

# Rural Water Use Efficiency Initiative

## Final Report

### Performance Evaluation of the Rural Water Use Efficiency Initiative – Adoption Program

prepared by

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## Introduction

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### **Key Points**

- *This is the evaluation plan for the \$23 million Queensland Rural Water Use Efficiency Adoption Program*
- *The initiative is a partnership between the Department of Natural Resources (DNR) and each of the main irrigation industries of cotton, dairy (and lucerne), horticulture and sugarcane*
- *Current assessment of water use efficiency in Queensland indicates that up to 40 percent of water is lost due to run off, drainage and evaporation*
- *The initiative aims to identify ways of converting a proportion of those losses into productive use and this evaluation program monitors and measures the progress towards that saving*

## Background

The Department of Natural Resource has developed a \$41 million Rural Water Use Efficiency Initiative. The Initiative is a partnership between rural industries and the government to improve the water use efficiency (WUE) and management of available irrigation water thereby improving the competitiveness, profitability and environmental sustainability of Queensland's rural industries.

The Initiative has four major elements:

- Industry Adoption Programs to improve WUE on farms;
- Reducing water losses from storages on farms;
- Financial incentives to achieve best practice irrigation water management; and
- Reducing water losses in irrigation water supply and distribution systems.

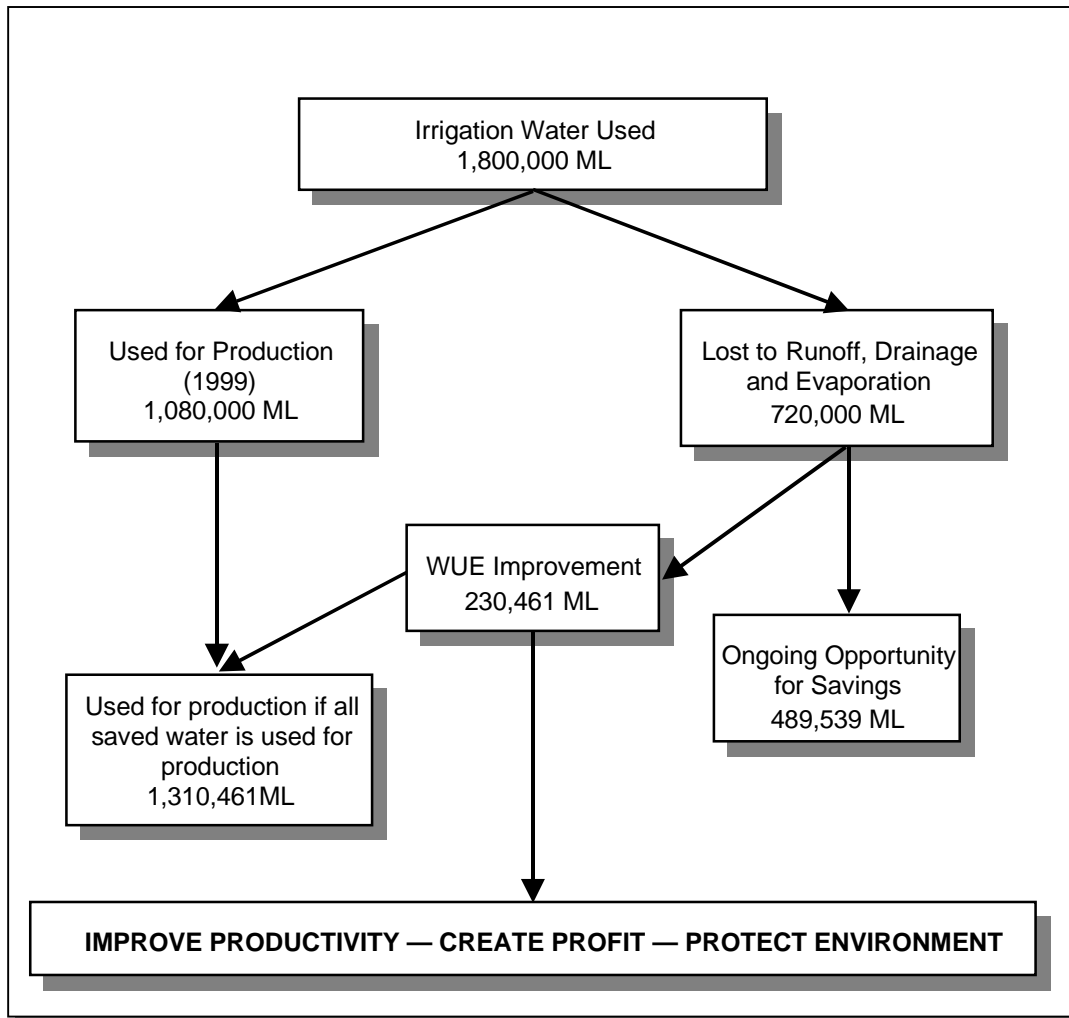
Key benefits expected to flow from the improved WUE and management are:

- a) by 1 July 2003, an increase in agricultural production of \$280 million (equivalent to what would be achieved by supplying an additional 180,000 megalitres [ML] of irrigation water annually);
- b) the creation of 1,600 jobs in regional Queensland;
- c) improved farm profitability and viability of Queensland's rural industries; and
- d) reduced run-off and drainage of pesticides, salts and nutrients into rivers, aquifers and streams.

Approximately \$23 million of the total initiative funding will be spent on Industry adoption programs (extension, development and research) to improve water use efficiency on farms.

Current assessments of WUE in Queensland indicate that about 60% of irrigation water being used by farms is being used for crop or pasture production (Figure 1) with the balance being lost to runoff, drainage and evaporation. Losses to runoff and drainage lead to losses of fertiliser and pesticides from the farm and environmental damage. Even if the targets set by the Industries are achieved (Figure 2) then there will still be opportunities for further improvement as nearly 500,000ML will still be lost. The Adoption Initiative aims to establish a process for continuous improvement in WUE to address these losses on an ongoing basis.

**Figure 1 Rural Water Use Efficiency – Big Picture**



The \$18 million balance of the \$41 million will be allocated to the Initiative’s three remaining elements: Reducing Water Losses from Storages on Farms, Financial incentives to Achieve Best Practice Irrigation Water Management and Reducing Water Losses in Irrigation Water Supply and Distribution Systems. These will vary in their size, their ability to increase efficiency and the number of locations in which they can be implemented. Accordingly, the funding allocated to each element will vary.

The additional water which will become available to irrigators as a result of implementing improved water use efficiency practices and systems can either be used by them for increased agricultural production or they will be able to trade it once the proposed changes to water industry legislation are made.

The Queensland Government has established an Advisory Committee comprised of representatives from the DNR, rural industry organisations, government agencies, the Queensland Conservation Council (QCC) and the Irrigation Association of Australia (IAA) to oversee the implementation of the Initiative.

The key features of the adoption programs are outlined below.

- The Industry programs are being managed by rural industry organisations (CANEGROWERS for sugarcane; Cotton Australia for cotton and grains; Queensland Dairyfarmers’ Organisation for dairy and lucerne and Queensland Fruit & Vegetable Growers for horticulture). Each organisation has involved irrigators in the design and implementation of its adoption program. These approved Industry programs are being funded by the Queensland Government through DNR;

- Industries have undertaken DNR funded stocktakes of their Industries to:
- establish the level of current performance in WUE;
- identify the opportunities for improving WUE; and
- establish the priorities for action to improve WUE.
- participation by individual farmers in the programs is voluntary and is not confined only to those irrigators supplied from regulated supplies;
- milestones and targets for the ML saved and percentage of irrigators achieving Best Management Practice (BMP) have been established by each Industry and progress against these milestones will be reviewed at set intervals (generally annual to suit irrigation cycles);
- the adoption programs will be supported by R&D activities to develop further information on improved irrigation water management techniques;

A positive feature of the program to date is that the total amount of the four Industry's improvement in WUE targets exceeds the Initiative's key performance target of 180,000 ML for the State program (Figure 2).

**Figure 2** *Indicative Industry and State Targets*

Industry	Target ML	Initiative Funding \$ m	Possible Benefits \$m <sup>*2</sup>	Target BMP % Adoption <sup>*3</sup>
Sugar	72,660	4.9 <sup>*1</sup>	90	70
Cotton / Grain	60,000	3.0 <sup>*1</sup>	27	70
Horticulture	30,000	3.4 <sup>*1</sup>	147	40
Dairy	58,503	2.5 <sup>*1</sup>	8.5	40
Lucerne	9,298		3.4	40
<b>Total Industry</b>	<b>230,461</b>	<b>13.8<sup>*1</sup></b>	<b>&gt;276</b>	<b>–</b>
<b>State Target</b>	<b>180,000</b>	<b>23</b>	<b>280</b>	<b>–</b>

\*<sup>1</sup> Funds provided by DNR for the Industry Adoption Programs. It does not include the costs of the Industry Stocktakes/Audits or contributions by Industries towards the Adoption Programs.. It also excludes GST, R&D support for the adoption programs, DNR support for the adoption programs, certain Industry Program Coordinator costs, and other costs, eg. training programs for adoption program staff.

\*<sup>2</sup> Estimates taken from Industry Adoption Proposals.

\*<sup>3</sup> Different approaches will be taken by Industries but basically the percentage of farmers surveyed who have substantially achieved BMP over the term of the Initiative.

## Aim and Objectives

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### ***Key Points***

- *The aim of the project has been to develop the criteria, measures and processes required to enable and independent performance evaluation of the adoption program*
- *Performance is to be evaluated at mid term and completion*
- *The evaluation will consider changes in performance within industries and across regions*

The aims of the consultancy were to work with Industries and DNR to develop the criteria, measures, process and activities which will be used to undertake independent performance evaluations of the Adoption Program at both mid term and completion.

***The overall objective of the Performance Evaluation is to evaluate the Industry Adoption Programs and the whole program in terms of the following priority performance criteria:***

- *improved water use efficiency;*
- *percentage of irrigators achieving Best Management Practice;*
- *Achievements in WUE without the RWUE Initiative.*

The Performance Evaluation involves three stages:

- Stage 1 – Development of Criteria, Measures, Processes and Activities;
- Stage 2 – Mid Term Performance Evaluation; and
- Stage 3 – Overall Performance Evaluation at Completion.

Stage 1 concentrated on defining the identified and expected outputs and outcomes from the initiative particularly in regard to the original targets set by the Industry Programs and DNR.

Stage 2, the mid term evaluation, will measure performance and analyse the effectiveness of the activities, measures, and processes in delivering the program's overall targets. It will also make recommendations about any changes needed in both the Industry Programs and the overall Program to deliver these targets.

Stage 3, the overall performance evaluation at completion will also measure performance and analyse the effectiveness of the program's activities.

The evaluation in Stages 2 and 3 will consider changes in performance within Industries, across regions and statewide. Performance will be measured against the criteria and targets identified by the Industries and DNR in their evaluation plans and other criteria established in this consultancy.

Whilst the management of the Industry programs against the milestones will be undertaken by the Industries and DNR jointly it is proposed that Stages 2 and 3 of the performance evaluation will be undertaken by independent consultants using the criteria measures and processes outlined in this report.

