

# Irrigation Futures

## of the Goulburn Broken Catchment



Final Report 11 – Water and food: futures thinking

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Provides a brief introduction to the project and how the project objectives have been met.

#### **Final Report 1 – Scenarios of the Future: Irrigation in the Goulburn Broken Region**

Provides an overview of the region, drivers for change, scenarios, implications and strategies.

#### **Final Report 2 – Regional scenario planning in practice: Irrigation futures of the Goulburn Broken Region**

Provides a manual of project methodology for next-users.

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# **Irrigation Futures of the Goulburn Broken Catchment**

## **Final Report 11 – Water and food: futures thinking**

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Cooperative Research Centre for Irrigation Futures



A Sustainability Education program of the Department of Primary Industries.

This booklet was compiled by Ann Fagan (Irrigation Futures Curriculum Project) LandLearn, October 2007, supported by LandLearn staff: Sheree Burke, Jessica Connor, Kathryn Goyen, Sherin Halliday, Jim Mead and Kylie Tuhan.

#### **LandLearn aims to:**

- Engage students in active, experiential learning which can include on-going participation in community environmental management projects
- Encourage and support the incorporation of studies about sustainable agriculture and natural resources management into schools' curricula
- Provide support for teachers and school communities through professional development, current learning and teaching resources and student activities that make learning fun
- Promote partnerships between schools and community groups, such as Landcare, and between urban and rural school communities.

#### **Key messages**

Caring for our land and its resources is a shared responsibility. Learning and action now is an investment in a future with:

- A sustainable environment
- Quality food and natural fibres produced by farmers using responsible practices
- Viable rural and regional communities
- Challenging, valued and purposeful careers and employment in agriculture-based industries.

#### **Support for schools**

Visit the LandLearn website: [www.landlearn.net.au](http://www.landlearn.net.au)

As a provider of curriculum resources and support, LandLearn works in the context of a holistic, integrated approach to environment education. Schools can adapt the learning activities and teaching resources to suit their particular curriculum structure, pedagogical approach and learning themes. Sustainability and the environment, including sustainable agriculture as the source of food and natural fibre, can provide an integrating framework for the implementation of the Victorian Essential Learning Standards.

Principals, Curriculum and Professional Development Coordinators and teachers are invited to contact LandLearn to discuss the support LandLearn offers to schools, including professional development and fieldwork. Themes we can assist with include sustainable agriculture as the source of food and natural fibre, school gardens (especially edible ones) as learning environments, landcare, natural resource management, biodiversity in a range of landscapes, all underpinned by the principles of sustainability education.

LandLearn teaching and learning resources aim to support transformative learning that will empower students to take responsibility for their actions and for behaviour change to contribute to a sustainable future. The resources include activities to encourage students as individuals, and whole school communities to participate in local community action and projects to support relevant local and regional management plans.

Email: [landlearn.program@dpi.vic.gov.au](mailto:landlearn.program@dpi.vic.gov.au)

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### Notes:

1. Underlined words and phrases in this resource are defined or explained in the Glossary.
2. The VCE Geography Study Design and Victorian Essential Learning Standards Geography Domain both list *spatial concepts* to provide a conceptual structure and framework for geographic investigations. These are in italics.
3. At the time of writing, the Internet addresses appearing in this book were correct. Owing to the dynamic nature of the Internet, however, we cannot guarantee that all of these addresses will remain intact.



## Background

**Water and Food: futures thinking** is the outcome of collaboration between two different projects within the Victorian Department of Primary Industries – Irrigation Futures of the Goulburn Broken Catchment and LandLearn. Staff of both programs recognised the value of the outputs of Irrigation Futures for the education sector and the opportunities to develop teaching and learning materials relevant to important issues confronting communities everywhere and affecting the future world of students today.

The scenario planning methodology that was utilised to explore the future of irrigated agriculture in the Goulburn Broken Region can be applied in a number of disciplines, particularly when exploring issues related to the future sustainability of place or system – social, environmental and economic. Irrigation Futures also provided the basis for teaching and learning resources to support units in Victorian Certificate of Education (VCE) Geography, Agricultural and Horticultural Studies and Environmental Science.

Although this resource is about the Goulburn Broken Catchment in Victoria and addresses the Victorian curriculum guidelines, the teaching and learning materials in **Water and Food: futures thinking** can be adapted for use within the curriculum structures of other states. They provide examples and learning opportunities for use in sustainability education in the context of futures thinking or envisioning. The scenario planning methodology, modified for student use, can be adapted to explore a variety of issues and themes.

**Irrigation Futures of the Goulburn Broken Catchment** was the initiative of a small group of community leaders whose foresight recognised the need for the region to plan for the long term future. The aim of the project was to work with stakeholders to develop a vision and strategies for irrigated agriculture in the catchment (specifically the Shepparton Irrigation Region) over the next 30 years. Stakeholders involved in the project included Goulburn Broken Catchment Management Authority (GBCMA), Goulburn Murray Water (GMW), agriculture enterprise organisations particularly dairy and horticulture, Department of Sustainability and Environment (DSE), community landcare, local government and farmer organisations.

The project was undertaken over four years June 2003 to June 2007 during the time when the region experienced prolonged dry conditions for 10 years which still (late 2007) continue, making it the worst drought on record in the Goulburn Broken Catchment. The Irrigation Futures project has contributed to the Food Bowl Modernisation Project, another initiative coming out of the regional community in late 2006. The research findings of the Irrigation Futures and its outputs, including the scenarios, continue to inform the development of the Food Bowl Modernisation Project and strategic planning by government, land and water management agencies and the irrigated agriculture- based industry in the Region.

**Irrigation Futures of the Goulburn Broken Catchment** publications, including the scenarios in full and summary form, an explanation of the methodology and more detailed information about the catchment are available on the websites listed below.

- Department of Primary Industries (Victoria) [www.dpi.vic.gov.au](http://www.dpi.vic.gov.au) Select Victoria Resources Online then search for 'Irrigation Futures Goulburn Broken Catchment'
- Land & Water Australia [www.lwa.gov.au/](http://www.lwa.gov.au/) Search for 'Irrigation Futures Goulburn Broken Catchment'
- CRC for Irrigation Futures [www.irrigationfutures.org.au/](http://www.irrigationfutures.org.au/) Search for 'Irrigation Futures Goulburn Broken Catchment'

This curriculum resource, **Water and Food: futures thinking** and the associated teaching resources and fieldwork is available as pdf files on CD from LandLearn, Department of Primary Industries (Victoria). See page 2 for contact details. The fieldtrip explores eleven sites in the lower Goulburn Broken Catchment between Nagambie and Barmah Forest. Teachers can select the sites most relevant to the themes and issues they wish to address: irrigation, environmental flows, river and wetlands management and water quality, salinity. A "virtual fieldtrip" of some of the sites via PowerPoint is included on the CD.



## Curriculum Connections

### Victorian Essential Learning Standards

Use of the learning and teaching activities in **Water and Food: futures thinking** may contribute to achievement of elements of the Standards summarised in the Victorian Essential Learning Standards Domains and Levels box at the beginning of each activity. Indications of relevant Domains and Levels are provided to assist teachers to make decisions about the appropriateness of these activities for their students.

The following tables indicate key elements of the Standards for Level 6 that are addressed by activities. Teachers may adapt these activities to address Standards at other levels. Relevant activities are represented by activity number.

