRM capacity | Jun-17 | 80% of attendees respond in evaluation survey that they have increased knowledge NRM best practice |
| | | Assess and monitor the health of native vegetation on your farm | The Birds on Cotton farm Id book is extremely popular even 5 years after it was first published. However technology has progressed significantly in that time and many growers are using smart pone technology to access information and collate data. | Capacity to implement NRM activities on-ground especially where there is no obvious production benefit. The propossed app will also have a simple monitoring tool allowing growers to monitor birds on their farm. Birds number and richness are good indicators of vegetation health. | Increased number of growers using industry NRM Id and monitoring tools and increased health of biodiversity | All cotton community | Update the very successful Birds on cotton farms book so that it is more accessible to growers who are using smart phone technology to access information. This format will also allow us to include a very simple monitoring tool which will allow growers and the industry to collect some information about what birds are being currently found on | Growers, consultants, RDO's | Development of a smart phone APP | Stacey Vogel | researchers such as Rhiannon Smith & Adam Smith from UNE. NWLLS, Auscott & Namoi Cotton | Birds on cotton Farm App | 100 downloads of App and 20 growers monitoring birds | Increased grower knowledge of birds and their habitat requirements on cotton farms. Increased industry knowledge of what birds are occurring on cotton farms | Jun-16 | 100 dowloads of App and 20 growers monitoirng bird numbers |
| **Extension foundations** | myBMP Adoption | | myBMP serves three functions of ensuring growers are farming responsibly, are able to access international market opportunities and have access to industry defined best management practices | Currently 40% of the industry is activity involved in myBMP. The industry has a target of 60% having completed level one of myBMP. | This would demonstrable commitment of the industry to responsible farming and provide accredited cotton for markets. | Involves compliance with government set regulation, marketing programs such as BCI and working with module leads and researchers to maintain best practice definition. | myBMP content is reviewed and updated annually by module leads. Best practices in myBMP underpin the practice change targeted by the CottonInfo program and provides access to on line resources to support those practices. | Growers | myBMP is integrated with extension activities as the source of best practice definition and resources to support change on farm. Annually a forum is held to provide module leads with an opportunity to share updates and for RDO's to be informed of new resources and functionality. | CI Manager and myBMP Manager | Module leads, RDO's and CA RM's. | | | Increased grower adoption of best practice as defined and supported by the resources in myBMP. | Oct-15 | 60% of growers registered and completed level one of myBMP. |
| | Regional extension foundations | | For effective extension engagement, regional networks and relationships need to be fostered and developed | The CottonInfo program is relatively new and the role of the team is still being developed and understood by regional cotton communities | Strong networks enable information flow and resilient communities | Cotton growers and near farm professionals and their organisations | Participation by RDO's and Tech Specialists in appropriate industry organisations and events, and supporting visiting researchers and cotton professionals. | Growers, consultants, near farm professional organisations | Coordinating with CA and CSD, supporting research activity at a regional level, contributing to regional organisations as required, | RDO's | Regional organisations | Involvement in regional activities that support networks and key relationships | | Stronger networks and improved information flows within regions. | Jun-15 | RDO's are recognised as the regional option for connecting research with growers and consultants. |

# **CottonInfo** technical specialist summary July 2015

**Name:** Stacey Vogel

**Technical specialist for:** Natural Resource Management

**Contact details:**
M:0428 266 712
E: staceyvogel.consulting@gmail.com

**Key messages for the season:** *What are the top 3-5 messages that you want the CottonInfo team to know/disseminate about your topic area for the 2015-16 season? List these below.*

1. The new Birds on Cotton Farm App is available for iOS and Android smart phones in August 2015 and can be used to identify, manage and monitor birds in cotton landscapes.
2. Riparian vegetation plays an important role in supporting sustainable agricultural production through the provision of services such as clean good quality water, erosion control and bank stability, carbon storage and sequestration and habitat for beneficial animals (IPM).
3. Land management practices directly impact on the condition of riparian land and hence the value of the services it can provide a farming business.
4. Planted native vegetation barriers (permanent and temporary) can be a useful tool for managing spray drift. Remnant native vegetation is NOT a vegetative barrier or buffer and BMP's for spray application should be implemented to protect these areas from spray drift. http://www.cottoninfo.com.au/publications/nrmpesticide-input-efficiency-using-vegetative-barriers-minimise-spray-drift-cotton

**Key activities:** *What are the key activities that you will be engaging in? Do you require any input/support from other members of the CottonInfo team? List these below.*

- Extending the Birds on Cotton farm App (release Feb 2016). The Cottoninfo team can assist by using the monitoring tool within the App when out in the field and encourage people within cotton landscapes to use the App as well.
- Developing and implementing a survey matrix to benchmark growers current management of riparian areas on cotton farms and the factors that influence their long-term commitment to on-going active management. The CottonInfo team can assist through undertaking the survey with local growers and/or helping the survey team identify growers who would be willing to participate in the survey.
- "Cottoning onto the great outdoors" – a series of family based extension events showcasing the natural environment in cotton landscapes will be run over the next 12 months in NSW & QLD. The cottonInfo team can assist by identifying local "social networks' of growers and their families who may be interested in participating in activities such as kayaking, bird watching, evening wildlife spotlight nights etc
- RiverCare Champion Project (Mark Palfreyman, "Tallwood"). Through demonstration of good riparian practice increase the industries awareness of the value of riparian land and engage them in the concept of RiverCare ie good riparian stewardship. CottonInfo can assist by extending extension messages sent out through NRM technical specialist through their own networks.

**Outcomes sought:** *What are the key outcomes you are seeking from your activities? List these below.*

- 100 unique users downloads of the Bird App and 20 unique users monitoring birds in cotton landscapes by June 2016.
- Benchmark of current practice on cotton farms managing riparian areas. Improved data for setting and implementing industry targets for riparian condition and best practice.
- 100 people with improved knowledge of BMP's for biodiversity management across 2 cotton growing catchments

**Key research projects underway:** *What are the key research projects underway in your area that are specifically relevant for the CottonInfo team re extension?*

The impact of improved water use efficiency on paddock and catchment health in the Border rivers Condamine Balonne areas – Dr Andrew Biggs (QDNR)
Summary of research and contact details at
http://cottoninfo.com.au/publications/focus-nrm-research-how-can-trees-intercept-salinity

Managing riparian corridors on cotton farms for multiple benefits, *relevant to all areas* – Dr Rhiannon Smith (UNE)
Summary of research and contact details at
http://cottoninfo.com.au/publications/focus-nrm-research-river-red-gums-cotton-landscapes

Critical thresholds for riparian vegetation regeneration in the northern Murray-Darling Basin – Dr Sam Capon (Griffith Uni)
Summary of research and contact details at
http://cottoninfo.com.au/publications/focus-nrm-research-riparian-vegetation-and-land-management

