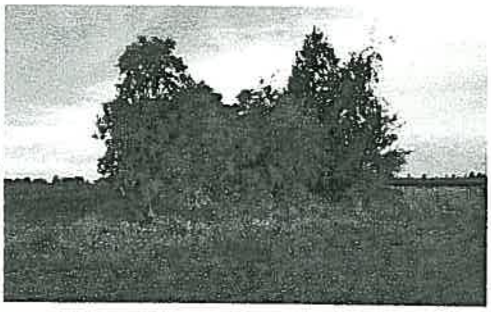
2002 - Prg 1

Cotton
Research & Development

Integrated Area Wide Management





Emerald Irrigation Area

Final Report to
Cotton Research and Development Corporation
Project DNR3C

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Queensland Government
Natural Resources and Mines

Cotton
RESEARCH & DEVELOPMENT

Annual, Progress and Final Reports

REPORTS

Part 1 - Summary Details

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

CRDC Project Number: **DNR3C**

Annual Report: ☐ Due 30-September

Progress Report: ☐ Due 31-January

Final Report: ☒ Due 30-September (or within 3 months of completion of project)

Project Title: Evaluation of Integrated Area Wide Management in Rural Landscapes

Project Commencement Date: Oct 2001 **Project Completion Date:** Oct 2002

Research Program: Sustainability of Natural Resources

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1. BACKGROUND

In July 2000, an *Integrating Our Approaches* workshop involving Irrigators from the Emerald Irrigation Area (EIA) and Dawson Valley, private sector consultants, Industry Development Officers, and staff from NR&M, DPI and Sunwater explored how property planning requirements could be rationalised. The workshop brought together the different groups involved in such activities with cotton, and the fruit and vegetable sector - the development of best management practices, water use efficiency, water and vegetation reform, crop production, and property level land and water management plans. It was the first time all these different groups had got together to talk about how to make the property planning process simpler, be it voluntary or regulatory. The workshop explored issues such as duplication and rationalisation of effort, information access and management, grower experiences, cost and incentives, property versus landscape scale.

Key perceptions were:

- Government Agencies seemed to be increasingly conducting projects, setting policies and legislation, but excluding landholders in the information gathering, interpretation and decision making process.
- Environmental reform pressures were driving the way government was engaging with growers, not whole farming systems (environment + production + economics).
- Landholders and consultants had information that would be useful to the planners.
- Industry and its consultants were not integrating and managing their information very well, and certainly not in a spatial context.
- Much of the government data was not accessible or being accessed by the growers and private sector consultants.
- Information was not getting to the growers, when it should, and at a scale that was relevant.
- The information needed for voluntary processes was very similar to that needed for regulatory processes.

There was:

- A level of mistrust in some State Agency science and some of their datasets, particularly those associated with legislative reform.
- Under utilization; uncoordinated sharing and integration of data at a district scale.
- Slow uptake of some land, water and vegetation management practices and strategies that would make a difference to our catchments, despite research having demonstrated otherwise.
- Change fatigue amongst the growers and community.
- Polarisation of information gathering and sharing – some parties were hesitant to participate because the motives of another party trying to collect information were not always clear, thus a trust issue. Secondly the benefits to them in jointly participating in the process were not always clear.
- These issues were affecting interpretation of some research findings - ownership issues i.e. the data doesn't apply to my land or me, or my experience is different.

The workshop participants unanimously supported the need to explore a better community information model - a resource centre concept, with local leadership and greater stakeholder cooperation. The growers wanted better information support mechanisms to help them with their property planning and decision-making. The issue wasn't simply transfer of information. They also wanted recognition that they were already proactively engaged in identifying, monitoring and managing risk.

Bill Wilkinson and Ian Rankine travelled to a number of different regions on the east coast of Australia to assess how others were dealing with such issues. A twelve month jointly funded project proposal was then developed between CRDC, NRM, DPI and 4T Consultants Pty Ltd was developed.

The project commenced during a time when considerable natural resource reform was underway. The following summary of events leading up to the start of the project and then during the project provides and indication of environmental reform issues that occurred.

1997 - The Central Highlands Regional Resources Use planning group and Fitzroy Basin Association were established.
1997 - Bedford Water Auction – first instance in Fitzroy Basin of legal requirement to have an approved land and water management plan attached to sale of water.
1997 - Cotton Australia finalising its voluntary BMP second edition and building support program to assist growers, along with industry adoption targets.
1998 - The Draft Fitzroy Basin Water Allocation and Management Plan (WAMP).
1999 - Fitzroy Basin Water Allocation Management Plan approved.
1999 - Vegetation reform requiring property management plans to clear vegetation commenced
2000 - Sunwater (irrigation scheme operator) established as a corporatised government organisation
2000 - Water Act 2000 introduced - replaced WAMP's with Water Resource Plans as a statutory instrument; water trading possible; lower bound pricing; conversion of water licences to interim water allocations and then water allocations through a Water Resource Operational Planning process; institutional separation of water service provider (Sunwater) and the regulator (NRM&E); land and water management plan (LWMP) requirements with water trading.
2000 - State LWMP guidelines finalised.
Development of Fitzroy Basin regional lwmp guidelines underway
2000 - Water Use Efficiency program rolled out across Queensland.
2001 - National Action Plan for Salinity and Water Quality program commenced preparation of catchment plans and a way to set resource condition targets.
2002 - Draft Fitzroy Resource operations Plan released
2002 - Price paths for Sunwater set until June 2005 for rural water supply schemes.

This background made it a challenge to overcome the mistrust growers initially had in actively participating in information sharing, particularly with NRM&E, because of the regulatory processes the organisation was driving. There was also some concern by some private sector groups that IAWM was attempting to take away some of their business. The IAWM team had to spend considerable effort in people processes to build relationships, linkages, trust and confidence, and demonstrate the project team was there to value-add.

2. OBJECTIVES

The pilot project set out to demonstrate to growers and the community, how information technology could help them, and the benefits (economically, socially and environmentally) to them in taking a greater role in managing and interpreting data to. It would establish a means for growers to access integrated data from a whole landscape and farming systems perspective and help growers monitor condition and trend outcomes of best management practice.

Specific objectives were:

1. Implement a pilot project (that will be transferable to other cotton growing areas) which will demonstrate the value of area-wide approaches to managing information.
2. Coordinate the capture and integration of both static data (e.g. soil types, drainage) and dynamic data (e.g. pest numbers, land-use, meteorological, water quality and quantity) so that these can be analysed and presented in real-time.
3. Promote information sharing and integration to value-add to current data being captured. Use this interpreted data to develop strategies, based on the more complete area-wide datasets.
4. Develop tools that facilitate better knowledge and systems approaches to management and adult learning.
5. Improve resource management practice and outcomes.
6. Demonstrate future potential of an integrated approach.

3 METHODOLOGY

3.1 Overview

A study area was defined using the township of Emerald, the surrounding Emerald Irrigation Area and the dryland and grazing land immediately adjacent. Total area comprised 162,000ha (see Appendix1).