### Standards addressed at Level 6

Strand	Domain	Dimension	Key elements of standard Students ...	Activity number
Physical, personal and social learning	Civics and Citizenship	Civic knowledge and understanding	...explain how citizens influence government policy through ...interest groups ...take a global perspective when analysing an issue...	2 3
		Community engagement	...draw on a range of resources, including the mass media to articulate and defend their own opinions about political, social and environmental issues in national ...contexts. ...contest, where appropriate, the opinions of others. ...develop an action plan which demonstrates their knowledge of an environmental issue and suggest strategies to raise community awareness of it. ...participate in ...citizenship activities ...at school and in the local community.	1 2 3
Discipline-based Learning	The Humanities - Economics	Economic knowledge and understanding	...describe how markets, government policies, enterprise and innovation affect the economy, society and environment in terms of economic growth, use of resources...and ecological sustainability. ...predict the economic consequences of proposed government policies and make informed choices among alternative public policy proposals. ...analyse vocational pathways and education and training requirements...	1 2  3  4
		Economic reasoning and interpretation	...use relevant economic concepts and relationships to evaluate ...and debate the costs and benefits of contentious economics related issues of local and national concern. ...explain how current economic conditions can influence decisions made by ...producers and government policy makers.	2 3

	The Humanities - Geography	Geographic knowledge and understanding	<p>...explain the operation of a major natural system and its interaction with human activities.</p> <p>...evaluate the consequences of the interaction and develop a policy to address an issue related to it.</p> <p>...analyse development issues and formulate and evaluate comprehensive policies, including for sustainable use and management of resources, to alter development patterns at a range of scales.</p> <p>...use evidence based on inquiries and geographical language and concepts.</p>	1 2 3
	Science	Science knowledge and understanding	...use a specific example to explain the sustainable management of a resource	2
		Science at work	<p>...describe the science base of science-related occupations in their local community</p> <p>...use the relevant science concepts and relationships as one dimension of debating contentious...science related issues of broad community concern.</p> <p>...provide examples of the work of scientists that demonstrate different approaches to developing scientific knowledge or solving a scientific problem.</p>	<p>4</p> <p>2 3</p> <p>4</p>
	Thinking Processes	Reasoning, processing and inquiry	<p>...discriminate in the way they use a variety of sources.</p> <p>...generate questions that explore perspectives</p> <p>...complete activities focusing on problem solving and decision making which involve a wide range and complexity of variables and solutions.</p> <p>...employ appropriate methodologies for creating and verifying knowledge in different disciplines</p> <p>...make informed decisions based on their analysis of various perspectives and sometimes contradictory information.</p>	2 3 4
Interdisciplinary Learning		Reflection, evaluation and metacognition	<p>(when reviewing information and refining ideas)...explain conscious changes that may occur in their own and others' thinking and analyse different perspectives...</p> <p>Explain different methodologies used by different disciplines to create and verify knowledge</p> <p>Use specific terms to discuss their thinking, select and use thinking processes and tools appropriate to particular tasks and evaluate their effectiveness.</p>	2 3 4

## Victorian Certificate of Education

Use of the learning activities and teaching materials in this resource may contribute to addressing elements of the outcomes in the VCE Units listed below. Curriculum Connections and Notes for Teachers are provided at the beginning of each activity to assist teachers make decisions about the appropriateness for their students.

Subject	Unit	Area of Study	Outcome ...students should be able to...	Activity
Geography	1: Natural environments	2. Changes in natural environments	...analyse and explain changes in natural environments due to natural processes and human activity.	1 2
	2: Human environments	2. Changes in human environments	...analyse and explain changes due to human activities in rural and urban environments.	1 2
	3: Regional resources	1. Use and management of an Australian water resource	...analyse the use and management of water within the Murray-Darling Basin region and evaluate its future sustainability.	2
Agricultural & Horticultural Studies	3: Technology, innovation and business design	1. Current Technology	...discuss a range of technologies commonly used in agricultural and / or horticultural businesses and by a specific business; and the relationship between decision making and the application of technology that may affect outputs of a business.	2
		2. New and emerging technology	...describe the range and evaluate the predicted impact of innovations that are likely to affect a specific agricultural and / or horticultural business in the near future.	2 3
	4: Sustainable management	2. Sustainability in agriculture and / or horticulture	...evaluate resource management practices within agriculture and / or horticulture.	2 3
		3. Resource management and maintenance	...apply and analyse the concepts of sustainability to resource management in agricultural and / or horticultural businesses.	2
Environmental Science	1: The environment	2. Environmental change	...analyse one human induced environmental change and options for remediation.	2 3
	4: Ecological sustainability	2. Applied environmental science	...use the principles of ecologically sustainable development and environmental management to evaluate a selected environmental science project.	2 3

## National and other states

The **National Goals for Schooling in the Twenty-first Century** (Adelaide Declaration 1999) includes the statement that when students leave school they should ... "have an understanding of, and concern for, stewardship of the natural environment, and the knowledge and skills to contribute to ecologically sustainable development." It is recognised that futures thinking or envisioning is an important element of learning about sustainability, and so helps students to develop the understanding and skills they need to contribute to a sustainable future.

Although this resource is about the Goulburn Broken Catchment in Victoria and addresses the Victorian curriculum guidelines, the teaching and learning materials in **Water and Food: futures thinking** can be adapted for use within the curriculum structures of other states. They provide examples of and learning opportunities for futures thinking or envisioning. The scenario planning methodology, modified for student use, can be used to explore a variety of issues and themes.

Teachers in other states are welcome to adapt the learning and teaching materials in this resource to address elements of the curriculum guidelines and standards specific to your state, providing due acknowledgement of the source of the materials is given.

Please note that this document is one of three parts that are contained on the CD **Water and Food: futures thinking**. Teachers and others who want the Teaching Resources section and / or the fieldtrip need to contact LandLearn for a copy of the CD. The Teaching Resources include fact sheets on irrigation systems, additional career profiles for Activity 4, and A4 size versions of the maps included on pages 14-21 for classroom use.

**NSW LandLearn** is accessible on [www.dpi.nsw.gov.au/](http://www.dpi.nsw.gov.au/) Search for LandLearn

Schools in the southern region of NSW can arrange to visit Murrumbidgee Rural Studies Centre (MRSC) where fieldtrips focused on irrigation in that region can be arranged. MRSC has accommodation facilities on site. For further information, see [www.mrsc.nsw.edu.au/](http://www.mrsc.nsw.edu.au/) or follow the link 'face to face' on NSW LandLearn website.

# Introduction

## Scenario planning

Scenario planning is an approach to strategic thinking about the future. Scenarios are a way of describing alternative, plausible futures based on different combinations of facts, trends and informed assumptions. Scenario planning is not about predicting the future but a tool to help plan and prepare for it.

A series of scenarios or 'stories' provides different views on the same general topic and by considering all scenarios together, an organisation, community or group with common purpose can better understand and explore the options, opportunities and issues.

Depending on the context, the process engages participants in identifying and reviewing the trends and drivers that are likely to influence or impact on their vision for the future, their work and / or their personal and community lifestyles. Questions might be posed to help the community or organisation identify and articulate their vision or what they want the future to look like. The relative importance of different drivers and influences is assessed, as is the degree of likelihood that they will occur. The consequences of a driving force or an influence can be explored by mapping its causes and effects using tools such as a futures wheel (see Activity 3). Out of these explorations, stories (usually four) of alternative but plausible futures can be written.

When considered together, these scenarios help participants or stakeholders to better understand their options and opportunities, and the organisation or community can then use the scenarios to plan strategically for the future from an informed and shared basis.

In the context of Environment Education, scenario planning can be used as part of a suite of futures thinking tools to explore the concept of sustainability and what that means to people as individuals and as members of different communities – school, workplace, organisation, local, global. For further information and resources on futures thinking in Environment Education see Tilbury, D. and Cooke, K. (2005) **A National Review of Environmental Education and its Contribution to Sustainability in Australia: Frameworks for Sustainability.**

Scenario planning is increasingly used by corporate, industry and government organisations in their strategic planning. It was developed by the Royal Dutch Shell Company during the late 1960s and early 1970s enabling it to respond rapidly to the oil shocks of the early 1970s and grow to one of the largest oil companies in the world. Governments have also used scenario planning to plan infrastructure and the development of communities and economies. In Singapore and the Netherlands, scenario planning is a coordinated, whole-of-government activity providing coherence and direction to future thinking. More locally and recently it has been applied in a project based in the Goulburn Broken Catchment.