# **CottonInfo** technical specialist summary May 2016

**Name:** Stacey Vogel

**Technical specialist for:** Natural Resource Management

**Contact details:**
M:0428 266 712
E: staceyvogel.consulting@gmail.com

**Key messages for the season:** *What are the top 3-5 messages that you want the CottonInfo team to know/disseminate about your topic area for the 2016-17 season? List these below.*

1. The new Birds on Cotton Farm App is available for iOS and Android smart phones iis available and can be used to identify, manage and monitor birds in cotton landscapes.
2. CottonInfo has launched Cotton RiverCare which is a program that promotes and supports responsible management of riverine areas within cotton growing regions of Australia, further information and links to our facebook and twitter sites can be found under tools & trials on the CottonInfo website.
3. Riparian vegetation plays an important role in supporting sustainable agricultural production through the provision of services such as clean good quality water, erosion control and bank stability, carbon storage and sequestration and habitat for beneficial animals (IPM).
4. Woody thickening (shrubby fast growing woody species) in riparian woodlands, can be strongly influenced by the amount of canopy and litter cover. Minimizing clearing and grazing impacts on litter and canopy cover in riparian woodlands can help reduce the process of woody thickening as well as the establishment of weeds.

http://www.cottoninfo.com.au/publications/focus-nrm-research-riparian-vegetation-and-land-management

5. Planted native vegetation barriers (permanent and temporary) can be a useful tool for managing spray drift. Remnant native vegetation is NOT a vegetative barrier or buffer and BMP's for spray application should be implemented to protect these areas from spray drift. http://www.cottoninfo.com.au/publications/nrmpesticide-input-efficiency-using-vegetative-barriers-minimise-spray-drift-cotton

**Key activities:** *What are the key activities that you will be engaging in? Do you require any input/support from other members of the CottonInfo team? List these below.*

- **Extending the Birds on Cotton farm App**. The Cottoninfo team can assist by using the monitoring tool within the App when out in the field and encourage people within cotton landscapes to use the App as well.
- **"Cottoning onto the great outdoors" – a series of family based extension events** showcasing the natural environment in cotton landscapes will be run over the next 12 months in NSW & QLD across 3 catchments. The cottonInfo team can assist by identifying local "social networks' of growers and their families or regional organisations and groups who may be interested in participating in activities such as kayaking, bird watching, evening wildlife spotlight nights etc
- **Cotton RiverCare Project** (Mark Palfreyman, "Tallwood"). Through showcasing the diversity of native species on a cotton farms and demonstrating good riparian practice,

increase the industry and general publics awareness of the value of riparian land on cotton farms. CottonInfo can assist by promoting the facebook and twitter site as sources for more information. Follow the links from http://www.cottoninfo.com.au/cotton-rivercare

- Kathryn Korbel from Macquarie University is developing a **groundwater health index.** Over the next few months I will be seeking help from the team to identify 6 growers in 2 valleys (Namoi & Border rivers) who would be happy to participate in a trial to develop a practical and affordable groundwater health tool for the cotton industry.

**Outcomes sought:** *What are the key outcomes you are seeking from your activities? List these below.*

- 100 unique users downloads of the Bird App and 20 unique users monitoring birds in cotton landscapes between June 2016 and June 2017.
- 500 likes of the Cotton Rivercare facebook page and 100 followers on twitter
- 100 people with improved knowledge of BMP's for biodiversity/riparian management across 3 cotton growing catchments
- 6 growers participating in a trial to develop a groundwater health tool.

**Key research projects underway:** *What are the key research projects underway in your area that are specifically relevant for the CottonInfo team re extension?*

Critical thresholds for riparian vegetation regeneration in the northern Murray-Darling Basin – Dr Sam Capon (Griffith Uni)
Summary of research and contact details at
http://cottoninfo.com.au/publications/focus-nrm-research-riparian-vegetation-and-land-management

Groundwater ecosystem functioning and potential impacts
Dr Kathryn Korbel (University of Macquarie)
http://www.cottoninfo.com.au/publications/focus-nrm-research-new-and-rare-species-stygofauna-our-aquifers

Evaluating the Extent of Hydraulic Connectivity Between the Great Artesian Basin and the Lower Namoi Alluvium A/Prof Bryce Kelly (UNSW)
http://www.cottoninfo.com.au/publications/nrm-focus-nrm-research-evaluating-extent-hydraulic-connectivity-between-great-artesian

Grazing in Riparian areas can lead to increased weed establishment, erosion and loss of wildlife habitat.

Mark Palfreyman, Cotton rivercare champion, recently made the decision to remove grazing from his riparian areas. Mark hopes this decision will reduce loss of habitats such as logs (via trampling), allow more regeneration and improve groundcover and litter helping to suppress weed establishment and reduce erosion along his riverbanks.

To help monitor the impact of removing grazing Mark with the help of CottonInfo's NRM Technical Specialist Stacey Vogel has established two permanent vegetation monitoring points. Site 1 has had minimal grazing and site 2 has a long term history of grazing.

Site 1: Minimal history of grazing

Site 2: Moderately grazed

As can be seen from these photos site 1 has a good cover of litter with lots of fallen logs, few weeds and many trees and shrubs. Site 2 in comparison has very little litter and fallen logs and is dominated by the weed Lippia. Site 2 also has less trees and shrubs reducing the production of litter and fallen logs at the site.

The importance of litter in suppressing weed establishment was recently highlighted in a CRDC funded project by Dr Sam Capon and Stephen Balcombe from the University of Griffith. Their research also highlighted the role litter plays in assisting germination of riparian woody vegetation and the negative impact grazing intensity can have on riparian vegetation structure and litter loads.

A fauna survey recently undertaken on "Taraba" by ecologist Phil Spark found a good diversity of species on and around the farm with 131 species identified. However the abundance of each of these species was quiet low, which is a trend across Australia due largely to vegetation fragmentation and habitat loss. Many species of fauna live and shelter in large logs or rely on native groundcover such as tussocky grass for shelter and food. Grazing via trampling and selective

browsing reduces groundcover and litter as well as the potential for native vegetation species to germinate and establish.

How can I reduce the impacts from my stock?

- Exclude stock or reduce grazing pressure
- Fence riparian areas off from stock
- Provide alternative watering points for stock
- Leave large fallen logs (>10cm) as habitat and erosion control structures
- Monitor and assess your own groundcover
- Control weeds, especially in area of low groundcover

**For further information**

Riparian Vegetation and land management – Dr Sam Capon and Stephen Balcombe University of Griffith
http://www.cottoninfo.com.au/sites/default/files/documents/NRM%20researcher%20summaries%20-%20Riparian%20vegetation%20-%20June%202016.pdf

"Taraba" Fauna survey results – CottonInfo blog

Assess and monitor your groundcover - myBMP Sustainable Landscapes (natural assets) Maintain groundcover standard and supporting resources.