The Department of Natural Resources and Mines (NR&M) established a section within their office that would enable 4T Consultants Pty Ltd and the project staff a base to operate from. The Department provided office space, a computer, access to an A0 plotter and A3 colour laser jet printer, and network connections for the project. NR&M provided existing spatial datasets such as Landsat TM satellite imagery, cadastral data, roads and infrastructure data, soils, land use mapping, topographic data, surface water gauging stations, groundwater bores, streams and main irrigation infrastructure. The Department also provided access to its wet lab facilities for processing samples, and use of its field water monitoring equipment (MERCK 330i pH and EC meter) and field sample bottles. The team purchased ESRI ArcMap ™ v8.2 (desktop GIS software) and ESRI ArcPad ™ v5.0 (Palmtop GIS Software); handheld GPS units (Garmin GPS76) and some handheld PDA's or palmtops (HP series).

Kelly Mellor was appointed as the project officer. Kelly was well known by the growers and consultants, had a strong family connection with cotton, and had worked as an agronomist / bug checker. This assisted the team to fast track the engagement of growers and consultants.

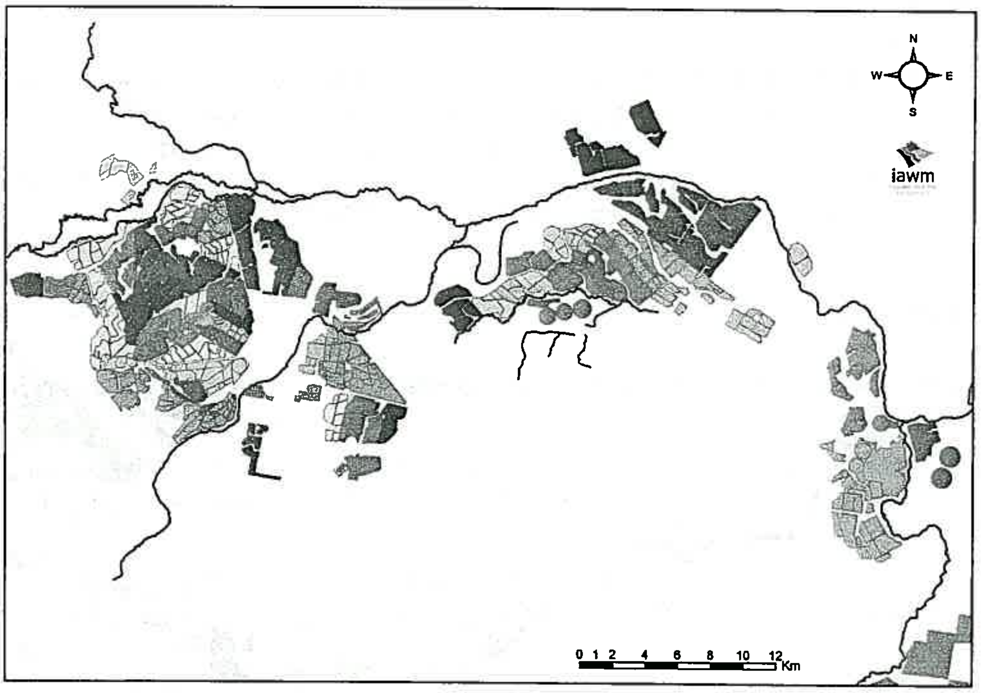


Figure 1: Distribution of cotton growers in the EIA 2002/03 (Colours denote different growers)

The team purchased satellite imagery with more detail - SPOT4 Panchromatic. SPOT5 was available and would have been more suitable due to smaller pixel size, but the project funds didn't extend to purchase of this at the time. SPOT4 was considered adequate to achieve the project goals. Ground control points were collected with a GPS and the imagery ortho-rectified.

Maps of the district were produced, and the consultants and growers assisted the IAWM team to map the land use down to field level, identify each property boundary, the specific property field names / codes used by the grower, and which consultant serviced which grower that season. These key datasets were then used to link pest data collected by each of the consultants. They could also be used to link production data such as yield and ginning data to soils so that these could be represented spatially in map form.

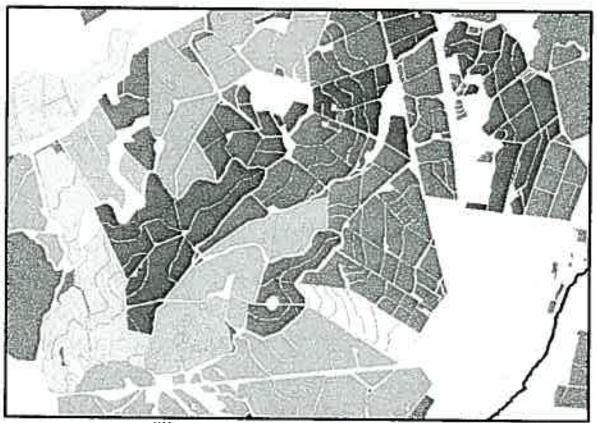


Figure 2: Field mapping and labelling

The project team then undertook a number of smaller case studies to explore the benefits of area-wide data sharing, integration and interpretation; and the effectiveness of area-wide condition and trend monitoring:

- Pest mapping and use of palm pilots to collect data
- Surface water quality monitoring
- Seepage and salinity monitoring
- Information exchange protocols

These are outlined in more detail below.

3.1 *Pest Mapping and Use of Palm Pilots to Collect Data*

This case study explored how pest data could be presented spatially on a district wide basis. Pest data is perhaps the best example of where the cotton industry is involved in collecting reliable, continuous data but not making full use of it. Maps of pest numbers and distribution, provided at regular intervals throughout the season, may be an additional tool for the consultants, industry and growers when assessing strategies to control insect pests such as *Helicoverpa spp*, aphids, and white fly. Immediate spray decisions are very important, but could spray decisions be better, if the consultant knew what 'hotspots' were emerging, and what was happening in the surrounding district, rather than property by property decision-making? Monitoring the district 'hotspots' via maps might help to pre-empt egg lays, emerging problems and chemicals might be able to be applied more strategically. This might improve chemical usage, reduce costs and provide more tools for pest management decision making. When the pest data is combined with other spatial data, such as meteorological data, crops type, planted where, and varieties - even more information might emerge.

The project set out to capture one full season of data and present it spatially. This would require gaining approval from all the growers and consultants to use their data; coordinating collection of the data; converting hard copy formats into digital format; and resolving the best way to communicate the results back. It would also involve exploring ways that could help consultants collect geo-positional information (i.e. where in each field, each bug count was actually done). There were nine cotton agronomists working in the area at the time.

The project team spent a number of days with the agronomists in the field assessing how they recorded information. All were using bug checking cards and pencils. None were using palmtops or GPS. Most were storing their data in hard copy format, some in MS-Excel format, but often not entered until weeks later. Generally, they were not using CottonLogic™, a cotton industry software program.

The team coordinated the supply of GPS units for a field exercise, whereby the consultants would record each sample location as they conducted their normal business. The exercise enabled a track of where sampling was taking place. This in itself, if done over a period of time, and across all consultants, might provide a useful study of sample bias or sample representativeness. Recording the GPS coordinate at each sample site was achievable, and point coverage was for all the fields the consultants visited on that day. The corresponding pest data still needed to be entered into the computer manually.

