# IRRIGATION FUTURES OF

# THE GOULBURN BROKEN CATCHMENT

## Milestone 3 Report
## June 2005


**Primary Industries Research Victoria (PIRVIC) - Tatura**
**Department of Primary Industries**

in collaboration with

**Community Engagement Network**
**Department of Sustainability and Environment**


Victoria
The Place To Be

NATIONAL PROGRAM FOR
Sustainable Irrigation

GOULBURN
BROKEN
CATCHMENT
MANAGEMENT
AUTHORITY

GOULBURN-MURRAY
WATER

Cooperative Research Centre for
IRRIGATION
FUTURES

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**Stakeholder Reference Committee:**

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**Technical Working Group:**

**Narrative Team :** Alan Canobie, Bruce Cumming, Joe Demase, Peter Fitzgerald, John Laing, David Lawler, Oliver Moles, Bev Phelan, Claire Pinniceard, Peter Sargent, Rien Silverstein, Kate Tehan (vice Sally Dickinson).

**Analysis Team**: Bruce Anderson, David Bourke, John Dainton, Lyn Gunter, Shane Hall, Peter Langley, Derek Poulton, Kevin Preece, Durham Prewett, Ross Wall, Gordon Weller

**Technical Advisory Committee:**

Dr Neil Barr, Jo Haw, Associate Professor Hector Malano, Associate Professor Bill Malcolm, Derek Poulton, Greg Roberts, Ken Sampson, Dr John Wolfenden.

**Project Funded By:**

Department of Primary Industries
Department of Sustainability and Environment
Goulburn Broken Catchment Management Authority
Goulburn-Murray Water
National Program for Sustainable Irrigation, Land and Water Australia

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## Attachments

# Milestone 3 Report

| | |
|---|---|
| **Project:** | **Irrigation Futures of the Goulburn Broken Catchment (VPI3)** |
| **Principal investigator:** | **Dr QJ Wang** |
| **Project duration:** | **1 July 2003 – 30 June 2007** |
| **Report due date:** | **1 July 2005** |

## Project Objectives

The objectives of the Irrigation Futures project are to:

- Facilitate key stakeholders to develop a shared vision on the future of irrigation in the Goulburn Broken catchment, and to identify scenarios of major constraints and opportunities and of regional response options.
- Understand the social, economic and environmental consequences of various scenarios through impact assessment based on an integration of the best available knowledge.
- Facilitate key stakeholders to build consensus on preferred regional options for future irrigation, and recommend regional follow-up actions.
- Develop a methodology that can be applied elsewhere in Australia for sustainable irrigation planning at a catchment scale.

## Context for Milestone 3 Report

The background, underlying philosophy and methodology for this project are outlined in Milestone 1b Report. In particular, that Report includes the:

- Stakeholder Participation Plan (and its external review),
- Communication Plan,
- Evaluation Plan.

Milestone 2 Report provides details of the:

- Planning, recruitment and running of the stakeholder engagement processes,
- Capture, synthesis, review and dissemination of the outputs from those engagement processes,
- The literature review for, and subsequent development of, the assessment process to be used in Stage 3 of the project.

This Milestone 3 Report provides:

- A compilation of the synthesised outputs from Stage 2 (Attachment A to this Report). This comprises the:
  - Aspirations of stakeholders for irrigated agriculture in the region,
  - Four External Scenarios describing the evolution of alternative plausible futures within which the region may have to operate over the next 30 years,
  - A suite of Regional Strategies to guide future regional actions,
  - A list of the assets within the region, and
  - A consolidated list of response options from all Workshops from which the suite of Regional Strategies were synthesised.
- The final version of the assessment process to be used in Stage 3 (Attachment B to this Report).
- Comments of the external reviewers on the proposed assessment process for Stage 3, and responses from the project team (Attachment C to this Report).
- Details of the communication activities undertaken by project team from Jan – June 2005 (Attachment D to this Report).

## Progress against Milestone 3

The work completed against each of the specific requirements of Milestone 3 is as follows:

### *(a) Assessment tool developed and documented*

At the start of the project, it was anticipated that assessments would be undertaken using a computer-based assessment tool. Following a review of the international literature on Integrated Assessment, an alternative approach was found more appropriate for the task. The alternative approach uses a participatory process to undertake Narrative exploration of the interplay between external factors, regional actions and the state of the region, supported by Analysis of concepts, qualitative relationships and in some cases quantitative relationships.

**Status: Completed**

The following resolution from the Governance Committee Meeting of 5 April 2005 is noted:

*The Governance Committee agrees that the assessment process is equivalent to the assessment tool specified in the original contract.*

*The Governance Committee agrees to waive the scheduled review of the assessment tool as required by the original contract (Stage 3A). The rationale is that*

*this would simply become a repeat of the recently completed review of the assessment process.*

As a precursor to the development of the assessment process for Stage 3, a comprehensive review of the literature on scenario-based foresighting was carried out. That literature review, and the subsequent development of the assessment process are provided in Attachment B. The process now is being used (and further refined) by the Technical Working Group.

### *(b) Peer review of the assessment tool*

**Status: Completed**

The peer review of the assessment process was carried out by:

Professor Ron Johnston (Executive Director, Australian Centre for Innovation, University of Sydney), and
Dr Nick Abel (Group Leader, Ecological and Economic System, CSIRO Sustainable Ecosystems)

Their comments were very supportive of the Narrative and Analysis assessment approach being proposed by the project team, and helped refine elements of the process. As indicated, their comments and the response of the project team are provided in Attachment C.

### *(c) Endorsement by the Stakeholder Reference Committee and project Governance Committee after receiving peer review*

**Status: Completed**

The assessment process was endorsed by the Stakeholder Reference Committee and the Governance Committee (5 April 05).

### *(d) Presentation and poster display at Annual Forum*

There has been no NPSI Forum during this period.

### *(e) Milestone 3 Report submitted for approval*

**Status: Completed**

This Milestone 3 Report is submitted for approval.

# IRRIGATION FUTURES OF THE GOULBURN BROKEN CATCHMENT

## Milestone Report 3 - Attachment A
## Stage 2 Output


**Primary Industries Research Victoria (PIRVIC) - Tatura**
**Department of Primary Industries**

in collaboration with

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**Department of Sustainability and Environment**


Victoria The Place To Be

National Program for Sustainable Irrigation

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# 1. Project Overview

Irrigation is a fundamental driver of the regional economy in the Goulburn Broken catchment. The regional farm-gate gross value of production from irrigated agriculture in 2000 was $1.35 billion. Investment in on-farm and processing infrastructure is about $100 million per annum.

However, irrigation is facing enormous challenges. As one of the oldest gravity irrigation systems in Australia, Goulburn-Murray Water's irrigation system needs substantial renewal of its ageing infrastructure assets in the next 20 years. Initiatives to increase environmental flows and potential climate changes will also have major impacts on irrigation. In addition, there are increasingly stringent demands on responsible natural resources management to meet social, economic, environmental and cultural outcomes.

## *The objectives of this project*

This project has been established to enable the region to successfully meet these challenges. It is a regional initiative, funded by the Goulburn Broken CMA (GBCMA), Goulburn-Murray Water (G-MW), Department of Primary Industries (DPI), Department of Sustainability and Environment (DSE), and Land and Water Australia (LWA).

The objectives of the project are to:

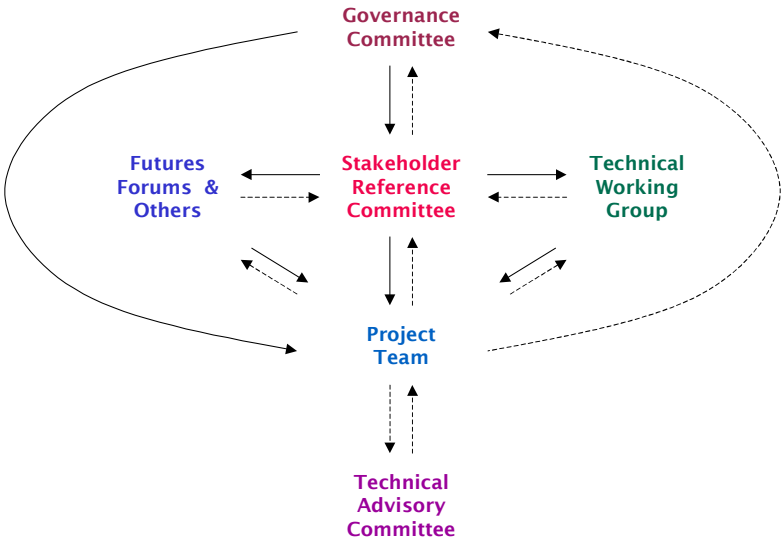
- Facilitate key stakeholders to develop a shared vision on the future of irrigation in the Goulburn Broken catchment over the next 30 years, and to identify scenarios of major constraints and opportunities and of regional response options.
- Understand the social, economic and environmental consequences of various scenarios through impact assessment based on an integration of the best available knowledge.
- Facilitate key stakeholders to build consensus on preferred regional options for future irrigation, and recommend regional follow-up actions.
- Develop a methodology that can be applied elsewhere in Australia for sustainable irrigation planning at a catchment scale.

## *Project Timetable*

| **Project Stage** | **Timeframe** |
|---|---|
| Stage 1: Project development | Jun 2003 – Dec 2003 |
| Stage 2: Vision, scenario and options | Jan 2004 – Dec 2004 |
| Stage 3: Assessment of consequences, and effectiveness of regional options | Jan 2005 – Jun 2006 |
| Stage 4: Building consensus | July 2006 – Jun 2007 |

## *Project organisation*

Project organisation, and the roles of each of the project organisational groups, are given below.




**Project organisation**

**Roles of project organisational groups**

| Organisational Group | Key Roles |
|---|---|
| Governance Committee (GC) | Set broad directions<br>Review project progress and performance<br>Make investment decisions |
| Stakeholder Reference Committee (SRC) | Provide guidance on processes for wider stakeholder participation<br>Consolidate ideas from wider stakeholders<br>Generate confidence in the regional community |
| Futures Forums and Others | Provide input from the community and other key stakeholders, including contributing ideas on values and aspirations, future scenarios and regional response options. |
| Technical Working Group | Further develop details of ideas generated by Futures Forums<br>Contribute knowledge and expertise to the assessment process. |
| Project Team | Facilitate the stakeholder participation process<br>Provide scientific input. |
| Technical Advisory Committee | Provide expert advice as required |

## *Stage 2 Processes & Outputs*

Stage 2 of the project used an extensive program of stakeholder engagement to identify vision, external scenarios and response options. Stakeholders from irrigated agriculture, major processors, business & community groups, local government, and agencies responsible for land & water management were invited to participate in a series of 4 full-day Workshops during 2004. Representation from women and young people was specifically targeted.

Workshops were held at major centres throughout the region (Echuca, Kyabram, Shepparton, Cobram, Benalla and Seymour). In total, stakeholder input has involved over 500 person-days. The output from Stage 2 was:

- Aspirations of stakeholders for irrigated agriculture in the region,
- Four External Scenarios describing the evolution of alternative plausible futures within which the region may have to operate over the next 30 years,
- A suite of Regional Strategies to guide future regional actions,
- A list of the assets within the region, and
- A consolidated list of response options from all Workshops from which the suite of Regional Strategies were synthesised.

This document presents the outputs from Stage 2, comprising the set of Aspirations, External Scenarios, suite of Regional Strategies and a list the Strengths and Weaknesses of the region. The collated Regional Options are contained in Appendix 1.

Communication of Stage 2 outputs will be carried out through:

- Wide distribution of a one page summary to stakeholders and community,
- Distribution of this document containing the synthesised Aspirations, External Scenarios and Regional Strategies to key stakeholders, with the document also being available to others upon request,
- Provision of oral presentations to key stakeholders such as the G-MW and GBCMA Boards, Northern Water Forum, participating Local Government organisations, regional MP's and major community groups.

## *Stage 3 Assessment of consequences*

Stage 3 of the project has recently commenced. The objectives are to:

- Develop full scenario stories describing the interplay of the External Scenarios, Regional Strategies and their consequences including the current plans for water reform,
- Assess the effectiveness and robustness of the suite of Regional Strategies.
- Develop a suite of options for future actions that will readily respond to the challenges and opportunities that arise.

The most effective and robust strategies will be recommended for adoption within the region. The work will be carried out by the Technical Working Group (which utilises the experience within the stakeholder community), supplemented with additional expertise as required.

## 2. Summary of Irrigation Futures Forum Aspirations

**In 2035 we want the community of the Goulburn Broken Catchment to be:**

- Seen as a world leader in food production (clean and green, export markets, growth)
- Efficient users of water, and have appropriate water distribution systems
- Recognised and valued as stewards of the land (proud to be farmers/irrigators, recognised for contribution to economy and community, keep natural resource condition in good shape for future generations)
- Achieving a balance between environmental, social and economic demands (industry exists in harmony with environment and community)
- A vibrant, prosperous (businesses, region, employment, eco/ag tourism, service industries) and diverse community
- A great place to live (community well-being, social networks, well-serviced, appropriate/maintained infrastructure, amenities)
- Happy people who have time for leisure
- Creating all kinds of opportunities for all (in particular young people and new farmers)
- Embracing new and existing technology
- Investing in the environment (biodiversity, healthy rivers, native vegetation, etc.)
- Continuing to have access to water resources for irrigation
- Planning strategically and making collaborative decisions (displaying community leadership, co-operation, working together as a wider community)
- Actively participating in decision making processes and implementation programs
- Managing change (preparedness, adaptability, innovation, learning culture).

# 3. External Scenarios

## *Introduction*

This document contains four external scenarios developed as a part of the Irrigation Futures of the Goulburn Broken Catchment project. These external scenarios describe the evolution of alternative plausible futures within which the region may have to operate over the next 30 years. They focus on factors which are largely outside the immediate control of the region but can have significant impact on the region.

The four external scenarios are not predictions of the future. They are intended to represent a range of possibilities of opportunities and challenges that the region may face. Elements of the scenarios are to be interpreted as metaphors or examples possible events that may occur. For example the outbreak of fire blight described in Scenarios 1 and 2 has been used to depict a bio-security threat to which the region may have to respond. Alternative biosecurity threats such as foot and mouth disease or avian influenza could have been used.

The four external scenarios presented in this document were developed using a set of 28 external scenarios generated by the Irrigation Futures Forums. The key driving forces were extracted from the Forum output by the project team. The project Stakeholder Reference Committee (SRC) developed a series of storylines for the key driving forces based on the forum generated ideas and pieced these storylines together to form scenario outlines. The project team then further developed the scenario outlines into full narratives.

The developed external scenarios provide one input for Stage 3 of the Project. They define the range of possible conditions under which the robustness of the regional options put forward by the community will be assessed. These external scenarios could also be used directly by key stakeholders as inputs to their own strategic planning processes.

## *External Scenario 1: Moving on*

### 2005 - 2010

The cost-price squeeze produces increasing levels of corporate ownership and amalgamation of farms throughout the region. These large operations invest heavily in technology, and achieve high levels of productivity. They require an increasingly skilled workforce, which creates opportunity for the provision of services and specialised equipment. However, the challenge of attracting sufficient numbers of skilled people to regions continues. Migration policy goes some way toward providing a solution, but also creates its own set of challenges.

The sea change within the community continues to produce significant growth in lifestyle properties. These are concentrated in aesthetically attractive areas in the upper catchment and along major rivers, near urban services and the Hume corridor. Part of that demand is from wealthy retired couples. This leads to the development of an articulate, well-connected 'grey-power' block, which has very clear ideas about what levels of amenity they want in the surrounding region. Challenges of land-availability and land-use conditions continue to frustrate both farmers and planners.

Community concern for environmental health and natural resource stewardship continues to grow, but there is a limited appreciation of the extensive change that this requires. Likewise, there is a preference for 'clean-green' food, but not the widespread willingness to pay more for it. As a result, primary producers continue to absorb costs of achieving market expectations in their business. Government Departments and businesses adopt the rhetoric of sustainability, but are still working out what that means.

The phase-in of the Free Trade Agreement (FTA) with the United States (US) has commenced. Australia's interest in a FTA with the Association Of South East Asian Nations (ASEAN) is strongly supported by Indonesia. The Agreement is signed and access to significant export markets is growing.

Oil, water and electricity costs continue to rise. On extremely hot days, interruptions to the electricity supply are starting to become more common. Constraints in transport interchange and portside facilities continue to frustrate exporters.

### 2010 - 2020

A shift in growing season appears to be occurring. Primary producers notice more warmer, drier winters and hotter, wetter summers. A considerable reduction in chill hours is observed. Rainfall continues to be lower than previously experienced, and the severity of extremes increases.

The Government allows the import of apples and pears from New Zealand, indicating that it has put appropriate biosecurity measures in place. In a relatively short time, fire blight is discovered in a number of horticultural areas throughout Australia. This causes community outrage and significant financial losses in regions. The Government is highly embarrassed, and commissions the CSIRO to develop a solution. New, genetically modified (GM), fire blight resistant varieties are developed, and to facilitate damage control, the Government agrees to their speedy utilisation. The decision to introduce GM products into the environment without significant debate produces on-going tension within the community.

Corporate farms are now the norm as very few private farms can continue in this capital-intensive environment. The Corporate Farms Association lobbies the Government for improvements in water distribution and transport infrastructure, and approval for the wider adoption of GMO in agriculture. Their argument is that to take full advantage of the FTA's, and thereby contribute to the improvement of Australia's balance of trade, they need updated infrastructure. They also argue that the uncertainties in global climate require that they have access to a flexible water delivery system.

In response, the State Government invites expressions of interest from the private sector to build, own and operate the water distribution system to agriculture for the irrigation region. The business opportunity lies within the policy that water savings produced by system improvements are available to the owners. The tender is awarded to a consortium of banks and builders. This ideological shift to private ownership of water distribution systems without debate, produces further tension within the community.

The irrigation delivery system is significantly rationalised (with compensation), and is reconstructed within 3- 4 years. The judicious combination of piping and total channel control allows producers to have access to water on demand, 365 days per year. The provision of a more flexible water delivery system gives rise to a whole range of new products and innovative growing systems. The price of water rises significantly, but producers agree that the benefits far outweigh the costs.

There is also increasing community pressure on Government to deal with greenhouse gases. The Government responds by providing establishment support for clean electricity generation systems, which are distributed throughout the landscape, and can connect to regional and national grids. Adoption of global carbon trading creates international interest in plantation development within Australia.

These improvements in infrastructure, plus breakthroughs in GMO (lowered chemical costs, less disease, improved taste) and strong population growth in South Asia / China, create a window of significant export opportunity for all agricultural sectors throughout the region. A more affluent and globally aware consumer wants access to a wide range of food products.

Developments in technology also see an increase in the availability and affordability of specialised robotic systems on-farm. There are stringent quality assurance requirements, which make producers more accountable for the quality of their product, and the environmental credentials of their production system.

### 2020 – 2035

The FTA's with the US and ASEAN have come into force. Australia is still producing bulk agricultural commodities where profit margins are small, but consistent. To cater for the affluent, health conscious market, Australia is also producing a line of high quality, niche 'bush' products. Strategic infrastructure improvements have enabled the movement of fresh products to international markets with a very quick distribution time. These products are unique to Australia (we have been able to isolate and protect parts of the wild gene pool), and they are particularly beneficial in protection against cancers.