Native vegetation monitoring – permanent photo points - https://www.youtube.com/watch?v=xFTE246xpkg

| | |
|---|---|
| **Property:** | Tabara |
| **Date:** | 3/02/2016 |
| **Site:** | 1 (river) |
| **Recorder:** | Stacey Vogel/Rhiannon Smith |
| **Management:** | No dieback, Lots of different age classes (excellent condition), some erosion on riverbacnk, lots of lippia |

| | | |
|---|---|---|
| | | Noticable lack of birds |
| **Regional Vegetation Class** | Namoi RVC - (78) Coolibah - river coobah - lignum woodlands | 11.3.15 QLD RE- Coolibah, Ac Stenophylla, lignum fringing woodlands on alluvial plains |

**Baseplot (50 x 20m)**

| | |
|---|---|
| Number of native canopy species mature: | 3 |
| regenration (dbh < 5cm) | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Number of large callitris (incl. dead trees) cm dbh: | 0 | | | | |
| Number of other large trees (incl. dead trees) cm dbh: | 3 | | | | |
| Number of trees with hollows - (incl. dead trees): | 7 | | | | |
| Length of dead fallen timber (diameter >10cm and length >50cm): | 40m | | | | |
| Canopy health (% of expected canopy in good condition): | 90% | | | | |
| Reason | | | | | |
| Canopy species (note order of dominance): | Coolibah | River red gum | Melaleuca Trichostachya | | |
| Tall shrubs/midstorey: | Eremophila bignoniiflora (eurah) | Acacia Stenophylla | Whitewood | Myoporum montanum (boobialla) | Pittosporum angustifolium (Butter Bush) |
| Species adjacent to plot: | Casuarina cristata (belah) | Acacia Salicina | | | |

## Subplot (20 x 20m)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of native shrub and small tree species (>1m high): | 3 | | | | | | | | | |
| Names: | lignum | mimosa | Eremophila maculata spotted (Emu bush) | | | | | | | |
| Number of native groundcover species: | 27 | | | | | | | | | |
| Names: | asperula conferta (common woodruff) | New Zealand spinach | Warrego summer grass | black roly poly | caustic weed | tar vine | altananthera denticulata (lesser joyweed) | malvastrum americanum | Ixiolaena brevicompta (flat billy buttons) | Craspedia spp. (billy buttons) |

| **2.5m radius around points along transect** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Projected foliage cover (%)** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **P8** | **P9** | **P10** |
| Native canopy | 5 | 0 | 5 | 10 | 40 | 40 | 45 | 50 | 70 | 50 |
| Native midstorey >1m | 5 | 5 | 0 | 5 | 15 | 20 | 10 | 15 | 15 | 15 |
| Weeds canopy & midstorey | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Quadrats (1 x 1m) along transect** | | | | | | | | | | |
| **Ground Cover %** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q10** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Native groundcover (plants <1m) | 5 | 5 | 20 | 5 | 5 | 30 | 45 | 15 | 5 | 5 |
| Weeds (plants <1m) | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 0 |
| Mosses and lichens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Organic litter | 20 | 70 | 5 | 85 | 95 | 55 | 45 | 75 | 85 | 85 |
| Rock/bare ground | 75 | 25 | 75 | 10 | 0 | 5 | 5 | 5 | 5 | 10 |
| **Total (%)** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| verbena spp. | enteropogon acicularis (windmill grass) | fleabane | sporobolus caroli | salsola kali | Ipomea lonchophylla (peach vine) | Haloragus glauca | minuria (type daisy) | Goodenia glauca (pale goodenia) | Golden goosefoot | Amulla | Nardoo | Native sensitive grass | neptunia gracilis |

clumped bindweed

Rhyncho

Quina

| | |
|---|---|
| **Property:** | Tabara |
| **Date:** | 30216 |
| **Site:** | 2 (creek) |
| **Recorder:** | Stacey Vogel/Rhiannon Smith |
| **Management:** | Grazing removed |

Channel width 15-20m steep eroding banks
No dieback, lots of different age classes of trees. Very Good Condition

| | | |
|---|---|---|
| **Regional Vegetatio Class** | (73) River Red Gum Riverine woodland forest | 13.3.5 QLD RE -RRG fringing open forest |
| **Baseplot (50 x 20m)** | | |

| | | |
|---|---|---|
| Number of native canopy species mature: | | 3 |
| regenration (dbh < 5cm) | | 3 |
| Number of large callitris (incl. dead trees) cm dbh: | | 0 |
| Number of other large trees (incl. dead trees) 10cm dbh: | | 9 |
| Number of trees with hollows - (incl. dead trees): | | 5 |
| Length of dead fallen timber (diameter >10cm and length >50cm): | 30m | |
| Canopy health (% of expected canopy in good condition): | | 80 |

| | | | | | |
|---|---|---|---|---|---|
| | Reason | | | | |
| Canopy species (note order of dominance): | Coolibah | River red gum | Melaleuca trichostachya | | |
| Tall shrubs/midstorey: | Acacia Stenophylla | Whitewood | Acacia Salicina | Geijera parviflora (wilga) | |
| Species adjacent to plot: | Rosewood | | | | |

## Subplot (20 x 20m)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of native shrub and small tree species (>1m high): | 2 | | | | | | | |
| Names: | lignum | mimosa | | | | | | |
| Number of native groundcover species: | 21 | | | | | | | |
| Names: | Chloris truncata | New Zealand Spinach | Tarvine | Black rolypoly | Golden goosefoot | Warego summer grass | Ammulla | Nardoo |
| Weeds | Lippia | Fleabane | | | | | | |

## 2.5m radius around points along transect

| **Projected foliage cover (%)** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **P8** |
|---|---|---|---|---|---|---|---|---|
| Native canopy | 60 | 65 | 40 | 30 | 30 | 10 | 5 | 30 |
| Native midstorey >1m | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Weeds canopy & midstorey | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Quadrats (1 x 1m) along transect

| Ground Cover % | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| Native groundcover (plants <1m) | 0 | 5 | 10 | 20 | 20 | 50 | 5 | 10 |
| Weeds (plants <1m) | 90 | 85 | 60 | 10 | 20 | 0 | 20 | 25 |
| Mosses and lichens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Organic litter | 10 | 10 | 30 | 65 | 50 | 35 | 65 | 40 |
| Rock/bare ground | 0 | 0 | 0 | 5 | 10 | 15 | 10 | 25 |
| **Total (%)** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** |

## QLD biocondition site assessment datasheet

**50x20m area**

CWD total length 75m

**100x50m area**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total number of tree species single stem over 2m | RRG | Coolibah | Rosewood | Tea Tree | Whitewood | Acacia Salicina | wilga | acacia stenop |
| Proportion of dominant canopy (EDL) species with evidence of recruitment % | | | | | | | | |

**50 X 100m area: Native Plant Spp richness**

| | | | | | | |
|---|---|---|---|---|---|---|
| shrub | a. saliciana | a. stenophylla | whitewood | wilga | lignum | mimosa |