In order to develop a GIS support system that could record pest distribution information in close to real time, an electronic data gathering and transfer system would be more efficient than manual data entry. As CottonLogic™ is well established in the cotton industry, the IAWM team examined the feasibility of using handheld PDAs (Palm Pilot devices) to collect the data into CottonLogic™ and then link the output to the GIS system. The CottonLogic™ development team provided four Palm devices and IAWM provided the others, so each of the consultants in the Emerald area had a PDA with CottonLogic™ installed.

There were two components to this research:

- Evaluate use of the PDAs and CottonLogic™ in the field.
- Examine the compatibility of CottonLogic™ from field to desktop and with the GIS system so that links could be established for real time mapping.

All of the cotton consultants participated in the research, and the project team acknowledges their support and efforts during the pilot. A number of them put considerable time and effort into trying to work with the PDAs and CottonLogic™. Some had real difficulty incorporating the technologies into their existing operating procedures.

An evaluation was carried out at the end of the pilot by way of questionnaire. In summary, the use of CottonLogic™ on PDAs in the field was not successful in the Emerald area. The main reasons were:

a) Most consultants visit multiple clients every day. At the end of each visit, they provide a detailed report to the grower. Therefore, the consultant still had to write out a report sheet so that the grower had a record. This doubled their work effort at each farm and slowed down their ability to cover the number of fields they needed to.

b) The consultants found it easier to transfer data from the check cards, than to read the counts from a PDA screen.

c) Many do not use CottonLogic™ on a regular basis. They have developed their own systems and find CottonLogic™ difficult to use.

d) Field entry into CottonLogic™ did not enable data entry in the format they used. Some consultants were using percentages for pest infestations rather than number of pests per meter row.

e) All carried mobile phones and additional equipment to monitor whitefly. They found the PDAs were just another thing to carry in difficult (often wet) conditions. They also found it difficult to check the crop and use the PDA simultaneously.

f) In-field data entry was significantly faster on check cards, than the PDAs.

g) No 'primary record' whilst in the field. If the PDA was lost in-field towards the end of a day, all the data would be lost. A hardcopy system enables the consultant to recover the records from the grower or field cards if required. One consultant lost a full days' data when the batteries failed on the PDA.

h) 'Graffiti' input using the Palm handwriting method was difficult. Use of an on-screen virtual keyboard was difficult because it reduced the screen view significantly.

i) Training new workers on the use of the PDA was considered a possible drawback. In contrast, it was relatively easy to train new employees to fill in check cards correctly.

Some of the consultants used MS-Excel worksheets, so the project team provided them with Pocket PC (Windows™) based PDAs so that they could carry out a comparison to the Palm® devices. They found the same limitations as listed above in (a), (d) and (e). They also found that Pocket Excel (a cut down version of Excel for the Pocket PC unit) had limited functionality and would not link directly to their PC based worksheets. This could be overcome, but it would involve a redesign of their worksheets and their historical records. They were reluctant to do this. The small screen on the Pocket PC made worksheet navigation difficult so only a small portion of the screen (and worksheet) could be viewed at any time.

On a positive note:

a) They agreed that electronic transfer of data to a PC based storage, analysis and reporting system was highly desirable. They found their end of season data capture, transfer and reporting to growers and the CCA, was very time consuming and not very 'resource efficient'.

b) PDAs as a reference tool to examine historical records, and store information such as grower details, farm histories, chemical facts etc. was desirable. If the data could be captured and transferred into the main PC system in a different way, then analysed and synchronised with a PDA that the consultant carried in-car, they felt this would allow them to examine spray histories, chemical re-entry periods etc.. They would not use the PDAs for in-field data collection.

c) Presentation of data in a spatial context was desirable to examine the area wide trends, so they could mesh that with their field observations and provide a better service to growers.

Other issues encountered:

- The PDA and CottonLogic™ were unnecessarily difficult to set up. Most of these problems were fixed by the project team with support from the CottonLogic™ group.
- Loss of data from the older Palm devices (Handspring Visor™) when the standard 'AA' batteries went dead. This should not occur, and it could not be replicated by the project team. The newer PDAs overcome this with NiMH rechargeable batteries that are charged each time the PDA is synchronised with the PC based system.
- Consultants lacked computer skills to configure their system and CottonLogic™.
- CottonLogic had no facility for whitefly nymph monitoring at the time of the trial, and the consultants could not enter values in decimals. Cards were used and only a 'field average' was entered into the PDA, the average had to be a whole integer.
- The consultants are not using CottonLogic in the field and only two currently use it for desktop records – the others use either Microsoft Excel or the Cotton Consultants Australia database so that they do not have to repeat data entry. Establishing routines to use and convert CottonLogic data does not seem warranted.

The GIS system demonstrated many possibilities to study actual pest distributions and interactions. This type of information cannot be presented in charts or reports, and 'averages' over time for the district are of little value. The trends have to be represented spatially to be of use to the growers and the area wide groups. By capturing this data, the growers and consultants also have a historical record (both spatial and temporal) of the pest patterns in their district. Do the outbreaks always start in a certain area, move in a similar direction; are there constant 'hot spots'; and are these related to the land use, weather conditions or other factors in those areas?

The project team mapped the pest data on a whole field basis. The method could be adapted to examine in-field variability by using a GPS. The current aircraft and ground rig configurations could then assess objectively whether variable rate technologies (vrt) could be employed to obtain more precise application, save costs and be more environmentally responsible.

The impediments to processing and presenting pest data were:

- Physical data acquisition and transfer. This was the primary impediment to streamlining the entire process - how to overcome in-field data acquisition and transfer it to the GIS.
- Data was collected in various forms - hard copy, CottonLogic™ and Excel™. It was then entered into MS-Excel and saved as in database format. This was not such a difficult task, but costly in time mainly due to the delays in obtaining checking records from consultants. They constantly use the field check books, and retain them in their vehicles so that they can refer to them during follow up checks. If maps were to be done in 'real time', and these field books used as the input data source; the books would have to collected data copied and returned to the consultant the following morning.
- CottonLogic™ data from the PDAs could not be directly linked into the GIS system because the native CottonLogic™ export table layout and field formatting was incompatible (e.g. numbers appearing as text so that averages etc. did not work). Additional programming would need to be developed to make this process easier. The CottonLogic™ developers indicated that output formats could be rectified.

In the Emerald area any new system would have to have the following features:

- A hardcopy capacity so that the consultant can leave a report with the grower

- Minimal additional equipment to carry into the field
- An electronic means, with minimal effort, to transfer the data from the field forms into a standard format on a computer that was directly compatible with the GIS.
- Data formats compatible with MS-Excel so that consultants can perform their own analysis.