## Methodology Used and Outcome

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### **Key Points**

- *Development of the evaluation program has been undertaken in three major steps*
- *Firstly, a framework for evaluation was developed in consultation with each industry*
- *Secondly, a workshop was held involving the industries and program stakeholders to agree on a framework, to develop industry specific content and to prepare an action plan and timetable to finalise the program*
- *Thirdly, a final iteration was undertaken of finalising industry content which involved another round of consultation with key industry representatives*
- *The outcome was a three tiered evaluation model to assess improvement in WUE, movement to BMP and the social indicators of awareness and participation, together with a program management structure. The model was based on Evaluation Plans developed by each Industry segment*

Three major activities were undertaken to establish the detailed requirements of the client, involve the Industries in the development of evaluation details and achieve ownership and agreement for the process, measures and criteria being used. Ownership was an essential component as the Industries will be responsible for collecting the data being used to evaluate performance and DNR need to be confident about the processes being used to collect the data.

### 1. Framework for the Evaluation

This activity considered the existing targets, the priority performance criteria, measures for these criteria, processes to collect and analyse the data and other activities needed to evaluate performance. It also considered other possible performance criteria that could add value.

Meetings were held with the four Industry groups and DNR to clarify the evaluation component of their Industry adoption plans and involve them in the development of the overall evaluation plan. Information on tracking performance was an important part of the project management planning at both the regional and state level so the early development of the detailed measures and processes were in their interest.

DNR and the Industries had already negotiated key performance criteria as part of the funding proposals. These are based on results from stocktakes of the Industries and knowledge developed from R&D and existing activities aimed at improving WUE. Whilst some targets have been set by Industries these still have to be further developed with irrigators at a local level.

The detail for measuring performance and collecting the information to measure change had not previously been established. During this activity emphasis was placed on who should be responsible for collecting and monitoring data.

The Industry adoption plans were considered in regard to the overall evaluation framework. Industries' views on the processes and activities to be used to collect data for the final evaluation were canvassed. These processes included resurvey of irrigators involved in stocktakes and regional surveys, stratified irrigator surveys, field data collection on selected farms and desktop collection of available data. Industry groups considered that they, and not government, should collect and manage data for their industries where practical.

Preliminary meetings with DNR and the Industry Coordinators enabled the development of an agreed framework of **priority** criteria and targets. These are:

- overall on farm improvement in WUE equivalent to 180,000ML of irrigation water (*Priority Criteria*);
- the percentage improvements in WUE in the negotiated Industry programs (*Priority Criteria*);

- percentage of growers achieving Best Management Practice for irrigation by 2003 (*Priority Criteria*);
- attitudes and awareness;
- management and irrigation system changes;
- saved water usage by irrigators; and
- productivity improvement, benefits and costs, and environmental benefits at the regional, industry and state levels.

Whilst the consultants and the initial brief identified other performance criteria (many were mentioned in the Initiative and the Industry proposals) these were considered to be lower priorities for evaluation. Accurate collection of this data would be difficult and would detract from the priority areas. Examples of these non-priority criteria are:

- impacts on competitiveness of Industries;
- employment;
- social benefits and costs; and
- community benefits.

As a result of these meetings a framework model (Appendix 1) was developed to provide focus on the priority criteria and the way in which they contribute to the main objective – *improvement in WUE*.

A major issue identified in the Industry stocktakes and the establishment of the initiative was the lack of data relating to the water used for irrigation and information about how efficiently it is being used. A major emphasis of the initiative is to acquire more accurate data but it has been agreed that this would only be available for certain areas in 2003.

For this reason, the model aims to track changes in attitudes and actions as well as BMP and WUE. The model will enable tracking of these changes and this will enable future predictions to be made on the benefits of the Initiative.

All the Industries had developed performance targets for the *priority criteria* but they had not identified how they would measure and accurately collect data on these changes.

## 2. Stakeholder Workshop

A one day structured workshop of all interested parties (Appendix 2 lists attendees) was held at Bardon on the 21 December 1999 (See Appendix 3 for Agenda) to:

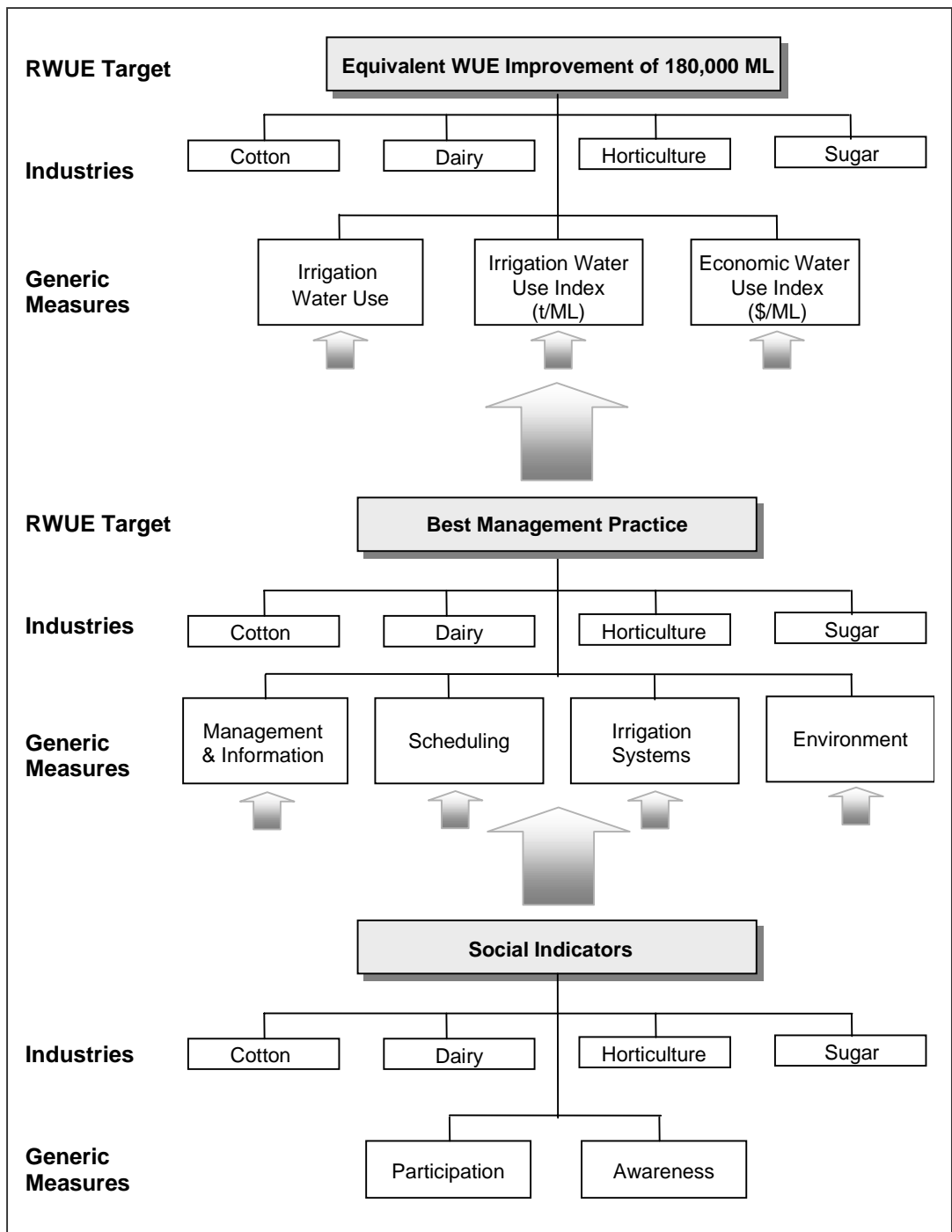
- work with Industries to further develop the evaluation criteria and processes;
- develop Industry Performance Evaluation (PE) Action Plans and an Overall Plan for the program; and
- prepare an Action Plan and Timetable to finalise the details for the PE Plans.

The workshop agreed on the model to be followed (Figure 2), helped develop the processes to be used and identified areas where common approaches could be used. Whilst industries need to take different approaches, it was agreed that definitions and data collection techniques would follow similar agreed standards where practical. For example, the efficiency measures and indices developed by Barrett, Purcell and Associates (1999) would be used to evaluate performance of WUE.

The model takes a top down and bottom up approach. The top down aspect recognises that irrespective of the industry, there are some common measures of water use efficiency, best management practices and participation indicators that can be audited at a statewide level. However, from the bottom up perspective, the model recognises the differences between industries and thus avoids prescribing how or what measures are developed below what are termed generic measures. It is up to each industry develop this level of detail, which has been included in the individual industry evaluation plans.

The arrows between ML improvement in WUE, Best Management Practice and Social Indicators reflect the path of adoption for the RWUE program. Initially awareness created will result in a proportion of farmers participating in extension and research programs, which will lead in turn to a change in management practices, by a proportion of the participants. It is only then after a move to better management practices that these activities will be reflected in the water use efficiency measures.

Figure 3 Overview Evaluation Model



Consideration was given to the evaluation and measurement of external factors that may impact on performance. Risk factors such as climate variability, pests and disease, water supply, water quality, R&D support, commodity price and government policies could have a major positive or negative effect on performance. Evaluation Plans were to consider how to record and quantify the impacts of these factors on performance.

The industries were able to identify the basic information needed to evaluate performance at the workshop (see Workshop notes, Appendix 4) but required further time to add detail and complete the Evaluation Plans in an agreed format to be forwarded to them by the consultants. The format (Appendix 5) and the agreed evaluation model were forwarded to Industry Coordinators on the 23 December 1999 with completion due by 14 January 2000.

### 3. Structuring Program Management

This step aimed to formalise the results from the workshop. The draft evaluation proposals developed by industry were to be discussed with stakeholders and then the program management document finalised and forwarded to the consultants for incorporation in the overall plan. They were to clearly outline:

- The activities to be undertaken, the processes to be used and their timing;
- The criteria and the measures to be used and who will collect information;
- Responsibility for managing the different processes and activities;
- Risk management procedures; and
- Reporting arrangements.

All the Industries had difficulty preparing their plans particularly in the sections dealing with measuring WUE and BMP guidelines. To address these issues the consultants met with the individual Coordinators to work with them to finalise their plans. Changes were made to the model to simplify the approach used for evaluating improvement in BMP. The new approach places emphasis on substantially meeting the critical BMP criteria listed in Appendix 6. Surveys to establish the percentage meeting the critical criteria will be carried out and audited by the Industries. The approaches used and samples from the returns will be audited by the independent evaluator in conjunction with DNR. Results of these surveys should be able to be validated against the changes in WUE sample. In addition detail was included on survey approaches and sample numbers (Appendix 7) and the procedures to measure and calculate changes in WUE.

For uniformity these plans were redrawn by the consultants based on these discussions. These were forwarded to the Coordinators for consideration and the final Industry Performance Evaluation Plans are outlined in the section on Industry Plans.