**Grass spp richness**

same as Namoi

**Forbs and other spp richness**

same as Namoi

| | |
|---|---|
| **Non-native plant cover (%)** | 80% |
| **Euc large tree DBH** | 80 |
| **No. of large euc trees:** | 14 |
| **No of large non-euc trees:** | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sporobolus mitchellii | caustic weed | Austris danthonia (Wallaby | Lxiolaena brevicompta | Digitaria divaricatissima | Abutilon oxycarpum | Paspalidium C | Entero pogon acrcularis | carex inversa | Verbena | eryrigium plantagirian | climbing saltbush | ruby saltbush |

| **P9** | **P10** |
|---|---|
| 50 | 5 |
| 0 | 0 |
| 0 | 0 |

| Q9 | Q10 |
|---|---|
| 5 | 10 |
| 0 | 15 |
| 0 | 0 |
| 5 | 65 |
| 90 | 10 |
| **100** | **100** |

# Ecological Benchmarks RVC - RRG (RVC 73) - site 2 Coomonga Creek

| | | benchmark | 30216 |
|---|---|---|---|
| ***50x20m plot*** | | | |
| Large tree diameter (cm) | | **80** | |
| Large *Callitris* diameter (cm) | **NA** | | |
| Number of large trees | | **5** | 4? |
| Number of large *Callitris* trees | **NA** | | |
| Number of trees with hollows | | **7** | 5 |
| Length of coarse woody debris (m) | | **70** | 30 |
| Native species richness (canopy) | | **2** | 3 5 |
| Native species richness (canopy recruitment) | | **2** | 3 |

| | benchmark | 30216 |
|---|---|---|
| ***20x20m sub-plot*** | | |
| Native species richness (midstorey) | **3** | 3 5 |
| Native species richness (groundcover) | **20** | 21 5 |
| ***Transect points*** | | |
| Native canopy cover (%) | **25** | 31 |
| Native midstorey (shrub) cover (%) | **10** | 10.5 |
| Native groundcover (%) | **35** | 14.5 |
| Mosses/lichen cover (%) | **0** | 0 |
| Organic litter cover (%) | **35** | 62 |
| Rock/bare ground cover (%) | **30** | 20.6 |

75% condition score of benchmark

| | | |
|---|---|---|
| *Species richness (canop, midstorey &* | **15** | **15** |
| *canopy cover %* | **10** | **10** |
| *shrub cover %* | **5** | **5** |
| *NV groundcover%* | **15** | **6** |
| *OM cover % (1x1m plots)* | **5** | **5** |
| *Weed % (1x1m plots)* | **15** | **3** |
| *No. Large trees* | **15** | **13** |

| | | |
|---|---|---|
| *Hollows in trees* | **5** | **5** |
| *Tree regenerating overstorey* | **10** | **10** |
| *CWD* | **5** | **3** |
| | **100%** | **75%** |

*NV groundcover % low and high*

## Ecological Benchmarks RVC - Coolibah-River cooba - Lignum (RVC 78) - Site 1 MacIntyre River

| | | benchmark 30216 | |
|---|---|---|---|
| ***50x20m plot*** | | | |
| Large tree diameter (cm) | | **60** | |
| Large *Callitris* diameter (cm) | **NA** | | |
| Number of large trees | | **4** | 3 |
| Number of large *Callitris* trees | **NA** | | |
| Number of trees with hollows | | **5** | 7 |
| Length of coarse woody debris (m) | | **20** | 40 |
| Native species richness (canopy) | | **2** | 3 |
| Native species richness (canopy | | **2** | 3 |

86% condition score of benchmark

| | | |
|---|---|---|
| *Species richness (canop, midstorey &* | **15** | **15** |
| *canopy cover %* | **10** | **10** |
| *shrub cover %* | **5** | **5** |
| *NV groundcover%* | **15** | **6** |
| *OM cover % (1x1m plots)* | **5** | **5** |

| | benchmark 30216 | |
|---|---|---|
| ***20x20m sub-plot*** | | |
| Native species richness (midstorey) | **2** | 4 |
| Native species richness (groundcover) | **20** | 27 |
| ***Transect points*** | | |
| Native canopy cover (%) | **15** | 31.5 |
| Native midstorey (shrub) cover (%) | **10** | 10.5 |
| Native groundcover (%) | **30** | 14 |
| Mosses/lichen cover (%) | **0** | 0 |
| Organic litter cover (%) | **30** | 62 |
| Rock/bare ground cover (%) | **40** | 21.5 |

| | | |
|---|---|---|
| *Weed % (1x1m plots)* | **15** | **12** |
| *No. Large trees* | **15** | **13** |
| *Hollows in trees* | **5** | **5** |
| *Tree regenerating overstorey* | **10** | **10** |
| *CWD* | **5** | **5** |
| | **100%** | **86%** |

*Native groundcover % low*

| | |
|---|---|
| **Property:** | Tabara |
| **Date:** | 2010162 |
| **Site:** | (creek) |
| **Recorder:** | Stacey Vogel |
| **Management:** | Grazing removed |

Channel width 15-20m steep eroding banks recent flooding and rain
No dieback, lots of different age classes of trees. Despite

**Baseplot (50 x 20m)**

| | | | |
|---|---|---|---|
| Number of native canopy species mature: | 4 | | |
| regenration (dbh < 5cm) | 3 | | |
| Number of large callitris (incl. dead trees) cm dbh: | 0 | | |
| Number of other large trees (incl. dead trees) 80cm dbh: | 6 | | |
| Number of trees with hollows - (incl. dead trees): | 5 | | |
| Length of dead fallen timber (diameter >10cm and length >50cm): | 56m | | |
| Canopy health (% of expected canopy in good condition): | 75 | | |
| Reason | | | |
| Canopy species (note order of dominance): | Cooliba h | River red gum | Melale uca trichost achya |

| | | | | |
|---|---|---|---|---|
| Tall shrubs/midstorey: | Acacia Stenophylla | Whitewood | Acacia Salicina | Geijera parviflora (wilga) |
| Species adjacent to plot: | Rosewood | | | |

## Subplot (20 x 20m)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of native shrub and small tree species (>1m high): | 2 | | | | | | | | | | | |
| Names: | lignum | mimosa | | | | | | | | | | |
| Number of native groundcover species: | 22 | | | | | | | | | | | |
| Names: | orchid | New Zealand Spinach | Tarvine | Black rolypoly | Golden goosefoot | red grass? | Ammulla | Nardoo | Sporobolus mitchellii | caustic weed | rush sp. | Lxiolaena brevicompta (yellow daisy) |
| Weeds | Lippia | Fleabane | milk thistle | peppercress? | wood sorell | | | | | | | |