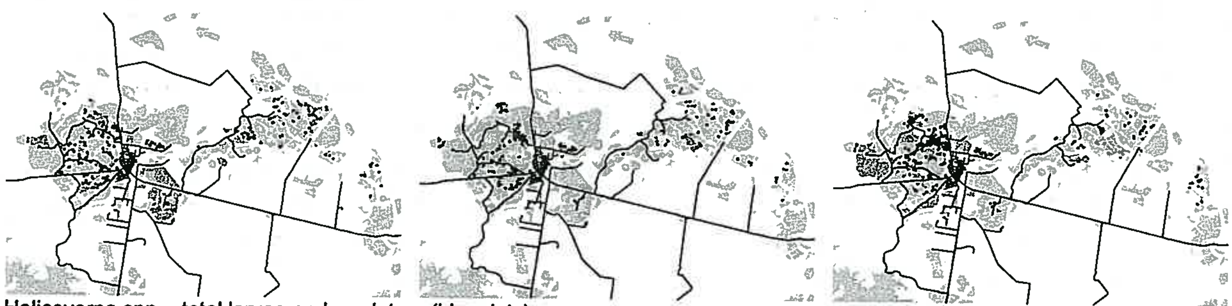
The PDA/CottonLogic™ combination is presently not suitable in the Emerald area, and may be more suited to single large cotton enterprises where the in-house consultant maintains the records for that farm only. The Emerald situation is quite common in other valleys so practical solutions would be applicable in all cotton growing areas.

The following series of maps illustrate the possible output.

Helicoverpa spp. – total eggs

Helicoverpa spp. – total eggs and predators (blue dots)

Helicoverpa spp. - total larvae



Helicoverpa spp. - total larvae and predators (blue dots)

Figure 3: Examples of time series of pest distributions. Left 6/1/03, Centre 13/1/03, Right 20/1/03

3.2 *Surface Water Quality Monitoring*

Sub-catchments were mapped from digital topographic data, farm plans and drainage studies. Sampling commenced in February 2002 and still continues. All samples have been grab samples. The February 2002 data was collected during stormwater runoff events only, and involved random sampling until some understanding of catchment flows developed. In June 2002, the team identified critical sampling points that would provide useful condition and trend information within and at the outlets of many of these sub-catchments. The sampling sites included urban and agricultural land uses, tail water as well as stormwater. The sites included farm tail drain outlets, irrigation drains, urban drains, creeks, rivers, and constructed wetlands. Some sites were sampled weekly, others fortnightly, others monthly and random samples were taken during stormwater events at these sites and others as runoff dictated. Sampling in this manner commenced rigorously from September 2002 on.

The following parameters were sampled at each site:

1. February 2002 – September 2002 (Stormwater runoff events only)

    - Date and Time
    - Total Suspended Solids (g/L)
    - Turbidity (NTU and TTU)
    - Pesticides (µg/L)

2. September 2002 – Current
   At critical control points (45 stations)

    - Date and Time
    - Total Suspended Solids (g/L samples over 200 NTU)
    - Turbidity (NTU and TTU)
    - Electrical Conductivity (µS/cm)
    - pH
    - Air Temperature (degrees Celsius)
    - Water Temperature (degrees Celsius)
    - Dissolved Oxygen (percentage saturation and/or mg/L)
    - Various site observations used by Waterwatch staff (wind, cloud cover, presence or absence of snags and water plants)
    - Total Nitrates (mg/L)
    - Total Phosphates (mg/L)
    - Macro-invertebrates (genus level)
    - Pesticides (µg/L)

   At random, a range of sites

    - Date and Time
    - Total Suspended Solids (g/L samples over 200 NTU)
    - Turbidity (NTU and TTU)
    - Electrical Conductivity (µS/cm)
    - pH
    - Total Nitrates (mg/L)
    - Total Phosphates (mg/L)
    - Pesticides (µg/L)

One litre volume, 120mm wide mouth plastic containers were used to collect samples. The bottles were scrubbed clean with phosphate free detergent and rinsed with deionised water before use. This water was analysed for turbidity, total nitrates, total phosphates, pH and EC. If turbidity levels exceeded 100 NTU's as measured by the turbidity tube, the samples were analysed for total suspended solids in the laboratory. Grab samples were collected more then once within a twenty-four hour period at some sites, and only in a few instances across the runoff hydrograph.

Weekly, fortnightly and monthly data sampling schedule started in September 2002. At these sites, macro-invertebrate populations were sampled using a hand net and identified down to genus level. The date, time, type of runoff (irrigation or storm), dissolved oxygen, water temperature, percent surface cover of aquatic plants (floating and submerged), and a visual on weather conditions were recorded. Where possible, an estimate of flow was made. Gauging stations with digital loggers existed at three of the critical control sites, so this data was periodically downloaded to assess recorded flows. In all instances field data was recorded on customised paper forms and filed chronologically. This data was then captured electronically and stored in a database. Over 600 samples were collected and analysed.

About one third of the critical control points in the agricultural sub-catchments were sampled for pesticides four times during the cotton season. This was once within each of the four defined stages in the cotton insecticide strategy. In addition, random samples were taken during stormwater runoff events within the urban area, at critical control points and additional random sites. In all, a total of (80) pesticide samples were collected between February 2002 and March 2003.

Different methods and equipment were compared for monitoring sediment, EC and Nutrients. A few additional samples were collected throughout the year in plastic nutrient sample bottles (as provided by the accredited laboratories) at the same time as the grab sample. These were used to check the total nitrate and total phosphate results obtained using the field-testing kits. A range of portable field meters was compared for EC and pH. At all times the team explored techniques and practical, cost effective equipment that growers could use.

Water quality reports for the 2002/ 03 season were prepared - one to the Emerald Irrigators and another to the Emerald Shire Council environmental officers. Both were provided as confidential reports to enable both parties to review the findings and develop action plans that will improve water quality outcomes in future events.

Irrigation drain catchments were intersected with the soils data, to identify those catchments that had minimal soil variation, and representative soils growing cotton. The regional catchment group was setting targets for turbidity in streams. Turbidity is reasonably easy information to collect. However, there was no information that helped a grower or even government Agency staff make practical sense of what a turbidity reading meant in practical terms i.e. how much soil lost. Sediment loads enable estimation of soil loss if runoff volumes are known. Measuring sediment load is more difficult than turbidity. The team set out to establish if a reasonable correlation could be developed and graphed, so that a practical field tool could be developed for the growers. This would then enable growers to confidently assess performance against catchment targets using simple turbidity measurements.

The team selected RR4 drain on the left bank, and re-intersected the soils at key points up the drain catchment.

Soil Type	Soil Code	Sub Catchment Ha LN1	LN1/2	RR4	RR6	RR7/1
Tertiary Cracking Clay	BUg	230.3	382.6	2303.4	437.2	276.2
	TbUg	670.7	247	369.8	491.2	8.1
Alluvial Cracking Clay	AUg,	80.3	4.6	649.2	137	0
Alluvial Non-cracking Clay	AUf	59.9	7.7	264.38	83.4	0
Alluvial Sand	AUc	0	0	0	25.9	0
Alluvial Gradational	Gn	0	0	0.8	7.8	10
Alluvial Duplex	ADb,ADd,ADr	11.3	0	198.3	51.3	14
Rock	R	0.2	0	12	0.9	45
Total		1052.7	641.9	3837.88	1324.7	353.3

Table 1: Soil type assessment of each drain Left Bank EIA

Two sites were selected. One site represented 99% alluvial cracking clay – typical of that found on much of the right bank floodplain, and a second that represented 95% basaltic tertiary clays (TbUg and BUg soils) that are the dominant cotton soil types farmed on the left bank.There was a correlation.