The trade opportunities in agriculture have reduced as importing countries (such as China) gradually develop their own production capability. Australia enters a period of fierce competition for agricultural export markets at a global scale.

Corporations now fund significant research and development. Agriculture now requires more technicians than labourers. Australian corporate farmers now export farming systems.

Water is expensive, but now valued by the overall community as an essential resource which needs to be protected. Energy costs have been lowered by the establishment of regional ‘energy farms’.

## *External Scenario 2: New Frontiers*

### 2005 – 2010

The increasing affluence of the urban community has resulted in a growth in tourism throughout this period. In parallel to the increased tourism, urban communities continue to go through a 'sea change' seeking alternative lifestyles. The affordability of seaside properties continually decreases during this period, resulting in an increased emphasis on inland rural properties with appealing aesthetic qualities, including near by hills and water, that are near to employment centres.

The Federal Government signs and ratifies a number of free trade agreements with trading partners including the United States and Southeast Asia (ASEAN) including New Zealand. During this period, these agreements have little effect on the trade of agricultural products due to the long transition periods included. However, throughout the period, awareness and concern for health and the safety of food continues to increase in the domestic market, which is demonstrated through consumer purchases.

The communities concern for the environment slowly increases throughout the period. The government response to this concern is to encourage natural resource stewardship by individuals and corporations. Despite this concern for the environment, demand for both oil and electricity continues to grow at rates greater than population growth, and renewable forms of these energy sources still form only a small proportion of total use.

Internationally, the United States continues its 'war on terror' and leading terrorist figures remain elusive. Meanwhile the international community, lead by the United States, continues to lambast countries viewed as 'outposts of tyranny'. By the end of the period, countries on the list of 'outposts of tyranny' include several former allies, particularly in the Middle East.

### 2010 - 2020

The effects of the increased tourism and rural residential development, resulting from the 'sea change', begin to emerge. The 'newcomers' begin to demand considerable improvements to natural resource conditions to meet their aesthetic expectations. Communications technology developments mean that proximity to employment is now less important, resulting in an expansion of the areas subject to rural residential development. Community demands include greater environmental flows and improved water quality. Governments respond by slowly increasing regulations on agricultural practice to initially limit the off-site impacts, but also the on-site impacts later in the period. A review of water policy in Victoria has enabled farmers to convert medium security water to high security at an appropriate exchange rate, creating additional environmental flows while providing increased security for irrigators. The water policy review also cleared the few remaining barriers to free interstate water trade. Controls are also introduced to manage the natural resource consequences resulting from increased tourism.

During this period, the retiring Baby Boomers show their political and purchasing power, voting for governments that provide increased services and benefits to retirees and supporting continued rural residential development. The ageing population also begins to place additional demands on the labour market for the health and aged care workers, particularly in rural areas.

2014-2016 sees a period of drought culminating in a widespread bushfire throughout Victoria. Government offers no exceptional circumstances assistance to individuals or businesses, due to a growing realisation that both drought and bushfire are risks that everyone should manage. Intense rainfall following the bushfire results in a short-term degradation of water quality in major storages

Free trade agreements slowly begin to take effect. One of the first signs of the agricultural impact of these agreements is the availability of New Zealand apples and pears on the Australian market. The market for these New Zealand apples and pears expands rapidly in Australia, as the reductions in chill hours, resulting from climate change, reduce Australian yields. Toward the end of the period fire blight outbreaks occur throughout Australia, further crippling the pome fruit industry. Substantial increases in the price of fruit, resulting from reduced supply, causes consumer outrage.

The concern for health and wellbeing among the wider community increases, resulting in increased demand for organic and biodynamic foods. While the agricultural industry continues to campaign for access to genetic modification technology, there is a continued reticence by the wider community and government to allow the adoption of genetic modification. Internationally, the expectations of consumers toward food begin to converge, requiring greater variety, year round availability of products and stringent quality assurance practices.

Oil is still an important source of energy. In response to increased international pressure on its member countries, branded as 'outposts of tyranny', OPEC continually reduces oil production. The price of oil reaches unprecedented levels and begins to slow the global economy. The United States leads a war in the Middle East to break the oil cartels, reactivating troops who have only recently returned from peacekeeping duties in Iraq. The war promotes a period of rapid technological development to solve the problems of the combat zone. Techniques for the synthetic production of food are developed that enable the transformation of basic elements such as starch and sugar into nutritional foods. Initially this technology is used solely by the military, however multinational corporations begin to undertake research into its commercial application.

**2020 - 2035**

The environment remains a high priority for the community, with the health of the Murray River a particular concern. While the first step decision taken as a part of the Living Murray process in 2004 has resulted in some minor improvements to the health of the Murray River, the barrages at the river mouth have now been identified as the major impediment for further improvements. Low energy, solar-powered desalination systems have been developed that enable Adelaide to cease drawing water from the Murray River. The barrages are progressively removed and the Murray Darling Basin Commission revises salinity management objectives and controls for the entire Basin.

Government regulation of agricultural land use has not achieved the outcomes desired by the wider community, but has seen the abandonment of agriculture throughout parts of the state. Government takes the opportunity to purchase areas of former agricultural land for tourism, recreational, aesthetic and environmental purposes.

Disease, climate change and government regulation has seen production from agriculture decline. Consumer outrage at increases in prices for food and pressures from international trading partners cause a progressive change in community and government attitudes toward genetic modification. Government subsequently allows the use of genetically modified organisms for agricultural production. Synthetic food production becomes a commercial reality, initially for dairy products, including milk, and subsequently growing to include meat and fruit substitutes. A niche market of authentic (non-synthetic) foods exists, but the premium prices sought for such goods place them out of the reach of most consumers. The majority of agricultural production fulfils the demand for the raw ingredients of food synthesis. Totally automated transport systems have removed the need for most forms of manual labour, apart from specific one-off tasks. The majority of employment is now in the production and maintenance of automation systems.

A decline in the power of the United States, due to large levels of foreign debt and a continued reliance on carbon-based energy sources, has resulted in strengthened global governance by the United Nations. International free trade has been mandated. The combination of free trade and technological development has produced a global equalisation in production costs for agriculture and many other industries.

## *External Scenario 3: Pendulum*

### 2005 – 2010

Community concern for the environment rapidly grows. Disillusionment with the re-elected Howard government increases due to a continued and costly involvement in Iraq and continued failure to recognise and respond to environmental problems, including climate change. The 2007 federal election results in the Greens holding the balance of power in the Senate and demanding a plan to reduce the Murray Darling Basin Cap by a further 3500 GL over 10 years. Plans are developed to enable this reallocation of water, with 1500 GL to be returned to the environment by 2010, of which Victoria is expected to contribute 650 GL.

Free trade agreements with the United States and several Southeast Asian countries are negotiated, signed and ratified by Government. In anticipation of trade opportunities, multinational corporations continue a stream of takeover bids for Victorian based processors of agricultural products. Very little change in the operation of the processors is observed during the first few years after the takeovers have occurred.

Ongoing uncertainty in the major oil producing regions, particularly the Middle East, result in progressive increases in fuel prices. Having signed the Kyoto Protocol, the Green influenced federal government provides funding for the rapid development of renewable alternative energy sources. Bio-fuels are seen as the answer for the transport industries.

Energy prices rises result in increases in inflation. The Reserve Bank attempts to control inflation with a series of increases in interest rates. Higher interest rates stem the 'sea change' and force many of those recently adopting alternative lifestyles back to the cities to seek higher paid employment.

The Federal government legislates a permanent ban on the use of genetically modified organisms. To support the agricultural industry, the Federal government establishes the Centre for the Selection and Breeding of Native Genetics to encourage the development of indigenous flora and fauna for food and fibre production.

### 2010 – 2020

To realise part of its commitment to the return of water to the Murray River, South Australia removes the barrages from the Murray mouth and constructs desalination plants to provide drinking water to Adelaide. The commitment of additional water to the environment enables the Murray Darling Basin Commission to revise its salinity management objectives and controls within the Basin. To meet the remainder of its commitment of 1500 GL, the Victorian Government adopts a least cost approach, mandating a buy-back of all Victorian medium-security water as a first step and entering the New South Wales market to attempt to meet the remainder of its commitment. The New South Wales market fails to yield sufficient water and the Victorian government is forced to reduce entitlements and compensate irrigators. Once the water has been returned to the environment, the Federal government assumes ultimate control over water and the newly formed Department of Water Resources becomes responsible for the supply and delivery of water to all users.

The effects of amalgamation and take-overs in the processing industry begin to emerge. Cost minimisation and risk management processes introduced by the processing industry results in growers being offered long-term contractual agreements and increased opportunities for support industries through out-sourcing arrangements. Processors are also encouraging pre-processing of products on farms to minimise transport and energy costs. The new roles of support industries and farms require additional skills to assist with management, finance and technology development.

Biofuels are now in high demand due to their compatibility with existing engine technologies and the recognition that they do not contribute net greenhouse gas emissions. 'Energy' farms appear and begin to compete for the remaining irrigation water with the dairy and horticultural industries.

Later in the period, the effects of reduced water availability emerge with farmers being forced to sell up and the closure processing plants. The irrigation areas contract and Government takes the opportunity to restructure the rural water providers to separate water supply and delivery roles from other non-supply roles.

Reduced availability of water and multinational monopolies force increases in the price of food. Increased prices for food provide an opportunity for the commercialisation of recently developed alternative food technology that allows the manufacture of complex foods from basic elements, eg. simple and complex carbohydrates. A market for basic food elements slowly develops.

Internationally, concern with the use of genetically modified foods begins to emerge. This concern arises due to the escape of modified genes into natural systems and several unexplained human health issues that have been anecdotally linked to genetically modified foods. Australia's GM free status begins to become a competitive advantage.

Community outrage at the dramatic decline in rural areas and the lack of outcomes produced by the increased environmental flows results in a rapid swing back to conservative Government values and the 2020 election sees the National Party win government.

### 2020 – 2035

The newly elected National Party government immediately initiates an agenda of reform. A radical review of government bureaucracy and regulation occurs with a considerable reduction in both, particularly those covering agricultural practice. The government deems that environmental flows are not worth the economic cost and increases the Murray Darling Basin cap on diversions. An auction of the reallocated water realises sufficient funds to rebuild irrigation infrastructure throughout the Basin. As a part of the government reform process, the Department of Water Resources is broken up and a series of water supply and delivery companies are created and progressively privatised. Multinational corporations, lead by Monsanto, purchase controlling-shares in the new water supply and delivery companies. Water supply and delivery companies immediately raise water prices to ensure a return to shareholders.

Early in the decade, several years of above average rainfall are experienced. For 2 consecutive years, wide-spread flooding occurs during winter. These floods result in

widespread damage to property in low-lying areas and a reversal of the downward trend in water table depths.

Internationally, the floating of the Chinese yuan creates a major economic upheaval. Slowly over the period, the value of yuan increases against the Australian dollar and other world currencies. This means that Australian goods are increasingly competitive in China and consequently demand increases.

The majority of food production is now performed in laboratories owned by large multinational corporations, with basic ingredients supplied by both agriculture and aquaculture. Laboratory based food production creates a demand for a highly skilled labour force, both in the production of basic ingredients and food production laboratories. A small market exists for premium authentic foods, however these foods are priced out of the range of the majority of consumers.

Toward the end of the period, climate change is widely acknowledged as a natural process that operates on long cycles. It is now recognised that a peak in global temperature was observed in 2020 and a period of slow cooling has occurred since that time. While increasing levels of green house gasses had been observed until 2015, it now appears that these levels have stabilised. The enhanced greenhouse effect is now managed through a global net carbon budget and trading scheme. New demands for energy are now primarily provided by renewable sources.

## *External Scenario 4: Drying up*

### 2005 - 2010

Good rains come for a couple of years. The drought appears to have ended, and the mood in the country has picked up markedly. Production levels are high, and the Chinese market has started to open up to Australia. Money is coming into the region again. A lot of older farmers use this buoyant opportunity to exit the industry, and their farms are usually bought by neighbours. In general, people are getting their debt to manageable levels, and the family farm has been saved yet again.

Good times always come with a hook. The economic boom produces low levels of unemployment. Because work is readily available in the cities, the fruit and vegetable industries struggle to attract sufficient numbers of people (both skilled and unskilled) to work here.

The war on terror continues, and the US leads a coalition of the committed into Iran to deal with the threat of its nuclear capability. The US budget deficit continues to grow causing worldwide economic uncertainty, and as a result the $US starts to fall. This generates a number of global impacts, one of which is a significant downturn in the ability of Pacific Rim countries to sell their manufactured goods. The flow-on effect is that these countries do not buy a range of our agricultural exports.

The unexpected loss of these markets is a significant blow for Australia, and the (initially) stronger $A further hinders our efforts to find alternative markets. To try to manage the situation, agricultural processors try to store product where possible, but ultimately they have to refuse inputs from producers. To deal with this loss of income, most farmers decide to go into a holding pattern (ie continue farming but with limited production), and just wait out the downturn. This drop in production results in widespread job losses in the agricultural sector, reduced sales for regional shopping centres, hard times for farm machinery and car retailers etc. The Government recognises that the economic slow-down is worldwide, and encourages the banks to take a sympathetic approach to loan adjustments.

Late in the decade, the US is forced to introduce major structural adjustments to its economy in order to manage its budget deficit. The worldwide economy starts to recover, and gradually moves toward the re-establishment of pre-downturn trading patterns.

The good rainfall comes to an end, and the next drought starts. Some people say that the last drought didn't really end, and that the good rainfall was just a hiccup.

### 2010 - 2020

Even though rainfall is low at the moment, the initial production environment for agriculture within Australia is very positive. Due to the good rainfalls in 2005 - 07 and the limited production in 2008/09, Eildon is 60% full, and water is available. Market prices for water are relatively low, and riverine ecosystems are in good health. Likewise energy costs have not risen for 2 years, and due to the previous levels of unemployment in the region, people are keen to work.

ABARE reports that China is gradually shifting its agricultural enterprise toward high value horticulture. It therefore starts to become a major competitor in areas that have traditionally been Australian export markets. The Chinese strategy appears to

be to increase its export income by concentrating on high-value products, and to import the relatively low-priced, bulk agricultural commodities to provide food for the masses.

In the US, a voter backlash to the war on terror sees Hilary Clinton elected as the next president. This produces a shift away from the aggressive intervention previously observed in US foreign policy. It also sees a continuation of the difficult structural adjustments within the US economy, initiated by the previous administration.

The drought increases in severity. The region has had significantly below-average rainfall for 8 years. Five years into this decade, the levels in Eildon are such that water allocation has been progressively reduced to 80%, 50% and then 30% of water right in consecutive years. The good years have turned to dust again, and irrigators cannot get enough water for their product. The scheduled review of water allocation under the 2004 White Paper commences, and Government policy is that flows to the environment are to be increased. There is limited empathy for embattled irrigators trying to stay in business.

**2020 – 2035**

The good news is that at the end of the decade, the rains recommence.

The widespread nature of hardship has seen the Government provide special assistance to regional communities. The family farm is still the main form of agricultural enterprise. A significant element of consumer demand in affluent nations is the preference for "natural" foods. Hence, while there has been pressure from farming groups to introduce genetically modified (GM) plant and animal varieties during these hard times, widespread community concern for health and food safety means that the Government has not acceded to this demand. As a result, Australia is one of the few countries in the world still producing (largely) GM-free agricultural products.

# 4. Stage 2 Recommendation: Regional Strategies

## *Introduction*

Through an extensive participative program run by the Irrigation Futures Project, the community and key stakeholders of the Goulburn Broken Catchment have expressed their values and aspirations, explored plausible futures, examined the region's strengths and weaknesses, and put forward ideas on regional options for the future.

The ideas put forward on regional options for the future are many and wide ranging. The suite of Strategies presented here result from an attempt to synthesise these ideas. It is intended that these Strategies genuinely reflect the community views and will provide useful guidelines for regional organisations, community groups and the community in general.

Each of the Strategies embodies many community and stakeholder ideas. It is pleasing to note that many of the Strategies are consistent with current directions and practices in the region. However, it is intended that a greater level of awareness and understanding of these directions and practices is brought about through the deliberation on these Strategies.

The diversity of the community and stakeholder ideas has given rise to a number of insights, which provided the basis for the Key Principles as well as a number of specific Strategies. The Key Principles outline the collective roles of regional organisations, community groups and the community in general and the fundamental approach to management systems and processes. They are very much about ways of doing things. It is intended that these Key Principles will contribute in some way to the evolving culture of the region.

The Strategies in this document are high level strategies. Undoubtedly the richness in specifics of the community and stakeholder ideas documented separately will provide an excellent basis for developing detailed actions in the future.

Although the Strategies focus on measures that can be taken collectively by the region through regional organisations and community groups, many of the ideas underlying the Strategies may also prove to be useful for individuals to draw on.

Through the exploration of plausible futures, we have learnt that the future is uncertain. Many factors external to the region will impact on us. However, we can position the region by building strong Social Capability, Land, Water and Environmental Capability, and Industry Capability, to embrace future opportunities and challenges to fulfil our aspirations.

## *Key Principles*

1. The region will initiate and coordinate actions to attain sound social and institutional arrangements and physical infrastructure, so that enterpreneurship and innovation will flourish, and environment and community wellbeing will be protected and enhanced.

2. The region will involve active participation of the community in decision making to effectively utilise local knowledge and take into account a diversity of views, so that decisions will be robust and owned by the community.

3. The region will build strong adaptive capability, continually monitor, learn, innovate and make adaptive changes to manage future uncertainties, so that the region will embrace opportunities and challenges when they arise.

## *Building Social Capability*

1. Develop a framework for regional adaptive management to deal with future effects of water reform and other driving forces.

2. Review current mechanisms for knowledge generation, accumulation, exchange and use, and examine ways for improvement.

3. Continually rejuvenate memberships and processes of community groups and community involvement in organisations.

4. Value and support leadership development through a variety of programs.

5. Facilitate community groups to discuss significant issues related to natural resources management, to explore cultural values and build strong community networks.

6. Continually support community groups to take initiatives in natural resources management and celebrate their achievements.

7. Continually promote a culture of regional cooperation among organisations, sharing information and coordinating decision making.

8. Maintain effective communication between organisations, community leaders and the community, to ensure strong community input to regional decision making and government policy formulation.

9. Actively promote, to people living both inside and outside the region, the benefits of irrigated agriculture and the opportunities that the region can offer.

10. Provide support for individuals to recognise and adapt to changes.

## *Building Land, Water and Environmental Capability*

1. Explore potential effects of water reform and other driving forces on the region and ways to manage these potential effects.

2. Value the ability of irrigation infrastructure to adapt to future changes in land and water uses, and adopt flexible technologies and management processes where appropriate.

3. Develop a sound plan for water pricing and associated services to ensure the viability of irrigation delivery services and ability of irrigation enterprises to adapt to changes, and to balance short term and long term needs.

4. Investigate options for flexible land amalgamation and subdivision and sound land use zoning, to enhance the adaptive capability of the region to respond to future land use changes.

5. Further investigate the role and feasibility of prime irrigation development and re-development zones in attracting investment to the region.