## 2.5m radius around points along transect

| Projected foliage cover (%) | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Native canopy | 60 | 65 | 40 | 30 | 30 | 10 | 5 | 30 | 50 | 5 |
| Native midstorey >1m | 0 | 10 | 5 | 20 | 5 | 5 | 0 | 5 | 0 | 0 |
| Weeds canopy & midstorey | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Quadrats (1 x 1m) along transect

| Ground Cover % | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Native groundcover (plants <1m) | 5 | 5 | 5 | 50 | 25 | 10 | 0 | 0 | 5 | 0 |
| Weeds (plants <1m) | 95 | 95 | 80 | 0 | 0 | 25 | 35 | 35 | 0 | 30 |
| Mosses and lichens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Organic litter | 0 | 0 | 15 | 50 | 75 | 55 | 55 | 25 | 20 | 10 |
| Rock/bare ground | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 40 | 75 | 60 |
| **Total (%)** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** |

| Water Test on Coomonga Creek | pH | EC | Phosphate | Nitrate |
|---|---|---|---|---|
| | 6 | 260us | 0.16MB | faulty equipment no result |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Digitaria divaricatissima | blue bell | galvanised bur | clumped bindweed | tall purple gflower | climbing saltbush | ruby saltbush | Pale goodenia | ? |

| Water Test on Coomonga Creek | pH | EC | Phosphate | Nitrate |
|---|---|---|---|---|
| | 6 | 260us | 0.16MB | faulty equipment no result |

| Sp Code | Common Name | Scientific Name | Status | Recorded | | | | |
|---|---|---|---|---|---|---|---|---|
| T1000 | Goldfish | *Carassius auratus* | Exotic | few | | 30/03/2015 | 30/03/2015 | 1 |
| T044 | Carp | *Cyprinus carpio* | Exotic | 100's | | 2/10/2012 | 2/10/2012 | 3 |
| T217 | Murray Cod | *Maccullochella peelii* | Vul EPBC | nil | | 11/07/2008 | 11/07/2008 | 10 |
| T310 | Golden Perch | *Macquaria ambigua* | | | 3 | 23/05/2012 11:46 | 23/05/2012 11:46 | 2 |
| T018 | Redfin Perch | *Perca fluviatilis* | Exotic | nil | | 4/12/2013 | 4/12/2013 | 3 |
| T060 | Silver Perch | *Bidyanus bidyanus* | Vul | | 1 | 11/07/2008 | 11/07/2008 | 1 |
| T1001 | Western Carp Gudgeon | *Hypseleotris klunzingeri* | | | 10 | 5/11/2013 | 5/11/2013 | 4 |
| T055 | Flathead gudgeon | *Philypnodon grandiceps* | | nil | | 3/12/2013 | 3/12/2013 | 7 |
| T904 | Dam Yabby | *Cherax destructor* | | | 1 | 5/11/2013 | 5/11/2013 | 6 |
| T013 | Mosquito Fish | *Gambusia holbrooki* | | nil | | 2/04/2009 16:00 | 2/04/2009 16:00 | 10 |
| T1038 | Gambusia | *Gambusia sp.* | | nil | | 5/11/2013 | 5/11/2013 | 13 |
| T051 | Australian Smelt | *Retropinna semoni* | | | 6 | 23/05/2012 10:44 | 23/05/2012 10:44 | 2 |
| T361 | Bony Bream | *Nematalosa erebi* | | | 20 | | | |
| T1020 | Freshwater Catfish | *Tandanus tandanus* | Vull population | nil | | | | |
| Nil | Silver Catfish - Moonfish | *Neosilurus hyrtlii* | | | 1 | | | |
| T360 | Murray Darling Rainbowfish | *Melanotaenia fluviatilis* | | | 20 | | | |
| nil | Freshwater Prawn | *Macrobrachium australiense* | | 1,000's | | | | |
| T1018 | Shrimp | *Paratya australiensis* | | nil | | | | |

| Family | Species Code | *Scientific Name* | Common Name | Legal Status | Count | Preferred habitat to enhance and |
|---|---|---|---|---|---|---|
| Acanthizidae | 471 | *Acanthiza nana* | Yellow Thornbill | P | 1 | dry shrubland, woodlands & open forests |
| Acanthizidae | 476 | *Acanthiza apicalis* | Inland Thornbill | P | 2 | dry shrubby woodlands & open forests |
| Acanthizidae | 465 | *Smicrornis brevirostris* | Weebill | P | 2 | grassy woodlands & open forests |
| Accipitridae | 224 | *Aquila audax* | Wedge-tailed Eagle | P | 1 | widespread, nests in remnants, forages across landscape |
| Accipitridae | 226 | *Haliaeetus leucogaster* | White-bellied Sea-Eagle | Mig EPBC | 1 | proximity to large dams, and rivers |
| Accipitridae | 228 | *Haliastur sphenurus* | Whistling Kite | P | 2 | grassy open woodlands, woodlands & open forests |
| Anatidae | 211 | *Anas gracilis* | Grey Teal | P | 2 | ephemeral or permanent water body, rivers, creeks, breeds in hollows |
| Anatidae | 208 | *Anas superciliosa* | Pacific Black Duck | P | 2 | ephemeral or permanent water body, rivers, creeks, breeds in hollows |
| Anatidae | 202 | *Chenonetta jubata* | Australian Wood Duck | P | 6 | pasture paddocks and open woodlands in the proximity of dams & streams |
| Anatidae | 205 | *Dendrocygna eytoni* | Plumed Whistling-Duck | P | 20 | dams, wetlands, floodplains, irrigated paddocks, crops, streams |
| Anhingidae | 101 | *Anhinga melanogaster* | Darter | P | 2 | large shallow waters, lakes, swamps, lagoons |
| Ardeidae | 188 | *Egretta novaehollandiae* | White-faced Heron | P | 1 | shallow freshwaters, clay pans, farm dams, flooded pastures |
| Ardeidae | 185 | *Egretta garzetta* | Little Egret | P | 1 | shallow wetlands and dams |
| Ardeidae | 189 | *Ardea pacifica* | White-necked Heron | P | 2 | shallow freshwaters, clay pans, farm dams, flooded pastures |
| Ardeidae | 186 | *Ardea intermedia* | Intermediate Egret | P | 4 | wetlands, pastures, crops, floodplains |
| Ardeidae | 192 | *Nycticorax caledonicus* | Nankeen Night Heron | P | 10 | shallow margins of streams and wetlands, flooded pastures |
| Artamidae | 702 | *Cracticus torquatus* | Grey Butcherbird | P | 1 | grassy & multilayered woodlands and open forests, paddocks |
| Artamidae | 543 | *Artamus leucorynchus* | White-breasted Woodswallow | P | 2 | grassy open woodlands, watercourses, wetlands |
| Artamidae | 705 | *Gymnorhina tibicen* | Australian Magpie | P | 2 | grassy open woodlands - open forests, watercourses, paddocks |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cacatuidae | 269 | *Cacatua galerita* | Sulphur-crested Cockatoo | P | 10 | woodlands, open forest, watercourses, crops |
| Cacatuidae | 271 | *Cacatua sanguinea* | Little Corella | P | 10 | grasslands, woodlands, watercourses, crops |
| Cacatuidae | 273 | *Eolophus roseicapillus* | Galah | P | 10 | grasslands, woodlands, watercourses, crops |
| Campephagidae | 424 | *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | P | 1 | grassy open woodlands - open forests, watercourses |
| Campephagidae | 430 | *Lalage tricolor* | White-winged Triller | P | 2 | grassy open woodlands - open forests, watercourses |
| Casuariidae | 1 | *Dromaius novaehollandiae* | Emu | P | 1 | grasslands, woodlands, open forests, paddocks |
| Charadriidae | 133 | *Vanellus miles* | Masked Lapwing | P | 4 | paddocks, margins of flood ways, dams, claypans |
| Climacteridae | 555 | *Climacteris picumnus* | Brown Treecreeper | P | 2 | dry grassy woodlands and open forests, hollows |
| Columbidae | 957 | *Columba livia* | Feral Pigeon | Introduced | 1 | urban & agricultural areas, woodlands, paddocks |
| Columbidae | 32 | *Geopelia humeralis* | Bar-shouldered Dove | P | 2 | grassy & shrubby woodlands, watercourses, |
| Columbidae | 30 | *Geopelia placida* | Peaceful Dove | P | 4 | grassy & shrubby woodlands, watercourses, |
| Columbidae | 43 | *Ocyphaps lophotes* | Crested Pigeon | P | 6 | grassy open woodlands, woodlands |
| Coraciidae | 318 | *Eurystomus orientalis* | Dollarbird | P | 1 | grassy woodlands & open forests, paddocks, hollows |
| Corcoracidae | 693 | *Corcorax melanorhamphos* | White-winged Chough | P | 1 | dry shrublands, open woodlands - open forests, paddocks, watercourses |
| Corvidae | 930 | *Corvus coronoides* | Australian Raven | P | 1 | open plains, open woodlands - open forests, paddocks, watercourses |
| Cuculidae | 348 | *Scythrops novaehollandiae* | Channel-billed Cuckoo | P | 1 | paddocks |
| Dicaeidae | 564 | *Dicaeum hirundinaceum* | Mistletoebird | P | 1 | grassy & multilayered woodlands/open forests, heaths, mistletoe |
| Dicruridae | 364 | *Rhipidura leucophrys* | Willie Wagtail | P | 1 | dry grassy open woodlands & open forests, watercourses |