## Regional scenario planning in practice: Irrigation futures in the Goulburn Broken Catchment

Irrigated agricultural industries underpin the prosperity of the Goulburn Broken Catchment, a *region* facing major challenges currently and in the near future:

1. Prolonged drought and the trading of water have resulted in the use of much less irrigation water within the *region* than previously.
2. The extensive irrigation infrastructure is old, dated in design and in need of replacement or of phasing out.
3. A less favourable international trade environment puts pressure on the viability of agricultural businesses.

Following community concern for the future of irrigation in the *region*, the Goulburn Broken Irrigation Futures project was established to facilitate strategic conversations and to better prepare the *region* for the challenges it faces in the future. The project adopted a scenario-planning approach to achieve the following objectives:

- A shared vision for the future of irrigation in the Goulburn Broken Catchment over the next 30 years, and four scenarios of major constraints and opportunities and response options
- Understanding of the social, economic and environmental consequences of various scenarios through impact assessment that integrates the best available knowledge
- Key stakeholders reaching consensus on preferred options for future irrigation, and recommending follow-up actions
- A methodology that can be applied elsewhere in Australia for sustainable irrigation planning at a catchment scale.



The main features of scenario planning used in the Irrigation Futures project are:

1. **Stakeholder participation.** Considered critical to the success of the project, it “broadens the ‘scientific’ view of systems, utilises local knowledge, considers stakeholder values, and increases the ownership of planning outputs and develops the capacity of the stakeholder community to respond to change and partake in community activities”. [Note that this feature is also considered vital in the Environment Education context.]
2. **Systems analysis.** Irrigation in the *region* is very complex. The issues are many and varied with complicated connections within and outside the catchment. Systems analysis was used to explore the scenarios in two contexts: one in which the region does have influence and the other which is beyond the region’s power to influence.
3. **Integration into strategic planning of key stakeholder groups.** Adoption of the outcomes was an important measure of the project’s success. Because the findings are broad strategic ideas, the means of implementing them at a practical level had to be demonstrated. A series of targeted investigations of specific issues with key stakeholder groups examined how different organisations could best prepare for the challenges and opportunities described in the scenarios. These investigations were timed to coincide with the organisations’ strategic planning activities, for example the investigation into implications for catchment management coincided with the review of the Shepparton Irrigation Region Catchment Strategy.

*Source: Irrigation Futures of the Goulburn Broken Catchment Final Report 2 – Regional scenario planning in practice: Irrigation futures of the Goulburn Broken Region. (2007) Department of Primary Industries*

Activities in this curriculum resource explore the Irrigation Futures scenarios, their implications for the *region* and for the broader Victorian and Australian communities, through the availability of food for example. Water management is an issue that affects everyone in some way so an understanding of the possible futures for irrigated agriculture might inform other investigations related to water management that students undertake.

The scenario planning process can be adapted for use in the classroom as a learning tool or used in school programs for sustainable futures. Some schools may have teachers, principals and / or students who participated in Open Book Scenarios Teaching for Uncertain Futures. See References below for further information.

## References and resources for teachers about scenario planning

### Print

Bateman, D. *Futures Education and the promise of VELs* in **EINGANA** – Journal of the Victorian Association for Environment Education Vol. 28, No 2, August 2005

O'Brien, P. (2000) **Scenario Planning: A Strategic Tool**. Bureau of Rural Sciences, Kingston, ACT

Tilbury, D. and Cooke, K. (2005) **A National Review of Environmental Education and its Contribution to Sustainability in Australia: Vol 1 Frameworks for Sustainability band Vol 2 School Education**. Australian Government Department of the Environment and Water Resources and the Australian Research Institute in Education for Sustainability (ARIES)

### Internet

**Education for Sustainability (EfS) Portal** <http://www.aries.mq.edu.au/portal/index.htm> > Key EfS docs > Understand EfS > Envisioning

The site contains links to a range of print and web-based resources for futures thinking and other relevant sustainability education resources. The portal has been developed by Australian Research Institute in Education for Sustainability (ARIES)

**The Future Belongs to Those Who...a guide to thinking about the future** download from <http://www.altfutures.com/docs/FuturesTechniques.pdf>

The seven page document provides useful summaries of different futures thinking techniques.

## Related LandLearn resources

Creating Sustainable Futures A joint project between LandLearn and McDonagh Design, Creating Sustainable Futures is an innovative approach to teaching and learning sustainability. It includes OBLIQUE inspirations, a tool for creative thinking that has direct relevance and application in futures thinking.

See [www.landlearn.net.au](http://www.landlearn.net.au) for further information



# The Goulburn Broken Catchment

## Introduction

To set the scene and provide a context for the learning and teaching activities contained in the resource, this section describes and gives a perspective on the current conditions in the Catchment, particularly in the Shepparton Irrigation Region or Lower Catchment. It includes some of the factors, both natural and human, that have influenced the present situation.

## Goulburn Broken Catchment

The Catchment has an area of 2.4 million hectares, or 10.5% of Victoria. It provides 11% of the Murray Darling Basin's stream flow, although it occupies only 2% of the Basin land area. The source of the Goulburn River is *located* in the Great Dividing Range near Woods Point, south of Mt Buller. The river flows a *distance* of 500km in a north westerly direction to its confluence with the Murray River 10km north east (upstream) of Echuca. The Broken River, a major tributary, flows into the Goulburn at Shepparton.

## Administrative boundaries

Figure 1 shows the catchment management zones and irrigation delivery areas in the *region*. The Goulburn Broken Catchment Management Authority (CMA) administers the catchment in three *regions*: the Upper Goulburn Region; the Mid Goulburn Region; and the Shepparton Irrigation Region (SIR). The boundary of the Shepparton Irrigation Region is defined by the irrigation delivery areas and extends west beyond the boundary of the Goulburn Broken Catchment to include all of the Rochester irrigation area which is in the Campaspe Loddon catchment of the North Central CMA.