6. Investigate options for land retirement from irrigation or from agricultural production, based on land capability.

7. Develop a vision of significant environmental areas and corridors for protection and enhancement, so that other land use and infrastructure planning complements the environmental vision and that tourism potential is enhanced.

8. Encourage landowners to integrate environmental features, such as native vegetation, animal sanctuaries and wetlands, with agricultural production systems.

9. Set out clear standards for environmental and natural resource management through irrigation site use licences, and through responsible land ownership guidelines.

10. Manage environmental water reserve soundly to maximise the environmental benefit.

11. Periodically review water allocation policy such as water allocation to different users and level of reliability of water products.

## *Building Agricultural Industry Capability*

1. Promote a positive image of careers in the agricultural industry, through positive stories in media and involvement in schools.

2. Provide agricultural employers with innovative training opportunities on staff management and succession planning, so that young people are attracted to enter into and develop career paths in the agricultural industry.

3. Maintain active and high quality programs for agricultural research, development and education.

4. Research market potential and production systems for emerging and new products.

5. Value and support diversity in agriculture enterprises, farming systems and products in the region.

6. Investigate options for structural change in the agricultural businesses, for example, corporate dairy farms jointly owned by several families.

7. Actively seek support and opportunity for upgrading transport, energy and communications infrastructure, develop major regional centres, expand tertiary education and research facilities.

8. Provide support to irrigators on transition to new water policy implementation, in particular, on how to use different reliability water products.

# 5. Summary of Strengths and Weakness of the Region

## *Strengths of the region*

### Institutions

- Strong institutions with capacity
- Organisation/structure of the catchment
- Landcare
- Community involvement/ engagement
- Stable government (Local)
- Government Departments of Agriculture

### Knowledge

- Understanding of the environment
- Knowledge within the community – accepted and adopted
- Expertise, experience and adaptability
- Information track record
- Intellectual property

### Research and Education Facilities

- Research facilities (Charles Sturt Uni., University of Melbourne, Tatura)
- Educational facilities
- Strong scientific community

### Community

- Social critical mass
- Diversity of opinions, ethnicity and culture
- Flexibility, Adaptability (willingness to change)
- Entrepreneurial, Risk takers (adopt new technologies)
- Expertise (educated, innovative and capable people)
- Proactive
- Population (Density (source of labour), growth, quality)
- Democracy, people power
- Strong regional leadership
- Community comes together
- Capacity to attract investment
- Growth within shires
- Strong regional centres
- Small communities
- Lifestyle choices
- Well established social and sporting opportunities
- Economic prosperity
- Incredible potential to produce food and society/community

### Location

- Proximity to transport infrastructure (ports/sea terminals, international airport, rail, roads)
- Proximity to markets (Melbourne/Sydney, supply chain and resources)
- Proximity to major cities (away from urban sprawl, opportunity to recruit consultants)
- Proximity to water sources (Murray River)

### Infrastructure

- Good existing infrastructure (roads, rail, education, hospitals)
- Infrastructure is in good condition (roads)
- Secondary industry infrastructure
- Irrigation infrastructure
- Infrastructure costs are borne locally = more control

### Climate

- Rainfall
- Sunlight
- Variety
- Nice climate
- High rainfall and cool temperatures in upper catchment

### Soils

- Variety of soils
- Soil structure – salinity levels generally good
- Soil management
- Deeper, richer soils

### Water

- Water quantity, quality & surety (availability, reliability, security)
- Water distribution
- Water source options – eg groundwater
- Relatively clean environment
- Highest water efficiency in terms of least losses
- Eildon Dam = regular water supply

### Land

- diverse land use
- land availability (for development)

### Natural Resources

- Murray Rivers and urban townships
- Landscape brings tourism and recreation
- Large areas of public land
- Forested upper catchment
- Scenic value
- Quality of environment
- Pleasant living environment
- Variety of topography (opportunity for more dams)
- Greater level of vegetative buffering = environment (streams) in better condition

### Industry

- Diversity of production (crops, products, people, skills and finance)
- Reasonable equity and profitable businesses
- Established industries
- Management skills (capacity to attract investment, experience)
- Innovation and take up of technology
- Industry connection and leadership
- Quality of disease resistance
- Service providers / industries
- Safety
- Adaptability / versatility of agricultural industries
- Processing facilities (food processing)
- Transport industry – availability of trucks, rail
- Market image (clean green, quality)
- Markets (Asia, proximity to domestic)
- Labour availability
- Strong base for tourism

## *Weaknesses of the region*

### Communication, knowledge and attitudes

- Lack of promotion (communication/marketing/research)
- Perception of irrigation / agriculture (large scale irrigation socially unacceptable)
- Full new ideas
- Conservatism in agriculture
- Lack of confidence (low morale)
- Fear of and resistance to change
- Community disharmony
- Acknowledgment of plight of farmers, communities and businesses
- People not accessing services

### Environment

- Lack of public acknowledgment of damage to the environment
- Lack of real consideration of value of environment
- Degraded catchment (including river systems, previous damage)
- Aesthetic qualities (environmental assets are low, not attractive)
- Fragility of system
- Environmental knowledge

### Climate

- High rainfall and cool climate
- Climate variability
- Drought prone
- Climate too hot for perennial pasture

### Demographics and society

- Thinly populated
- Age profile (ageing population, loss of young people)
- Lack of career opportunities – bigger $ in metro area
- Low socio-demographic group
- High proportion of welfare dependant people in the area
- Urbanisation – changing of population dynamics/distribution
- Culturally diversity (not enough to drive change)
- Concentrating wealth trends
- Housing
- No major regional centre (upper catchment)

### Education

- Lack of local education and cultural facilities and opportunities (tertiary)

### Industry Weaknesses

- Shortage of labour and skills (expensive)
- Lack of succession (Young people in/into industry, few professional farmers)
- Dominance of (dependence on) particular industries (eg dairy, livestock)
- Defensiveness
- Big business (multinationals, corporatisation)
- Reliance on technology
- Price takers (supermarkets and multinationals)
- Dependence on resources (water, fuel)
- Dependence on bulk commodities and world markets
- Distance to international markets
- Concentration of production – this region doesn't receive its share (of?)
- Development opportunities (eg wrt climate) are not compatible with water quality etc
- Farm management quality (understanding soil dynamics, understanding of agribusiness)
- Farm finances (Profitability, debt load, capital barriers)
- Vulnerability to disease (Biosecurity)

- Short term conditions (post drought situation, farms going out of business)
- Lack of recognition as worthwhile area – food production
- Lack of industry connection (few lobby groups, isolation)
- Absentee landowners & business operations

### Tourism

- Low base for tourism
- Lining up of tourism with lifestyle attraction
- Lack of "driver" industry – possibility of tourism? (tourism related jobs at 35%)
- Degradation produced by tourism & vandalism

### Water

- Water pricing
- Water trade (water leaving the area)
- Low water availability and reliability
- Water allocation (high allocation, allocated elsewhere)
- Access, reliability, availability of water in upper catchment (eg King Parrot Ck)
- Major storage – limits ability to adapt flow regimes, & quantity already allocated
- Quality of groundwater

### Soils

- Threats to soils (salinity, sodicity, acidity, fertility, fragility, degradation)

### Governance

- Lack of political influence (Inability to organise and effectively influence others)
- Underwhelming capacity within/response from/performance of Local Govt
- Local government (competition between, rather than regional)
- Key decision-makers remote from the area
- Public sector performance (Lack of coordination between government departments, bureacracy)
- Reliance on individualism
- Communication

### Infrastructure

- Condition of infrastructure
- Communication infrastructure (Lack of services (internet, mobile phone), ageing, expensive, scatered)
- Irrigation infrastructure (old, ageing, poor condition, under resourced, 19th century technology, spread out)
- Loss of rural services and infrastructure (hospitals)
- Quality of medical facilities

### Land

- Land prices (influence of urban development)
- Development of land (amalgamation of land, difficult to access)
- Land use planning (Unplanned change, planning in early days)
- Diverse Topography– doesn't lend itself to large scale investment
- Loss of good (productive) farming land (rules to protect)
- Land use intensity

### Research

- Lack of relevant and futuristic research – funding lacking, not acted on
- Little R&D occurring with respect to industry needs

# Appendix 1: Consolidated Response Options

## *Introduction*

This appendix is a consolidation and preliminary analysis of the options developed by the Irrigation Futures Forums.

The original options and option elements generated by the Irrigation Futures Forums were collated and the underlying themes were extracted. The options were then coded according to the themes and grouped under each theme. Overlapping and common options were combined to develop a set of unique strategy ideas. These strategy ideas were then organised in groups according to common sub-themes.

A preliminary analysis of the strategy ideas was undertaken to identify current activities and programs occurring within the sub-themes, and the rationale underlying each of the strategy ideas.

A preliminary set of underlying strategy ideas, including alternatives where they were identifiable, was develop from strategy ideas within each theme.

The material within this appendix is presented in the major themes. Each theme contains a faithful summary of the workshop output, an expression of the main strategies represented within the workshop output and a commentary on aspects of the workshop output where there appeared to be a large gap between the workshop output and current activities and knowledge.

The Regional Strategies presented earlier in this document represents a synthesis of these consolidated Regional Options.

## *Land use change*

### Desired Outcomes and Purposes

Mosaic landscape
Long term sustainability
Irrigation development along river corridors
Appropriate resources committed to land
Management of environmental impacts
Greener businesses
Ensure land use is compatible with irrigation delivery system refurbishment
Protection of good quality agricultural land
More natural flow regimes
Enable land use change to occur
Encouraging land used change to occur

### Mechanisms

*Developing direction of change* [i]

1. Develop a vision of land use
2. Reconfiguration plans – plans to change land use
3. Municipal based land use audit
4. Land capability study

*Enabling and controlling change* [ii]

5. Planning overlays to restrict land use – related to land capability, community needs
6. Site licences
   a) Crop type to soil type
7. Create land use development zones
   a) Reduced paperwork for amalgamation/subdivision
   b) Related to infrastructure (irrigation etc.)
8. Simpler land/farm amalgamation and subdivision rules
9. Long term leasing arrangements
10. Government land acquisition
    a) Compulsory
    b) Voluntary

*Financing the change* [iii]

11. Investment from business or green groups to facilitate land use change
12. Low interest loans
13. Government funding
    a) Compensation
    b) Incentives

*Supporting the change* [iv]

14. Provide emotional support
15. Provide assistance to identify alternative employment opportunities
16. Neighbour management

### Underlying Strategy Ideas

| | | | |
|---|---|---|---|
| 1 | Impose mandatory changes to land use | Enabling land use transitions in a preferred direction | Allow land use transitions to occur under a free market |

## Comments

i. Many organisations within the region have a vision of the future eg GBCMA, G-MW, City of Greater Shepparton. While the development of these visions has often included representatives of 'the community', there is little ownership of these visions by the broader community. However, if 'the community' is going to influence government and region's institutions, they need to have some idea of its desired future independent of the institutions.

ii. There is an assumption that an optimal configuration of land use exists and is it is desirable to achieve this configuration. This view leads to a perception that highly regulated landuse is desirable.

iii. There are many opportunities for financing changes in landuse. Government is unlikely to finance land use change unless there is some significant public benefit in the land use change for example purchasing land with water to recover the water, or purchase for environmental purposes.

iv. One of the major differences between farming and other business is the emotional attachment. The farm is not separate from home and therefore any land use change results in upheaval of 'home', which is a large emotional commitment.

## *Governance*

### Desired Outcomes and Purposes

Smaller, responsive regional government with vision and control
Reduced infrastructure costs
Restricted metropolitan development
Climate of transparency
Regional cooperation
Decisions closer to the community
Unify water management across states
Regional government

### Mechanisms

*For Government*

1. Decentralise government
2. Create and empower elected regional water management committees through legislation
3. Set and enforce rules and limits (variable between regions)
   a) Set environmental limits by CMA
   b) Set best management practice by water authority
   c) Hydraulic loads
   d) Water quality
4. Demonstrate support for agriculture
5. Develop cooperation between local governments
6. Develop regional government structure
7. Develop effective consultation processes (all governments)
8. Encourage initiative

*For Individuals / Community* [i]

9. Lobby government

### Roles of Government

Own and fund infrastructure assets
Provide climate of fairness
Achieve prosperity, security, order, respect, sustainability
Identify resources

### Underlying Strategy Ideas

| | | |
|---|---|---|
| 1 | Lobby government to achieve desired governance changes | |
| 2 | Catchment Management Authority establishes and enforces rules | |

### Comments

i. There is very little the regional community can do to change governance structures except for lobbying governments.

## *Leadership*

### Desired Outcomes

Purposes/ Rationale
Leaders bring people with them
Positive leaders model resilience
Foster community leadership for short and long term

### Mechanisms [ii]

1. Develop junior leadership programs in schools, shires and clubs, including mentoring
2. Encourage participation in existing leadership programs eg. Fairley, Rotary, CFA.
3. Develop rewards for leadership and participation
4. Industry leadership programs including water industry. For example retired industry leaders acting as mentors
5. Identify emerging leaders and existing leaders needing training
6. Develop training and support and have ready to deliver
7. Community support leaders, including reimbursement of costs of leadership jobs.
8. Conduct regional leadership forums for networking and idea interchange, eg think tanks, workshops
9. Encourage entrepreneurs and risk takers

### Roles of Leaders

- Communicate visions to the community
- Listen to the community
- Gain knowledge of the issues
- Make decisions
- Raise awareness in the community

### Underlying Strategy Ideas

| | | |
|---|---|---|
| 1 | Encourage leadership development within region through support of current leader and leadership programs | |

### Comments

ii. Leadership development programs already exist within many organisations within the region. For example Tatura Milk has an associate director program, Moira Shire have a Junior Shire Council, Rotary and other service clubs have a number of programs that aim to develop leadership skills.

## *Water*

### Desired Outcomes Purposes/ Rationale

Maintain water at minimum cost to support irrigated agriculture
Provide certainty and investment confidence
Provide media consistency

### Mechanisms

*Usage controls* [iii]

1. Introduce a site use licence
   a) controlling water use on crop/soil,
   b) controlling irrigation application method,
   c) with irrigation training as a requirement
   d) phase in periods
   e) participatory development
2. Target water use to soil type

*Water Market* [iii]

3. Make water tradeable throughout system
4. Promote water as an investment and promote water barons as heroes
5. Establish water leasing market
6. Establish water futures market
7. Prevent groundwater trading

*Water Allocation* [v]

8. Return water to the environment
   a) Sacrifice sales water
   b) Allocate a percentage of available water, seasonally adjusted
9. Make best use of environmental water
10. Unregulated access to water
11. Reallocate water
    a) Financial incentives
    b) Retain reserves for other allocations required in the future
    c) Based on historic usage and average years defining guaranteed levels of supply
12. Regularly review allocation policy
13. Clearly define (and communicate) allocation security levels for regulated system
14. Guarantee irrigation licence volumes in unregulated system
    a) Amend farm dams legislation to allow flexibility.
15. Control irrigation development and water use in unregulated areas
16. Plan water demand to allow for urban growth
    a) Sacrifice sales water
17. Create recreational water reserves

*Water Price* [vi]

18. Define [and communicate] permanent and temporary TWE prices
19. Plan water price changes over 5-10 years
20. Establish basis for water pricing
21. All water beneficiaries pay, including tourism and recreation.

*Water management*

22. Privatisation of the water industry
23. Distribute water 365 days per year
24. Opportunistic harvesting [vii]

## Underlying Strategy Ideas

| | | |
|---|---|---|
| 1 | Develop a water use licence to place conditions on the use of water | |
| 2 | Enable water reallocation through the water market | Encourage government to reallocate water |
| 3 | Develop and communicate a planned approach to water pricing | |
| 4 | Investigate service improvements for irrigation water delivery | |

## Comments

iii. This may be covered to some extent in the white paper. The site licence being developed as a part of the white paper is less prescriptive than suggested by the workshop participants, however this may change in the future.

iv. Some elements of this are covered in the white paper. The development of leasing and futures markets will be dependent on people demanding these products and a market place would emerge should the demand become sufficiently large. The future consequences of white paper proposals are not well understood.

v. Water allocation is dependent on rules and processes established by government and therefore can be changed. The region can only influence these changes.

vi. Two processes are currently occurring within G-MW. An external review of G-MW water pricing by is currently being undertaken by Frontier Economics. A Water Plan is also being developed that sets out the price G-MW charges for water for the next 3 years. The Essential Services Commission assesses the Water Plans against certain detailed principles set out in the Water Industry Regulatory Order and decide whether to approve the prices proposed by the businesses or the manner those prices are to be calculated or otherwise determined. Opportunities for customer feedback are provided within both process.

vii. This mainly applies to unregulated catchments and possibly diversions in the regulated systems. Diversions account for approximately 15% of the water delivered by G-MW.

## *Infrastructure*

### Mechanisms/Actions

*Financing irrigation infrastructure*

1. Infrastructure partnerships with industry eg. philanthropists, BOOT schemes
2. Government funded irrigation infrastructure modernisation
3. Government bridge profit gap
4. Who profits from infrastructure upgrade pays for it

*Water delivery system modernisation renewal/redevelopment*

Undertake investigations of

5. Appropriate areas for reconfiguration/retrofitting new technology
6. Inappropriate areas for open channels
7. Alternative supply systems
   a) Temporary irrigation supply systems
   b) Integrated farm-supply systems
   c) Pipes
   d) Farm dams for storage
8. Investigate impact of irrigation infrastructure costs
   a) Location of new development
   b) Renewing infrastructure versus greenfield development
9. Research existing infrastructure

Options/requirements for modernisation

10. Headworks change
11. Technology for channels
    a) Total channel control
12. Preferential irrigation system reconfiguration where high value agriculture
13. Distribute water in pipes
    a) All water supplies
    b) Stock and domestic water
    c) Greenfield sites
14. Improved flow measurement
15. Consistency with land zoning
16. Encourage efficient farm storage
17. Enhance irrigation system capacity
18. Develop an upper Goulburn reticulation system
    a) Identify areas for agriculture/aquaculture to be served by pipeline
19. Reconfigure system to ensure flexibility
20. Local input into delivery and storage system redevelopment

*Water delivery system rationalisation*

21. Close irrigation areas
    a) Consult with community
    b) Financial compensation
    c) Compulsory acquisition
    d) Relocate existing users

*Irrigation infrastructure management*

22. Irrigation system planning
23. Compile an inventory of irrigation infrastructure its current status and requirements for upgrade [viii]
24. Price infrastructure according to service delivery standards
25. Mock catastrophe

*Transport infrastructure*

26. Complete upgrade of GV highway
27. Create fast rail service
28. Develop inter-modal freight hub at Mangalore
29. Develop regional centre at Seymour

*Other infrastructure*

30. Better utilisation of existing facilities eg. arts etc.

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Reconfigure (rationalise and renew) irrigation infrastructure with thorough investigations of the alternative irrigation supply technology and community involvement. | |
| 2 | Plan and develop regional transport infrastructure | |

**Comments**

[viii] G-MW have developed an asset database that describes the infrastructure and its condition.