| | | | | | | |
|---|---|---|---|---|---|---|
| Dicruridae | 415 | *Grallina cyanoleuca* | Magpie-lark | P | 2 | grassy open woodlands - open forests, watercourses, paddocks |
| Dicruridae | 728 | *Myiagra inquieta* | Restless Flycatcher | P | 2 | dry grassy woodlands & open forests, watercourses |
| Halcyonidae | 322 | *Dacelo novaeguineae* | Laughing Kookaburra | P | 1 | grassy woodlands & open forests, paddocks, hollows |
| Halcyonidae | 326 | *Todiramphus sanctus* | Sacred Kingfisher | P | 2 | grassy woodlands & open forests, paddocks, hollows |
| Maluridae | 529 | *Malurus cyaneus* | Superb Fairy-wren | P | 1 | shrub associations in woodlands, open forests, heath |
| Meliphagidae | 634 | *Manorina melanocephala* | Noisy Miner | P | 1 | dry grassy open woodlands, woodlands |
| Meliphagidae | 646 | *Philemon citreogularis* | Little Friarbird | P | 1 | grassy woodlands & open forests, nectar |
| Meliphagidae | 585 | *Plectorhyncha lanceolata* | Striped Honeyeater | P | 1 | dry grassy and multilayered woodlands & open forests |
| Meropidae | 329 | *Merops ornatus* | Rainbow Bee-eater | Mig EPBC | 1 | grassy woodlands & open forests, paddocks, burrows |
| Motacillidae | 647 | *Anthus novaeseelandiae* | Richards Pipit | P | 1 | plains grassland, shrubland, open woodland, crop paddocks |
| Oriolidae | 671 | *Oriolus sagittatus* | Olive-backed Oriole | P | 1 | grassy & multilayered woodlands & open forests |
| Pachycephalidae | 408 | *Colluricincla harmonica* | Grey Shrike-thrush | P | 1 | forests |
| Pardalotidae | 976 | *Pardalotus striatus* | Striated Pardalote | P | 1 | grassy & multilayered woodlands & open forests, hollows |
| Petroicidae | 392 | *Eopsaltria australis* | Eastern Yellow Robin | P | 1 | forests |
| Petroicidae | 377 | *Microeca fascinans* | Jacky Winter | P | 1 | grassy open woodland, woodland, shrubland, paddocks |
| Phalacrocoracidae | 97 | *Phalacrocorax sulcirostris* | Little Black Cormorant | P | 2 | bays, mangroves, rivers, swamps, lakes |
| Phalacrocoracidae | 100 | *Phalacrocorax melanoleucos* | Little Pied Cormorant | P | 4 | large and small rivers, dams, mangroves, swamps, lakes |
| Phasianidae | 11 | *Coturnix ypsilophora* | Brown Quail | P | 1 | grasslands, open woodlands, woodlands, crops |
| Podargidae | 313 | *Podargus strigoides* | Tawny Frogmouth | P | 1 | grassy woodlands & open forests |
| Psittacidae | 295 | *Psephotus haematonotus* | Red-rumped Parrot | P | 4 | grassy open woodland & woodland, hollows |
| Rallidae | 56 | *Gallinula tenebrosa* | Dusky Moorhen | P | 2 | rivers, swamps, water storages, wetlands |