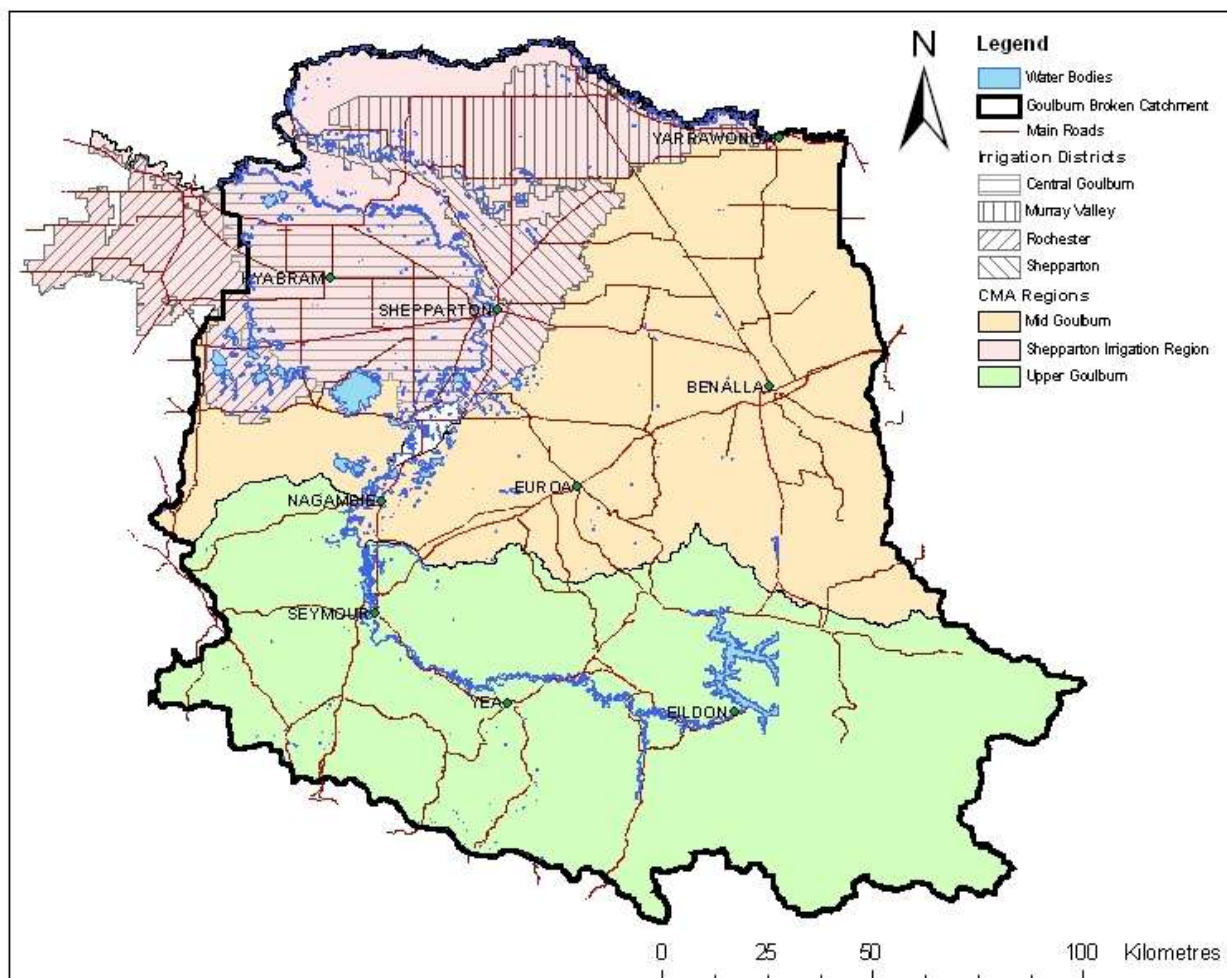


Figure 1 Catchment management and irrigation districts *located* within the Goulburn Broken Catchment.

## Climate - Rainfall

Rainfall varies considerably across the Catchment, with average annual totals ranging from 430 mm in the far north-west of the Catchment to 1700 mm in the south-east. Rainfall variation is also significant. Figure 2 illustrates the variability of rainfall for Tatura, in the north-west of the Catchment and Lake Eildon, in the south-east. Pan evaporation is less variable than rainfall, with average annual pan evaporation varying from 1000 mm in the south to 1500 mm in the north. Over the past decade (1997-2007), the *region* has experienced below average annual rainfall and above average pan evaporation in the majority of years. Figure 2 also shows the seasonality of rainfall and pan evaporation in the *region*. Pan evaporation is highly seasonal with peak rates occurring during summer, while the seasonality of rainfall is lower, with monthly totals highest during the winter and spring. This seasonality highlights the importance of irrigation to the SIR.

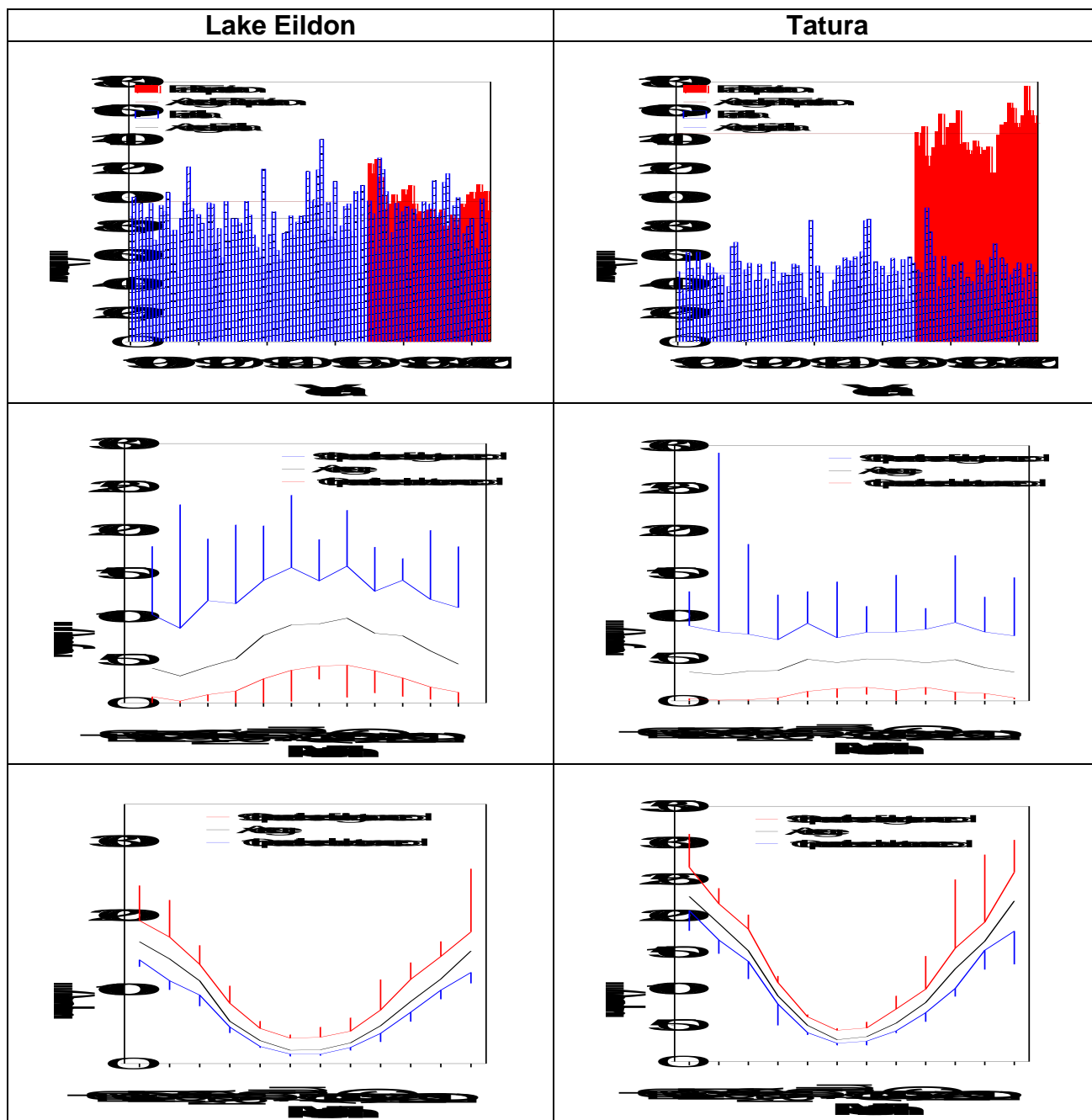


Figure 2 Historical rainfall and pan evaporation for two sites *located* in the Goulburn Broken Catchment (Source: Bureau of Meteorology)

## Temperatures

Temperatures in the Catchment vary with topography. The average summer maximum temperatures are often around 30°C, even warmer in the north but much cooler in the south eastern high country. During winter, average maximums are approximately 13°C in the north and 4°C in the high country. The number of days with a minimum temperature of less than 1°C is significant for fruit production in the SIR as some varieties of fruit have a chilling requirement in the dormant phase (winter) to flower and set fruit properly.