## *Education*

### Mechanisms/Actions

*Vocational education*

1. Encourage formal education of farmers and community in general
2. Provide education for farmers on:
   a) Best soil usage
   b) Knowledge sharing
   c) Business planning
   d) Succession
   e) How to use the new water products
3. Provide education to assist with employment adjustment

*Community Education*

4. Undertake science in the community projects
5. Informal education via media
6. Inculcate knowledge and understanding of rural systems through all levels of society

*School education* [ix]

7. Create a regional careers advisory centre
   a) vertical integration education
   b) people with different jobs
8. Introduce dairy and horticulture courses in high schools
9. Promote benefits of multicultural society in schools
10. 'Dairy farmer in residence' at schools
11. Primary school to include environmental issues

*Tertiary Education*

12. Fund and operate regional [tertiary] education and research centres
13. Increase local tertiary education opportunities
14. Education based on local capabilities (people, resources, limits, soil and water)
15. University faculty in Seymour or Tatura linked to Melbourne universities environmental/agricultural research and resources
16. Create a regional centre of excellence for science and education

### Underlying Strategy Ideas

| | | |
|---|---|---|
| 1 | Provide education opportunities for:<br>• farmers,<br>• schools<br>• wider community | |
| 2 | Encourage the development of regional research and education facilities | |

### Comments

[ix] Vocational education courses including dairy and horticultural courses are available at many secondary schools in the region as a part of year 11 and 12 VET programs. There appears to be an assumption made in some cases that if agricultural studies are provided as a part of secondary education more people will want to stay in the region and undertake agriculture as a career.

## *Management and Protection of Environmental Resources*

### Mechanisms/Actions

*Planning Natural Asset Management*

1. Set vision and targets for stream improvement
2. Planning to preserve a sustainable environment within constraints of our natural resources
3. Integrated regional approach to land and water management
   a) Enhanced role of CMA
   b) State government must take a strong co-ordination role
4. Valuing our environmental assets
   a) Know what our assets are
   b) How they are valued
   c) Community expectations with respect to management and preservation
   d) Communication of agreed values and strategies for their protection

*Water Quality*

5. Management of water quality through
   a) Stream flow buffers
   b) Storage buffers
   c) Protect water quality via best practice principles
   d) Management of water quality in Lake Eildon
   e) Continuing salinity works in upper catchment
   f) Education of our 'playground' users and residents about their impact on water quality
6. Control runoff

*Salinity*

7. Look after salt affected areas through use of pumped saline groundwater
8. Develop 'pilot' project to return salt affected land to natural revegetated state
9. Tree planting in salt generating sub-catchments

*Environmental management on private land*

10. Encourage and reward environmental stewardship
11. Management of 'retired' land
    a) Lease land by government/environmental groups as environmental reserves and pay landowners to manage
    b) Investigate the role of forestry on retired irrigation pasture
    c) Ecological services – people exiting farming, tourism (eg custodians of land for ecological benefits)
12. Rate rebates for environmental works
13. Continue landcare activities
14. Increase farms with animal sanctuaries and wetlands

*Other*

15. Increase awareness of positive effect of environment
16. Make best use of environmental water
17. Establish world centre for environmental trading
18. Environmental tourism
19. Establish enterprises that utilise environmental assets better
20. Environmental flows as a % of available water
21. Source capital from business, green groups
22. Partnerships with industry eg business, philanthropists

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Plan natural resource management according to community expectations and values | |
| 2 | Protect water quality | |
| 3 | Manage the impacts of salinity on productive land and water quality | |
| 4 | Encourage landowners to protect and enhance environmental assets | |
| 5 | Investigate mechanisms to enable retirement of land from:<br>(a) irrigation<br>(b) agriculture | |
| 6 | Encourage the development of environmental businesses | |

## *Improvements to Agricultural Production Systems*

### Purposes/Outcomes

Farmers need to be viable
Not to lose more water to the environment
Profitable, sustainable agricultural enterprises

### Actions/Mechanisms

*Managing Saline Land and Water*

1. Pump groundwater for salinity control
2. Use saline water for
   a) Aquaculture
   b) Forestry
3. In saline areas farmers need to look at
   a) Irrigation techniques
   b) Soil type selection
   c) Alternative uses

*Irrigation and Water Management*

4. Balance water use efficiency improvements with other environmental impacts such as greenhouse gasses
5. Increase efficiency of water use through
   a) Automation of flood irrigation
   b) Use of spray or trickle irrigation on high value or difficult to lay out land
   c) Permanent sub-surface irrigation of pasture and broad acre cropping
   d) Irrigation scheduling
   e) Better use of water through land capabilities
   f) Matching forage to irrigation method and soil type
   g) Low water use crops
6. Fund changes in irrigation methods through water trade
7. Control runoff

*Farm products*

8. Produce bulk commodities, for example
   a) Bulk milk products
9. Produce niche products, for example
   a) Niche milk products
      - Nutriceuticals
   b) Organics
10. Develop new products and enterprises based on
    a) native genetics, eg native flowers, kangaroos, macadamias, quandongs, oil, bush foods
    b) cash crops eg green tea, exotic fruit
    c) biofuels
    d) fibre
11. Equine industry growth
12. Ecological services provided by people exiting farming, tourism
13. Use existing immigrants skills and culture to add diversity and value to products

Farming systems

14. Cropping systems
    a) Opportunistic cropping
    b) Turbo-charge winter cropping
15. Create farming systems more harmonious with natural order

a) Grow summer active forage crops in Queensland and truck to northern Victoria if required

16. Encourage nature mimicking on farm through
    a) Technology
    b) Communication
    c) Education
17. Plantation development
18. Revegetation as an alternative land use
19. Increase farms with crops
20. Conduct local research and development on diverse production systems
21. More self sufficient dairy farms
22. Alternative enterprise structures (status quo, corporate, lifestyle)

Investment in agricultural production

23. Attract entrepreneurs and venture capital
24. Attract capital from government, corporate, greenies, carbon credits.

*Technology*

25. On farm adoption of technology
26. Encourage the adoption of technology on farms through
    a) increased awareness
    b) overcoming barriers to adoption

*Other*

27. Neighbour management
28. Energy use efficiency
29. Promote land practices that reduce 'waste' from enterprises
30. Land use efficiency
31. Recognise capabilities of resources ie. Land, water, climate.

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Increase the efficiency of water use on farms | |
| 2 | (Investigate) Develop a range of commodity-based and niche agricultural industries | |
| 3 | (Investigate the benefits of) Develop(ment) of a range of farming systems and farm enterprise structures. | |
| 4 | Encourage (and facilitate) investment in agricultural production | |
| 5 | Encourage responsible management of saline land. | |

## *Community Engagement*

### Outcomes/Purposes

Develop community ownership of water issues
Effective consultation

### Actions/Mechanisms

*Defining the directions for the future*

1. Develop vision for region using [x]
   a) A combined group of regional stakeholders
   b) Regional forums
2. Provide opportunities for all people in the community to be involved in shaping the future

*Links between community and decisions*

3. Improve consultation processes by identifying organisations that are successful and working with them eg. service clubs, landcare
4. Active involvement in process eg. water policy, reconfiguration, diversity
5. Better representation on water service, government and community regional committees
6. Improve coordination between all committees involved in the future of irrigation and water
7. Keep people informed and key decision makers informed about the community issues, ideas and experiences
8. Ensure local and regional responsibility for managing change
9. Help facilitate change management through
   a) Creative workshops
   b) Counselling
   c) Education
   d) Research
   e) Community discussion forums

*Other*

10. Provide an accessible, neutral community issues/resolution centre/space eg. koori court
11. Hold a mock catastrophe
12. Science in the community projects
13. Understand community expectations with respect to management and preservation of natural resources

### Underlying Strategy Ideas

| | | |
|---|---|---|
| 1 | Develop a vision of the future of the region involving the entire community | |
| 2 | Improve links between the wider community and decision making processes | |

### Comments

[x] See earlier comment on visions

## *Labour/Young farmers*

### Desired Outcomes / Purposes

Lifestyle comparable to urban
Infrastructure, hospitals etc
Make money
Viable communities
Developing and retaining employees
Attract and keep young people in agriculture

### Mechanisms/Actions

*Improving employee conditions*

1. Train and support employers, including farmers, in
   a) people management including
      - Lifestyle demands of employees
      - Increasing sophistication of the workforce
   b) recruitment
   c) coaching and mentoring of young people
   d) developing career paths and
   e) developing employee skills through further education
2. Improve pay and working conditions on the job, particularly flexibility
3. Develop industry-wide occupational health and safety package
4. Develop career paths in agriculture, make it attractive
5. Provide appropriate and affordable training, pre and on farm
6. Training facilities to provide skilled workforce

*Encouraging and assisting new entrants into agricultural industries*

7. Provide a range of options and entry levels for young people into agriculture
8. Promote benefits of farming including lifestyle, social, money
9. Inspire motivation and passion for farming
10. Increase profile of agriculture as a career
11. Develop a cadetship program to suit agricultural industries, including
    a) Screening employers to ensure suitability (accreditation)
    b) Offer career development advice to cadet
12. Recruit new labour for new developments thus encourage new settlement
13. Process to assist young farmers into business including
    a) Costs
    b) Skills
14. Encourage banks to back young people
15. Improve farm succession through
    a) Encourage involvement in decision-making on farm and in businesses
    b) Knowledge transfer between generations

*Other*

16. Encourage migrants to rural areas to provide
    a) Skills
    b) Cultural diversity
    c) Unskilled labour
    d) Ideas
17. Reduce reliance on labour through
    a) Development of labour saving technology
    b) Improved mechanisation
18. Create a labour bank

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Improve employee conditions to ensure the continued availability of labour to the agricultural sector within the region. | |
| 2 | Assist new entrants into agriculture | |
| 3 | Encourage migration into region | |

## *Promotion/Marketing*

### Outcomes/Purposes

Build community capacity
Attract new industry
Attract people with skills and expertise

### Actions/Mechanisms

*Product Branding and Marketing*

1. Create and market local brands
   a) Innovative marketing
2. Regional branding[xi]
   a) Distinctive logo signifying produced in Goulburn valley
   b) Promote to metropolitan consumers the value, efficiency, quality and necessity of region and what logo signifies
   c) Establish logo within the processing and supply companies within the region
   d) QA process must be developed and maintained by a regional body retaining integrity
   e) Regional marketing body established to oversee process
   f) Licence use of regional brand to best practice enterprises
3. 'Clean green' (Quality) production [xii]
   a) Farm and regional level
   b) Promote to
      - decision makers and
      - markets local and international
   b) Protect market opportunities
   c) Effective chain from farm gate to end consumer
   d) Quality assurance system to prove
4. Target convenience and healthy niches
5. Influence healthy eating
6. Develop marketing program which promotes irrigation land and products (water wise tick)
7. Research product markets
   a) Identify market trends
   b) Existing agricultural products,
   c) Emerging markets,
   d) Markets for produce, pricing, access
8. Marketing program
9. Sustainable farming and environmental management – pay for sustainable produce, influence produce imported
10. Have local industries attack global markets together - regional marketing effort

*Promote Irrigation and Agriculture*

11. Provide education through agricultural tourism and eco-tourism
12. Improve irrigation image in larger community
    a) Communicating value and importance of irrigated agriculture
    b) Including current information on water use and efficiency in school curriculum
    c) Targeting departmental heads with information packs
    d) Having a positive approach to political manifestos – lobbying
    e) Theme advertising in urban areas
13. Promote benefits of farming
14. Promote the need for total community investment in infrastructure

*Promote Region*

15. Undertake market research on regional self promotion
16. Develop a regional promotion plan
17. Promote our strengths
    a) opportunities for new industries
    b) environmentally focussed and care for our land and resources
    c) regional water initiatives
    d) food producing area
    e) diversity
    f) excellence in productivity and environmental management
18. Create a regional information database to encourage entrepreneurs and innovators
19. Industry development program to attract appropriate industries
20. Promote community – community awareness of region and environment
    a) CMA to take lead in promotion to urban areas

*Promote Environmental Stewardship*

21. Communicate dependence on natural resources eg
    a) Promote that farmers are users of soil and water and not sheep and cattle
22. Raise awareness in farming community of agricultural and conservation needs
23. Promote better practice through marketing program with media support

*Other*

24. Recruit and foster reuse and recycle enterprises
25. Actively promote new enterprise opportunities – seek and find community scholarship
26. Promote skills and benefits of multicultural society
27. Promote self esteem and optimism

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Investigate the impact of the marketing of credence values of regional production. | |
| 2 | Develop a marketing strategy for regional products based on good information. | |
| 3 | Promote the contribution of irrigation and agriculture to the region, state and country. | |
| 4 | Promote the Goulburn Valley to encourage regional development. | |
| 5 | Encourage environmental stewardship. | |

**Comments**

[xi] Many 'local' brands already exist eg Tatura butter, Cobram cheese, Goulburn Valley fruit, etc, however these brands do not necessarily require specific conditions. The federal government has recently developed a HomeGrown iniative to enable labeling of all Australian grown produce. The HomeGrown logo will be licenced and funds raised from the licencing of the Home**Grown** logo will be used for the administering the Code of Practice and the promotion of the Home**Grown** logo domestically via a National advertising and public relations program.

[xii] Work being undertaken as a part of a project within the DPI is examining willingness of consumers to pay for credence values such as sustainable produce and processes to demonstrate credence values. Preliminary output suggests that triple bottom line factors are unlikely to provide a significant market advantage and are more likely to be included in quality assurance requirements.

## *Research and Development*

### Mechanisms/Actions

*Research and Development Infrastructure*

1. Joint Melbourne University and Tatura research facility
2. Fund Regional centre of excellence for science and education
3. Rationalisation of state and regional organisations to direct research and development

*Research into Water Infrastructure*

4. Research the most appropriate water delivery method – channel capacity
5. Research into existing infrastructure
6. Study of farm dam versus piping
7. Study of dam and regional distribution infrastructure
8. Research and development of
   a) Temporary supply systems including outlets, spur channels/pipes
   b) Integration of farm and supply channel systems
   c) Appropriate zones for open channels

*Irrigation Research*

9. Investigate
   a) Benefits of watering on demand and improved measurement techniques
   b) Most appropriate irrigation application methods for crops and soils
   c) The beneficiaries of improved water use efficiency
   d) Different uses, markets and technologies for reuse and recycled water
10. Develop of low water use crops
11. Develop new irrigation technologies and products

Technological development

12. Research and development of new farm technologies
13. Develop new technologies
14. Develop labour saving technology
15. Understand benefits and demand for new technology
16. Research and develop new products eg biofuels, oilseeds, fibre

*Resources for research and development*

17. Secure funding from government and private enterprise
18. More resources allocated to research and development
19. Influence research direction eg DRDC

*Economic investigations*

20. Identify points on the economic spectrum that would drive adoption of advanced irrigation technology
21. Economic analysis of options for diversification
    a) Marketing
    b) Structure (co-op versus company)
    c) Process
    d) Fundamentals eg. technology, farming system

*Other*

22. Research, benchmark and then apply understanding of soils and other aspects of land management
23. Conduct market research on
    a) Existing agricultural products
    b) Emerging markets
    c) Regional self promotion
24. New instruments for farm production

25. Conduct local research and development on diverse production systems
26. Research and development for successful community change management
27. Government agencies actively promote agricultural resources
28. Global sharing of ideas
29. Encourage major universities/CSIRO/State government to develop a research paper on irrigation sustainability

**Underlying Strategy Ideas**

| | | |
|---|---|---|
| 1 | Encourage the development of regional research and education facilities. | |
| 2 | Develop and encourage a program of research to enable the continued development of the region. | |

## *Enabling and supporting industries*

### Mechanisms/Actions

*Industry communication and advocacy*

1. Improve effectiveness of industry groups
2. Use and expand industry groups
3. Informed and inclusive communication across industry
4. Develop relationships between producers and processors

*Other*

5. Cooperatives and industry buying into market and ownership of land and water
6. Encourage food/product processing -> need to be able to ensure stability
7. Ensure better utilisation of machinery and equipment
8. Service providers to contract irrigation services for example
   a) Packaging technology to suit irrigator requirements
   b) Managing irrigation entire areas
9. Create business opportunities for support industries that are needed
10. Rationalise food cooperatives
11. Information technology communications development – get broad band/leading edge technology to assist managing risk
12. Increase tourism of water sites
13. Identify critically lacking service areas not related to irrigation and address these
14. Help reduce the vulnerability of industry during drought

### Underlying Strategy Ideas Strategies

| | | |
|---|---|---|
| 1 | Improve industry advocacy and communication between industry, producers and processors. | |
| 2 | Create an environment that encourages the development of secondary industries. | |

# IRRIGATION FUTURES OF

# THE GOULBURN BROKEN CATCHMENT

## Milestone Report 3 - Attachment B
## Stage 3 Approach
## June 2005


**Primary Industries Research Victoria (PIRVIC) - Tatura**
**Department of Primary Industries**

in collaboration with

**Community Engagement Network**
**Department of Sustainability and Environment**


Victoria The Place To Be

National Program for Sustainable Irrigation

Goulburn Broken Catchment Management Authority

Goulburn-Murray Water

Cooperative Research Centre for Irrigation Futures

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**Project Funded By:**

Department of Primary Industries
Department of Sustainability and Environment
Goulburn Broken Catchment Management Authority
Goulburn-Murray Water
National Program for Sustainable Irrigation, Land and Water Australia

# Table of Contents

# Introduction

Irrigation is a fundamental driver of the regional economy in the Goulburn Broken catchment. The regional farm-gate gross value of production from irrigated agriculture in 2000 was $1.35 billion. Investment in on-farm and processing infrastructure is about $100 million per annum.

However, irrigation is facing enormous challenges. As one of the oldest gravity irrigation systems in Australia, Goulburn-Murray Water's irrigation system needs substantial renewal of its ageing infrastructure assets in the next 20 years. Initiatives to increase environmental flows and potential climate changes will also have major impacts on irrigation. In addition, there are increasingly stringent demands on responsible natural resources management to meet social, economic, environmental and cultural outcomes.

## *Project Objectives*

This project has been established to enable the region to successfully meet these challenges. It is a regional initiative, funded by the Goulburn Broken CMA (GBCMA), Goulburn-Murray Water (G-MW), Department of Primary Industries (DPI), Department of Sustainability and Environment (DSE), and Land and Water Australia (LWA).

The objectives of the project are to:

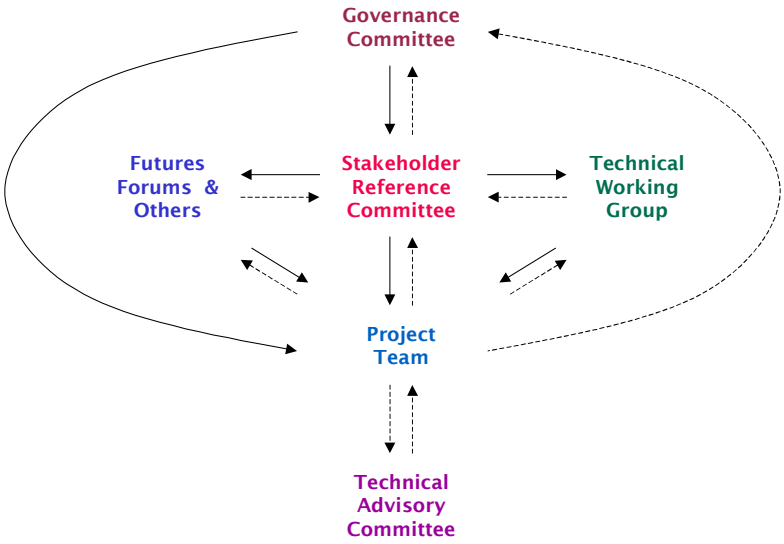
- Facilitate key stakeholders to develop a shared vision on the future of irrigation in the Goulburn Broken catchment over the next 30 years, and to identify scenarios of major constraints and opportunities and of regional response options.
- Understand the social, economic and environmental consequences of various scenarios through impact assessment based on an integration of the best available knowledge.
- Facilitate key stakeholders to build consensus on preferred regional options for future irrigation, and recommend regional follow-up actions.
- Develop a methodology that can be applied elsewhere in Australia for sustainable irrigation planning at a catchment scale.