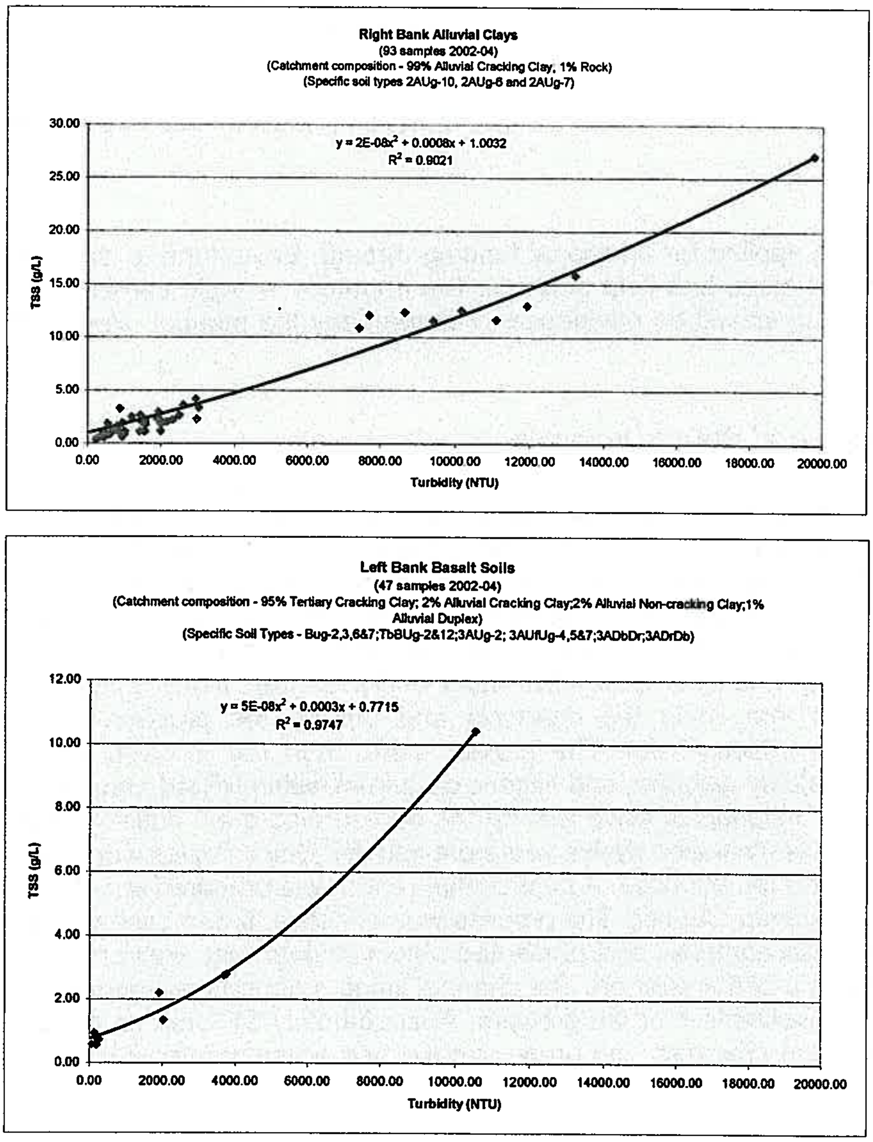


Figure 4: Turbidity (NTU) correlation with Total Suspended Solids (g/L)

A graph was developed that would provide an easy interpretation for the growers. Growers can now use an inexpensive turbidity tube to estimate NTU's and then read TSS from the chart. By measuring the area being irrigated and the tail water flow, the grower can estimate the amount of soil that is moving from that area in the tail water or runoff. A colour code bar down the side is a simple means to tell the grower if BMP is tracking ok.

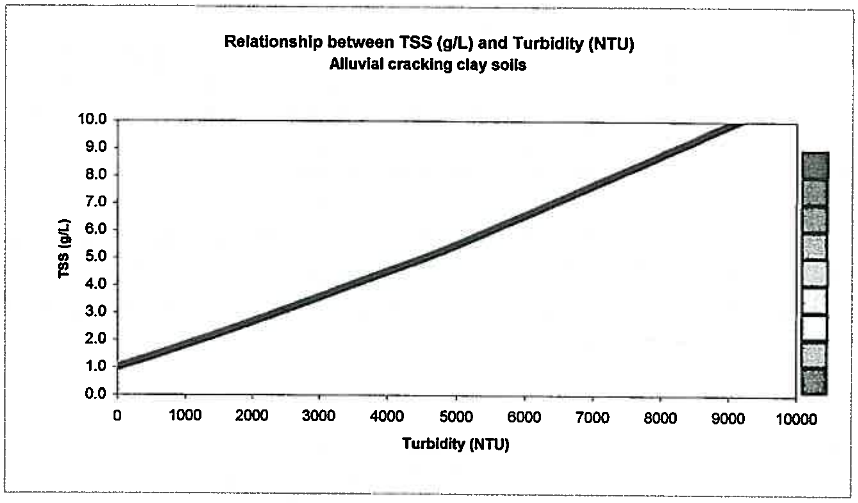


Figure 5: Simplified extension tool for cotton growers to assess turbidity within the EIA

The project team applied for additional funding through Envirofund to develop a water quality training book and glove box field guide for the irrigators. A triple carbon copy field recording book and sampling kit will be developed to accompany the manual, along with an accredited training program.

3.3 Seepage and Salinity mapping

Growers identified that they were still having problems with seepage from the Selma Supply Channel. The problem was not a new one. Studies had been undertaken in the late 1970's. Supply losses had been assessed in sections of the channel in the 1980's. Different lining products had been trialled, and a network of sub-surface drains had been installed. Costs to install these were shared between the government and the growers affected. At the start of the project the growers had approached Sunwater and even the Fitzroy Basin Association to seek some investment into lining the channels and solving the problem. Unfortunately these approaches were unsuccessful. The project team, then got involved and coordinated the capture of data held by growers, and historic data from within NR&M and DPI. The IAWM team then undertook monitoring of flows leaving the sub-surface drain outlets (which had not been done since they were installed twelve years previously). Soil samples were also taken on some fields, and analysed for chlorides. A confidential report was prepared and the growers took it to the Sunwater Customer Council. The process was effective. It demonstrated that growers as a collective group had compiled and presented objective data that would require both parties to get on with finding a better solution. The channel lining program was modified as a result of the information and involvement of the growers. Approximately $1.2 million dollars has now been budgeted to line the channels and growers have had an input into which sections should be lined.