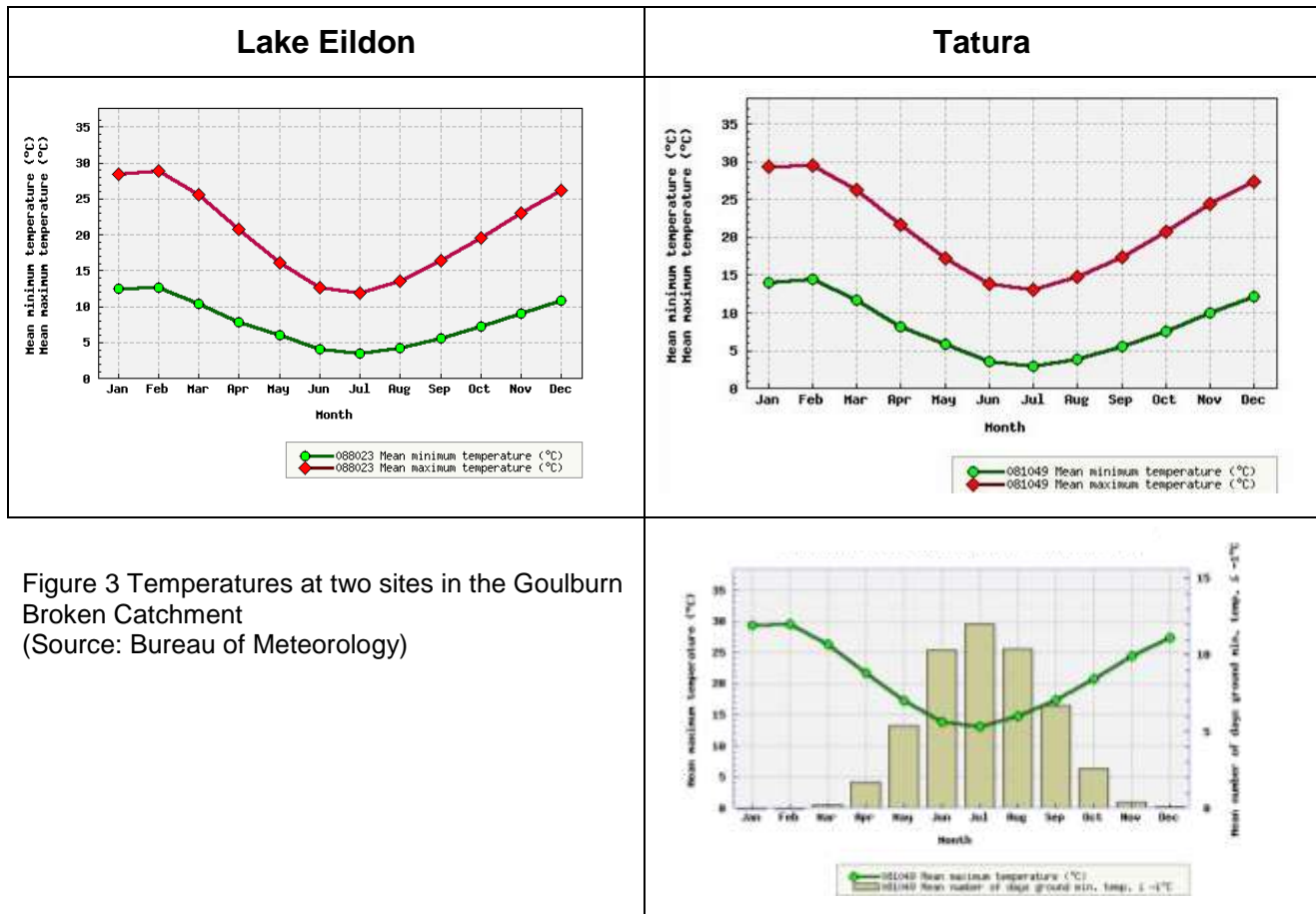


Figure 3 Temperatures at two sites in the Goulburn Broken Catchment  
(Source: Bureau of Meteorology)

## Irrigation

The majority of irrigation water used in the catchment is applied in the Shepparton Irrigation Region with approximately 317 000 hectares of the 500 000 being intensively irrigated. Depending on seasonal allocations the SIR uses about 1.5 million megalitres of water annually, representing 40 to 45% of all water used for irrigation in Victoria. The irrigation water is *distributed* through publicly-owned, constructed infrastructure. The network of open, earthen channels within the *region* is extensive, enabling delivery to all irrigation properties. However, much of this infrastructure is ageing and will require replacement over the next 20 years. Groundwater is an important water source for many users in SIR. The *region* has over 1 100 bores licensed to pump 45 000 megalitres per year.

In the Mid and Upper *regions*, irrigation water is predominantly diverted from rivers and streams by the landholders who have licensed allocations.

## Land Soils

The Region has a wide diversity of soil types. In the SIR, the majority of soils originate from sediments deposited by riverine and Aeolian (wind borne) processes. In the higher parts of the catchment, the diversity of soils is much greater due to the steeper topography, higher rainfall and different parent materials. Many of the soils are highly suitable for agriculture if the inherent characteristics of sodicity and acidity are carefully managed. The SIR Catchment Strategy

recognises the need for better understanding of soil health and integrated management in relation to habitat management, soil biodiversity and the impact of acidic soils on increasing acidity of waterways, for example.

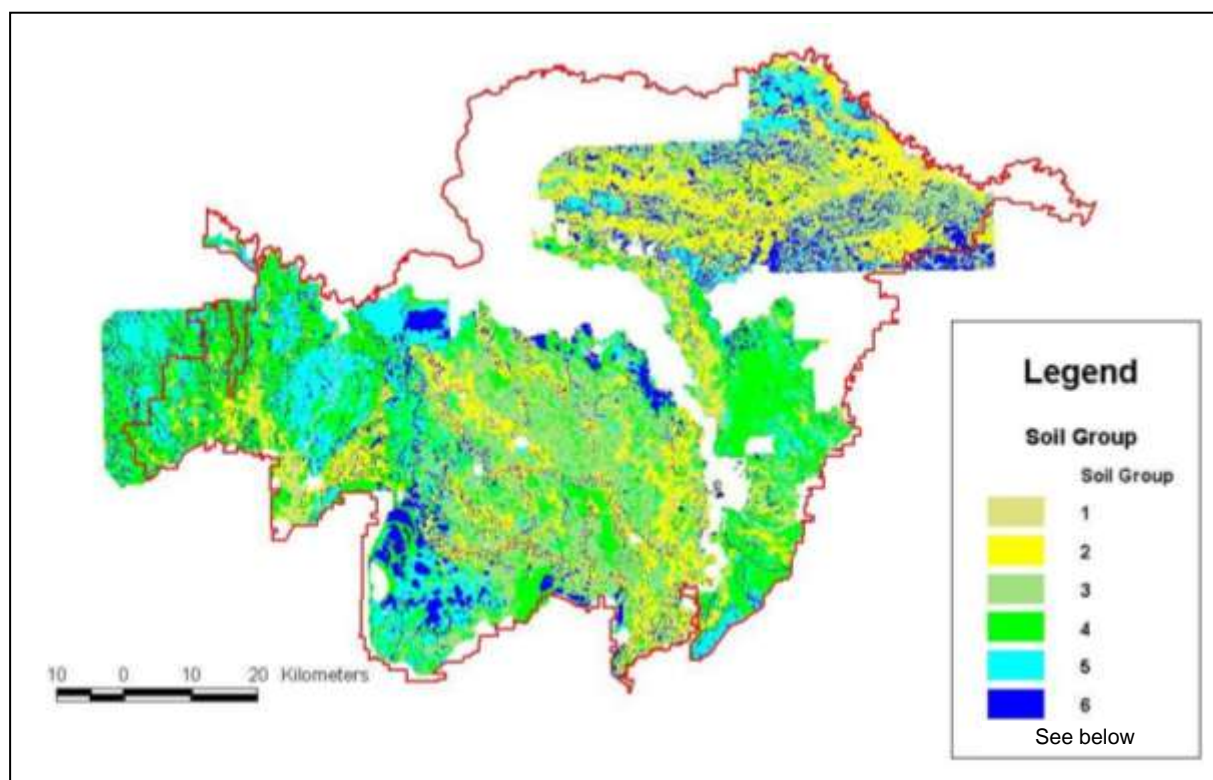


Figure 5 Soils of the Shepparton Irrigation Region

## Soil Groups

Soils with similar land use capabilities are grouped in 6 soil groups designed primarily for giving an indication of crop suitability of soils. Groups 1 and 2 soils are light, sandy loams requiring sound irrigation management and good practice to water the crop root zone and minimise seepage through the soil profile. Groups 3 and 4 are loams and clay loams and Groups 5 and 6 soils are the heavier clay loams and clay soils. Topographically, Group 1 soils are *located* at the highest parts of the landscape, and Group 6 soils at the lowest parts of the landscape.

Group 1: Very good soils, if given careful irrigation management, for horticulture crops, vegetables, tomatoes ... Summer fodder crops, cereals, lucerne, and perennial and annual pastures...