| | | | | | | |
|---|---|---|---|---|---|---|
| Strigidae | 242 | *Ninox boobook* | Southern Boobook | P | 1 | open woodlands, woodlands, open forests, hollows |
| Strigidae | 246 | *Ninox connivens* | Barking Owl | Vul TSC | 1 | open woodlands, woodlands, open forests, hollows |
| Sturnidae | 998 | *Acridotheres tristis* | Common Myna | Introduced | 1 | grassy open woodland, woodland, urban areas, paddocks |
| Sylviidae | 509 | *Cinclorhamphus mathewsi* | Rufous Songlark | P | 1 | grassy open woodlands & woodlands, nests in grass |
| Threskiornithidae | 181 | *Platalea regia* | Royal Spoonbill | P | 6 | Large shallow waters, wetlands, dams, billabongs, floodplains |
| Threskiornithidae | 179 | *Threskiornis molucca* | Australian White Ibis | P | 6 | grasslands, irrigated crops, dams, wetlands, wet pastures, floodwaters, |
| Tytonidae | 249 | *Tyto alba* | Barn Owl | P | 1 | open woodlands, woodlands, open forests, hollows |
| | | *Platycercus adscitus* | Pale-headed Rosella | P | 1 | grassy woodland & open forest, hollow trees |
| | | *Nymphicus hollandicus* | Cockatiel | P | 1 | grasslands, woodlands, watercourses, crops |
| | 692 | *Corvus orru* | Torresian Crow | P | 1 | open woodlands - open forests, paddocks, watercourses |
| | | *Struthidea cinerea* | Apostlebird | P | 1 | dry shrublands, open woodlands - open forests, paddocks, watercourses |
| | | *Taeniopygia guttata* | Zebra Finch | P | 1 | grasslands, shrublands, open woodlands, watercourses, paddocks |
| | | *Manorina flavigula* | Yellow-throated Miner | P | 1 | dry grassy open woodlands, woodlands & shrublands |
| | 597 | *Lichmera indistincta* | Brown Honeyeater | P | 1 | grassy and multilayered woodlands & open forests, nectar |
| | | *Pomatostomus temporalis* | Grey-crowned Babbler | Vul TSC | 1 | grassy open woodland, woodland, shrubland, paddocks |
| | | *Cinclorhamphus cruralis* | Brown Songlark | P | 1 | grasslands, open woodlands, woodlands, nest in grass |
| | | *Northiella haematogaster* | Blue Bonnet | P | 2 | grassy open woodland & woodland, hollows |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Aprosmictus erythropterus* | Red-winged Parrot | | P | 6 | grassy woodland & open forest, hollow trees |
| 1 Fyke trap | S28.62914 E149.70443 | 10/20/2016 7:47:55 AM | | 192 m | | |
| 4 Turtle traps | S28.62938 E149.70485 | 10/20/2016 7:35:57 AM | | 188 m | | |
| Camp | S28.63150 E149.70355 | 10/20/2016 6:52:56 AM | | 183 m | | |
| HARP 1 Macintyre River | S28.63269 E149.69436 | 10/19/2016 5:15:25 PM | | 173 m | | |
| HARP 2 Macintyre River | S28.61800 E149.66491 | 10/20/2016 10:27:51 AM | | 189 m | | |
| HARP 3 Coomonga Creek | S28.60032 E149.68651 | 10/20/2016 10:44:59 AM | | 191 m | | |
| Site 1 Coolibah - River Red Gum | S28.63028 E149.70473 | 10/20/2016 7:24:11 AM | | 187 m | | |
| Site 2 Bimble box - Budda | S28.55727 E149.73330 | 10/24/2016 12:29:02 PM | | 195 m | | |
| Site 3 Carbeen - Red Gum | S28.55066 E149.71335 | 10/20/2016 11:29:04 AM | | 195 m | | |
| Site 3 end of Elliott trap line | S28.55003 E149.71491 | 10/20/2016 11:46:40 AM | | 196 m | | |

| Family | Species Code | Scientific Name | Common Name | Legal Status | Site 1 Macintyre River - cracking grey clay | Site 2 Bimble box - Budda Brown clay | Site 3 Carbeen - Red gum sandy duplex | Coomonga Creek | Habitat |
|---|---|---|---|---|---|---|---|---|---|
| Agamidae | 9106 | *Amphibolurus burnsi* | Burn's Dragon | P | 1 | 1 | | | logs, debris, woodland & open woodland ground cover |
| Agamidae | 2177 | *Pogona barbata* | Eastern Bearded Dragon | P | | 1 | | | logs, debris, woodland & open woodland |
| Chelidae | 2016 | *Chelodina expansa* | Broad-shelled Snake-necked Turtle | P | 3 | | | | western rivers and more permanent lagoons & wetlands |
| Chelidae | 2017 | *Chelodina longicollis* | Eastern Snake-necked Turtle | P | | | | 1 | all streams and water impoundments |
| Chelidae | 2034 | *Emydura macquarii* | Murray Short-necked Turtle | P | 3 | | | | low to mid elevation rivers, riparian zone, lakes |
| Elapidae | 2660 | *Denisonia devisi* | De Vis's Banded Snake | P | | | | 1 | cracking clay woodlands and grassland |
| Elapidae | 2673 | *Hemiaspis damelii* | Grey Snake | P | | | | 1 | cracking clay woodlands and grassland |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Elapidae | 2675 | *Hoplocephalus bitorquatus* | Pale-headed Snake | Vul TSC | 1 | | | | multilayered woodland & open forest, logs & debris, floodplain |
| Elapidae | 2693 | *Pseudechis porphyriacus* | Red-bellied Black Snake | P | 2 | | 1 | | grassy & multilayered woodlands & open forest, logs & debris |
| Elapidae | 2722 | *Suta suta* | Curl Snake | P | | 1 | | | cracking clay woodlands and grassland |
| Typhlopidae | 2606 | *Ramphotyphlops wiedii* | Brown-snouted Blind Snake | P | 1 | | | | grassy woodland & open forest, logs & debris |
| Gekkonidae | 2077 | *Diplodactylus vittatus* | Eastern Stone Gecko | P | | 1 | | | rocky multilayered woodland & open forest |
| Gekkonidae | 2082 | *Gehyra dubia* | Dubious Dtella | P | 4 | 1 | | 4 | multilayered woodland & open forest, dead trees |
| Gekkonidae | 2105 | *Heteronotia binoei* | Prickly Gecko | P | 2 | 2 | 2 | 1 | multilayered woodland & open forest, logs and debris |
| Scincidae | 2326 | *Cryptoblepharus pulcher* | Pretty Snake-eyed Skink | P | 2 | | 2 | | floodplain woodlands & open woodlands |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scincidae | 2429 | *Egernia striolata* | Tree-crevice Skink | P | 1 | | 1 | grassy & rocky woodland & open forest, logs & debris |
| Scincidae | 2492 | *Lerista timida* | Dwarf Three-toed Slider | P | 1 | | | grassy & rocky woodland & open forest, logs & debris |
| Scincidae | 2307 | *Lygisaurus foliorum* | Tree-base Litter-skink | P | 2 | | | grassy & rocky woodland & open forest, logs & debris |
| Scincidae | 2519 | *Menetia greyii* | Common Dwarf Skink | P | | 1 | | plains/slopes woodlands & open forest, litter, logs & debris |
| Scincidae | 2526 | *Morethia boulengeri* | South-eastern Morethia Skink | P | 2 | 2 | | multilayered woodland & open forest, logs and debris |
| Varanidae | 2271 | *Varanus gouldii* | Sand Monitor | P | | 1 | | multilayered woodland & open forest, logs & light soil |
| Varanidae | 2283 | *Varanus varius* | Lace Monitor | P | | 1 | | grassy woodland & open forest, hollow & dead trees |
| Scincidae | 2580 | *Tiliqua scincoides* | Common Bluetongue | P | | 1 | | grassy woodland & open forest, logs & debris |