3.4 Information exchange protocols

The team developed confidentiality agreements that each project team member signed at the outset. It was made crystal clear to the growers that the project was a pilot, and that all information would be managed confidentially. Grower data was grower data – they were the custodians, simply entering into an arrangement with the project team. Initially, each time data was needed, the team had to ring around all the growers and seek approval. This took time but was a team commandment. Eventually, the growers suggested that a technical refernce group be formed that could act in the best interest of all the growers. The project team would then liaise directly with the panel representatives. If the panel had any doubts it would refer the request to the next Irrigators group meeting. Similarly, if the team received a request for information from outside the EIA or project, the team would ask the technical group how they wished to respond – in other words the process whilst pushing some boundaries, still placed absolute respect in seeking approval from the growers.

This is an approach that led to some sectors suggesting the project was hiding data. What the project team was doing was building a genuine process that respected grower involvement, and built a framework by which researchers or those seeking IAWM data would need to talk with the technical reference group. This encourages better dialogue and it builds the premise that growers or a grower group can act as an information service provider. This is not new; Kondinan and other groups have been doing this for a number of years. Still, the growers were experiencing difficulties with the number of research workers not prepared to come and discuss their activities one-to-one or in a group with them, despite the fact that the research work outcomes would influence policy and the grower's future. This is still an issue. The reform environment and exodus of government from extension activities, has created an environment in which many government researchers no longer mix with growers on the ground or when they do, it is perceived to have a regulatory motive behind it. IAWM maintained independence and non-bias, and has played a constant role in encouraging parties to come together.

4 WERE THE OBJECTIVES ACHIEVED

Objective 1 - *Implement a pilot project that will demonstrate the value of area-wide approaches to managing information*

The IAWM pilot was successful in Emerald. The principles and methodology can be applied to other cotton growing areas. There is significant benefit in having a multi-disciplinary team that involves growers, the private sector and technical / extension staff from the Government and Scheme provider, working together on developing a better local information management, interpretation and distribution model. Information was provided by the different sectors under information sharing and confidentiality arrangements. It was then organised on a central computer server within the government office during the life of the project. This computer was security protected and not on the government network.

The collective data on the computer became a valuable asset. It was an information resource that growers wanted to see continue, but located external to government. TSuch a facility would make it far easier to support BMP and land and water management planning activities. It enabled the IAWM project team to help the growers develop new area-wide focused information that would assist in resolving some specific natural resource management issues.

The process raised some issues:

- Emerald had good existing spatial data, but most growers were unaware it existed or that they could get access to it.
- There was a lot of information collected routinely in the cotton industry. Much of it could be recorded spatially. It isn't being used to maximum advantage. Having spent the time and money to gather the data, it is actually costing the industry by not developing consistent ways to capture and amalgamate it, then integrate it with other spatial data.

- Important area-wide datasets can be built from historic landholder and consultant information. These datasets have the potential to assist in improving cotton production, and benchmarking bio-physical condition and trend.
- IDO's and industry support people are not making use of GIS software tools as part of normal business, like they do other software.
- There are cost efficiencies in purchasing some datasets such as satellite imagery on an area-wide basis, rather than growers seeking it individually.
- More thought should be given to negotiating data sharing agreements and multi-user licences for existing government data at a peak industry level. This would alleviate information exchange bottlenecks and help improve data access to local irrigator groups and cotton industry field staff. This is being explored and advanced under current IAWM funding arrangements through Queensland Farmers Federation not only in Queensland but also New South Wales.
- There is an urgent need to build some level of capacity and develop skills within the cotton industry field staff on the use of software enabling tools such as GIS (Geographic Information Systems).
- Establishing trust and a 'safe' environment for information exchange and cooperation is essential if IAWM concepts are to reach full potential. The pilot demonstrated that industry leadership makes this more readily acheivable.
- CRDC could play a leadership role in exploring the whole information management and exchange issue. Some discussion papers to stimulate thinking across the industry followed by a forum would encourage constructive dialogue and encourage a strategic way forward.

Objective 2 - *Coordinate the capture and integration of both static data (e.g. soil types, drainage) and dynamic data (e.g. pest numbers, land use, meteorological, water quality and quantity) so that these can be analysed and presented in real-time.*

The project undertook a significant search and discovery of existing information sources that would be useful. NR&M holds a lot of useful 'GIS ready' datasets. DPI did not have much information that had been collected with GPS coordinates. In fact, regional DPI staff did not make use of GIS technology.
The project assembled the data onto a central computer. It also constructed new spatial GIS datasets, namely:

- Sub-surface drainage system, Left Bank – location of pipes, outlets, depth and pipe fall
- Land use coverage – crop type by field
- Irrigation method coverage – method of irrigation by field
- Pest database
- Consultant coverage – property and consultant for 2002/03 season
- Surface water quality coverage – sites and sampling frequency
- Weather station coverage – EIA weather stations, brand and attributes

These required input and support from growers, Sunwater, NR&M and the consultants. Real-time presentation of some information is possible in the future, though not successfully achieved in this project because of reasons outlined later in the report.

Objective 3 – *Promote information sharing and integration to value-add to current data being collected. Use this data to develop strategies, based on the more complete area-wide datasets.*

The pilot project demonstrated practically how growers, the private sector and government gained value by pooling spatial and non-spatial datasets. Improving information integration and sharing, will contribute to better collective landscape decision making. The base datasets such as field boundary, field name, property boundary, soils, irrigation method, sub-catchment, irrigation drain catchments and crop type all form the foundation for better decision making possibilities. The project amply demonstrated the application of these to:

- Water quality assessment - first systematic area-wide approach to water monitoring in the irrigation area, and the first stormwater runoff data collected within the township
- Pest assessment – whitefly a good example, also spatial representation of pest numbers compared to predator levels
- A better understanding of irrigation methods used across the district and hence opportunities to look at water use efficiency
- Seepage losses and impacts from the Irrigation scheme supply channel, left bank

Objective 4 – *Develop tools that facilitate better knowledge and systems approaches to management and adult learning.*

Developing a joint information resource facility concept has proved to be an excellent tool for adult learning, participation and sharing of knowledge. It is an objective way of supporting the continuous improvement cycle in the voluntary Cotton BMP program, and it provides for cost efficiencies in monitoring and information provision. It also provides a means by which Industry can play a greater role in information management.

The water quality training booklet and kit will enable growers to participate in monitoring, with acceptable rigor, and collect information that helps not only assess their own business performance, but contribute to the area-wide information pool, and position industry so that it is recognised by the catchment authorities as a custodian of quality information.

Objective 5 – *Improve resource management practices and outcomes.*

You can't act on what you don't know, and you can often do more with some of the existing information that you already have. The project did deliver outcomes that will lead to improved resource management. These are listed below.

- *Pests*

The project illustrated some value to growers and consultants in looking at pest on an area wide basis. This led to the CGIA requesting the IAWM team to monitor an map silver leaf whitefly during the 2004/05 season.

- *Groundwater and salinity*

It also had considerable influence on shaping the channel lining program and seepage problems on the left bank. This process contributed to the decision by some landholders to line their farm dams and farm supply channels.