Group 2: Good soils for all horticultural crops (except citrus), pumpkins, peas, tomatoes, summer fodder crops, cereals, lucerne, and perennial and annual pastures.

Group 3: Good soils for apricots, apples, pears, plums, summer fodder crops, cereals and perennial and annual pastures; fair soils for peaches tomatoes, pumpkins, peas, beans and lucerne.

Group 4: Fair soils for pears and plums; good soils for summer fodder crops, cereals and perennial and annual pastures.

Group 5: Pears, plums and perennial pastures can be grown only if well drained; summer fodder crops, cereals and annual pasture can be grown.

Group 6: Soils not recommended for irrigation because of swampiness or uneven surface features

Source: Soil Surveys of Shepparton Irrigation Region (2000) Department of Natural Resources and Environment

## Settlement

European settlement in the Goulburn Valley began with squatters occupying large areas of land and grazing sheep. More formal settlement began following the Selectors Act of 1868 which allowed selections of up to 320 acres (130 hectares). However these farms were too small for



profitable agriculture, particularly during the drought of the late 1870s, and within 20 years only one in 10 of the original settlers remained (Barr and Cary 1992).

With the development of irrigation, further legislation in the early 20<sup>th</sup> century enabled schemes which broke up large landholdings into smaller blocks suitable for intensive irrigated agriculture. The size of these blocks varied according to land use suitability, with blocks of 35 acres (14 ha) offered in areas suitable for fruit production, 20 to 100 acres (8-40 ha) for dairy production and 100-200 acres (40-80 ha) for mixed farming operations. These blocks are the basis of land parcels used for agriculture today, with both advantages and disadvantages. The mixed sizes of land parcels make the *region* attractive to a wide range of agricultural businesses; however the diversity in size also constrains the ability of some agricultural businesses to grow.

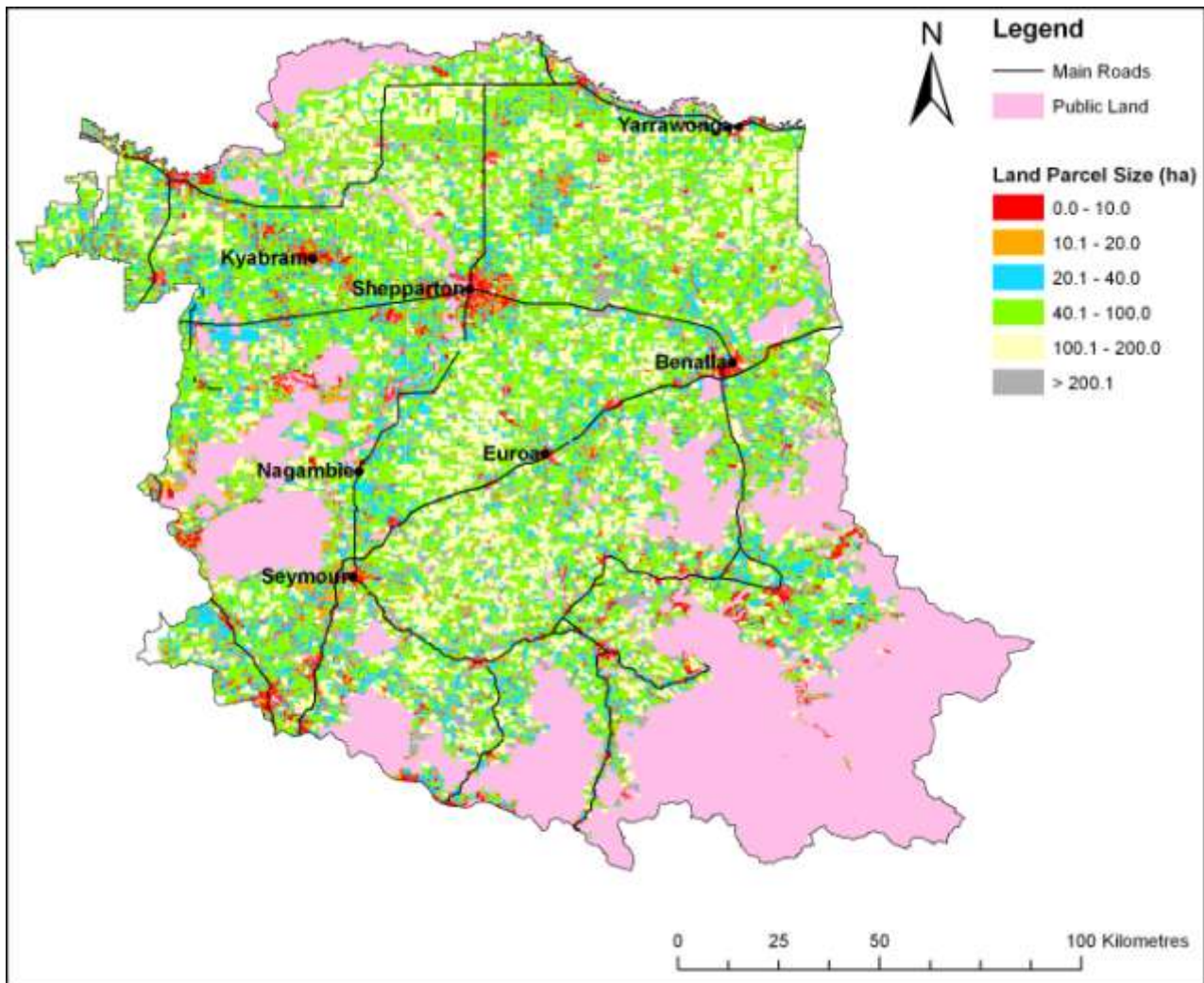


Figure 6 Land parcel size in the Goulburn-Broken catchment

There is *spatial association* between land parcel size and land use. Land holdings of less than 10 hectares increasingly tend to be lifestyle properties, concentrated around towns, water bodies and other areas with attractive landscape, recreation values or *distance* to Melbourne or regional centres. Farm size is changing as small farmers leave the industry and others increase the farm size to remain viable. The average size of dairy farms in the *region* is 165 ha and increasing.

### Land use

The majority of irrigated agriculture in the catchment occurs in the Shepparton Irrigation Region where land use is diverse; however a few major agricultural industries use the majority of the land. The dairy industry uses the most land, followed by fodder and grain production and livestock production. The available data (see Table 1) suggest that the area used for fodder and grain production increased between 1996-1997 and 2004-2005, while the area of land used by other industries decreased.

Table 1 **Land use of the Shepparton Irrigation Region (ha)**

Industry	1996-1997	2004-2005
Dairy	210 997	185 883
Horticulture	21 144	16 707
Livestock production	99 102	74 384
Fodder and grains	115 158	166 498
Lifestyle*		21 805
Total	446 401	465 277

\*Category introduced in 2004-2005

(Source: Douglass *et al.* 1998; McAllister 2005)

## Economy

The economic strength of the Catchment is its natural resource based farm, forestry and fisheries industries. These primary industries provide the raw materials to the secondary industries based mainly within the Catchment: food processing and packaging, feed milling, timber product manufacturing and fibre processing. In addition, the natural resource based tourism industry attracts a high level of investment and contributes to regional wealth.

Agriculture is a significant contributor to the regional economy. Between 1996 and 2005, the farm-gate value of agricultural production increased 42 percent, or approximately four percent per annum, from \$1.17 billion to \$1.67 billion. Dairy production is the largest single contributor, followed by livestock slaughter and fruit production. All industries, with the exception dairy and wool, experienced growth between 1996 and 2005. The wool industry has been influenced by declining global demand and prices for wool since 1990 (ABARE, 2005). The dairy industry in the region contracted significantly in 2002-2003 due to dry conditions and low irrigation water availability. It began a slow recovery during 2005-06 but is currently experiencing further contraction due to on-going drought in 2007.