## Mid Term Evaluation

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### ***Key Points***

- *The Mid Term Evaluation will be carried out by an independent evaluator in late 2000*
- *This evaluation will review the data, the process and progress made and thus enable changes or responses if necessary*

The mid term review should be carried out by the independent evaluator in 2000 / 2001 to fit in with irrigation seasons. It should include:

- Report outcomes / outputs against agreed measures / targets for Industries and the State;
- Review the effectiveness / and rigour of the data collection processes for each Industry Plan and the program;
- Report on suitability of the measures used to evaluate performance;
- Recommend any changes to the agreed evaluation plans;
- Recommend any necessary changes to the Industry Adoption Plans;
- Highlight areas where performance has been exceptional and indicate actions that could flow from these success areas; and
- Identify poor performance areas and suggest actions to correct or cease activity.

## Final Program Evaluation

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### ***Key Points***

- *The Final Program Evaluation will be carried out by an independent evaluator in 2003*
- *The evaluation will report outcomes against agreed measures and targets*
- *It will review the accuracy of the data*
- *It will identify the reasons for success or failure of the program*

An independent evaluator should carry out the final evaluation in 2003 to fit in with growing season. The evaluator will:

- report outcomes and outputs against agreed measures/targets for Industries, regions and state;
- report on accuracy of the data;
- using the data accumulated, undertake a Benefit/Costs analysis of the program;
- report on reasons for successes and failures; and
- provide recommendations for future actions to improve performance in WUE.

## Industry Plans

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### ***Key Points***

- *Separate evaluation plans were developed by the cotton, dairy, horticulture, lucerne and sugar industries*
- *Each industry's individual plan is consistent with the overall RWUE program and measures*
- *Verification or cross checking of data used for measuring performance is a key component of industry plans*

In the development of the following plans it was agreed that two plans be prepared for the Dairy/ Lucerne program. A similar approach was considered for the Cotton/Grains program but the processes being used for cotton and grain growers remains combined as the majority of those farmers grow both crops and utilise common water sources.

As mentioned different approaches have been used to calculate the improvement in WUE for each industry based on the existing industry systems and the processes to calculate WUE in the Stocktakes (in most cases these will be used as the benchmarks). In all cases it is planned to expand the sample size for calculating WUE and to use a larger sample population of Irrigators actually measuring water application and use. All the Industries are establishing a significant number of demonstration sites where irrigation water use irrigation systems/ practices will be monitored.

Whilst data will be collated at the times outlined in the plans some data collection will be ongoing and not fixed to the evaluation times. This data will be able to be analysed and will be useful in determining trends in improvement in WUE.

A key reason for the development of the model was the cross checking and validation of data across the priority criteria. For example, changes in BMP should be reflected in changes in WUE and vice versa.

## State Evaluation

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### ***Key Points***

- *A state wide survey of all irrigators is proposed to cover key issues relating to BMP and participation in the programs*
- *A benefit cost analysis will be undertaken to assess the return to investment in the program*
- *It will also include the benefits that would have occurred organically, without the program*

### Overview Survey at Completion.

It is proposed that a simple survey of all irrigators be conducted that covers key issues relating to BMP and involvement in the program. DNR should commission the evaluation consultants to develop this with the Industries and then the consultants should work with Industry to send it out to all irrigators and verify returns and the relationship to the more detailed industry WUE data (based on a smaller sample size). Appendix 8 outlines the type of information that should be acquired in this survey. Such a survey will allow interpretation of performance data from the industry surveys and demonstrations to a wider group.

### Adding up the Industries – WUE savings equivalents.

As discussed, the evaluation model is designed to build up to a common framework in order to measure water savings.

### A Benefit Cost Analysis

A benefit cost analysis will be conducted to ascertain the return on investment in the program. The benefit cost analysis will also consider the organic improvement that would have happened irrespective of the program. There is considerable historical data available, particularly in the cotton and sugar industries that can be used to extrapolate the growth rate of change prior to the RWUE program.

## Evaluation Plans

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The evaluation plans developed by the individual industries follow.

## Cotton / Grains Evaluation Plan

**Cotton / Grains** – Estimated current use 600,000ML (Cotton 510,000ML, Grain 90,000ML)

WUE Target: Equivalent WUE improvement of : 60,000ML)	Irrigation Water Use	Irrigation Water Use Index <sup>1</sup>	Economic Water Use Index
<b>Measures</b>	<ul style="list-style-type: none"> <li>• ML/ha</li> </ul>	<ol style="list-style-type: none"> <li><b>1. Crop Water Indices</b> Cotton:               <ul style="list-style-type: none"> <li>• Bales/ML Irrigation</li> <li>• Bales/ML Irrigation &amp; Rainfall</li> </ul>               Grain               <ul style="list-style-type: none"> <li>• t/ML Irrigation;</li> <li>• t/ML Irrigation &amp; Rainfall</li> </ul> </li> <li><b>2. Engineering Efficiency</b> (Component level &amp; farm level)               <ul style="list-style-type: none"> <li>• %</li> </ul> </li> <li><b>3. Agronomic WUE Index:</b> <ul style="list-style-type: none"> <li>• Bales/ML Transpiration (= CWUE Index)</li> <li>• t/ML Transpiration</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• \$/ML (Gross Income)</li> </ul>

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<sup>1</sup> Note: Irrigation Water Use Index is a derivation of Engineering Efficiency and Agronomic Crop Water Use Index.

WUE Target:	Irrigation Water Use	Irrigation Water Use Index	Economic Water Use Index
<p><b>Processes to Gather Measures</b></p> <ol style="list-style-type: none"> <li>1. Farm surveys will be carried out and processed using the methodology developed and field tested by Sunil Tennakoon.</li> <li>2. Initiative staff and other cooperators will be trained in methodology.</li> <li>3. Target numbers of farms are 30% of farms on Darling Downs (will be stratified sample to capture range) and 50% for other areas by 2003.</li> </ol>	<p><b>Regionally Specific:</b></p> <ol style="list-style-type: none"> <li>1. Regulated Areas <ul style="list-style-type: none"> <li>• Collect Production Data – from gins and farms (farm &amp; regional scale)</li> <li>• Collect Irrigation Data – from State Water Projects (SWP) water readings/water bills</li> <li>• Collect Rainfall data</li> </ul> </li> <li>2. Non-Regulated Areas <ul style="list-style-type: none"> <li>• Production Data – from gins and farms</li> <li>• Irrigation data – survey collected using format developed by Tennakoon and validated from demonstration sites and group notes</li> </ul> </li> </ol>	<p><b>Engineering:</b></p> <ol style="list-style-type: none"> <li>1. Calculate Farm Storage Efficiency; Farm Distribution Efficiency; Application Efficiency; Whole Farm Efficiency using Tennakoon technique:</li> <li>2. Detailed measures on 4 demo sites per region (valley); and</li> <li>3. Observations/measurements on 16-20 other sites per valley (= 5 – 50% per valley)</li> </ol> <p><b>Agronomic:</b></p> <p>Climatic data crop phenology and water use data; yield data (farm scale); management operations:</p> <p>Detailed measurements at 4 demonstration sites/valley and 16-20 other sites/valley (usage data + on-farm rainfall)</p>	<p><b>Yield Data:</b></p> <ul style="list-style-type: none"> <li>• Quantity /\$ values from gins;</li> <li>• Quality from gins;</li> <li>• Grain quantity, oil/protein from farm, survey or marketing authorities.</li> </ul> <p><b>Volume Data:</b></p> <ul style="list-style-type: none"> <li>• As for Irrigation Water Use Index.</li> </ul>
<p><b>Means of Verification</b></p>	<p><b>Farm Surveys:</b></p> <p><b>Baseline</b> – Check against demo farms</p> <p><b>Mid term</b> – Concentrate on awareness issues and participation in BMPs – regional level</p> <p><b>Final</b> – Check against demo farms</p>	<p>As for irrigation water use</p>	<p>As for irrigation water use</p>
<p><b>Timing of Evaluation Reports</b></p>	<ul style="list-style-type: none"> <li>• Baseline: June 2000;</li> <li>• Mid term: September 2001;</li> <li>• Final: September 2003</li> </ul>	<p>As per irrigation water use</p>	<p>As per irrigation water use</p>

## Best Management Practice: Cotton/Grains

<b>Target:</b>	<ul style="list-style-type: none"><li>• 70% of growers have substantially met the critical Best Management Practice criteria (Appendix 6)</li></ul>
<b>Measure:</b>	<ul style="list-style-type: none"><li>• % of all cotton and grain irrigators who have substantially met the critical Best Management Practice criteria for their location.</li></ul>
<b>Process:</b>	<ul style="list-style-type: none"><li>• In consultation with irrigators and industry, develop Irrigation BMP guidelines which are consistent with critical guidelines (Appendix 6)</li><li>• With industry incorporate irrigation guidelines into the Industry BMP guidelines</li><li>• Develop self assessment and audit process to enable 100% of all irrigators to evaluate where they are in terms of the guidelines and develop action plans for meeting guidelines</li><li>• Survey all irrigators annually using approved process</li><li>• Collate and Audit data to determine the % of irrigators who have made substantial change towards BMP</li></ul>
<b>Means of Verification:</b>	<ul style="list-style-type: none"><li>• Check results against changes in WUE surveys</li><li>• Check against local group's BMP activity and results</li></ul>
<b>Timing of Evaluation Reports:</b>	<ul style="list-style-type: none"><li>• Annually</li><li>• Report to DNR September 2001 and 2003</li></ul>

Cultural Change: Cotton/Grains

<b>Indicators</b>	<b>Awareness</b>	<b>Participation</b>
<b>Measures</b>	% and Numbers of irrigators that are aware of the program, BMP, and irrigation issues.	Percentage of irrigators at meetings. Percentage involved in demo sites.
<b>Processes to Gather Measures</b>	Survey Focus groups	Survey Focus groups
<b>Means of Verification</b>	Industry benchmarking surveys	Industry benchmarking surveys
<b>Timing of Evaluation Reports</b>	As for WUE	As for WUE

## Dairy Evaluation Plan

**Dairy** – Estimated current irrigation water use: 491,628ML

<b>WUE Target: Equivalent WUE Improvement of 58,503ML</b>	<b>Irrigation Water Use</b>	<b>Water Use Index / Application Efficiency</b>	<b>Economic Water Use Index</b>
<b>Measures</b>	<ul style="list-style-type: none"> <li>• ML/ha</li> </ul>	<ol style="list-style-type: none"> <li><b>1. Application Efficiency (field and farm level)</b> <ul style="list-style-type: none"> <li>• % (Available to crop / Supplied, stored or harvested)</li> </ul> </li> <li><b>2. Production Water Use Index</b> <ul style="list-style-type: none"> <li>• L milk/ ML (Irrigation + Effective Rainfall)</li> </ul> </li> <li><b>3. Irrigation Water Use Index</b> <ul style="list-style-type: none"> <li>• Additional L milk/ ML Irrigation applied</li> <li>• Additional Kg (DM)/ ML Irrigation applied</li> </ul> </li> <li><b>4. Crop Water Use Index</b> <ul style="list-style-type: none"> <li>• Kg (DM)/ML transpiration</li> <li>• L milk / ML transpiration</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• \$ / ML</li> </ul>