- *Water quality*

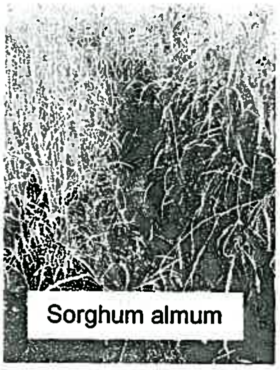
The water quality monitoring activities and data highlighted some isolated instances of high nutrient losses. On showing and discussing the data with the grower and industry support staff, the grower realised the economic costs to his operation and addressed the problem. This was not a public process and demonstrates how good information delivered in the right way can be helpful in changing practices. Continued monitoring and results now provide the same grower confidence now that his practices aren't deleterious.

- *Effectiveness of grass filters*

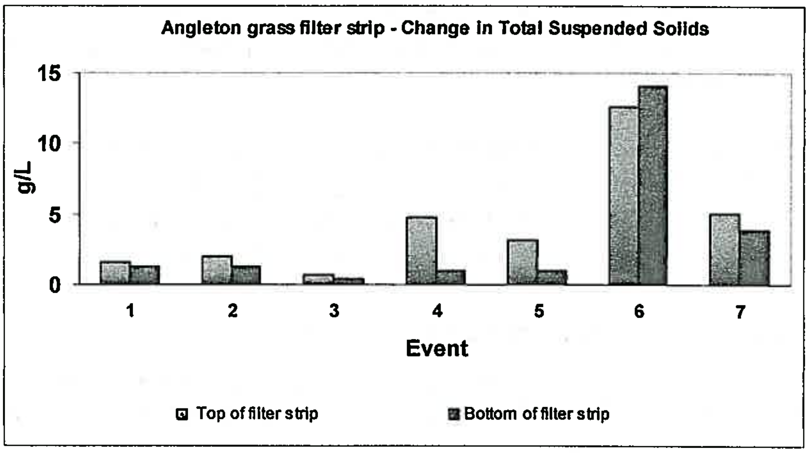
The project team investigated the effectiveness of two grass species within the EIA as sediment filter strips - Angleton grass (*Dicanthium aristatum*) and *Sorghum almum.*

Despite limited data, Angleton grass appears more effective at reducing soil loss, certainly during the smaller runoff events. The grass is naturalised locally and suits the heavy clay soils. Areas that receive periodic watering as expected at tail drain outlets will encourage good vegetative growth. It would be a more effective BMP recommendation as a grass filter and water quality buffer in Central Queensland on irrigated heavy clay soils. It would be particularly suited to outfalls, return drains and discharge points from flood irrigated properties.

Sediment load was not reduced under *Sorghum almum,* and field observation indicated the grass was concentrating flows at the more mature grass heights. This encourages higher velocities and an increase in sediment load. If slashed to keep its height kept low, *Sorghum almum* may function more effectively. Early in the season, the grass was short and runoff appeared to spread across the filter strip more effectively.



Whilst this data relates to Central Queensland, similar work could be done to assess effectiveness of grass species in southern areas.



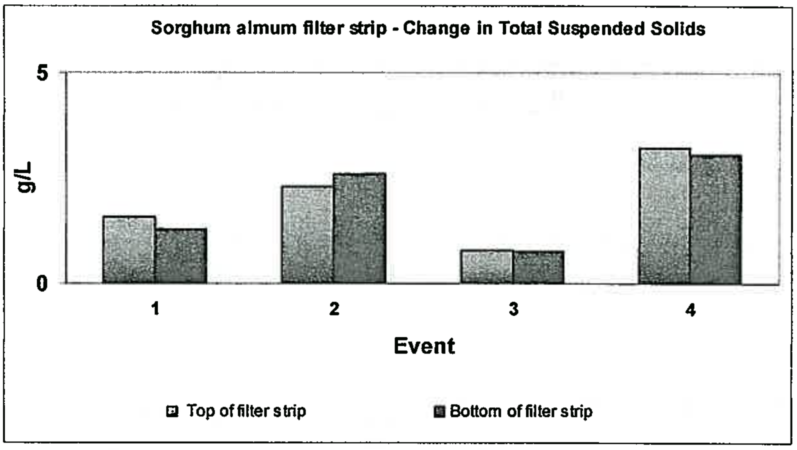


Figure 6: Comparison of Angleton and Sorghum almum

Objective 6 – *Demonstrate future potential of an integrated approach.*

The National Action Plan for Salinity and Water Quality process has identified the pilot project as an activity that should continue even explored in other areas in the State. This will provide an opportunity to see how the principles and learning's can be transferred elsewhere. The team will be working closely with Queensland Farmers Federation and the commodity groups such as cotton in the roll out of these case studies.

The growers continue to support the IAWM concept in Emerald, and the NAPSWQ funding will enable it to advance further. The benefits have been clearly demonstrated. Collectively, industry, Regional catchment authorities and government need to explore sustainable mechanisms that will keep such models working – this is a task currently underway.

5 CONCLUSION

Information and its use constitute a large part of our day-to-day business activity and economy. How well we use it, respect it, value and manage it, largely determine our ability to make good decisions, whether we reside in Government or in the private sector.

The IAWM pilot project has demonstrated a proactive and collaborative approach to landscape management through better information management, and at a scale that is relevant to growers. It has been successful in engaging growers and the community, regional catchment groups, consultants and government staff. It has encouraged landholders to see the value in contributing toward an information system that they have ownership in. Participants needed to be flexible and mature enough as they moved toward sharing data and building the information support system.

There are a few key 'take home' messages:

- It would be beneficial if CRDC and Cotton Australia invested in GIS training and consider providing GIS software to their field operatives. This should become a standard business software tool like Microsoft Excel and Microsoft Word has become, and it will open possibilities for improved technical support to growers, particularly nrm support.
- CottonLogic ™ is not a viable platform for pest data collection and linking with the GIS software for the following reasons:
    - It is not a product used or likely to be used by consultants in Central Queensland.
    - Has problems relating to the synchronising and downloading of data for use in other desktop applications such as Excel, Access and ArcMap - the exported data requires a lot of manipulation.
    - Consultants will not use PDA's in the field – they are cumbersome especially if checkers have a lens and whitefly disk as well.
    - No hard copy to leave with growers and data loss if a PDA "dies"
- The cotton industry should examine its role in information management, particularly environmental and bio-physical information. A more coordinated collection and management approach must now become core business for Cotton. The industry needs to guide the development of an acceptable industry managed information framework which will encourage cotton growers and local area groups to confidently participate in the management and provision of information that will support farm-based, area-wide and regional outcomes. There are two components – resource discovery (knowing what exists, its accuracy, the custodian, where to obtain it, and actually getting hold of it) and bio-physical and production trend information (dynamic data that has farm level sensitivities, but essential to track industry performance). The environmental reform and accountability pressures now dictate the need for industry to advance its own role in information management.
- CRDC needs to encourage, if not mandate that future production and environmental research is captured in geo-spatial forms and stored in an agreed format in an agreed place.
- IAWM has demonstrated that information management must also be underpinned with a 'learning environment' ethic and approached in this manner by all the collaborative

partners. It is not simply about gathering all the information into one place or gathering information to audit the industry. It is what growers are able to do with information that makes the difference. The reform environment has altered the manner in which delivering and achieving this effectively can occur. IAWM is one methodology growers seem comfortable to engage in.