## *Project Timetable*

| **Project Stage** | **Timeframe** |
|---|---|
| Stage 1: Project development | Jun 2003 – Dec 2003 |
| Stage 2: Vision, scenario and options | Jan 2004 – Dec 2004 |
| Stage 3: Assessment of consequences, and effectiveness of regional strategies | Jan 2005 – Jun 2006 |
| Stage 4: Building consensus | July 2006 – Jun 2007 |

## *Project Organisation*

Project organisation, and the roles of each of the project organisational groups, are given below.




**Project organisation**

**Roles of project organisational groups**

| Organisational Group | Key Roles |
|---|---|
| Governance Committee (GC) | Set broad directions<br>Review project progress and performance<br>Make investment decisions |
| Stakeholder Reference Committee (SRC) | Provide guidance on processes for wider stakeholder participation<br>Consolidate ideas from wider stakeholders<br>Generate confidence in the regional community |
| Futures Forums and Others | Provide input from the community and other key stakeholders, including contributing ideas on values and aspirations, future scenarios and regional response options. |
| Technical Working Group | Further develop details of ideas generated by Futures Forums<br>Contribute knowledge and expertise to the assessment process. |
| Project Team | Facilitate the stakeholder participation process<br>Provide scientific input. |
| Technical Advisory Committee | Provide expert advice as required |

## *Output from of Stage 2*

Stage 2 of the project used an extensive program of stakeholder engagement to identify vision, external scenarios and response options. Stakeholders from irrigated agriculture, major processors, business & community groups, local government, and agencies responsible for land & water management were invited to participate in a series of 4 full-day Workshops during 2004. Representation from women and young people was specifically targeted.

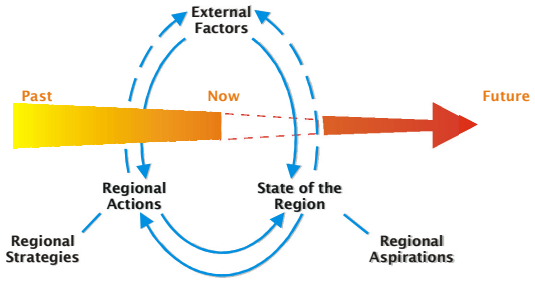
Workshops were held at major centres throughout the region (Echuca, Kyabram, Shepparton, Cobram, Benalla and Seymour). In total, stakeholder input has involved over 500 person-days. The output from Stage 2 was:

- Aspirations of stakeholders for irrigated agriculture in the region,
- Four External Scenarios describing the evolution of alternative plausible futures within which the region may have to operate over the next 30 years,
- A suite of Regional Strategies to guide future regional actions,
- A list of the assets within the region, and
- A consolidated list of response options from all Workshops from which the suite of Regional Strategies were synthesised.

## *Introduction to Stage 3*

### Context

Stage 3 of the project is focused on the further development of the material produced during Stage 2 and the assessment of the effectiveness and robustness of the Regional Strategies. A systems framework will underpin the further development and assessment process. The framework represents the temporal evolution of the interplay between External Factors, Regional Actions and State of the Region (Figure 1).




**Regional Aspirations** are the community goals and desires for the next 30 years in relation to business, family, the Goulburn Broken Catchment and irrigated agriculture.

**Regional Actions** are those actions taken by individuals (individual actions) and actions that require some degree of coordination by groups and organisations (coordinated actions). Regional actions can be taken in respond to challenges and opportunities presented by external scenarios and/or the State of the Region. They can also be taken as an initiative to create opportunities.

**Regional Strategies** are underlying approach and plan to guide regional coordinated actions both now and in the future.

**External Factors** are factors that influence but are beyond the control of the region. The external scenarios describe the temporal evolution of the external factors over the next 30 years.

**State of the Region** is the condition of the region as a result of past regional actions and external factors as well as the regional assets at the start point. One may regard the state of the region at a given time as the starting regional assets for the next time period.

**Figure 1 A systems framework for the assessment**

## Stage 3 Objectives

The objectives of Stage 3 of the project are to:

- Develop full scenario stories describing the interplay of the External Scenarios, Regional Strategies and their consequences including the current plans for water reform,
- Assess the effectiveness and robustness of the suite of Regional Strategies.
- Develop a suite of options for future actions that will readily respond to the challenges and opportunities that arise.

## Development of the approach to Stage 3

The approach to the further development and assessment of regional strategies has been developed drawing on a wide range of material including:

- A review of the international literature on methods of assessing the consequences of management interventions as a part of both scientific and policy analyses.
- A review of the current tools available for undertaking systems analysis within the Goulburn Broken Catchment.
- Consultation, involvement and review by:
    - Current practitioners within Australia undertaking planning and visioning analysis, and
    - The project's Stakeholder Reference Committee.
- Peer review: The approach to the further development and assessment of Regional Strategies has been externally reviewed and the feedback from the reviewers considered and incorporated into this version of the approach. The reviewer's comments and project team's responses are contained in Attachment C of this report.

This document presents a review of the integrated assessment literature and uses the findings of the review to identify and describe the approach to Stage 3 of the project.

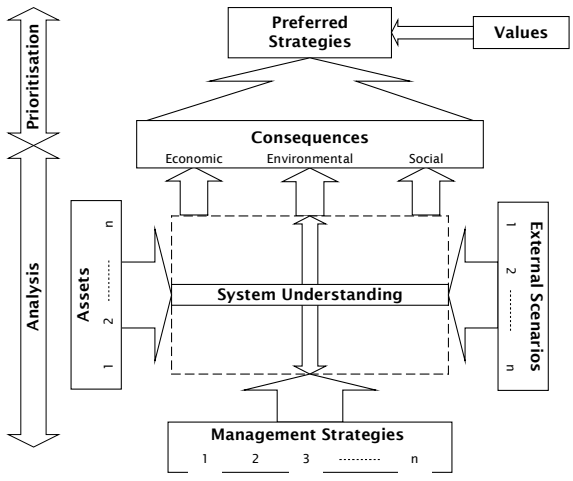
# Literature Review

## *What is Assessment?*

Many definitions of assessment exist within the literature in the context of assessing strategies and actions. Most definitions can be placed into one of two broad categories:

1. identifying and understanding the consequences of the management strategies, and
2. identifying preferred strategies given the consequences of those strategies.

These two activities can be considered as two sequential phases of assessment (Figure 2). The first phase, analysis, involves identifying, and assessing, the impact of the strategies on a series of consequence measures, for a given set of scenarios and assets. The second phase, prioritisation, is concerned with examining the priorities and trade-offs between the consequence measures to identify preferred strategies.




**EXTERNAL SCENARIOS** are descriptions of plausible future positions of factors that influence but are beyond the control of the region.

**MANAGEMENT STRATEGIES** (Regional Strategies) are those strategies addressing areas that are under the control of the region.

**ASSETS** describe the available resources of the region and their condition.

**CONSEQUENCES** are measures used to describe the impacts of a particular Scenario and set of Options. With current Triple bottom line thinking, measures are commonly categorised as Economic, Environmental and Social measures.

**SYSTEM UNDERSTANDING** describes the knowledge relating elements of the Scenarios, Assets and Options to the Consequences. The level of detail and complexity represented in the system understanding can vary from a qualitative mental model through to detailed quantitative simulations of processes.

**VALUES** are the moral principles and beliefs that underpin the behaviour of the community.

**PREFERRED STRATEGIES** are those management options that achieve the balance of Consequences that represent the values.

**Figure 2 Framework for Assessment**

Stage 4 of the Project is concerned with building consensus among stakeholders on the future directions of irrigation in the region. This stage is primarily concerned with the prioritisation phase of the assessment process. A brief review of approaches to prioritisation is included in Appendix 1.

Stage 3 of the Project is focused on the analysis phase of the assessment process. The analysis phase is concerned with identifying and understanding the consequence of management strategies. Such a task is the concern of the emerging 'meta-discipline' of *Integrated Assessment*.

Integrated Assessment involves integrating knowledge about a problem domain, for learning and assisting decision making. Integrated assessment emerged because it was realised that a single change in policy could no

longer be considered in isolation due to the complexity of societal issues (Rotmans 1998). The discipline has continually evolved since its emergence during the early 1970's. The evolution of the discipline has been influenced by the development of computational resources and changing attitudes toward computer-based modelling.

The following sections review methods used by the field of Integrated Assessment, describing the important concepts and the implications of these concepts for Stage 3 of the Project.

### *Paradigms of Integrated Assessment*

Early integrated assessments typically examined a single issue and evaluated the consequences of solutions to the issue, for example desertification. More recently integrated assessments have examined more complex and less well defined issues, particularly the consequences of urbanisation (Robinson *et al.* 2001) and climate change (Lorenzoni *et al.* 2000a; Lorenzoni *et al.* 2000b).

Initial applications of Integrated Assessment used a "normal" or "mainstream" scientific paradigm (Ravetz 2004). These applications typically use, and link, a suite of discipline specific models that are derived from established scientific principles.

Assessments using the normal science paradigm generally use detailed biophysical and economic models. Experts typically develop these models, with minimal interaction with the affected public. In some cases the limited interaction with the affected public has resulted in model output having little credibility (van der Sluijs 2002). There is also a perception, from the modelling community, that modelling using the normal science approach has had very little use for policy making (Engelen *et al.* 2000).

More recently, Integrated Assessments have used a "post-normal" or "Mode II" scientific paradigm (Harris 2002; Ravetz 2004). The post-normal scientific paradigm is used to resolve issues where the facts are uncertain, values are in dispute and the problems are typically complex (Funtowicz and Ravetz 2004). In general, these assessments are undertaken to inform policy decisions, when the stakes are high and decisions are urgent (Ravetz 2004). Typically, assessments using this paradigm aim to compile all available relevant knowledge, and use this knowledge to assess the consequences of management strategies. Experts and the affected public are involved because both groups can contribute knowledge of different forms to the assessment process.

Post-normal science embodies the precautionary principle, and is typically reacting to the unintended harmful effects of progress (Ravetz 2004). Extended peer review is fundamental to integrated assessment. It involves people with a desire to participate in the resolution of the issue, as well as those with some form of institutional accreditation (Funtowicz and Ravetz 2004). This approach more closely follows many of the traditional participatory methods of policy assessment, such as focus groups.

There is no one unifying approach to integrated assessment. Many factors govern the selection of approach for a particular application. These factors include the nature of the problem, purpose of the analysis, the availability of knowledge and information, available resources (including skills and budget) and the dimension of the problem domain.

## *Examples of Integrated Assessments*

### Normal Science Approach

There are many examples of integrated assessments using a normal science paradigm. The following section describes a few integrated assessments that have had an agricultural focus.

Fordham and Malafant (1997) developed the Murray Darling Irrigation Futures Framework during the late 1990's. The Framework combines a one-dimensional unsaturated soil-water flow model, a two-dimensional groundwater model, a lumped-conceptual surface hydrology and salinity model, crop production models (considering production losses due to water logging and soil salinity), a farm enterprise economic model and a regional economic input-output model. The model was used to simulate 20 year scenarios for two study areas, a 3,000 hectare catchment in the Cohuna area and a 7,000 hectare catchment in the Harston area (within the Shepparton Irrigation Region).

On a much larger scale, Engelen et al (2000) developed a decision support system to assist regional level environmental policy making. They combined climate models, catchment and hillslope hydrology and groundwater models, crop growth and natural vegetation growth models, crop and irrigation management models and a land use change model. The decision support system was applied to two pilot catchments in Europe, both of which were approximately 160,000 hectares in size. These models ran at resolutions from 1 hectare to 25 hectares and at time steps from half a day to one year. Each of the models was run independently with software facilitating the transfer of data between models. This decision support system was constructed without understanding who would use the system or information produced by the system.

Bell and Heaney (2000) describe a simpler, more purpose driven model, used to evaluate salinity management options within the Murray Darling Basin. They constructed a single model combining economic optimisation with surface and subsurface water movement and crop production functions. The model operates at a catchment scale and runs at an annual time step.

There are many other examples of these types of models that combine hydrology, crop growth and economic optimisation or impact assessment. In general these models are used to assess the impacts of particular management options including water allocation (Giupponi *et al.* 2004), salinity management (Greiner 1999), and production capability (Zuo *et al.* 2003).

### "Post-normal" Science Approach

There are far fewer examples of applications of a post-normal science approach to integrated assessments.

The Adaptive Environmental Assessment and Management (AEAM) process has been widely used in Victoria to assist with the development of Water Quality Strategies. The AEAM process was implemented where there was little documented information about the important processes, or the documented information was scattered among many different institutions. The principal purposes of the AEAM process for the Ovens Basin were:

- to involve all stakeholders and the wider community so as to encourage a common understanding of the issues, and ownership of the process and its outcomes;
- to develop a computer model to simulate the complexities of the environmental system being investigated;
- to achieve adaptive management, where modelling is used to make 'best bet' decision on management actions, actions that are implemented and their effectiveness tested, and modelling and management actions are continually refined based on experience gained (Felton and Martin 1996).

The models constructed are intended to give qualitative indications of likely relationships and intend to be used as exploratory tools, rather than providing exact answers. The systems are represented both algebraically and verbally, with relationships encoded as functional and lookup tables. All assumptions made during the development of the models were described in the model documentation.

A wide group of stakeholders was involved in defining the issues, possible management options and appropriate performance measures. A smaller group was then involved in developing a simulation model, which was used by the wider stakeholder group to test and evaluate possible management actions.

Wolfenden (2003) used a similar approach to assist with developing a vision for irrigation in northern New South Wales. They used a stakeholder workshop to develop an understanding of the factors contributing to their vision of a "sustainable water landscape". To assist with developing this understanding they used an influence diagram to examine the interconnections between parts of the system. Subsequently part of the influence diagram was quantified to demonstrate the potential for the approach to be used in developing a quantitative simulation model (Wolfenden 2003). The development of the simulation model was supported by a stakeholder working group. Wolfenden (2003) suggests that the approach is as much for the development of community understanding as it is about developing a detailed model of the system.

The Murray Flow Assessment Tool was developed to assess the ecological impacts of three different flow scenarios in the Murray and lower Darling Rivers (Scientific Reference Panel for the Murray-Darling Basin Commission Living Murray Initiative 2003). The tool was developed to combine the best available information on relationships between flow and ecological indicators. All evidence used in the assessment was documented within system, however there was minimal involvement of non-experts in the development of the tool. The tool was developed to inform specific policy decisions and displays many of the traits of the post-normal science approach, particularly with respect to making uncertainties and assumptions explicit and with respect the ability for users to interact with the tool. The minimal involvement with non-experts in the development of the tool has led to community mistrust of the output of the process (Paxinos 2004).

The Georgia Basin Futures project was a major regional integrated assessment project primarily concerned with issue of urbanisation in the areas surrounding the cities of Vancouver and Victoria in Canada (Tansey *et al.* 2002; Robinson *et al.* 2001; Envision Sustainability Tools and Sustainable Development Research Institute 1999). The project engaged the community

to identify the issues, develop a simulation model, develop future scenarios and express preferences in the final analysis of policies. The analysis undertaken uses a model to assess the quantitative impacts of policy decisions and does not examine the non-quantitative impacts. Modelling is undertaken at 10 year time steps using high level relationships. Uncertainty in the model is described in terms of a world view, which describes the rate of technological innovation, ecological resilience and social adaptability (Carmichael *et al.* 2004). The model is 'driven' by projections of population, economic activity and land use goals and policies influencing transportation, housing, lifestyle, agriculture, government, industry, water and labour. Policies can be implemented using incentives and subsidies ("carrots"), regulations ("sticks") or education and social marketing ("information"). Each of these implementation methods, along with a worldview, influences the rate at which the policies are adopted.

### Assessment of social consequences

The distinction between the normal and post-normal science paradigms is less clear within social analysis. Social analysis has been undertaken of two broad fields, understanding social change processes and understanding social impacts.

Social impact assessment is directed toward forecasting the consequences of a particular proposal, on people as individuals, groups or society as a whole (Burge and Vanclay 1995; Brouwer and van Ek 2004). The social impacts include changes to people's way of life, culture, community, environment, health, wellbeing and, fears and aspirations (Saddler *et al.* 2000).

Social impact assessments rely on stakeholders' perspectives to understand the potential impacts of a proposal. There are many methods available to undertake social impact assessments that rely on both primary and secondary data sources. Analytical methods used for social impact assessment are typically qualitative, often relying on descriptive techniques. Many environmental impacts assessments conducted in Victoria have also undertaken social impact assessments. Strategic perspectives analysis (Dale and Lane 1994) is a tool to undertake social impact assessment using a post-normal scientific paradigm.

Social impact assessment does not attempt to understand social change processes. Social change processes include both induced and passive changes in demographic, economic, geographical, institutional, political, socio-cultural and other processes (Saddler *et al.* 2000). These processes are typically more easily quantified than social impacts but are more diverse. The analysis of social change processes is typically, but not exclusively, undertaken using scientific methods using a normal scientific paradigm. Examples of social process analysis include agent-based modelling, where the purpose is typically to understand and reproduce human behaviour (Berger 2001), and demographic modelling.

## *Appraisal of Integrated Assessment Paradigms*

There are many issues common to all integrated assessments that need careful consideration. The following discussion briefly covers the concepts related to several of these issues and the interconnections between them.

## Complexity

An important feature of all integrated assessments is the complexity of the systems involved. Complexity extends beyond the mere complication of processes. Complicated systems can be considered as those systems that require many variables to explain system behaviour (Funtowicz and Ravetz 2004). Complex systems, on the other hand, contain significant and irreducible uncertainties of various sorts in any analysis of the systems and multiple legitimate perspectives on any problem (Funtowicz and Ravetz 2004). Complex systems may also have detailed interrelations between different components (Rotmans 1999; Kemp-Benedict 2004).

The complexity of systems is handled using many different approaches within integrated assessments. One school of thought believes that complexity can be handled adequately by computer models (Rotmans 1999), while others believe that the current state of computer modelling is inadequate, particularly in the description of social systems (Kemp-Benedict 2004).

When modelling complex systems there is a spectrum of approaches in existence. At one extreme, existing disciplinary models are linked on an input-output basis. This often leads to a complicated tangle of models and processes in which keeping track of the components hampers insight into the dynamic behaviour of the overall system (Rotmans 1999). At the other extreme, a suite of directly linked metamodels, or simplified models, may be used. These models often use simplified representation of individual processes, but display complex behaviour because they link many interacting components (Rotmans 1999).