<b>WUE Target:</b>	<b>Irrigation Water Use</b>	<b>Water Use Index / Application Efficiency</b>	<b>Economic Water Use Index</b>
<b>Processes to gather measures and calculate</b>	<ul style="list-style-type: none"> <li>• Queensland Dairy Accounting Scheme (QDAS) data -expand irrigation database from 10 farms to 150 (out of 269)</li> <li>• Expand no of farms with detailed water use and production monitoring to 25</li> <li>• For each target farm calculate ML/ha used by:               <ol style="list-style-type: none"> <li>1. DNR water use data for regulated areas; or</li> <li>2. Calculate from electricity use and pump and system capacity; or</li> <li>3. Field measurement using detailed irrigation and climate data measurement;</li> <li>4. Irrigated ha calculated from QDAS.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>• Calculate or measure Field Application Efficiency (engineering efficiency) using methodology developed from case studies for system efficiency, climate models, meters and soil monitoring (depending on data for surveyed farms)</li> <li>• Calculate utilised L milk /ha irrigated for survey farms from farm milk production and feed conversion model taking into account dryland pasture and purchased feed;</li> <li>• Calculate kg (DM)/ML (irrigation) WUE index from climate models, yield data (field trials and demonstrations, estimates from pasture growth models);</li> <li>• Measure and estimate pasture utilisation for selected farms;</li> <li>• Calculate CWU Index using production models.</li> </ul>	<ul style="list-style-type: none"> <li>• QDAS data set and other survey farms \$/ML at an average milk price of last litre milk</li> </ul>
<b>Means of Verification</b>	<ul style="list-style-type: none"> <li>• DNR records where available</li> <li>• Demonstration sites</li> <li>• Farm system evaluation records</li> </ul>	<ul style="list-style-type: none"> <li>• Field and R&amp;D trials</li> </ul>	<ul style="list-style-type: none"> <li>• Possibly data calculated at workshops, which could verify the range.</li> </ul>
<b>Timing of Evaluation Reports</b>	<p>Baseline: 1999 stocktake</p> <ul style="list-style-type: none"> <li>• Annual evaluation for QDAS data set.</li> <li>• Mid term: 2001 (from existing QDAS data)</li> <li>• Final evaluation: March 2003</li> </ul>	<p>Baseline: 1999 stocktake</p> <ul style="list-style-type: none"> <li>• Annual evaluation for QDAS data set.</li> <li>• Mid term: 2001 (from existing QDAS data)</li> <li>• Final evaluation: March 2003</li> </ul>	<p>Baseline: 1999 stocktake</p> <ul style="list-style-type: none"> <li>• Annual evaluation for QDAS data set.</li> <li>• Mid term: 2001 (from existing QDAS data)</li> <li>• Final evaluation: March 2003</li> </ul>

## Best Management Practice: Dairy

<b>Target:</b>	<ul style="list-style-type: none"><li>• At least 40% of irrigators have substantially met the critical BMP criteria.</li></ul>
<b>Measures:</b>	<ul style="list-style-type: none"><li>• Percentage of Dairyfarmers who have substantially met the critical BMP criteria (Appendix 6).</li></ul>
<b>Processes / Actions to Gather / Interpret Measures:</b>	<ul style="list-style-type: none"><li>• In consultation with irrigators develop BMP guidelines for irrigated dairy farms that are consistent with key area guidelines</li><li>• Develop a process to track changes in BMP for QDAS target group (150 irrigators)</li><li>• Develop the tracking system to enable it to be applied to a wider group over the time of the program (which together with the QDAS group should capture 60% of the irrigation water used in dairy)</li><li>• Train program staff and other (DPI) staff in methodology</li><li>• Develop criteria to evaluate whether irrigators have substantially met BMP in the key areas</li><li>• Survey and audit QDAS sample results annually;</li><li>• Analyse and audit results from the tracking group annually from first collection or at completion;</li><li>• Collate all data to determine achievement or degree of change towards BMP.</li></ul>
<b>Means of Verification:</b>	<ul style="list-style-type: none"><li>• For QDAS and any other data sets with calculated WUE check improvements in WUE measures against movement towards BMP</li><li>• Sales of /or record of equipment identified as contributing to BMP</li><li>• Final survey of all irrigators ( Appendix 8)</li></ul>
<b>Timing of Evaluation Reports</b>	<ul style="list-style-type: none"><li>• Annually for QDAS survey group;</li><li>• As for WUE for audit at Mid and Final Reporting</li></ul>

Cultural Change: Dairy

Indicators	Awareness	Participation
<b>Measures:</b>	<ul style="list-style-type: none"> <li>• % who have understanding of the project, it's two key objectives and how they can be involved</li> </ul>	<ul style="list-style-type: none"> <li>• % of Farmers making changes on farms</li> <li>• No's of Farmers involved in activities</li> </ul>
<b>Processes to Gather Measures</b>	<ul style="list-style-type: none"> <li>• Consultant to develop methodology to monitor</li> <li>• Final survey of all Irrigated Dairy farmers.(as above)</li> </ul>	<ul style="list-style-type: none"> <li>• Tracking program</li> <li>• Statistics from activities (Workshops, field days training etc)</li> <li>• Final survey of all</li> </ul>
<b>Means of Verification</b>		
<b>Timing of Evaluation Reports</b>	Mid term and final evaluation	Mid term and final evaluation

## Horticulture Evaluation Plan

**Horticulture** – Estimated current irrigation water use: 274,493 ML

WUE Target: Equivalent improvement in WUE of 30,000ML (11% overall )	Irrigation Water Use	Water Use Index	Economic Water Use Index
<b>Measures</b>	<p><b>Irrigation Water Use Index</b></p> <ul style="list-style-type: none"> <li>• ML/ha (crop season per year)</li> </ul> <p><b>Best Practice Irrigation Water Use Index</b></p> <ul style="list-style-type: none"> <li>• ML/ha (crop season per region) – note: some areas have no BMP growers and improvement will have to be monitored over several seasons</li> </ul>	<p><b>Crop Water Index (CWI)</b></p> <ul style="list-style-type: none"> <li>• t/ML (Irrigation and effective rainfall)</li> </ul> <p><b>Irrigation Water Use Index (IWUE)</b></p> <ul style="list-style-type: none"> <li>• t/ML applied</li> </ul> <p><b>Application Efficiency (Field)</b></p> <ul style="list-style-type: none"> <li>• % (Available to crop / Supplied)</li> </ul> <p><b>Efficiency Ratio (Farm, crop, region, state)</b></p> <ul style="list-style-type: none"> <li>• % (Improvement in Irrigation Water Use Index)</li> </ul> <p><b>Best Practice IWUI</b></p> <ul style="list-style-type: none"> <li>• t/ML</li> </ul>	<ul style="list-style-type: none"> <li>• \$/ML</li> </ul>

<b>WUE Target:</b>	<b>Irrigation Water Use</b>	<b>Water Use Index</b>	<b>Economic Water Use Index</b>
<p><b>Processes to Gather Measures</b></p> <ol style="list-style-type: none"> <li>1. The process to measure and calculate equivalent savings are detailed in the “ Audit of Water and Irrigation Use Efficiency on Farms within the Queensland Horticultural Industry” Barraclough (1999)</li> <li>2. Other processes and measures outlined will be used to fine tune this approach and provide additional WUE detail</li> <li>3. Key crops will be selected to focus on the additional WUE detail and provide an improved representative focus sample (10%) to calculate BMP for target crops.</li> <li>4. A tracking system will be developed to record information from the focus crops and other cooperator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use Barraclough’s Report for typical baseline numbers</li> <li>2. One or more of the following data sets will be used depending on the region</li> <li>3. DNR streamflow data (extraction trends with hydrologic estimation) for unregulated areas</li> <li>4. Use State Water Projects Data (or DNR) for regulated systems for sections of stream used for horticulture (difficult to get)</li> <li>5. Flow meter readings (for those who have them), flow meter installation at trial and demonstration sites</li> <li>6. Extrapolation of WUE increases from BP data within a region and the % of adoption of BP and Quantify any change in DNR streamflow patterns</li> <li>7. Use State Water Projects Data (or DNR) for regulated systems for sections of stream used for horticulture (difficult to get)</li> <li>8. Survey of 10% of growers in target crops in June 2001 and then more comprehensive survey in 2003</li> </ol>	<ol style="list-style-type: none"> <li>1. Use Barraclough’s Audit figures as baseline estimates (t/ML/crop/region)</li> <li>2. Survey of focus sample and farm tracking group to provide information on ML and yield</li> <li>3. Choose BMP growers based on grower and DPI staff suggestions</li> <li>4. Field trials with different management techniques on say neighbouring properties – see difference in yield per row or per tree, per ha and per ML</li> <li>5. Software analysis, gathering existing information to determine agronomic crop water use</li> </ol>	<ol style="list-style-type: none"> <li>1. Existing average Economic Water Use Index (\$/ML per crop per region)</li> <li>2. Best Practice Water Use Economic (\$/BPML/crop season per region)</li> <li>3. Product quality reflects increase in \$/ML</li> <li>4. Percentage improvement and adoption due to this project</li> <li>5. Use stocktake as baseline data</li> <li>6. Collect data from packing shed</li> <li>7. Gather market information</li> <li>8. Lab tests on quality</li> </ol>
<p><b>Means of Verification</b></p>	<ol style="list-style-type: none"> <li>1. Group discussion among growers group, DPI and DNR</li> <li>2. Decrease or increase in the extraction for surface or groundwater as evident from SWP or DNR reporting</li> <li>3. Field trial data and survey</li> </ol>	<ol style="list-style-type: none"> <li>1. Group discussion among growers group, DPI and DNR</li> <li>2. Data obtained from trial sites, past and present data from DPI and DNR</li> <li>3. Survey</li> </ol>	<ol style="list-style-type: none"> <li>1. Group discussion among growers group, DPI and DNR</li> <li>2. Data obtained from trial sites, past and present data from DPI and DNR</li> <li>3. Survey</li> </ol>
<p><b>Timing of Evaluation Reports</b></p>	<p>June 2001, June 2003</p>	<p>June 2001, June 2003</p>	<p>June 2001, June 2003</p>

## Best Management Practice: Horticulture

<p><b>Target:</b></p> <ul style="list-style-type: none"> <li>• At least 40% of irrigators have substantially met critical BMP criteria</li> </ul>
<p><b>Measures:</b></p> <ul style="list-style-type: none"> <li>• Percentage of Horticulture irrigators who have substantially met critical BMP criteria (Appendix 6)</li> </ul>
<p><b>Processes / Actions to Gather / Interpret Measures:</b></p> <ul style="list-style-type: none"> <li>• In consultation with irrigators develop BMP guidelines for irrigated horticulture farms that are consistent with key area guidelines</li> <li>• Develop a process to track changes in BMP for focus group (10% irrigators)</li> <li>• Develop the tracking system to enable it to be applied to a wider group over the time of the program (together the sample groups should capture 60% of the irrigation water used )</li> <li>• Train program staff and other (DPI) staff in methodology</li> <li>• Have farmers able to undertake self assessment</li> <li>• Developed criteria to evaluate whether irrigator has moved substantially towards BMP in the key areas</li> <li>• Survey and audit sample results annually</li> <li>• Analyse and Audit results from wider group annually from first collection or at completion</li> <li>• Collate all data to determine change towards BMP</li> </ul>
<p><b>Means of Verification:</b></p> <ul style="list-style-type: none"> <li>• For focus groups and any other data sets with calculated WUE check improvements in WUE measures against movement towards BMP</li> <li>• Check against Tracking data sets</li> <li>• Sales of /or record of equipment identified as contributing to BMP</li> <li>• Final survey of all horticulture irrigators ( Appendix 8)</li> </ul>
<p><b>Timing of Evaluation Reports:</b></p> <ul style="list-style-type: none"> <li>• Annually for focus group</li> <li>• As for WUE for audit at Mid and Final Reporting</li> </ul>