| | | | |
|---|---|---|---|
| Site 1 Coolibah - River Red Gum | S28.63028 E149.70473 | 187 m | 10/20/2016 7:24:11 AM |
| Site 2 Bimble box - Budda | S28.55727 E149.73330 | 195 m | 10/24/2016 12:29:02 PM |
| Site 3 Carbeen - Red Gum | S28.55066 E149.71335 | 195 m | 10/20/2016 11:29:04 AM |

| Family | Species Code | Scientific Name | Common Name | Legal Status | Site 1 Macintyre River - cracking grey clay | Site 2 Bimble box - Budda Brown clay | Site 3 Carbeen - Red gum sandy duplex | Coomonga Creek | Preferred habitat to enhance and protect | Shelter habitat |
|---|---|---|---|---|---|---|---|---|---|---|
| Hylidae | 3025 | *Cyclorana platycephala* | Water-holding Frog | P | 1 | | | | ephemeral dams, ponds, wetlands | Burows |
| Hylidae | 3165 | *Litoria alboguttata* | Striped Burrowing Frog | P | 10 | | | 10 | ephemeral dams, ponds, wetlands | Decomposing logs & litter |
| Hylidae | 3191 | *Litoria latopalmata* | Broad-palmed Frog | P | 20 | | | 10 | ephemeral dams, ponds, wetlands | Decomposing logs & litter |
| Hylidae | 3204 | *Litoria peronii* | Peron's Tree Frog | P | 6 | | | 2 | small streams, ephemeral dams, ponds, wetlands | Tree hollows |
| Hylidae | 3210 | *Litoria rubella* | Desert Tree Frog | P | 2 | | | | ephemeral dams, ponds, wetlands | Tree hollows |
| Myobatrachidae | 3131 | *Crinia parinsignifera* | Eastern Sign-bearing Froglet | P | 2 | | | | ephemeral dams, ponds, wetlands | Decomposing logs & litter |
| | 3128 | *Crinia deserticola* | Desert Froglet | | 20 | | | 10 | ephemeral dams, ponds, wetlands | Decomposing logs & litter |
| Myobatrachidae | 3059 | *Limnodynastes fletcheri* | Long-thumbed Frog | P | 20 | | | 6 | small streams, ephemeral dams, ponds, wetlands | Soil cracks, logs, litter |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Myobatrachidae | 3112 | *Platyplectrum ornatum* | Ornate Burrowing Frog | P | 1 | | | ephemeral dams, ponds, wetlands | Burrows |
| Myobatrachidae | 3062 | *Limnodynastes salmini* | Salmon-striped Frog | P | 1 | | | ephemeral dams, ponds, wetlands | Soil cracks, logs, litter |
| Myobatrachidae | 3063 | *Limnodynastes tasmaniensis* | Spotted Marsh Frog | P | 20 | 4 | 6 | small streams, ephemeral dams, ponds, wetlands | Soil cracks, logs, litter |
| Myobatrachidae | 3098 | *Notaden bennettii* | Holy Cross Toad | P | | 1 | | ephemeral dams, ponds, wetlands | Burrows |
| Myobatrachidae | 3151 | *Uperoleia rugosa* | Wrinkled Toadlet | P | | 2 | | ephemeral dams, ponds, wetlands | Decomposing logs or litter |

| | | | |
|---|---|---|---|
| Site 1 Coolibah - River Red Gum | S28.63028 E149.70473 | 187 m | 10/20/2016 7:24:11 AM |
| Site 2 Bimble box - Budda | S28.55727 E149.73330 | 195 m | 10/24/2016 12:29:02 PM |
| Site 3 Carbeen - Red Gum | S28.55066 E149.71335 | 195 m | 10/20/2016 11:29:04 AM |

| Family | Species Code | Scientific Name | Common Name | Legal Status | | Site 1 Macintyre River - cracking grey clay | Site 2 Bimble box - Budda Brown clay | Site 3 Carbeen - Red gum sandy duplex | Coomonga Creek | Habitat to enhance and protect |
|---|---|---|---|---|---|---|---|---|---|---|
| Macropodidae | 1265 | *Macropus giganteus* | Eastern Grey Kangaroo | P | 20 | 20 | | | 4 | good ground cover - woodland / open forest |
| | 1261 | *Macropus rufus* | Red Kangaroo | P | 4 | 2 | 2 | | | western plains grassland & open woodland |
| Macropodidae | 1242 | *Wallabia bicolor* | Swamp Wallaby | P | 2 | 1 | | 1 | | patches of thick understorey woodland & open forest, good ground cover |
| Tachyglossidae | 1003 | *Tachyglossus aculeatus* | Short-beaked Echidna | P | 1 | 1 | | | | logs, litter, good ground cover |
| Phalangeridae | 1113 | *Trichosurus vulpecula* | Common Brushtail Possum | P | 4 | | | 2 | 2 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Vespertilionidae | 1349 | *Chalinolobus gouldii* | Gould's Wattled Bat | P | 2 | 1 | | | 2 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Vespertilionidae | 1335 | *Nyctophilus geoffroyi* | Lesser Long-eared Bat | P | 3 | 1 | | | 1 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Vespertilionidae | 1334 | *Nyctophilus gouldi* | Gould's Long-eared Bat | P | 2 | 1 | | | 1 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Vespertilionidae | 1362 | *Scotorepens greyii* | Little Broad-nosed Bat | P | 1 | | | | 1 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Vespertilionidae | 1379 | *Vespadelus vulturnus* | Little Forest Bat | P | 2 | 1 | | | 1 | hollow trees, shrub layer, mixed age structure woodland/open forest |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Molossidae | 9045 | *Mormopterus sp. (little penis)* | Inland Freetail Bat | P | 1 | | | | 1 | hollow trees, shrub layer, mixed age structure woodland/open forest |
| Canidae | 1532 | *Vulpes vulpes* | Fox | U | 2 | 1 | | | | |
| Felidae | 1536 | *Felis catus* | Cat | U | 2 | 2 | | | | |
| Leporidae | 1511 | *Lepus capensis* | Brown Hare | U | 6 | 2 | 2 | 2 | | |
| Leporidae | 1510 | *Oryctolagus cuniculus* | Rabbit | U | 1 | | | 1 | | |
| Muridae | 1412 | *Mus musculus* | House Mouse | U | 4 | 1 | 1 | 2 | | |
| Suidae | 1514 | *Sus scrofa* | Pig | U | 10 | 10 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Site 1 Coolibah - River Red Gum | S28.63028 E149.70473 | 187 m | | | 10/20/2016 7:24:11 AM |
| Site 2 Bimble box - Budda | S28.55727 E149.73330 | 195 m | | | 10/24/2016 12:29:02 PM |
| Site 3 Carbeen - Red Gum | S28.55066 E149.71335 | 195 m | | | 10/20/2016 11:29:04 AM |