As an alternative to computer-based modelling, intuitive scenario exercises have been used to capture the complexity of systems, using narrative processes to describe mental models (Kemp-Benedict 2004). Narrative approaches allow people to handle the complexity that is not explicitly understood, or cannot be handled by numerical modelling methods (Kemp-Benedict 2004; Swart *et al.* 2004).

The management of complexity within an integrated assessment is at the conjunction of a number of important concepts, particularly the approach to assessment, the scale and resolution of the assessment and the management of uncertainty. A further discussion of these concepts follows.

## Qualitative and Quantitative Assessment

A wide range of analytical techniques have been used in integrated assessments. The analytical techniques can be loosely classified as quantitative and qualitative methods of analysis. The classification is not strict because some modellers undertaking quantitative analysis using numerical methods believe their analysis is only indicative or qualitative (Grayson and Doolan 1995; Felton and Martin 1996).

Quantitative analysis methods are most commonly reported. These techniques typically rely on formal mathematical models to represent the important features of human and environmental systems (Swart *et al.* 2004). These methods can provide structure, discipline and rigour to the analysis of the problem domain (Swart *et al.* 2004). In general, quantitative models perform well when simulating well understood systems over relatively short timeframes. However they are often not appropriate for simulating the long-

range future of systems, such as social or ecological systems, where the understanding of causal interactions is poor and the description of variables is highly uncertain (Swart *et al.* 2004; Kemp-Benedict 2004).

Often quantitative analyses are viewed as truth machines by stakeholders not involved in the development process (Rotmans *et al.* 1997). This can occur even though the analysts believe their analyses are heuristic devices (Rotmans *et al.* 1997). This has resulted in quantitative analysis techniques facing a credibility crisis when quantitative predictions do not match observations or stakeholder expectations. In response to this growing concern about the credibility of quantitative models, van der Sluijs (2002) identified several attributes of models to better enable acceptance of quantitative analyses. These attributes include:

- transparent as possible,
- explicit uncertainties,
- value-laden assumptions as explicit and variable,
- interactive,
- stakeholder use mediated by experts,
- facilitating problem structuring,
- fostering creative generation and exploration of rival problem definitions,
- allowing inclusion of local knowledge.

Qualitative analysis has traditionally been undertaken as a part of social impact assessment, however more recently it has formed an increasing part of integrated assessments. Within integrated assessments, qualitative analysis has typically been undertaken through narrative exploration of scenarios. Scenario exploration enables qualitative factors such as values, behaviours and institutions to be considered in analysis. Two forms of scenario analysis are reported in the literature.

Forward-looking analysis examines the consequences of a range of expected trends or attempts to outline the implications of different assumptions. Such analysis assists with identifying possible future trajectories. Backcasting however examines the feasibility and implications of desirable futures and can assist with identifying long-term risks (Swart *et al.* 2004). Qualitative analysis techniques are dependent on the perceptions and therefore require participatory approaches.

Neither qualitative nor quantitative analysis alone can provide a comprehensive assessment of the consequences of management options. Narrative (or qualitative) analysis facilitates debate about normative aspects of the analysis, while quantitative analysis contributes to adequate knowledge base and structural consistency (Swart *et al.* 2004).

### Uncertainty

Integrated assessments are concerned with the future, and therefore the management of uncertainty is very important (Rotmans 1999). Many types of uncertainty need to be considered within an integrated assessment. These uncertainties can be placed into two categories: uncertainty due to lack of knowledge and uncertainty due to variability.

Uncertainty due to lack of knowledge can arise from factors ranging from lack of observations and inexactness of observations through to ignorance and indeterminacy of processes. Uncertainty due to variability can result from natural randomness and behavioural diversity. Variability poses limits on what can be known and therefore can contribute to uncertainty due to lack of knowledge (Rotmans 1999).

There are many approaches to the management of uncertainty. Lack of knowledge of the system behaviour is often overcome by allowing multiple models to exist. This can be facilitated through explicitly acknowledging that multiple plausible conceptual (mental or mathematical) models of the system exist (Ravetz 2000), or through different parameterisations of a common model structure in the case of mathematical models (Envision Sustainability Tools and Sustainable Development Research Institute 1999; Rotmans and De Vries 1997). A lack of knowledge can be identified or overcome through the involvement of a diverse range of experts and non-experts in the assessment process.

Lack of knowledge about the future position of variables influencing, but beyond the control of, the scope of the analysis is typically handled using scenarios, or plausible alternative futures (Rotmans 1999). Scenarios are coherent and plausible stories of the future that describe co-evolutionary pathways of combined human and environmental systems (Swart *et al.* 2004). There are many methods of developing scenarios, including extrapolation, foresighting, backcasting.

Extrapolation involves identifying current trends in variables influencing the system being analysed and projecting these trends into the future.

Foresighting is a more generalised method of scenario development. Plausible future positions of important variables are examined in terms of trends, discontinuities and critical uncertainties. Trends occur when variables are expected to follow a historical trajectory into the future. Discontinuities are sudden shifts in a variable, and critical uncertainties, where the a variable may take many diverse paths (van der Heijden 1996).

Backcasting involves identifying a desired endpoint some time in the future and describing the evolution of the system back to the current time (Kok and van Delden 2004).

Uncertainty due to variability, whether it be due to natural randomness, biophysical, ecological or human behavioural variability or societal randomness, is typically handled using probabilistic methods such as stochastic modelling. Probabilistic methods can handle only the technical uncertainties and not the epistemological uncertainties.

Model validation or verification can also assist with managing uncertainty. Model validation involves the comparison of model predictions with observed data. These comparisons assess how well the model represents reality, and in doing so assist with identifying uncertainties caused by ignorance, indeterminacy and variability (Rotmans and van Asselt 2001).

Stakeholder participation in assessment fosters discussion and debate, and assists in developing a common understanding of the uncertainties. Stakeholders will have very different perceptions of the uncertainty of information. Shackley and Wynne (1995) related perceived uncertainty to the closeness of a stakeholder to the generation of knowledge. They suggest that those directly involved in knowledge generation and those isolated from

knowledge generation will perceive the greatest uncertainty in knowledge, while those involved in managing the problem will perceive the lowest uncertainty (Figure 3).

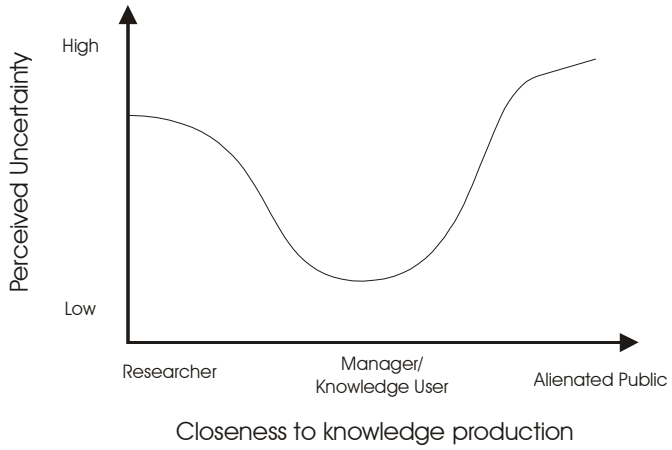



**Figure 3: Perceptions of uncertainty (after Shackley and Wynne 1995)**

Within an integrated assessment uncertainties exist at many levels. Adequately managing these uncertainties requires a range of techniques to be used. Participatory assessment processes involving a range of experts and non-experts can assist with identifying, reducing and managing the uncertainties.

## Scale and Resolution

Integrated assessments deal with a wide range of processes that occur over different spatial, temporal and structural scales. With respect to temporal scales, economic processes and technical change commonly occurs over the relatively short time scale of the invested capital, while demographic processes operate on time scales of generations (Rotmans 1999). Environmental processes occur over a wide range of time scales from sub-day through to hundreds of years. Similarly, these processes operate at different spatial scales, for example, atmospheric processes occur at regional, national and global scales, while land and water processes occur at point through to catchment scales.

Reconciling the temporal and spatial scales of the processes being considered is a major challenge for integrated assessment. Within the Lower Fraser Basin Quest analysis, a time step of a decade was adopted (Envision Sustainability Tools and Sustainable Development Research Institute 1999), because the primary focus of the analysis was driven by demographic processes. Analyses of water-related issues have typically used a much shorter time step such as days (Engelen *et al.* 2000) or months (Felton and Martin 1996). Processes have been resolved spatially in areal units ranging in size from hectares to hundreds of hectares.

Several approaches have been used to integrate processes occurring at different temporal resolutions. Metamodelling uses a summary of the output of a model simulating processes at small time steps to simulate the process at a larger time step (Rotmans 1999). Alternatively, models have been hierarchically linked to allow a model simulating small time steps to run between time steps of a larger time step model (Engelen *et al.* 2000).

Hierarchical modelling is typically undertaken in assessments using the normal science paradigm, while metamodelling occurs most commonly using the post-normal science paradigm. Both approaches can have their disadvantages. Using the hierarchical approach typically uses significant computational resources, while the metamodelling approach may result in inadequate resolution of process.

Understanding the scales at which the 'problems' occur assists with the development of appropriate conceptual (both mental and numerical) models and analysis boundaries of the processes and systems being considered.

### Expert And Non-Expert Participation

Participation in integrated assessment typically only occurs when the post-normal scientific paradigm is used. Participation can occur at many stages within the assessment process and can serve many purposes. At the crudest level, participation of stakeholders can serve to legitimise an assessment process. Alternatively, the involvement of experts and non-experts can add considerable value to the assessment process (van der Sluijs 2002). Expert and non-expert involvement in the assessment process can have a number of purposes including the exchange and contribution of knowledge and wisdom, the provision of alternative perspectives and value sets, and the review of the assessment assumptions, logic and robustness.

Involvement of experts and non-experts to contribute knowledge and perspectives to an assessment requires the commitment of considerable resources. However, this form of involvement can result in additional benefits to the participants, including the development of an understanding of alternative views of the world and raising awareness of system behaviour and the limits of knowledge, as well as to the assessment process (Dahinden *et al.* 2000).

Two general approaches to stakeholder involvement are described in the literature for implementing assessments that involve both qualitative and quantitative analysis.

The story and stimulation approach involves expert and non-expert stakeholders in building scenarios. Typically, a narrative team will develop qualitative storylines that describe the evolution of plausible futures, entailing both scenarios and management options and their combined consequences. A modelling team complements the narrative team and, following their lead, simulates the storyline. The modelling team plays four main roles:

1. Forcing a clarification of the terms and mechanisms
2. Exposing contradictions in mental models
3. Providing a feel for the scope of possible outcomes within the narrative framework,
4. Illustrating a particular scenario narrative (Kemp-Benedict 2004).

The simulation will typically use high-level conceptual models that represent the system described by the narrative. Information is passed between the two teams, iteratively, allowing for continual refinement the storyline.

The story and simulation approach allows people to intuitively handle the complexity of systems through the development of storylines. The intuition

is then clarified, checked and illustrated through simulation process. Reality checking of the process is also dependent on intuition because there is an implicit assumption that insufficient data exists to support any model validation.

Participatory modelling, on the other hand, attempts to combine local and expert knowledge into a system model that is used to explore the consequences of management interventions. Participatory processes are used to develop mental models of system behaviour, which form the basis of a model structure. The model structure is tested using available data and knowledge, and results fed back to the participants to allow mental models to evolve. This process allows for the continual refinement of the model structure until it represents the available data. The model is subsequently used to assess the consequences of management interventions (Varis and Lahtela 2002).

The participatory modelling approach allows for the combination of scientific and experiential knowledge and assesses the ability of the combined knowledge to describe available data. However, the approach relies on the data being available to assess the quality of the model.

The credibility of integrated assessments is highly dependent on the participation of stakeholders. Participation in the assessment process can take many forms. However, it is recommended that stakeholders are involved throughout the assessment process to ensure that a range of values, perspectives and knowledge sources are used (van der Sluijs 2002). Assessment approaches such as story and simulation and participatory modelling appear to have the greatest potential to incorporate stakeholder values and perspectives, and allow for both qualitative and quantitative analysis.

### *Summary*

The Irrigation Futures project has been established using a post-normal science paradigm. It is therefore important that this paradigm underpins the assessment of the regional strategies undertaken within Stage 3 of the project.

Stage 3 is concerned with assessing the consequences of strategies in a future environment that is highly uncertain. There are multiple perspectives of the problems, solutions, desired outcomes and the future environment in which the region will operate. Due to the diversity of perspectives, an assessment approach that enables stakeholder participation is essential. The approach needs to allow alternative values and mental models to be considered in the assessment process. Facilitating a debate about the philosophy and assumptions underlying the strategies will be as important as identifying the likely consequences of the strategies.

The systems operating within the region are fundamentally complex, with many interactions between components. While there is some knowledge about many of the biophysical, social and economic processes at work, considerable uncertainty still exists.

The knowledge that exists does so in many forms. Knowledge is stored as scientific understanding, derived from experimentation and modelling, and wisdom, gained through management and experiences within the system. Knowledge exists both quantitatively and qualitatively. All of this knowledge

will be required in the assessment to ensure the credibility of the outputs. This will therefore require a flexible approach that can draw upon and synthesise knowledge that is available, while explicitly acknowledging what is unknown or uncertain. The approach will need to enable a mix of qualitative and quantitative analysis.

Assessments may be required at several scales to reflect the community aspirations and multiple temporal, spatial and structural resolutions at which system processes operate. Metamodelling, both mental and numerical, appears to be a promising approach to handle transitions between assessment resolutions.

Only a limited number of assessment approaches exist that enable the factors described above to be incorporated. The story and simulation approach appears most promising due to its ability to incorporate a variety of knowledge in the development of the storyline. Coupling the story development with participatory analysis and modelling will enable the detailed exploration of alternative mental models and examination of the impact of different value sets. The participatory approach may also assist in raising awareness of the limitations of available knowledge.

# Stage 3 Approach

## *Overview*

Stage 3 of the Project involving assessment of the effectiveness and robustness of Regional Strategies will be undertaken using a narrative and analysis approach.

The narrative and analysis approach founded on using two complementary techniques to construct scenario stories. Scenario stories describe the unfolding of a full scenario, comprising the interplay between Regional Actions, External Factors and the State of the Region (see Figure 1). Scenario stories will be constructed for each of the external scenarios developed during Stage 2 of the project.

Narrative exploration will be used to construct broad scenario stories. Subsequent analysis will examine the logic of the scenario story and illustrate some of the detail of the stories, including the likely magnitude of the consequences. The analysis will be based on an understanding of system behaviour as described by qualitative and quantitative models.

## *Technical Working Group*

The Technical Working Group will undertake Stage 3 of the Project using the narrative and analysis approach. The technical working group will be separated into a narrative team and an analysis team, according to their preferred thinking style. Each team will predominantly use one technique to contribute to each scenario story.

### Narrative Team

The role of the narrative team will be to scope out a scenario story. They will discuss and describe the evolution and interplay of the external factors, regional actions and state of the region. The narrative team will focus on questions of who, what, where and when. Through the story development process, the narrative team will, implicitly or explicitly, develop concepts and make decisions.

Members of the narrative team will prefer a right brain style of thinking. Right brain thinking tends to be holistic and rely on intuition. Members of the narrative team like bringing information and ideas together and will not be concerned if there is little detail or information is subjective.

The expected output from the narrative team will be a collection of connected ideas that describe the foundations for the scenario story.

### Analysis Team

The role of the analysis team will be to examine and provide a critique of the scenario story. In undertaking the critique, the analysis team will need to clarify the concepts and decisions and examine the logic and rationale of the scenario story. Through this process, the analysis team will be able to illustrate the scenario stories, providing details and examples of the regional actions and consequences. The analysis team will focus on questions of how and why.

Members of the analysis team will prefer to use a left brain thinking style. Left brain thinking tends to be logical and rational. Members of the analysis

team will prefer to understand a problem by looking at its parts and use objective information to identify a solution.

The output from the analysis team will be an embellished and rigorous scenario story.

### *Scenario Story Development Process*

The Narrative and Analysis teams will develop the scenario stories using an iterative process. The Narrative team will commence the story development process, to ensure an holistic perspective of the story. The Analysis team will subsequently review the logic and robustness of the story and add detail. The story will be returned to the Narrative for review and to add richness to the story.

The two teams will provoke and assist each other. Through the iterative process, they will develop and clarify concepts, and request and provide information. The process will allow the teams to stretch each other's thinking, and reduce and handle uncertainty by sharing knowledge and perspectives. The flow of information between the Narrative and Analysis Teams is illustrated in Figure 4.

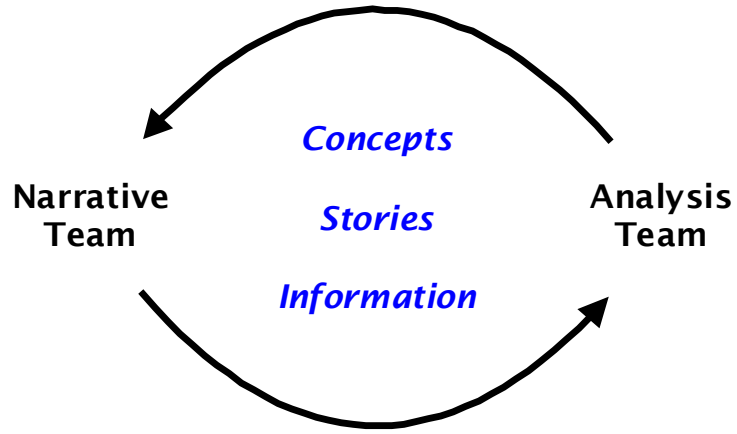



**Figure 4 Flow of information between Narrative and Analysis teams**

The scenario stories will be developed in workshops with each team. It is anticipated that several workshops will be required to develop a scenario story. Therefore, the scenario stories will be developed in sections describing the unfolding of events over the periods used in the External Scenarios.

The system under consideration is highly complex and has many parts interacting at a range of scales. The narrative and analysis approach will handle this complexity through the scenario stories. These stories will describe the important regional actions and consequences, including individual behaviour and regional responses. The scenario stories will not attempt to describe everything at all times, but will only describe the important features and events occurring at any time.

## Implementation of the Approach

There are a number of steps to the implementation of the Narrative and Analysis approach. This section discusses the progress and considerations in the implementation of the approach.

### *The Technical Working Group*

#### Selection Process

Nominations for the technical working group were sought from the Stakeholder Reference Committee and members of the Irrigation Futures Forums. Nominees were requested to describe their skills in a number of areas considered important for Stage 3 of the Project. Forty-four names were put forward for membership of the Technical Working Group.

The project team prioritised the nominations to ensure that a broad range of skills was covered and the group was a manageable size. The prioritised list of nominees was presented to the Stakeholder Reference Committee for final approval. Twenty-three members were accepted for membership of the technical working group. A list of members and their skills is presented in Appendix 1.

### *Work Program*

#### Workshop 1 (6th May 2005): Introduction to Stage 3

Workshop 1 was held as an introductory session for the entire Technical Working Group. The workshop covered four main areas: introducing Stage 3 of the Project, forming the two teams, teasing out the Aspirations, and an introduction to the water reform white paper.

The introduction to Stage 3 of the Project covered the purpose and approach to Stage 3. The introduction also discussed the expected output and the experimental nature of the approach.