## Cultural Change: Horticulture

<b>Cultural Change Indicators</b>	<b>Awareness</b>	<b>Participation</b>
<b>Measures</b>	<ol style="list-style-type: none"> <li>1. Percentage of growers and the farming communities knowledgeable about the project</li> <li>2. Percentage of growers aware of issues related to water policies and BMP</li> </ol>	<ol style="list-style-type: none"> <li>1. RWUE Management Committee Attendance and feedback</li> <li>2. Workshop / Training Participation</li> <li>3. Local Group Participation – sharing ideas and equipment</li> </ol>
<b>Processes to Gather Measures</b>	<ol style="list-style-type: none"> <li>1. Introductory workshops by region</li> <li>2. Survey of growers (drive around areas and ask if the growers are aware of RWUEP – explaining the project as there are lots of projects going on)</li> </ol>	<ol style="list-style-type: none"> <li>1. Workshop participation will indicated project interest by monitoring - Head count</li> <li>2. Monitor the Management Committee – keep a record of attendance with reasons for any apologies – feedback will indicate interest or otherwise</li> </ol>
<b>Means of Verification</b>	<ol style="list-style-type: none"> <li>1. Document the Advertising undertaken to raise awareness of the project</li> <li>2. Document response to invitations</li> <li>3. Final survey of all irrigators</li> </ol>	<ol style="list-style-type: none"> <li>1. Extension officer to record the Management Committee</li> <li>2. Extension officer to record the workshop attendance along with one or two growers agreeing on numbers and the percentage of attendance</li> <li>3. Final survey of all irrigators</li> </ol>
<b>Timing of Evaluation Reports</b>	June 2001, June 2003	June 2001, June 2003

## Lucerne Evaluation Plan

**Lucerne** – Estimated current irrigation water use: 175,455ML

<b>WUE Target: Equivalent Improvement in WUE of 9,298ML</b>	<b>Irrigation Water Use</b>	<b>Water Use Index / Application Efficiency</b>	<b>Economic Water Use Index</b>
<b>Measures</b>	<ul style="list-style-type: none"> <li>• ML/ha.</li> </ul>	<ol style="list-style-type: none"> <li><b>1. Application Efficiency (Field and farm level)</b> <ul style="list-style-type: none"> <li>• % (Available to crop/ Supplied, stored or harvested).</li> </ul> </li> <li><b>2. Production Water Use Index</b> <ul style="list-style-type: none"> <li>• T (DM)/ ML (Irrigation + Effective Rainfall);</li> </ul> </li> <li><b>3. Irrigation Water Use Index</b> <ul style="list-style-type: none"> <li>• T (DM)/ML Irrigation applied</li> </ul> </li> <li><b>4. Crop Water Use Index</b> <ul style="list-style-type: none"> <li>• T (DM)/ML transpiration</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• \$ / ML</li> </ul>
<b>Processes to gather and calculate</b>	<ul style="list-style-type: none"> <li>• Re-survey 75 farmers (baseline) at mid term and final based on Stocktake Study</li> <li>• Develop a survey sample and data tracking process to capture water Use, Productivity and Economic data from irrigators who use 60% of water used</li> <li>• Expand no. of farms with detailed water use and production monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Survey population as for Irrigation Water Use</li> <li>• Calculate or measure Field Application Efficiency (engineering efficiency) using methodology developed from case studies for system efficiency, climate models, meters and soil monitoring (depending on data for surveyed farms)</li> <li>• Collect yield data from survey farms</li> </ul>	<ul style="list-style-type: none"> <li>• Use baseline data set and other survey farms \$/ML at farm gate prices and an average price.</li> </ul>

<b>WUE Target:</b> <i>Equivalent Saving of 9,298ML</i>	<b>Irrigation Water Use</b>	<b>Water Use Index / Application Efficiency</b>	<b>Economic Water Use Index</b>
<b>Processes to gather and calculate measures</b> continued	<ul style="list-style-type: none"> <li>• For each target farm measure or calculate ML/ha used by:               <ol style="list-style-type: none"> <li>1. DNR water use data for regulated areas; or</li> <li>2. Calculate from electricity use and pump and system capacity; or</li> <li>3. Field measurement using detailed irrigation and climate data measurement;</li> <li>4. Irrigated ha from survey / tracking.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>• Calculate Production Water Use Index kg (DM) /ML (irrigation applied + effective rainfall) from farm data climate and production models and data from field trials and demonstrations;</li> <li>• Calculate Irrigation Water Use using data collected above;</li> <li>• Calculate CWU Index using production models.</li> </ul>	
<b>Means of Verification</b>	<ul style="list-style-type: none"> <li>• DNR records where available</li> <li>• Demonstration sites</li> <li>• Farm system evaluation records</li> </ul>	Field and R&D trials	<ul style="list-style-type: none"> <li>• Possibly data calculated at workshops, which could verify the range.</li> </ul>
<b>Timing of Evaluation Reports</b>	Baseline: 1999 stocktake <ul style="list-style-type: none"> <li>• Annual evaluation for QDAS and tracking survey data sets.</li> <li>• Mid term: 2001</li> <li>• Final evaluation: March 2003</li> </ul>	Baseline: 1999 stocktake <ul style="list-style-type: none"> <li>• Annual evaluation for survey data set.</li> <li>• Mid term: 2001</li> <li>• Final evaluation: March 2003</li> </ul>	Baseline: 1999 stocktake <ul style="list-style-type: none"> <li>• Annual evaluation for survey data set.</li> <li>• Mid term: 2001</li> <li>• Final evaluation: March 2003</li> </ul>

## Best Management Practice: Lucerne

<b>Target:</b>	<ul style="list-style-type: none"><li>• At least 40% of irrigators have substantially met critical BMP criteria</li></ul>
<b>Measures:</b>	<ul style="list-style-type: none"><li>• Percentage of Lucerne who have substantially met critical BMP criteria (Appendix 6)</li></ul>
<b>Processes / Actions to Gather / Interpret Measures:</b>	<ul style="list-style-type: none"><li>• In consultation with irrigators develop BMP guidelines for irrigated lucerne farms that are consistent with key area guidelines</li><li>• Develop a process to track changes in BMP for target group (70 irrigators)</li><li>• Develop the tracking system to enable it to be applied to a wider group over the time of the program (together the sample groups should capture 60% of the irrigation water used in lucerne)</li><li>• Train program staff and other (DPI) staff in methodology</li><li>• Developed criteria to evaluate whether irrigator has moved substantially towards BMP in the key areas</li><li>• Survey and audit sample results annually</li><li>• Analyse and Audit results from wider group annually from first collection or at completion</li><li>• Collate all data to determine change towards BMP</li></ul>
<b>Means of Verification:</b>	<ul style="list-style-type: none"><li>• For survey and any other data sets with calculated WUE check improvements in WUE measures against movement towards BMP</li><li>• Check against Tracking data sets</li><li>• Sales of /or record of equipment identified as contributing to BMP</li><li>• Final survey of all irrigators ( Appendix 8)</li></ul>
<b>Timing of Evaluation Reports</b>	<ul style="list-style-type: none"><li>• Annually for QDAS and tracking survey groups;</li><li>• As for WUE for audit at Mid and Final Reporting</li></ul>

## Cultural Change: Lucerne

Indicators	Awareness	Participation
<b>Measures</b>	<ul style="list-style-type: none"> <li>• % who have understanding of the project, its two key objectives and how they can be involved</li> </ul>	<ul style="list-style-type: none"> <li>• % of farmers making changes on farms</li> <li>• No's of farmers involved in activities</li> </ul>
<b>Processes to Gather Measures</b>	<ul style="list-style-type: none"> <li>• Consultant to develop methodology to monitor</li> <li>• Final survey of all Irrigated Lucerne farmers</li> </ul>	<ul style="list-style-type: none"> <li>• Tracking program</li> <li>• Statistics from activities (workshops, field days training etc)</li> <li>• Final survey of all</li> </ul>
<b>Means of Verification</b>	Final survey (Appendix 8)	-
<b>Timing of Evaluation Reports</b>	Mid term and final evaluation.	Mid term and final evaluation.

## Sugar Evaluation Plan

**Sugar** – Estimated current irrigation water use: 1,211,000 ML

<b>WUE Target: Equivalent improvement in WUE of 72,660ML (6% increase in Production Water Use Index)</b>	<b>Irrigation Water Use</b>	<b>Water Use Index</b>	<b>Economic Water Use Index</b>
<b>Measures</b>	<ul style="list-style-type: none"> <li>• ML irrigation / ha</li> </ul>	<ol style="list-style-type: none"> <li><b>1. Crop Water Use Index (CWI)</b> <ul style="list-style-type: none"> <li>• Tonnes of cane / ML of water applied (irrigation and effective rainfall)</li> </ul> </li> <li><b>2. Crop Response Index (CRI)</b> <ul style="list-style-type: none"> <li>• Tonnes cane / ML. Response in yield from irrigation (irrigated yield – rain fed yield) to irrigation water applied</li> </ul> </li> <li><b>3. Irrigation Application Efficiency (IAE) - %</b> <ul style="list-style-type: none"> <li>• Proportion of total irrigation water applied to a field compared to the water stored in the rooting zone of soil</li> </ul> </li> <li><b>4. Efficiency Ratio (IR) - %</b> <ul style="list-style-type: none"> <li>• CWI as a percentage the Benchmark CWI (13.3 T/ ML)</li> </ul> </li> </ol>	<p>Not measured but could be calculated (\$/ML) using mill productivity data</p>

<b>WUE Target:</b>	<b>Irrigation Water Use</b>	<b>Water Use Index</b>	<b>Economic Water Use Index</b>
<p><b>Processes to Gather Measures</b></p> <p>The processes to collect and interpret data are outlined in detail in the document “Benchmarking Crop Water Index for the Sugar Industry” by Tilley and Chapman (1999)</p>	<ul style="list-style-type: none"> <li>• All farm level DNR water data will be analysed for all regulated irrigation schemes</li> <li>• For un-metered bores such as in the Burdekin delta, water use information for 10% of growers will be extrapolated from a relationship between in line flow meters and electricity accounts</li> <li>• Using these techniques approximately 50% of irrigated canegrowers will be analysed</li> </ul>	<ul style="list-style-type: none"> <li>• Farm level water data and mill productivity data will be analysed using the APSIM (sugar) model to calculate CWI for farms and the district</li> <li>• CRI will be calculated for irrigated experiments only</li> <li>• IAE will be calculated at farms and sites where measuring devices are installed or where R&amp;D data enables estimation from farm systems and practices for the soil types</li> <li>• ER will be calculated for the State and regional data (currently 59% for the state)</li> </ul>	
<b>Means of Verification</b>	-	-	-
<b>Timing of Evaluation Reports</b>	Baseline: 4/2000 Midterm: 6/2001 Final: 6/2003	Baseline: 4/2000 Midterm: 6/2001 Final: 6/2003	