Table 2 **Contribution of primary industries to the farm gate gross value of production, Goulburn Broken Catchment 2001**

Industry	%
Milk production	34.5
Livestock slaughtering	21.5
Fruit excluding grapes	14.3
Cereals for grain	5.9
Pastures and grasses	5.2
Vegetables	5.1
Wool	3.6
Forestry	3.3
Other primary industries (grapes, aquaculture and other smaller industries)	6.7

Source: Socio-Economic Profile of the Goulburn Broken Catchment including all of SIR

## Shepparton Irrigation Region - the “food bowl”

The Shepparton Irrigation Region is known as the “Food Bowl” of Australia with agriculture production valued at \$1.24 billion (Farm Gate Value of Agricultural Production 2003-04). The SIR produces 25% of Victoria’s economic earnings and the total economic output was calculated at \$6.2 billion 2003-04). The main agriculture industries are fruit production, dairying and cropping. Agriculture is becoming more efficient and more intensive, with production levels doubling every 10 years while the area of land used for agriculture is decreasing. Synergies (*spatial association and spatial interaction*) exist between many of the agricultural industries in the Region, for example, the dairy industry relies heavily on the hay and grain production.

## Manufacturing and food processing

*Spatial association and spatial interaction* occur between agriculture industries, particularly dairying and horticulture and the food processing and packaging industries so manufacturing in the Goulburn Broken Catchment is concentrated in the SIR. Timber processing occurs mainly in the upper Catchment and wine making is found in concentrated *locations* across the Catchment.

Table 3 **Estimated value of the food processing and manufacturing sector, \$M**  
**Goulburn Broken Catchment**

	<b>2001</b>	<b>2005*</b>
Dairy processing	\$1 590.6	\$1 611.2
Fruit processing	\$502.8	\$509.3
Meat processing	\$128.8	\$130.5
Vegetable processing	\$218.2	\$221.1
Wine	\$31.8	\$32.2
Other food manufacturing	\$12.2	\$12.4
Wood & paper manufacturing	\$169.0	\$174.1
Other manufacturing	\$14.1	\$14.5
<b>Total manufacturing</b>	<b>\$2 667.5</b>	<b>\$2 705.3</b>

\* estimated using Australia’s rate of growth ABARE 2005

Source: Socio-Economic Profile of the Goulburn Broken Catchment including all of SIR

## Population

The Catchment has a population of 203,000 (2005 estimate based on 2001 census and *Victoria in Future* 2004 DSE) with 126,430 people living in Shepparton Irrigation Region (SIR).

The Goulburn Broken *region* is culturally diverse. While only 10 percent of the population was born outside Australia, over 23 percent of the population have at least one of their parents born overseas (Australian Bureau of Statistics 2002). This cultural diversity has attracted new migrants to the area who have brought new ideas with them so helping the *region* develop a strong culture of innovation. Recent arrivals include families from Africa (Congolese particularly) and Iran and Iraq in the Middle East.

## Community support

The Catchment’s community is active and people are generous with their time and money. A recent survey of Victorian communities found that levels of voluntary activity and participation in organised community groups in the *region* were higher than the state wide average (Department for Victorian Communities 2005). Many members of the community are concerned about the local environment, evident in the membership and participation in landcare and other environmental organisations.



## Institutional support

The *region* has a wide range of institutions that encourage and support the development of the Catchment. The *region's* industries and professions are well organised. A network of active industry and professional associations provides a public voice for agricultural industries and supports industry development activities.

Many state and federal government agencies are *located* in, and have active programs to support the *region*, including research and extension activities for agricultural industries and a limited range of related educational institutions and courses. There are ten local governments that actively encourage the development of the *region*. All of these agencies are relatively mature and work together co-operatively, providing certainty for investment.

## Environment

There is a diversity of environments across the Catchment. While large areas of the *region* have been cleared of natural vegetation, some parts have extensive native vegetation cover, particularly riparian zones and the mountainous areas of the upper Catchment. These *locations* are attractive for tourists and lifestyle residents. There is a large number of wetlands and waterways, the most significant being Barmah Forest where the Lakes are a Ramsar wetland. Many of the wetlands have environmental water allocations, although these are relatively small.

Impact of human activity on the environment over the past 150 years has resulted in issues that affect the sustainable management of the natural resources of the *region*. Loss of native vegetation and habitat, water quality of the rivers and streams and salinity are issues that have been the focus of management strategies and action, particularly since the late 1980s. Over the past decade, prolonged dry conditions and the severe drought have highlighted the impact of climate change and the need to manage water resources more sustainably for the future of irrigated agriculture and food production, as well as for the environmental and for urban, industrial and recreation use.

## Salinity

Historically, salinity has been identified as a threat to agricultural production in the Catchment, particularly in the Shepparton Irrigation Region. First evidence of salinity problems emerged in the late 1920s following severe floods, particularly in areas of poor drainage (Barr and Cary 1992). Surface drainage programs were not seen as a priority during the initial development of irrigation infrastructure. Periodic efforts at providing surface drainage have been made, starting in the Depression of the 1930s. By the 1950s it became apparent that surface drainage alone would not provide a complete solution to salinity and water logging problems, and investigations into the use of subsurface drainage began. Since 1990, the Shepparton Irrigation Region Land and Water Management Plan has accelerated the rate of implementation of salinity management infrastructure, particularly through community surface drainage and private groundwater pumping programs. Surface and subsurface drainage is now in place in many parts of the Shepparton Irrigation Region. See Figure 7.

A *regional* watertable monitoring program was also established as a part of the Land and Water Management Plan to help identify the areas at risk of salinisation. This monitoring has shown that between 1995 and 2005 the area of shallow watertable decreased substantially (see Figure 7) due to several factors, including the effects of management plan works, a dry climate sequence and water trade.

Notes:

The 1996-1997 irrigation season was the most recent time when full (100%) water allocations were available across the entire Goulburn Broken Catchment.

Water trade over recent years has resulted in irrigation water leaving the *region* as the purchasers of large volumes of water have been managed investment schemes *located* further down the Murray Valley in the Mallee and Mildura *regions*. As a result less irrigation water has been applied in the SIR.