- The IAWM approach helps support the continuous cycle of improvement that BMP is founded on. It provides a tangible means of demonstrating bio-physical condition and trend is being monitored and acted on. Condition and trend monitoring is not short term stuff.
- Cotton is only one neighbour in the landscape. Genuine collaborative and financial input from joint stakeholders is a must. CRDC funds were instrumental in the Emerald project getting off the ground. CRDC in partnership with other sectors could be part of the ongoing commitment to keep an IAWM style initiative running in the longer term in cotton growing valleys. CRDC could examine how it might provide some level of financial assistance to growers and a support team in other districts to begin developing industry IAWM style information initiatives.
- Cotton should continue to work with other commodity groups to seek efficiencies on information and service provision support and we believe an area-wide basis is the right scale to achieve this.

The project leaders would like to thank the growers, consultants and CRDC in particular for their support in this pilot project. Without the industry support and commitment, the project would not have been achievable. We would also like to acknowledge the investment by the State Government and 4T Consultants Pty Ltd. On a very positive note, the project received formal recognition from NR&M in 2003 when it won the State Regional Services award.

6 PUBLICATIONS

Rankine I & Wilkinson W. (2002). *Extending mobile GIS into difficult markets – Area-wide management in Central Queensland.* Paper and presentation: OZRI2002 Conference, Brisbane.

Rankine I & Wilkinson W. (2003). Improving rural industries ability to respond to management and environmental challenges – a discussion paper. Unpublished workshop paper, presented to Queensland Farmers Federation, Cotton Australia, Qld Fruit and Vegetable Growers Association: Brisbane.

Rankine I, Ramsay C, Bock P & Wilkinson W. (2004). IAWM water quality monitoring field guide. Training course resource.

Wilkinson W, Bock P, Ramsay C & Rankine I. (2003). Field dilution techniques used to assess high turbidity levels – how accurate are they? Unpublished but circulated to NR&M water quality monitoring staff.

Wilkinson W, Ramsay C and Rankine I. (2003). Various water quality reports to individual growers. Confidential condition and trend reports.

Wilkinson W, Rankine I, Bock P & Ramsay C. (2003). Water quality in the Emerald township area Feb 2002 – May 2003. Confidential report provided to Emerald Shire Council; Emerald.

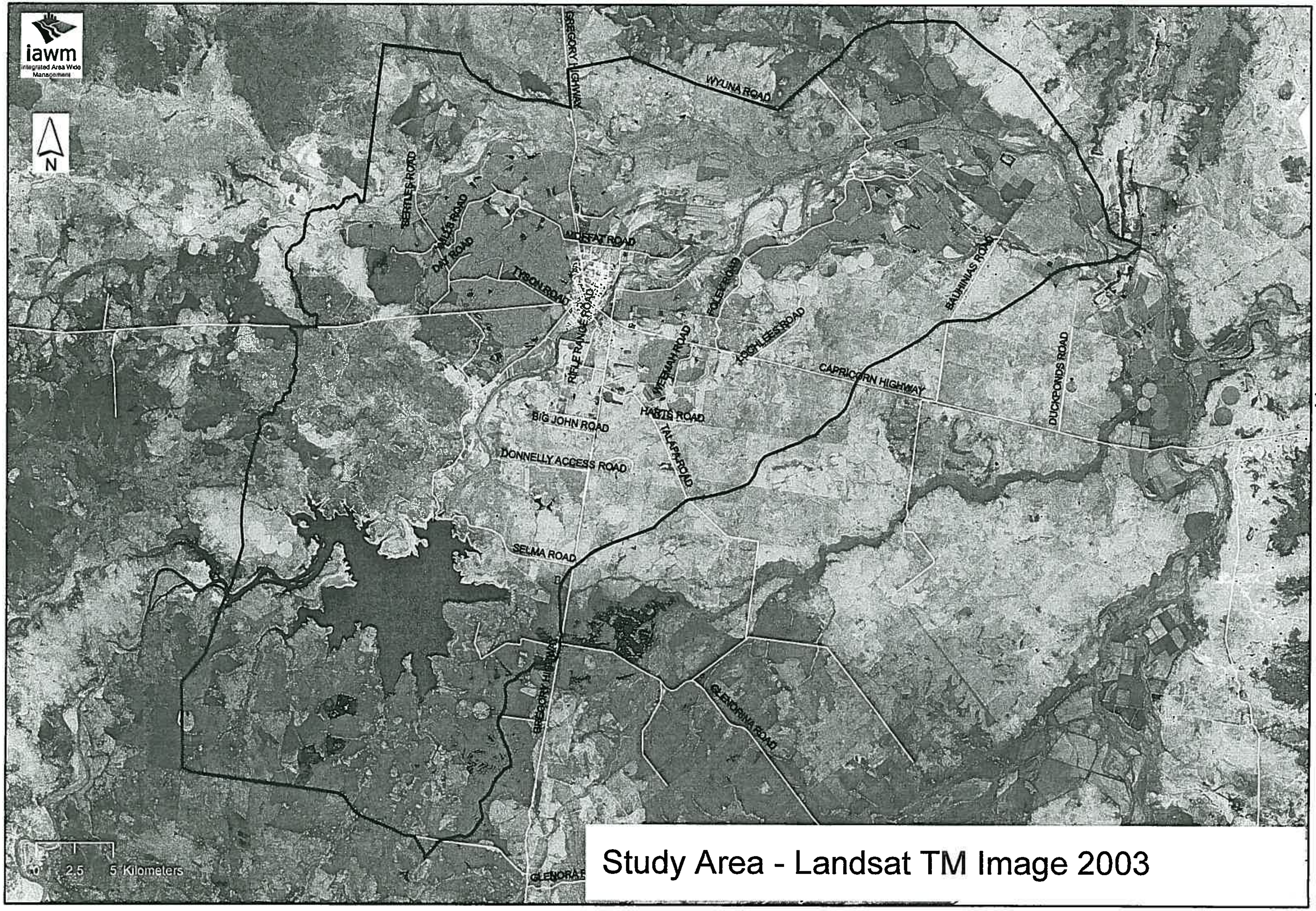
Wilkinson W, Rankine I, Bock P, Ramsay C & Mellor K. (2003). Water quality in the Emerald Irrigation Area Feb 2002 – May 2003. Confidential report provided to the Emerald Irrigators Association: Emerald.

Wilkinson W, Rankine I & Emerald State School. (2003). Clean-up Australia Day 2003. Grade 5 K12 Project, report and recommendations to Emerald Shire Council.

Wilkinson W, Bock P, Ramsay C & Rankine I. (2004). Seepage impacts in the Emerald Irrigation Area. Confidential report prepared for the Emerald Irrigators to table at Sunwater Customer Council Meeting: Emerald.

Qld Govt (2004) Integrated Area Wide Management as an approach to landscape management. Community Engagement Showcase presentation, Rockhampton 2004. http://www.getinvolved.qld.gov.au/share_yourKnowledge/keyinitiatives/showcase_ce/centralqld/integratedareawidemanagement

Appendix 1



Study Area - Landsat TM Image 2003