## Best Management Practice: Sugar industry

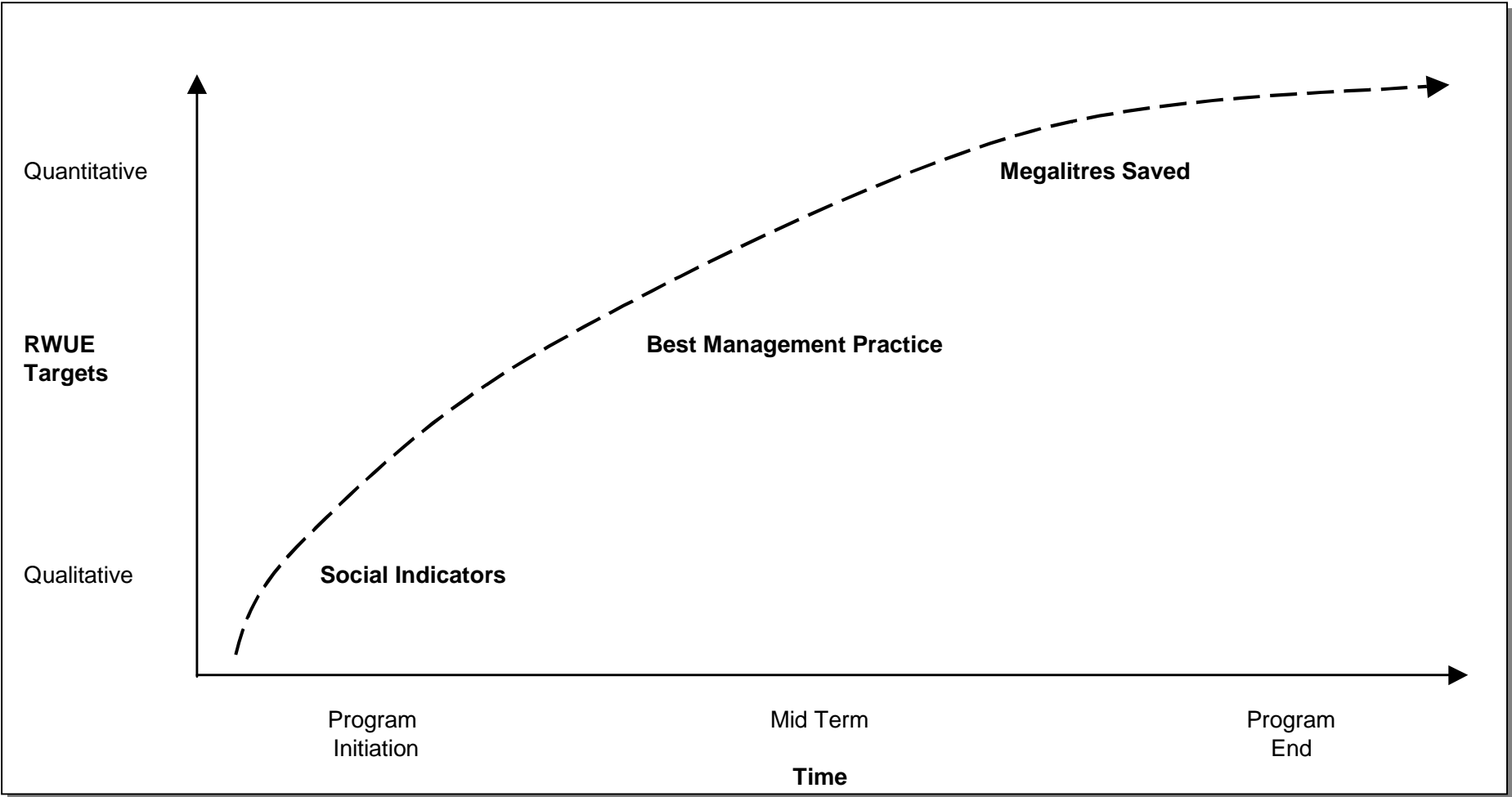
<b>Target:</b>	<ul style="list-style-type: none"><li>• At least 70% of irrigated canegrowers have substantially met critical BMP criteria by 2003</li></ul>
<b>Measures:</b>	<ul style="list-style-type: none"><li>• Percentage of irrigated canegrowers who have substantially met critical BMP criteria (Appendix 6).</li></ul>
<b>Processes / Actions to Gather / Interpret Measures:</b>	<ul style="list-style-type: none"><li>• In consultation with irrigators develop state and regional BMP guidelines for irrigated cane farms that are consistent with key area guidelines</li><li>• Develop a process to track changes in BMP for at least 5% of irrigated cane farms</li><li>• Develop a tracking system to enable self evaluation to be applied to a wider group over the time of the program ( Target 60% of the irrigation water use)</li><li>• Train program staff and other Sugar Industry staff in BMP assessment methodology</li><li>• Have farmers able to undertake self assessment</li><li>• Developed criteria to evaluate whether irrigator has reached or moved substantially towards BMP in the key areas</li><li>• Survey and audit survey results</li><li>• Analyse and Audit results from local group annually from first collection or at completion</li><li>• Collate all data to determine change towards BMP</li></ul>
<b>Means of Verification:</b>	<ul style="list-style-type: none"><li>• Check improvements in WUE measures against movement towards BMP</li><li>• Sales of /or record of equipment identified as contributing to BMP</li><li>• Final survey of all Canegrower irrigators ( Appendix 8)</li></ul>
<b>Timing of Evaluation Reports:</b>	<ul style="list-style-type: none"><li>• Baseline survey: April 2000</li><li>• Midterm: June 2001</li><li>• Final: June 2003</li><li>• Annually for any local groups involved.</li></ul>

Cultural Change: Sugar industry

Cultural Change Indicators	Awareness	Participation
<b>Measures</b>	% of growers aware of the WUE program and BMP irrigation for cane	Number of attendees at shed meetings, trial sites, training courses and all other meetings.
<b>Processes to Gather Measures</b>	Questions on awareness will be incorporated into the 10% survey of irrigators in each region.	Count number of attendees at shed meetings, trial sites and all other meetings.
<b>Means of Verification</b>	Final survey of all irrigators	Final survey of all irrigators
<b>Timing of Evaluation Reports</b>	Baseline      April 2000 Midterm        June 2001 Final            June 2003	Baseline      April 2000 Midterm        June 2001 Final            June 2003

# Appendix 1 – Initial Framework Model

## *Predicted Path of Adoption*



**ML Evaluation Model**

*RWUE Target*

**ML Saved**

*Industries*

**Each Industry**

*Generic Measures*

Irrigation Water Use

Engineering Efficiency (%)

Agronomic Water Use Index (t/ML)

Economic Water Use Index (\$/ML)

*Industry Measures*

Total ML

Effective Rainfall ML

Crop ML Applied

Crop ML Required

Production (tonnes)

Irrigation ML/Ha

Gross Revenue (\$/Ha)