The narrative and analysis teams were formed by allowing the technical working group members make an informed choice. The project team gave an overview of the role and skills of members of each team. The technical working group members were given a brief test to identify their preferred learning style. The test provided group members with an indication of their preference for rational or intuitive thinking. The group members were then invited to select a team to join, using their test result and the role of each team as a guide.

An introduction to the water reform white paper was provided by Naomi Douglas (DSE Water Policy). This session was held to ensure that the technical working group understood the contents of the White Paper. The white paper provides the basis of water policy for the next 10 years and therefore is important for understanding the future regional actions and consequences.

The final part of Workshop 1 involved further work on the Aspirations developed during Stage 2. The Aspirations described some high level outcomes desired by participants of the Irrigation Futures Forums. The task undertaken was to describe the dimensions of the aspirations. These dimensions describe the broad indications that could be used to understand if the aspirations have or have not been achieved.

## Workshops 2 onwards: Developing the Scenario Stories

Subsequent workshops will be held with each team separately, with information being passed between the two teams as described earlier.

Workshops of the Narrative team will involve progressively developing the scenario stories. The process of developing the story will commence by the narrative team internalising the current period of the scenario being considered. The team will then identify the actors important during the period and describe what these actors are doing. In describing what the actors are doing, the team will take on the role of the actor and describe their actions in the first person, for example starting sentences with "I will". This will enable the team to internalise the scenario and perspective of the actor.

The Narrative team will then describe the state of the region. The team will identify important areas that need to be reported on, including social, environmental and economic dimensions. To encourage a critical review of the state of the region, the team will take on the role of investigative journalists reporting on what they see happening in the region during that period.

Workshops of the Analysis team will involve reviewing the scenario story developed by the Narrative team. The review will consider the logic and completeness of the story, and learning that can be drawn from the story to inform future actions. The output from the review will be used to improve and further develop the scenario story.

Both teams will commence with an examination of the past five years (2000 – 2005) to assist in identifying the challenges and opportunities existing at the start of each scenario. This will also allow the teams to practice the skills required for the assessment process.

### *Dates*

The anticipated timetable for meetings of the technical working group presented in Table 1. Each team will meet at approximately four-week intervals, with entire group meetings in August and December.

**Table 1 Anticipated meeting dates for 2005**

| Meeting Number | Narrative Team | Analysis Team |
|---|---|---|
| 1 | 6th May | |
| 2 | 30th May | 6th June |
| 3 | 20th June | 4th July |
| 4 | 19th July | 25th July |
| 5 | 16th August* | |
| 6 | 12th September | 25th September* |
| 7 | 11th October | 25th October* |
| 8 | 7th November | 21st November* |
| 9 | 6th December | |

* To be confirmed

### Managing the Process

The proposed approach to Stage 3 is innovative and has not been used previously. Therefore, there is a degree of risk in adopting such an approach. To manage this risk, the project team will continually monitor and evaluate the assessment process and the output of the process. The monitoring and evaluation will be used to adapt the assessment process to accommodate both the needs of the project and participants.

Monitoring will involve a debriefing session at the conclusion of every workshop both with the participants and the project team to identify improvement in the workshop process. Evaluation of the story development process will on completion of the first scenario story, which is anticipated to take up to four workshops.

It is anticipated that the Technical Working Group will have the ability to complete four scenario stories within Stage 3 of the Project. If progress is slower than anticipated, the project team will consider extrapolating the logic and concepts developed in completed scenario stories to those that are incomplete.

## *Communication to Other Audiences*

During Stage 3 of the project, six monthly meetings of the Irrigation Futures Forums will be held to update members on progress. These meetings will allow the Forum participants to contribute ideas and suggestions to the assessment process and to participate in an extended peer review of the assessment. Regular briefings of the Stakeholder Reference Committee will also be held.

# Appendix 1 Methods of Prioritisation

As a part of the literature review on integrated assessment, we identified two parts to assessment; prioritisation and analysis. Approaches to analysis were discussed in the main part of the report. This appendix reviews the different approaches to prioritisation of management strategies.

There are three main formal approaches to assessing priorities to identify preferred management strategies. Each approach uses some sort of judgement of the value, either absolute or relative, of particular outcome measures. The three main approaches are risk assessment, economic assessment and decision analysis or multi-attribute utility assessment.

## Risk Assessment

Risk Assessment is a priority setting tool that ranks actions or processes according to the level of risk they pose to people, property, livelihoods and/or the environment. Risk is typically described as the product of the likelihood of the action occurring and the consequence or in some cases the exposure and the effect. Risks are subsequently prioritised using the framework presented in Figure 5.

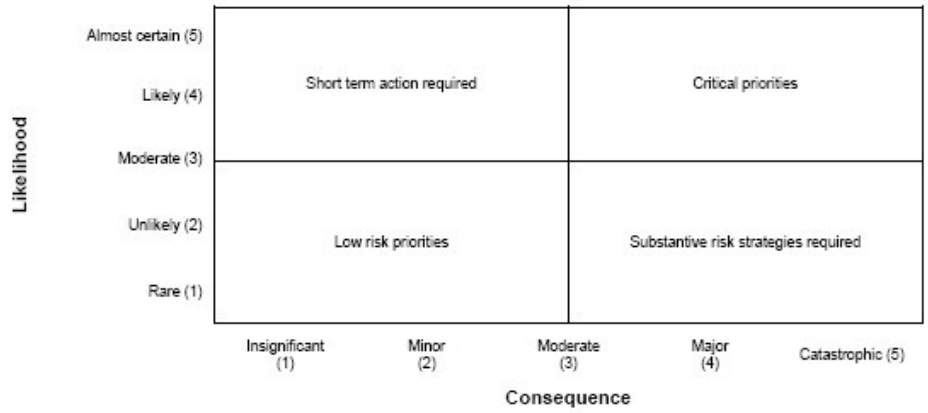



**Figure 5 Risk Assessment Proiritisation Framework.**

In environmental management, the risk of threats or threatening processes to environmental assets (natural features with some form of economic, social or environmental value) is commonly assessed. This process has been commonly applied in the development of Catchment Strategies in Victoria, following the requirements of the "National Framework for Natural Resource Management Standards and Targets". Formal software (RiVERS) has been developed to assist with prioritising areas for Catchment River Health Strategies within Victoria using a risk assessment approach (NCCMA 2004).

Risk assessment requires the consequences of interventions to be characterised. The Ecological Risk Assessment approach of Hart et al (2002) is an example of this, where both prioritisation and system understanding are brought together into a single framework.

Risk assessment approach prioritises actions and processes according to the risk they pose. This framework can be used prognostically to examine the change in risk when particular management options are implemented. However, there is no explicit consideration of the costs of remedial actions.

Value judgements are introduced when characterising what is actually at risk whether it is people, property, livelihoods or the environment, and its relative importance.

## Economic Assessment

Economic assessment is used to assess the relative costs and benefits of proposed management strategies using monetary measures. Cost-benefit analysis is the most commonly used tool for economic assessments. Cost-benefit analysis compares management strategies using measures such as Net Present Value and Benefit Cost Ratio. Economic assessment becomes difficult when costs and benefits are non-priced and therefore non-market based valuation techniques are required. In Victoria, DNRE (2002) required cost-benefit analyses of catchment action plans, preferring contingent valuation of non-priced goods and services.

## Decision Analysis

Decision analysis, or multiple criteria evaluation techniques, are used to compare and rank management strategies. Management strategies are evaluated against several quantitative or qualitative measures. A weighted aggregation (eg sum or average) of these measures is used to prioritise management strategies. The weights reflect the relative importance of each of the measures. Several methods are available for the development and analysis of priorities, including the Analytical Hierarchy Process (AHP) and Concordance Analysis. Eigeland and Hooper (2000) demonstrate the use of Multiple Criteria Analysis to rank irrigation farm performance considering social, economic and environmental factors.

## Appendix 2 Technical Working Group Members

| | |
|---|---|
| **NARRATIVE TEAM** | |
| Alan Canobie | Beef farmer – Numurkah |
| Bruce Cumming | Sub-project manager, Sustainable Irrigation Landscapes – Goulburn-Broken, DPI – Tatura |
| Joe Demase | Viticulturalist - Shepparton |
| Peter Fitzgerald | Dairy farmer, G-MW Board member - Tongala |
| John Laing | GV Environment Group - Toolamba |
| David Lawler | Senior Irrigation Advisor, DPI – Echuca |
| Oliver Moles | Planning Manager, DSE - Benalla |
| Bev Phelan | Counsellor, GV Agcare - Kyabram |
| Claire Pinniceard | Export piggery - Euroa |
| Peter Sargent | Horticulture – Strathmerton |
| Rien Silverstein | Horticulture – Shepparton |
| Kate Tehan (vice Sally Dickinson) | Municipal Economic Development, Campaspe Shire Echuca |
| **ANALYSIS TEAM** | |
| Bruce Anderson | Goulburn Valley Water – Shepparton |
| David Bourke | Dairy farmer – Tatura |
| John Dainton | Chair, Northern Water Forum - Shepparton |
| Lyn Gunter | Municipal councillor - Alexandra |
| Shane Hall | Orchardist – Mooroopna |
| Peter Langley | Horse breeding - Benalla |
| Derek Poulton | Goulburn-Murray Water – Tatura |
| Kevin Preece | Goulburn-Murray Water – Cobram |
| Durham Prewett | Milk supply manager, Nestle – Tongala |
| Ross Wall | Executive officer, Northern Victorian Fruit Growers Association - Mooroopna |
| Gordon Weller | Dairy farmer - Rochester |

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# IRRIGATION FUTURES OF

# THE GOULBURN BROKEN CATCHMENT

## Milestone 3 Report - Attachment C
## Response to Reviewers Comments
## June 2005


**Primary Industries Research Victoria (PIRVIC) - Tatura**
**Department of Primary Industries**

in collaboration with

**Community Engagement Network**
**Department of Sustainability and Environment**


Victoria The Place To Be

National Program for Sustainable Irrigation

Goulburn Broken Catchment Management Authority

Goulburn-Murray Water

Cooperative Research Centre for Irrigation Futures

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Denis Flett – Goulburn-Murray Water
Brigitte Keeble – Department of Sustainability and Environment
John Pettigrew (Chair) – Goulburn Broken Catchment Management Authority (GBCMA)
Sonja Tymms – Department of Primary Industries

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**Technical Advisory Committee:**

Dr Neil Barr, Jo Haw, Associate Professor Hector Malano, Associate Professor Bill Malcolm, Derek Poulton, Greg Roberts, Ken Sampson, Dr John Wolfenden.

**Project Funded By:**

Department of Primary Industries
Department of Sustainability and Environment
Goulburn Broken Catchment Management Authority
Goulburn-Murray Water
National Program for Sustainable Irrigation, Land and Water Australia

Review by Dr. Nick Abel

- **Irrigation Futures of the Goulburn Broken Catchment**
- **Comments on the Approach to the Further Development and Assessment of Regional Options proposed for Stage 3**

## *Introduction*

I was asked to:

- comment on the approach to the further development and assessment of regional options proposed for Stage 3 of this project;
- provide suggestions to help in the development of a detailed program to implement the approach.

To do this I read Milestone Report 2 and its attachments A to H, with a particular focus upon G and H.

## *Sound Project Structure and Excellent Processes*

The project structure, developed for the whole project, was well conceived originally, and has been thoroughly tested in the earlier stages of the project. It provides an excellent platform for the approach to Stage 3 ( hereafter 'the Approach'). Similarly, the stakeholder process was well designed, and judging by the running sheets, expertly managed (Attachment C). In establishing the Stakeholder Reference Committee (Attachment B), I did note a relatively weak representation of non-dairy irrigators. It probably is an accurate reflection of current water usage, but predetermines a tendency to 'business-as-usual'. This is a comment rather than a criticism, because you could not run a process like this which is biased against dairying! It does, though, put an extra responsibility on non-dairy participants and project staff to encourage lateral thinking. The Milestone Report shows strong awareness of this, but as the Report itself notes, a tendency to business-as-usual is still apparent in the scenarios.

Project Team's Response: We agree that the Stakeholder Reference Committee contains a strong representation of dairy irrigators. This committee was established using the Shepparton Irrigation Region Implementation Committee (SIRIC) as a base, which already had a strong presence of dairy irrigators. The membership of SIRIC was augmented to bring other expertise. The role of this committee is to provide guidance on processes for wider stakeholder participation, consolidate ideas from wider stakeholders and generate confidence in the regional community. The Irrigation Futures Forums is where the majority of the ideas were generated. These forums had a wide range of participants.

## *Dealing with Complicated Outputs*

The outputs from Stage 2 are community values and aspirations, response options, and five comprehensive scenarios. I agree with the Milestone Report that these outputs are at a fairly high level, and do not always provide sufficient detail for assessment. It is unclear from the project objectives whether the intention is to develop scenarios that are as well informed as possible, or whether the emphasis is on developing a shared vision of the future. If the former, the outputs might have been enhanced by having some discussion papers drafted by experts in particular fields – for example the

factors affecting agricultural exports; population futures; climatic change; the impacts on the regional economy of changes in water allocations, etc. You may still find that useful – but a literature review to inform your Narrative and Analytical teams would do the job.

Project Team's Response: Stage 2 of the project aimed to develop scenarios which are both well informed and owned by the community. One feature of the project is to place great value on local knowledge and on diversity in views and mental models. Early in Stage 2, we made the decision that we would not bring presentations by external experts or discussion papers to our workshops, as we did not want discussions to be influenced by individual experts or papers. We also wanted to demonstrate to our workshop participants that there was no hidden agenda behind the project. At Stage 3, we do bring in expertise from external sources, as suggested by the review.

You write of the 'prodigious amount of material' generated by the project, and the 'somewhat frightening" range and complexity of issues that impact on irrigated agriculture. In retrospect, should you have imposed what Holling calls a 'rule of hand' about the number of drivers allowed (five) (Gunderson and Holling 2002)? Brian Walker tells me (and I do not have a reference yet) that some mathematical modelling of abstract systems suggests that only systems with a small number of controlling variables can persist, larger numbers and the system is too unstable to survive. I don't know if this applies to drivers, but the 'rule of hand' forces participants to synthesise and rank their drivers. Too late for participants to do this, but your narratives and analytical teams still could do it in your Approach.

Project Team's Response: We agree that we need to focus on key variables. We also recognise that drivers can be at many different levels, and the 'rule of hand' concept is difficult to apply in practice. Five high level drivers can mean many drivers at lower levels. In addition, variables may become critical or not critical depending on the state of the system. It was also important to give forum participants the space to identify what they believed were critical drivers.

The outputs do lack internal coherence, and your Approach will have to address this. For example, in the Super Scenario 'Food for Thought', why, given the 'Keen Green' values, do the prices of fuel and water not rise, but the price of chemicals does? Another example, why under the 'Economic Ideals' Super Scenario does the price of water decrease when large volumes are being allocated to the environment? This is probably labouring the obvious, but I suggest the material already gathered, and the incoherence of parts of the output, could be reduced and organised better if in your Approach you could work out the causal relationships behind the scenarios and options. You could use influence diagrams etc., and the 'story-lines' the participants developed may be informative too. You will have to do this intuitively anyway, to make sense of what you have got, so you might as well do it explicitly.

Project Team's Response: The Super Scenarios were raw outputs from a one-day workshop (Stakeholder Reference Committee) in attempt to synthesise Forum workshop outputs. These scenarios have been further developed and presented in Attachment 1 of Milestone Report 3.

### *Drivers, Threats and Control Variables*

The mega drivers listed in the super scenarios did not seem to me to be all drivers. Resource shifts and allocations to me seems to be a regional consequence of changes in what clearly are drivers, such as community values and government policy. Likewise 'sudden change' is offered as a category of driver, whereas it might be better seen as a shock or disturbance to which the system responds. I do think it would help organise the material better if during the application of your Approach it is sorted more clearly into drivers (external), drivers (internal), control variables and shocks.

Project Team's Response: This is a terminology issue. We define "driver" as factors that could impact on the region's catchment, community and industry, either directly or indirectly. We found that the simplicity of defining factors as external and internal drivers suited for our workshops.

### *Scale*

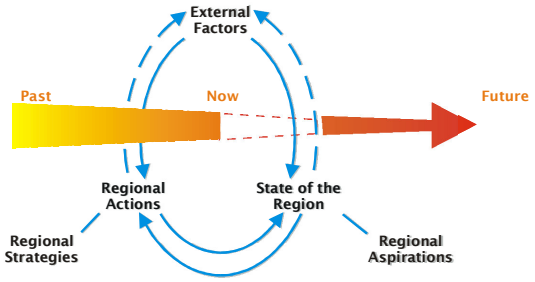
Would it also help organise the information if you distinguished between farm-scale, regional-scale and external changes?

Project Team's Response: We agree that this could be a useful way to organise information. In terms of regional actions, we have used "individual actions" and "coordinated actions".

### *A Stronger Organising Framework?*

All that said, I wonder if the participants' mental models of the system that underlie the outputs are in fact appropriate to what we think we already know of the behaviour of the system? For example, the Summary of Irrigation Futures Forum Aspirations (F, p18) include an equilibrial view of the system's behaviour, which is not appropriate for a system in which we know there are thresholds (in the relationship between tree cover and rate of water table rise in particular). And the Themes within the Regional Response Options reflect in my view some fairly top-down mental models of social change – lots of leadership, planning, governance, coordination, but nothing on market based instruments and local initiatives, which we know can be important in changing the system. I am biased towards a resilience-based conceptualisation of how the system works, with the behaviour of the system controlled for much of the time by slow variables (e.g. perennial vegetation cover, property rights, infrastructure etc), but with a tendency to become increasingly unstable as the quest for efficiency drives the system closer to thresholds (e.g. water table rise; salinity increase). When in this fragile state the system can collapse, release resources, stimulate innovation, and change direction (Gunderson and Holling 2002). I promote this approach because I am trying to apply it in the GB myself. I do think its worth a look. There is stuff in Walker B et al 2002 and in Gunderson and Holling 2002, and I attach a paper (submitted) by Anderies et al. I do realise that applying a resilience (or any other) framework retrospectively may anger the participants, especially as you would have to modify the scenarios and options to fit the theory, but its worth exploring as a way of increasing the value of the outputs.

Project Team's Response: The systems framework we have used is show in the diagram below.




**Regional Aspirations** are the community goals and desires for the next 30 years in relation to business, family, the Goulburn Broken Catchment and irrigated agriculture.

**Regional Actions** are those actions taken by individuals (individual actions) and actions that require some degree of coordination by groups and organisations (coordinated actions). Regional actions can be taken in respond to challenges and opportunities presented by external scenarios and/or the State of the Region. They can also be taken as an initiative to create opportunities.

**Regional Strategies** are Underlying approach and plan to guide regional coordinated actions both now and in the future.

**External Factors** are factors that influence but are beyond the control of the region. The external scenarios describe the temporal evolution of the external factors over the next 30 years.

**State of the Region** is the condition of the region as a result of past regional actions and external factors as well as the regional assets at the start point. One may regard the state of the region at a given time as the starting regional assets for the next time period.