Irrigation ML/Ha

ML Supplied Farm

ML Stored

ML Conveyed to Field

Productivity t/Ha

Quality \$/t

**BMP Evaluation Model**

**RWUE Target**

**BMP**

**Industries**

**Each Industry**

**Generic Measures**

Management

Environment

Irrigation Systems

Scheduling Systems

Information Systems

See BMP Management

See BMP Environment

See BMP Irrigation

See BMP Scheduling

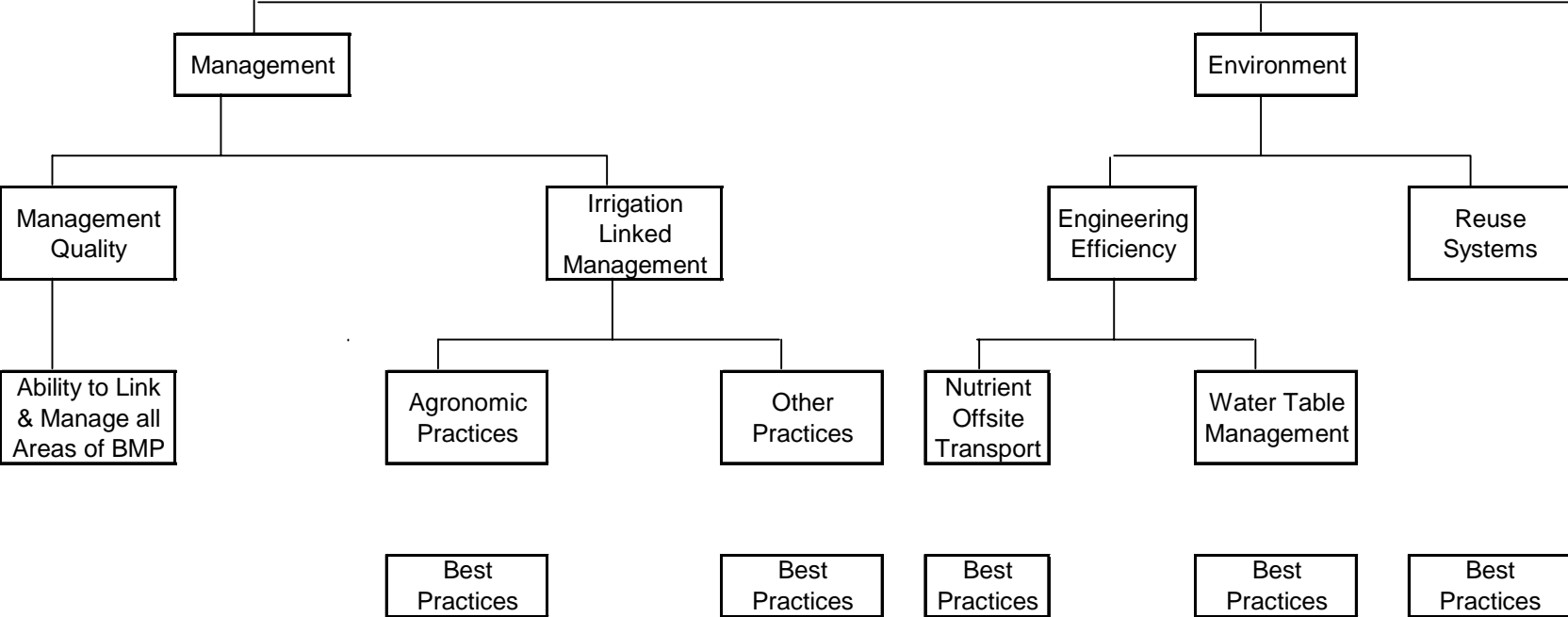
See BMP Information

**Detailed Measures**

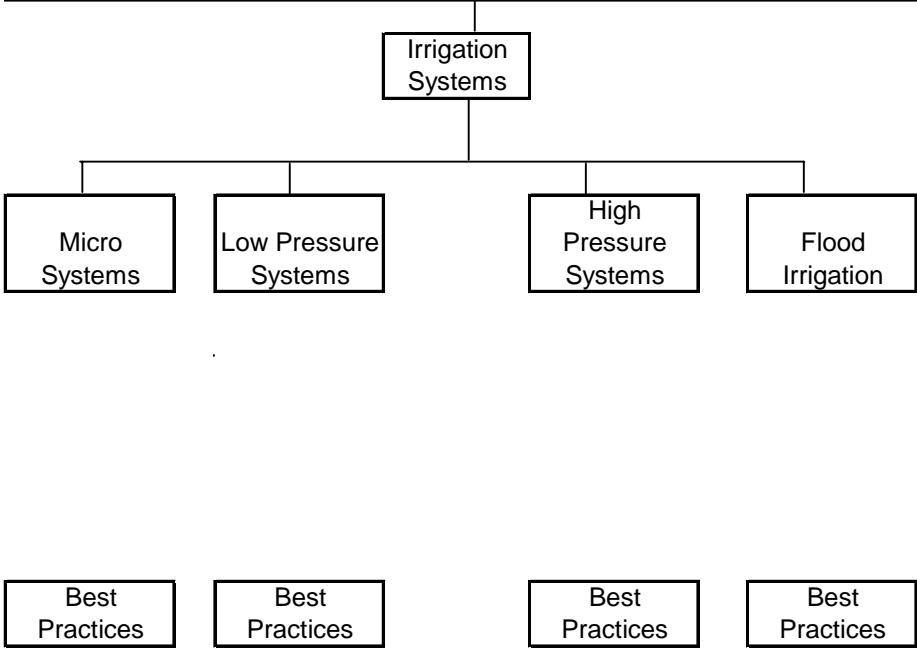
**Processes**

**Actions**

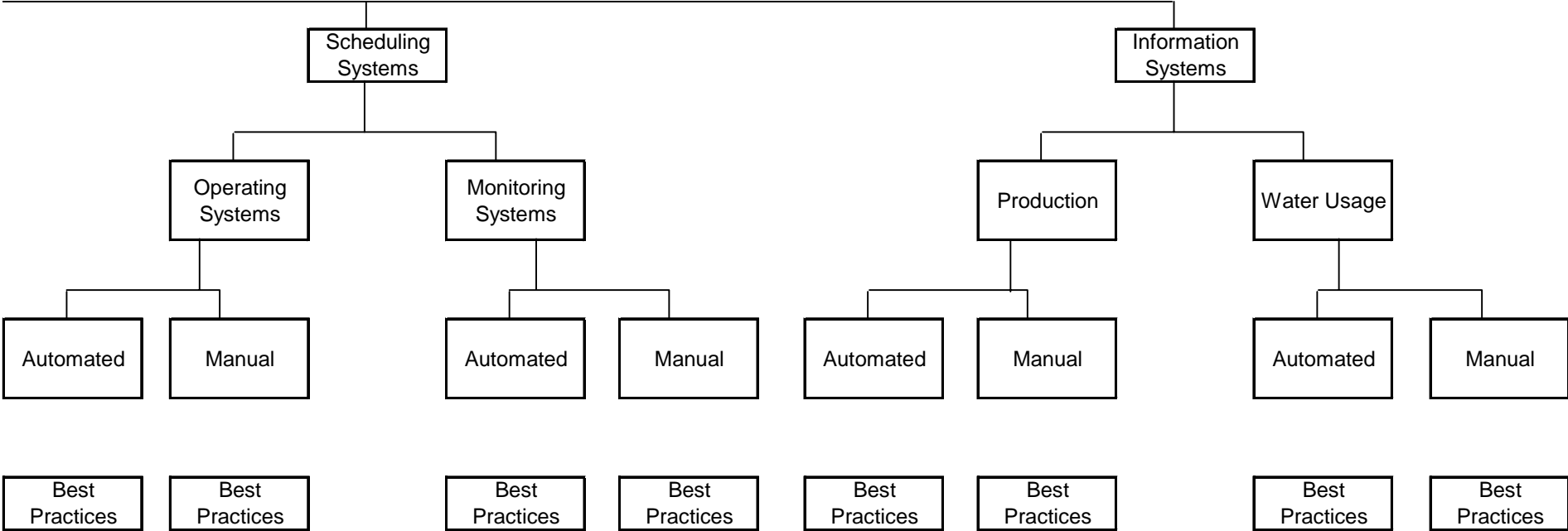
*BMP Evaluation Model – Management & Environment*



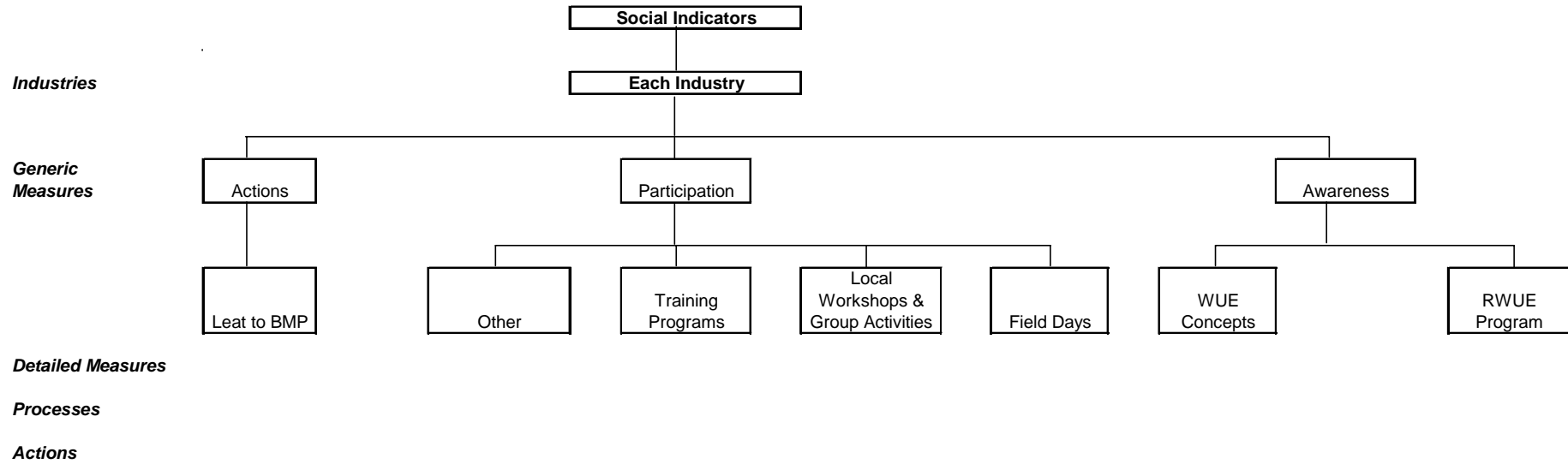
*BMP Evaluation Model – Irrigation*



*BMP Evaluation Model – Scheduling Systems and Information Systems*



*Social Indicators*



## Appendix 2 – List of Attendees at Stakeholders Meeting

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Aleemulah, Mohammed (Aleem)	RWUE Extension Officer, QFVG
Baillie, Craig	RWUE Extension Officer, Canegrowers
Bainbridge-Robb, Ann	Project Officer RWUE, DNR
Barber, Scott	RWUE Extension Officer, QFVG
Bell, Ian	Manager RWUE, DNR
Boetcher, Peter	SWP
Cardy, Leesa	RWUE, DNR
Danzi, Eric	Water Policy Officer, Canegrowers
Dawson, Noel	NRM Consulting
Dillon, Sue	Water Policy Officer, QFVG
Goyne, Phil	Cotton / Grain RWUE Coordinator, DPI
Hetherington, Geoff	Dairy Development Extension Officer
Kelsall, Tom	Barraclough & Company
McIntyre, Geoff	Australian Cotton CRC, DPI
McMahon, Gavin	BSES
Mullins, Warren	EPA
Raine, Steven	NCEA
Swepson, Pam	DPI
Tennakoon, Sunil	CSIRO
Waters, Warwick	Dairy/ Lucerne RWUE Coordinator, DPI
Wood, John	Barraclough & Company
Yule, Don	R&D Coordinator, DNR

## Appendix 3 - Meeting Agenda – Stakeholders Meeting

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### ***RWUE Evaluation Workshop - Agenda***

Date: **Tuesday 21 December 1999**

Where: **Bardon Centre  
390 Simpson Road  
Bardon QLD 4065**

Time: **8.45 am**

<b>Start Time</b>	<b>Elapsed Time</b>	<b>Presenter</b>	<b>Activities</b>
<b>8:45</b>	<b>0:15</b>		<b><i>Arrival</i></b>
<b>9:00</b>	<b>0:30</b>	Noel Dawson	<b><i>Introduction</i></b> Evaluation Process Benchmarking Opportunity Agenda
		All	Background
		All	Workshop Expectations
		John Wood	Break Activity Plans
<b>9:30</b>	<b>0:40</b>	Tom Kelsall	<b><i>Draft Evaluation Model</i></b> Overview of Model Confirmation/Adjustment of Model Structure
<b>10:10</b>	<b>0:30</b>	Noel Dawson Phil Goyne Warwick Waters Sue Dillon Eric Danzi	<b><i>Summary of Evaluation Program to Date</i></b> Cotton - Planned Evaluation Actions Dairy - Planned Evaluation Actions Horticulture - Planned Evaluation Actions Sugar - Planned Evaluation Actions
<b>10:40</b>	<b>0:30</b>		<b><i>Morning Tea</i></b>
<b>11:10</b>	<b>0:15</b>	John Wood	<b><i>Break Activity</i></b>
<b>11:25</b>	<b>1:00</b>	Noel Dawson Industry Groups	<b><i>Industry Specific Detail for Model</i></b> Working Session Structure Model "Below the Line" Identify Gaps & Required Actions
<b>12:25</b>	<b>0:35</b>	Group Reps	<b><i>Report Back to Workshop</i></b>
<b>13:00</b>	<b>0:45</b>		<b><i>Lunch</i></b>
<b>13:45</b>	<b>0:15</b>	John Wood	<b><i>Break Activity</i></b>
<b>14:00</b>	<b>0:30</b>	Tom Kelsall	<b><i>Shared Development Areas Across Industries</i></b> Identification Actions
<b>14:30</b>	<b>1:00</b>	John Wood	<b><i>Related Issues</i></b> Verification Benefit Cost Analysis Risk Factors and Management Identify Support Required Other Issues
<b>15:30</b>	<b>0:30</b>		<b><i>Afternoon Tea</i></b>
<b>16:00</b>	<b>0:45</b>	Noel Dawson	<b><i>Agreed Actions &amp; Time Frames</i></b>
<b>16:45</b>	<b>0:15</b>	Noel Dawson	<b><i>Wrap up &amp; Workshop Review</i></b>
<b>17:00</b>			<b><i>Close</i></b>

## Appendix 4 – Notes from Stakeholder Workshop

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### Cotton/Grains – Industry Specific Detail for Model

#### Water Use Efficiency

##### *No. 1:*

Generic Measure:	-	Irrigation Water Use Index
Measure:	-	Sales/ML Irrigation
	-	Bales/ML Irrigation & Rainfall
Processes:	-	Regionally Specific
Regulated Areas	=	Emerald/Theodore/St George I.A.
		<ul style="list-style-type: none"> <li>• Production Data - From Gins (Farm &amp; Regional Scale)</li> <li>• Irrigation Data - From SWP/Water readings – Water Bills</li> <li>• Rainfall Data</li> </ul>
Non-Regulated Areas	=	McIntyre/Darling Downs/Other St George
		<ul style="list-style-type: none"> <li>• Production Data - From Gins</li> <li>• Irrigation Data - Survey Collected &amp; Validated from demonstration &amp; group notes</li> <li>• Rainfall Data</li> </ul>

##### *No. 2:*

Generic Measure:	-	Economic WUE Index
Measure:	-	\$/ML
	-	Question: Is \$ value Gross Margin or Gross Income?
Processes:	-	Yield Data - Quantity (Bales/t) From Gins
	-	Quality Grade (Cotton) From Gins, Oil/Protein (Grains) From Survey
	-	Volumentation Data - as per Irrigation WUE Index

##### *No. 3:*

Generic Measure:	-	Engineering Efficiency
Measure:	-	ML/ML or (%)
	-	Component level & Farm Level
Processes:	-	Storage Efficiency ] Detailed Measures on
	-	Distribution Efficiency ] 4 Demo sites/valley
	-	Application Efficiency ] & Observation/
	-	Whole Farm Efficiency ] Measurements on 16-20
		] other sites/valley
		] (5-50%/Valley)



## Dairy/Pasture – Industry Specific Detail for Model

### Social Indicators:

- Participation:
- Numbers not best
  - Passive observation evaluation
  - Follow-up contract
- Awareness:
- Head count at days
  - “Serious hit” at sites
  - Farm visit question
- Action:
- Follow-up contract
  - Farm visit observation

\* Need systematic data collection, not at random

### ML Saved:

- Rustic Desk top modelling
- ML/ha a big challenge
- \* A device to identify irrigation events and time
- Regulated stream input
  - power consumption data
  - small % monitored
  - extrapolate from management
- Some training for QDAS data - % Quarterly

### Indices:

- ML/ha
- \$/ML
- \$/ha
- t/ML
- l/ML
- l/ha

### Irrigation Systems:

- Ongoing system checks, i.e.
  - opp. pressure
  - nozzle wear
  - how you manage
  - proposed plans
- Keep measures simple

### B.M.P.:

- Victorian and South Australian Six Step Process to Irrigation BMP

## Horticulture – Industry Specific Detail for Model

	Irrigation Water Use	Engineering Efficiency	Agronomic Water Use Index	Economic Water Use Index (\$/ML)
<b>Measures</b>	% of change in practice	ML in /ML used	T/ML	(a) no. pack outs/ha/ML (b) \$ = avg market rate (low, avg, high) (c) Quality reflects to \$
<b>Processes</b>	<ul style="list-style-type: none"> <li>• On field trials</li> <li>• Survey</li> <li>• Metering/ monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Software analysis</li> <li>• Metering</li> <li>• Existing Information</li> </ul>		<ul style="list-style-type: none"> <li>• Packing shed data analysed</li> <li>• Market info gathered</li> <li>• Lab tests on quality</li> </ul>
<b>Actions</b>		<ul style="list-style-type: none"> <li>• Technical person to review software</li> <li>• Using sites for this information</li> </ul>	<ul style="list-style-type: none"> <li>• Getting trial sites established</li> </ul>	<ul style="list-style-type: none"> <li>• Get sheds involved in program</li> <li>• Organise market information</li> <li>• Organise sampling and testing</li> </ul>

### Water Use Efficiency:

- A. Series of 4 x measures
- B. To develop Regional picture of increase in WUE
  - Quantify what's happened at all sites (BMP sites)
  - Do surveys to get information (use process on pg 1 – but streamline)
  - Compare to baseline data

## Sugar – Industry Specific Detail for Model

### Social Indicators:

- Participation:
- Attendance
    - Shed meetings (no) - with water topics
    - Demonstration (no) – cell group
    - Media monitors – compile – industry & community
    - Survey/enquiries/management groups
- Awareness:
- |       |   |                  |   |             |
|-------|---|------------------|---|-------------|
| - 10% | } | Attitudes        | } | UCQ/CRC     |
|       | } | Current practice | } | RWUE Survey |
- Action:
- Craig to incorporate
  - A question of program awareness – RWUE, Attitude to WUE
  - Grower plan to optimise WUE

### B.M.P.:

- Objective: Sustainability
  - Economic
  - Environment

### **A. Scheduling**

- Do you know PAWC/Soil types?
- Do you have a scheduling process?
- Do you use weather forecast?

### **B. Irrigation System**

- Run-off
- Drainage
- Application
- Uniformity

### **C. Management**

- Monitoring
- Keep records
- Options developed for systems => used for above
  - Awareness
  - Adoption

## Water Use Efficiency

### ***Water Use (Irrigation)***

- Schemes SWP (Privacy Issue) Database
- Effective rainfall = > APS Front
- Product – Factories
- Non declared area/dams (unregulated streams) = > Guess

### ***Engineering Efficiency – On-Farm***

- Application efficiency = > demonstration sites
- Conveyancing = > not to be done

### ***Agronomic***

- CWI
- CRI?
- Irrigation Efficiency

## Shared Development Issues

### General

- Soil irrigation systems understanding
- Data access and management => SWP to provide water delivery information
  - CIS - Billing
  - WERD - Licensing
  - COD - Historic
- Privacy and access
- Short & Longer term issues
- Adoption vs Evaluation
- Verification
  - Struggling (with it)
  - How to track project
- Benefit/Cost Analysis
- Risk Management
- Non-Controlled
  - Weather
  - Disease
  - Market/Price

### Modelling

1. Crop simulation
2. Performance evaluation (W. Waters system) , Database collection, Management and Dissemination
3. Nutrient soil and pesticide movement – R&D programs

### Survey Techniques & Methods

- Who – Bias
- Independent check
- Communication of Program
- Climate Data

## Appendix 5 – Industry Performance Evaluation Format

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Evaluation Plans: *(insert industry)*

WUE (Equivalent Saving 180,000ML)	Irrigation Water Use (ML/Ha)	Irrigation Water Use Index (t/ML) <sup>2</sup>	Economic Water Use Index (\$/ML)
<b>Measures</b> (Please number each measure and correlate those numbers to their related factors in the boxes below)	(Lay out each area that is to be measured and the units of measurement to be used)		
<b>Processes to Gather Measures</b> (Please ensure you address the validity of your approach eg survey sample size)	(How is the data to be gathered and how is it to be extrapolated to a state wide basis)		
<b>Means of Verification</b>			
<b>Timing of Evaluation Reports</b>	(Baseline, mid term and final evaluation)		
<b>Activity Plans to Implement Processes</b>	(What are you going to do to set up the program)		

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<sup>2</sup> Note: Irrigation Water Use Index is a derivation of Engineering Efficiency and Agronomic Crop Water Use Index.

Evaluation Plans: (insert industry)

Best Management Practices	Management & Information	Scheduling	Irrigation Systems	Environment <sup>3</sup>
<b>Measures</b> (Please number each measure and correlate those numbers to their related factors in the boxes below)	(Lay out each area that is to be measured and the units of measurement to be used)			
<b>Processes to Gather Measures</b> (Please ensure you address the validity of your approach eg survey sample size)	(How is the data to be gathered and how is it to be extrapolated to a state wide basis)			
<b>Means of Verification</b>				
<b>Timing of Evaluation Reports</b>	(Baseline, mid term and final evaluation)			
<b>Activity Plans to Implement Processes</b>	(What are you going to do to set up the program)			

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<sup>3</sup> Note: Environmental benefits are also consequence of BMP in other areas.

Evaluation Plans: *(insert industry)*

Cultural Change Indicators	Awareness	Participation
<p><b>Measures</b> (Please number each measure and correlate those numbers to their related factors in the boxes below)</p>	<p>(Lay out each area that is to be measured and the units of measurement to be used)</p>	
<p><b>Processes to Gather Measures</b> (Please ensure you address the validity of your approach eg survey sample size)</p>	<p>(How is the data to be gathered and how is it to be extrapolated to a state wide basis)</p>	
<p><b>Means of Verification</b></p>		
<p><b>Timing of Evaluation Reports</b></p>	<p>(Baseline, mid term and final evaluation)</p>	
<p><b>Activity Plans to Implement Processes</b></p>	<p>(What are you going to do to set up the program)</p>	

## Appendix 6 – Indicative Critical BMP Criteria

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### 1. Management and Information

- An irrigation/ water management plan for the farm integrated with overall farm management
- Measurement of water use linked with production, including the collection and interpretation of water use information.
- Using the information to revise and improve the plan and future actions (continuous improvement process)

### 2. Irrigation System

- The farmer operating an acceptable system within 10% of that system's best practice. An acceptable system must be capable of operating to an agreed effective performance within the environmental region. At a minimum the acceptable system must be capable of achieving 70% irrigation efficiency.

### 3. Scheduling

- Using a scheduling device or a proven system to effectively schedule irrigation

### 4. Environment

- Having a recycling system
- Run-off and drainage management

Environmental outcomes include salinity, nutrient and pesticide management

## Appendix 7 – Survey Requirements

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Information to be collected should include:

1. Number of ha irrigated for each crop
2. Production from those ha (total and production per ha for each crop)
3. Water used for each and in total (overall ML and ML per ha for each crop)
4. Water purchases, sales and trading
5. Water allocation

This information is required at the final survey date and also at the program beginning to ensure the initial and final performance is captured as well as the improvements due to the program.

Specific measures to be captured

1. Number of farmers           &           % of total
2. Number of ha               &           % of total
3. Production of each crop   &           % of total
4. Average price (State Averages) in order to calculate industry values
5. ML used for each crop     &           % of total

An appropriate target would capture 50 % of the Ha/Production/ML of the industry.

## Appendix 8 – Final Survey Outline <sup>1</sup>

1. Location:                      Postcode or irrigation area
2. Irrigated area:              ha
3. Source of irrigation water: Tick source and where available amount ML
  - Regulated supply
    - Supply
    - River
    - Underground
  - Unregulated supply
    - Stream
    - On farm storage
    - Underground
  - Other
4. Crops grown:                Type and ha of each crop grown
5. Production:                By crop
6. Type of Irrigation system/s: Tick
  - Centre pivot
  - Lateral move
  - Centre Pivot
  - Soft hose winch
  - Hard hose winch
  - Drip /trickle
  - Microspray
  - Handshift
  - Solid set
  - Furrow
  - Flood
  - Other
7. Irrigation Management: Tick
  - Do you have Irrigation management plan?
  - Do you measure irrigation water used?
    - How?
      - Meter
      - Estimate from pump capacity and time
      - Estimate from field observations
      - Calculate from scheduling device
      - Other measurement or calculation (list)
      - Don't measure

- Do you use measurement to calculate water use efficiency / improve water management?
  - Do you schedule irrigation using:
    - Scheduling device?
    - Proven field estimation system?
    - Experience?
    - Don't schedule
8. Do you have runoff recycling system?
9. Are you aware of the Rural Water Use Efficiency Initiative?
10. Have you been involved in any of the following irrigation activities?
- Meetings /Workshops
  - Field days
  - Field Demonstrations
  - R&D
  - Training
11. Do you think you have improved you irrigation efficiency over the last 4 years?
- If yes by how much?: .....%

1 Where possible data will be collected for 1999 and 2002/2003 seasons.