The Regional Response Options collected at the Forum workshops have been synthesised to a set of Regional Strategies (See Attachment 1 of Milestone Report 3). Underlying the Strategies is the need for the region to have a system for adaptive management and change and to develop fundamental adaptive capabilities (Social; Land, water and environmental; Industry). We believe that this is very much consistent with the resilience concept.

### *Integrated Assessment*

Unfashionable to say this, but you could do IA using a set of non-integrated models off the shelf. Alternatively you might build a quick and dirty model and perhaps use it in conjunction with off-the-shelf models.

Economic modelling - while cost-benefit analysis is useful to see if an investment is economically efficient, it tells you nothing about impacts on the regional economy and jobs, so to the toolkit you discussed under Economic Assessment, I would add Input-output or General Equilibrium models. We have an IO model for the GB with water included along with monetary flows.

You seem to feel that your post-normal approach is not compatible with more conventional modelling. If so, I don't feel the same. I think that conventional models can inform post-normal science.

An approach that I feel is truly post normal is Bayesian Belief Modelling. It might be fruitful to use this as it links local and scientific knowledge. I think you know this approach.

Project Team's Response: We are of the view that the systems we are dealing with are too complex and uncertain for computer modelling to be

meaningful. Therefore, we have decided to do Narrative exploration of the interplay between external factors, regional actions and the state of the region, supported by Analysis of concepts, qualitative relationships and in some cases quantitative relationships.

### *Other Comments*

The Milestone Report is very clearly written, and a pleasure to read. The project has been carefully designed, and judging by the Report, very well managed. It is also innovative – one example is the innovative idea of offering a prize for innovation by participants!, and another the 'History wall'. A third is the combination of narrative and the analytical approaches, which is brilliant. I would say in its conception and execution so far, the project is a model for scenario development here and abroad.

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# Review of the Goulburn Broken Irrigation Futures Project

## Stage 3

**by**

**Professor Ron Johnston**
**Executive Director**
**Australian Centre for Innovation**

**January 2005**

### *Summary*

On the basis of a detailed reading of the Milestone Report 2 of the 'Irrigation Futures of the Goulburn Broken Catchment' Project I can conclude:

- by international standards, this is an extraordinarily ambitious and well-conceived futures project, and the evidence available suggests it is being executed in a very professional manner, with particular emphasis on evolutionary learning, and effective stakeholder engagement;
- the adoption of an appropriate 'integrated assessment' approach offers sound prospects for further progress;
- the proposed key methodology of distinct Narrative and Analysis teams is relatively novel, but, effectively managed, could be very effective.

### *Project Overview*

The report identifies a four-stage project, extending over four years:

| | |
|---|---|
| Stage 1 | Project development |
| Stage 2 | Vision, scenario and options |
| Stage 3 | Further development and assessment of regional options |
| Stage 4 | Building consensus. |

It should be noted that the scale and length of this project will undoubtedly alow for an extremely thorough and rigorous approach. However there may be some disadvantages in attrition of stakeholders, for a wide variety of reasons eg fatigue, new interests, changing personnel, leaving the industry or the region.

Project Team's Response: This has been managed reasonably OK at Stage 2 with a retention rate of over 70% in a period of six months. About a third of the Stage 2 participants have put in nominations for involvement in the Technical Working Group at Stage 3. Strategies for keeping participants involved in the project in the next two years include sending communication material regularly and meeting to provide report on project progress and seek comments every six months.

In addition, a futures project extending over four years must allow for, and adapt to, substantial changes in key parameters, drivers, assumptions, perceived risks, etc, over the lifetime of the project

Project Team's Response: Among such substantial changes is the implementation of the White Paper on water. The project will continually review such changes and incorporate information into the project processes and outputs as necessary.

Four major sets of outputs are identified from the recently completed Stage 2:

- a set of community Values and Aspirations for the future of irrigation in the Goulburn Broken Catchment
- a set of Scenarios describing the plausible positions of factors that influence irrigation in the catchment over which the catchment has no control. These represent opportunities and threats that the catchment may face in the future

- a set of Assets describing the available resources within the catchment and their current condition. These represent the current strengths and weaknesses of the catchment.
- A set of Regional Response Options describing factors within the control of the catchment that will respond to the challenges and opportunities presented by scenarios.

It should be recognised that the distinction between factors that the catchment can and cannot control is inevitably contingent. Changes in external or internal situations can convert a factor from being inside to outside control, and vice versa.

Project Team's Response: We have adopted a simple framework to focus community discussions on regional actions, with the recognition that there is a dynamic interplay among external factors, regional actions and regional consequences. Stage 3 will explore this interplay in much greater depth than Stage 2.

More significantly, the translation of futures concepts into the language of strategic planning provides the initial basis for developing an effective interface between the language and processes of futures studies and that of practical planning and decision-making.

I have argued[1] that the appropriate objective of foresight exercises is not the solution of future problems, but as the transformation and reduction of uncertainties into a form where the tools of strategic planning can be applied.

This goes to the heart of the major weakness of all futures-type exercises – the effective translation into decision-making and action.[2] This project has quite clearly recognised this challenge, and the processes and methods being used would appear to be most appropriate for ensuring effective, implementable (and implemented) outcomes.

Project Team's Response: We are very much in agreement with the reviewer. The focus of developing future scenarios in this project is about developing regional strategies and testing their effectiveness and robustness.

There are two further features of the project which I regard as representative of best practice. The first of these is the strong commitment to a participatory approach and effective stakeholder engagement. I quote at some length to justify my support for this approach[3]:

***An Alternative Framework for Foresight***

> *As a management tool, foresight, particularly in the forms of model-based projections and scenario planning, is being rapidly adopted in the private sector, and to address specific technological or sectoral issues in government Departments and agencies. However, significant challenges to the further progress of foresight have been*

[1] Johnston, R.,and Tegart, G., 'Some Advances in the Practice of Foresight', *Proceedings of the Workshop on the Role of Foresight in the Selection of Research Policy Priorities,* Seville, 2002; forthcoming in the *International Journal for Foresight and Innovation Policy*

[2] This argument is elaborated in Johnston, R., 'The State and Contribution of International Foresight: New Challenges' delivered to the Spanish Presidency Foresight Conference, *The Role of Foresight in Policy Prioritisation and Planning,* Seville, May 2001

[3] Johnston, R., 'Foresight; Revising the Process', *International Journal of Technology Management*, Vol 21 Nos 7/8, 1999.

*identified in this paper. They include the gap between general theoretical models and current practice, the need to develop a comprehensive inventory of foresight tools, and the fact that evaluative empirical research lags far behind the fast-growing practice of foresight.*

*But perhaps the greatest limitation is in the lack of effective engagement with political and administrative decision-making processes. Research and technology foresight has developed largely outside the world of bureaucratic politics, marked by the 'contested terrain' for ideas and advantage.*

*A possible alternative framework for foresight, which might provide the basis for addressing these issues, is provided by the approach labelled as ' participatory policy analysis'. This is defined, perhaps clumsily, as:*

> *an applied social science discipline which uses multiple methods of inquiry, argument and process facilitation to assist a pluriform set of stakeholders in a policy network to explore and exchange in a direct interaction with each other their different mental maps regarding values, definitions, causes and solutions of problems and to develop and test as effective as needed a shared and robust policy theory on an issue. The ultimate goal is to improve the problem solving capacity of the individual stakeholders and the policy network as a whole. [27]*

*This is seen as a response to the increasing complexity of human and social problems:*

> *New cross-disciplinary techniques to assist decision-makers are rapidly emerging worldwide. Scientists around the globe have been experimenting with new methods of perceiving, understanding and communicating complexity. Many techniques and technologies have been employed with varying results. The more successful have attempted to capture problems in a systematic way, to facilitate group participation in the articulation of alternatives for action, and to enable a group to evaluate various alternatives. Inevitably, these efforts employ a method for communication that is less sequential than written language and more ' right brain' in encouraging spontaneity, but nonetheless disciplined in use to ensure reasonable results. [28]*

*The benefits of stakeholder participation during a process of policy analysis are described as:*

> *more creativity, improve production and diffusion of knowledge, integration of different sources of information/knowledge, better mutual understanding between opposing groups, early political coordination, improved legitimacy or enhancement of democracy, no separation between diagnosis and action, improved decision quality, commitment of participants, and more effective communication of results between analysts and users [29]*

*A review of participatory policy analysis applications has identified their focus on ill-structured or complex policy problems. Their objectives include exploring and explaining conflicts of interest or values, collecting information from stakeholders to reduce complexity and uncertainty, creating or stimulating the development of a network, establishing a legitimate base for further action, or motivating change.*

*These passages have been quoted at length to emphasise the commonality between this approach, and that of foresight, particularly in the form of scenario planning. 'Stakeholder exchange of their different mental models', the 'communication of complexity through right brain processes', 'more creativity', ' commitment of*

*participants' and 'better mutual understanding between opposing groups' are all features of the process-based techniques like scenario planning.*

*But 'no separation between diagnosis and action' and 'more effective communication of results between analysts and users' are not evidently strong characteristics of foresight. An important step in the further development in foresight, particularly as applied to research and technology, may well be to recognise that the different techniques also carry with them implications for the extent of engagement with the decision-making process.*

*Expert-based approaches may generate technical confidence, but fail in terms of interfacing with decision-makers. Participatory techniques offer the potential of a much higher level of engagement with the decision-making structures, but may be less conducive to accessing the insights of the technical experts. Furthermore, the 'point of balance' will differ in different cultures and economic structures.*

The second feature of significance is the adoption of the "post-normal science" paradigm. While the conceptual developments underpinning this perspective have at least a twenty year history in the sociology of science, leading to arguments that the very nature of reliable knowledge is being transformed (from Mode 1 to Mode 2 knowledge)[4], it is only in the past few years that the acknowledgement of fundamental uncertainty in knowledge has begun to be accepted and directly built into analytical and decision-making processes addressing the future.

This project represents one of the fairly early adopters of this approach. The advantages are that there are many opportunities for learning. The disadvantages are that there is only limited experience to build on.

Project Team's Response: The Stage 3 approach is very much experimental in the future. Therefore, the project team will need to constantly review the project methodology and be adaptive.

### *Stage Three – Further Development and Assessment of Regional Options*

Stage 3 of the project involves three main tasks:

- Development of a detailed assessment process
- Further development of the material from the Irrigation Futures Forums
- Assessment of the options (ie "assessment of the consequences of policy options in a future environment that is highly uncertain")..

This is to be underpinned by a systems framework: "the impact of the combination of options and scenarios on outcome indicators will be assessed by understanding how each component of the options and scenarios influences the system behaviour and how the outcome indicators respond to changes within the system."

In this context, "assessment is about understanding the combined impact of options and scenarios on outcome indicators."

This raises two issues. First, quite what is the nature of options, and what do they include. Thus, on page 8 they are described as ways to realise our

[4] Gibbons, M., et al, *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, Sage Publications, London, 1994.

aspirations that may be described at two levels: “Broad Direction of what we want to achieve”, and “Course of Action describing how the broad direction is implemented”.

However, on page 5 of Attachment H, options are described as “describing factors within the control of the catchment that will respond to the challenges and opportunities presented by scenarios.”

Each of these three aspects appears to represent somewhat different components viz a preferred future, mechanisms of implementation, and internal capabilities, or strengths. I would suggest there is a need to make a very clear distinction between these three, and ensure that thinking and analysis does not confuse one with the other.

Project Team’s Response: The confusion has resulted from our inconsistent use of words. The underlying concepts have also evolved over time. We believe we have now reached a better set of terms:

Future options for regional actions - Regional actions include those actions taken by individuals (individual actions) as well as actions that require some degree of coordination by groups and organisations (coordinated actions).

Regional strategies – Underlying approach and plan to guide regional coordinated actions both now and in the future.

Regional assets – internal capabilities (strengths and weaknesses).

State of the Region – is the condition of the region as a result of past regional actions and external factors as well as the regional assets at the start point. One may regard the state of the region at a given time as the starting regional assets for the next time period.

Regional actions can be taken in respond to challenges and opportunities presented by external scenarios and/or regional consequences. They can also be taken as an initiative to create opportunities.

The second issue is just how the task set out above under the systems framework is actually to be pursued and completed, given the uncertainty not only of many of the underlying data, but also of the nature of the inter-relationships between the various factors, before we add the special uncertainty associated with addressing the future. This brings us the proposed approach.

### *Proposed Stage Three Methodology*

The decision has been made that the originally proposed approach for Stage 3 based on the development and use of a ‘Scenario Assessment Tool’ to assess the consequences of the various management options is not appropriate. Scenario assessment is a reasonably well-developed process, but it is usually focussed on issues of internal consistency, rather than on assessment of consequences.

The rationale that is offered is essentially based on the complexity of the issues to be addressed, the limitations of relevant knowledge, and the variety of viewpoints that different actors and stakeholders would bring to such an assessment. All of these criticisms are well-founded.

Hence drawing on an excellent review of the literature on the emerging field of ‘Integrated Assessment’, a participatory approach is proposed based on what might be called a dialectical interplay between a Narrative Team and an

Analysis Team. The former have the role of constructing a suite of stories of plausible futures. The latter will bring the rigour of systems modelling to testing the plausibility of the stories and illustrating the magnitude of the impacts.

In simple terms, this separation mirrors the distinction between right-brain creative activity and left-brain critical activity. The importance of this distinction, and the need to separate the activities is well recognised in the futures field. But I am not aware of a project where the two functions have been embodied in distinct groups.[5] More commonly they are separated as successive stages carried out by a single group.

In my view this is a very interesting approach, well-worth pursuing. However, its effectiveness, and success, will depend crucially on a combination of detailed planning and, even more importantly, active monitoring, learning and development and introduction of adaptive strategies, tools and information throughout the life of this Stage.

It will be a major, experimental learning exercise. It will take the form of action research, engaging the members of the Technical Working Group. And in the language of futures, this project/Stage will itself be a classical exercise in 'inventing the future rather than predicting it'.

Some practical considerations with regard to membership of the two teams: it may be best to appoint members according to their right brain/left brain preferences (simple non-threatening diagnostic tools are readily available. There may also be value in allowing for some swapping of roles at an appropriate time eg a workshop where roles are reversed.

The proposed assessment process is to rely heavily on structured workshops. While such workshops are undoubtedly an important component, I would se the need also for each team to have significant time to work with their own members, and to respond individually to various tasks. The whole process could be supported by an effective electronic 'bulletin board' type information and idea exchange mechanism.

It is evident that a high level of support would be required from the project team.

Project Team's Response: The project team has adopted a monitoring and evaluation strategy for Stage 3 of the Project. This includes monitoring and evaluation of the participatory processes and the output from the workshops This will allow the process to continually evolve to meet the participants and project requirements.

In forming the two teams, a simple test was used to inform participants of their preferred learning style. Participants were then allowed to make an informed choice of the team they joined.

Methods of communication within and between the teams were discussed with participants during the first workshop. The majority of participants preferred to receive written material in hard copy, and to use electronic communication only for short messages.

[5] I have been unable to access the Kemp-Benedict reference

# IRRIGATION FUTURES OF

# THE GOULBURN BROKEN CATCHMENT

## Milestone 3 Report - Attachment D
## List of Communication Activities for Stage 3A
## January - June 2005


**Primary Industries Research Victoria (PIRVIC) - Tatura**
**Department of Primary Industries**

in collaboration with

**Community Engagement Network**
**Department of Sustainability and Environment**


Victoria The Place To Be

National Program for Sustainable Irrigation

Goulburn Broken Catchment Management Authority

Goulburn-Murray Water

Cooperative Research Centre for Irrigation Futures

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**Project Team:**

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Robert Chaffe – Community Engagement Network, Department of Sustainability and Environment

**Governance Committee:**

Murray Chapman – National Program for Sustainable Irrigation, LWA
Denis Flett – Goulburn-Murray Water
Brigitte Keeble – Department of Sustainability and Environment
John Pettigrew (Chair) – Goulburn Broken Catchment Management Authority (GBCMA)
Sonja Tymms – Department of Primary Industries

**Stakeholder Reference Committee:**

Mark Allaway, Alan Canobie, Bruce Cumming, Alan Crouch, Steve Farrell, Peter Gibson, Colin James, Peter McCamish, Ian Moorhouse, Chris Norman, Russell Pell (Chair), Kylie Pfeiffer, Derek Poulton, Ann Roberts, Nick Roberts, Nick Ryan, Ken Sampson, Justin Sheed, Alan Sutherland, David Taylor, John Thompson.

**Technical Working Group:**

**Narrative Team :** Alan Canobie, Bruce Cumming, Joe Demase, Peter Fitzgerald, John Laing, David Lawler, Oliver Moles, Bev Phelan, Claire Pinniceard, Peter Sargent, Rien Silverstein, Kate Tehan (vice Sally Dickinson).

**Analysis Team**: Bruce Anderson, David Bourke, John Dainton, Lyn Gunter, Shane Hall, Peter Langley, Derek Poulton, Kevin Preece, Durham Prewett, Ross Wall, Gordon Weller

**Technical Advisory Committee:**

Dr Neil Barr, Jo Haw, Associate Professor Hector Malano, Associate Professor Bill Malcolm, Derek Poulton, Greg Roberts, Ken Sampson, Dr John Wolfenden.

**Project Funded By:**

Department of Primary Industries
Department of Sustainability and Environment
Goulburn Broken Catchment Management Authority
Goulburn-Murray Water
National Program for Sustainable Irrigation, Land and Water Australia

# List of Communication Activities

# Stage 3A

# Jan – June 2005

### *(a) Reports*

- Irrigation Futures of the Goulburn Broken Catchment: Milestone 3 Report, DPI Tatura, June 2005.

### *(b) Governance Committee*

- Completion of Stage 2 requirements, 5 April 05

### *(c) Stakeholder Reference Committee*

- Progress Report, 28 January 05
- Approval of synthesised scenarios & options, 4 & 11 March 05
- Plans for the TWG, 29 April 05

### *(d) Technical Working Group*

- Initial meeting to outline directions, form teams etc, 6 May 05
- Narrative Team, review of history and introduction to the process for Stage 3, 30 May 05
- Analysis Team, review of history and introduction to the process for Stage 3, 6 June 05
- Narrative Team, internalisation of scenario 1, prediction of actions of various stakeholder groups during the period 2005-10

### *(e) Stakeholder Groups*

- Report back of synthesised scenarios and options to combined meeting of all Irrigation Futures Forum Workshop groups, 18 March 05
- Presentation of Stage 2 outputs, senior G-MW, GBCMA, DSE & DPI staff, 23 March 05
- Brief presentation of project overview and findings to CRCIF Winter Zone Advisory Group, 6 April.
- Presentation of Stage 2 outputs, G-MW Board, CEO of MDBC & senior G-MW staff, 25 May 05
- Presentation of project findings to G-MW's Annual Water Services Committees Meeting, 8 June.
- Presentation of Stage 2 outputs, Councillors & senior staff, City of Greater Shepparton, 14 June 05
- Presentation of Stage 2 outputs, senior staff Water Sector Group, DSE, 27 June 05

### *(f) Articles / Newsletters*

- 'Irrigation Futures for the Goulburn Broken Catchment Project', DPI Project update Leaflet, June 2005

### *(g) Other presentations*

- Presentation of Stage 2 outputs & discussion of Stage 3 approach, Prof Stuart Hill, Social Ecology, University of Western Sydney, 24 June 05