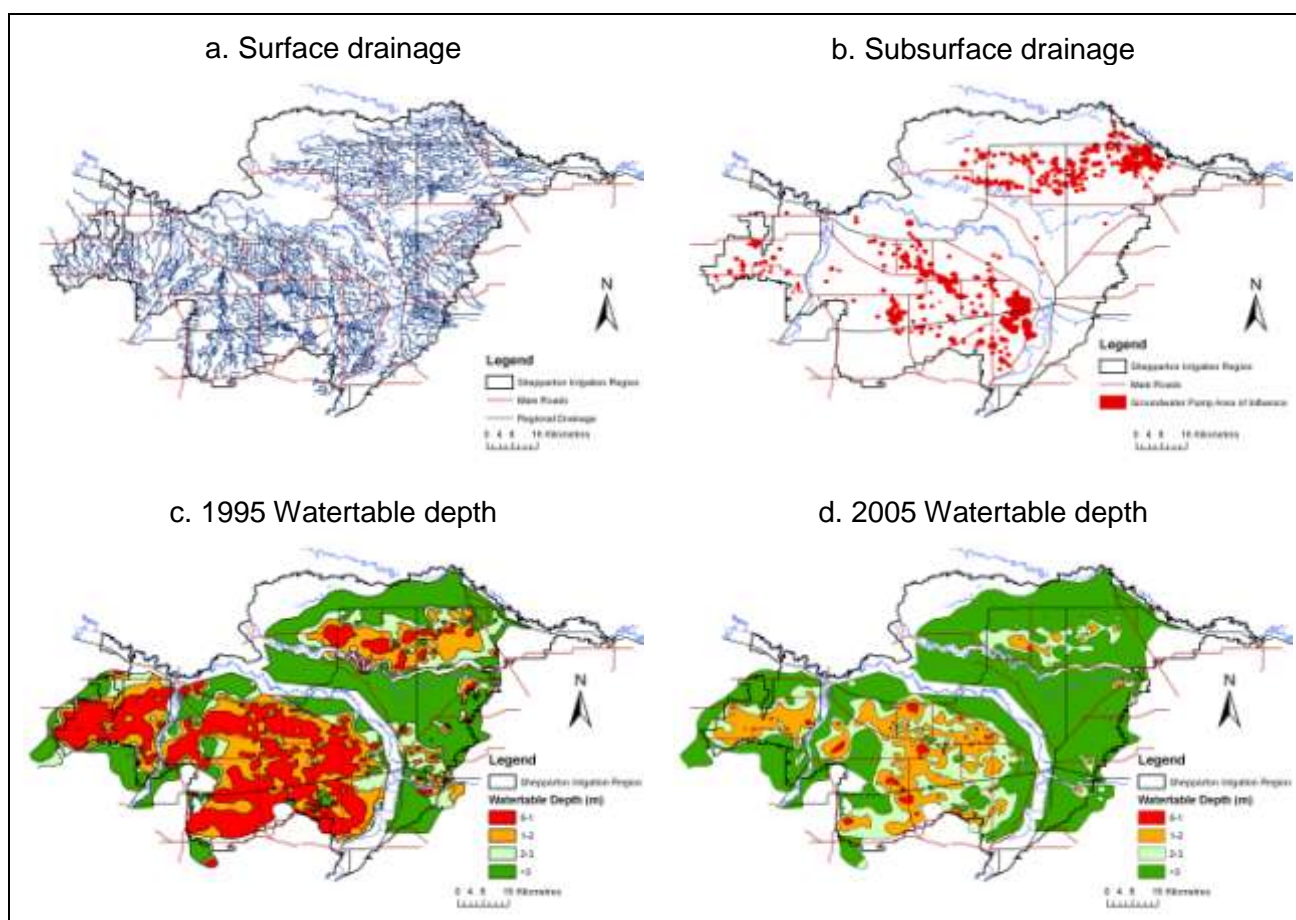


Figure 7 **Salinity and drainage in the Shepparton Irrigation Region**

Note: These maps are available in A4 size for classroom use in the Teaching Resources section of the CD Water and Food: futures thinking

Increasing evidence of land salinisation throughout the Murray Darling Basin and forecast increases in river salinity led to the formation of the Murray Darling Basin Commission (MDBC) in the mid 1980s. To manage the emerging salinity problems, the 1988 MDBC Salinity and Drainage Strategy placed constraints on the disposal of saline drainage water to the Murray River. These constraints mean that any new drainage works installed in the Region need to be offset by salinity credits, which can be obtained by providing financial support for salinity reduction works.

Salinity is one of the environmental issues addressed by the Catchment Strategies in the Goulburn Broken. It is addressed briefly here because of the *spatial interaction* with irrigation. Resources for students addressing salinity and other issues, and the Catchment generally are listed at the end of Activity 1.

## The Future

The regional community recognises there are many challenges in the future. The key to a sustainable future will be finding the balance between the competing needs of the environment and agriculture for a diminishing water resource. Climate change and its impact is not yet fully understood but it does change the way we consider water as a renewable and sustainable resource; and it reinforces the importance of the community working together to find new ways of farming and managing the environment.

## References

ABARE (2005) **Australian commodity statistics 2005**. Australian Bureau of Agricultural and Resource Economics Canberra.

Barr N and Cary J (1992) **Greening a brown land: The Australian search for sustainable land use** Macmillan Education Australia: South Melbourne

Douglass W, Poulton D, Abuzar M and Morris M (1998) **Results of the Irrigated Farm Census 1997**. Goulburn-Murray Water: Tatura.

Robertson D, Wang Q.J, Soste L, and Chaffe R. (2007) **Scenarios of the future: Irrigation in the Goulburn Broken Region** Department of Primary Industries

**Shepparton Irrigation Region Catchment Strategy Update 2003** (2003) Goulburn Broken Catchment Management Authority

**Socio-Economic Profile of the Goulburn Broken Catchment** (2006) Goulburn Broken Catchment Management Authority

# Activity 1: Setting the Scene: Goulburn Broken Catchment

## Curriculum Connections

Use of this learning and teaching activity may enable students to demonstrate elements of the Standards or VCE outcomes. Indications of relevant Victorian Essential Learning Standards Domains and Levels, and the VCE subjects and outcomes are provided to assist teachers make decisions about the appropriateness of the activity for their students.

Refer to Curriculum Connections pages which describe the relevant elements of standards and outcomes in greater detail.

### VCE

Geography Unit 3 (see Notes for Teachers)  
**Victorian Essential Learning Standards**  
**Domains and (Levels):**  
Geography (6)

**Duration:** 1-6 hours.

**Setting:** The classroom

## Summary

This activity is designed to provide students with knowledge of the Goulburn Broken Catchment so they have the necessary context for other activities in this resource and the related learning and teaching materials.

## Student outcomes

Students will be able to:

- *Locate* and map key natural and human geographic features of the region
- Describe the geographic characteristics of the *region* and *distribution* patterns, particularly relating to irrigation
- Identify the human activities that have impacted on the natural processes and contributed to *change over time* in the *region*

## Background notes for teachers

Use of the different parts of this activity will depend on students' prior learning about Goulburn Broken Catchment and how you wish to use other activities in this resource. Note that most of the activity focuses on the lower catchment or Shepparton Irrigation Region because of the irrigation theme of this resource. The questions may need to be extended if you want students to look at the whole catchment in the same depth. VCE Geography Unit 3 classes may find Activities A and B useful as pre-fieldtrip preparation or an introduction to irrigation as a major use of water in the Murray Darling Basin.

## Materials

- Atlases
- Copy of outline map of Goulburn Broken Catchment for each student
- Internet access and / or print resources about the Goulburn Broken Catchment (See Resources section) and / or multiple copies of 'The Goulburn Broken Catchment' pages 13-22



## Activities

### A. Mapping the Goulburn Broken Catchment

See Student Worksheet. If you intend students to use their maps for Activity C, this may need to be explained first so they consider their poster layout.

### B. Twenty Question Quiz

1. Work through the quiz with the whole class, perhaps in 2 or 3 teams, to see how many questions can be answered from prior learning and general knowledge.
2. Divide the remaining unanswered or partly answered questions between pairs or small groups of students (maybe based on the teams) to research the answers then bring class together for sharing.

### C. Goulburn Broken Catchment poster or presentation

- 1) Students prepare a poster or ICT based presentation to summarise their knowledge and research of the Catchment. The map from Part A could form the basis of their posters with point form summaries, small maps and images around it.
- 2) Students could work in pairs or groups and focus on different geographic characteristics, features or *distribution* patterns then present to the class.
- 3) Posters or presentations could address some or all of the following:
  - Topography or landform
  - Vegetation
  - Climate
  - Natural water courses and wetlands
  - Irrigation water distribution and use
  - Agriculture systems
  - Environmental issues, eg. salinity
  - Population distribution and settlement pattern
  - Transport networks
  - Other suggestions from students and discussion
- 4) Encourage students to summarise their information under each sub-heading into 3 to 5 dot points.
- 5) Present and / or display the posters for reference while using other activities in this resource.

## Resources

### Internet

**Victorian Resources Online** <http://www.dpi.vic.gov.au/dpi/index.htm> > Victorian Resources Online

The Catchment Regions are listed on the VRO home page. The site provides comprehensive information, maps and images about all Victorian catchments.

**Goulburn Broken Catchment Authority** <http://www.gbcma.vic.gov.au/> For information about Shepparton Irrigation Region select Implementation Committees and under Publications > Published Documents > Catchment Community and Economy > SIR brochure

**Goulburn Murray Water** <http://www.g-mwater.com.au/> For a useful map > Irrigation, Surface Water and Groundwater > Irrigation > Area map

### Print

Hanna, D. & Fagan, A. **Agriculture and Land Management Fieldwork Kit** (2001) DNRE (now out of print but check your library)



## **Worksheet      Mapping the Goulburn Broken Catchment**

On a blank map of Goulburn Broken Catchment complete the following tasks using the appropriate geographic techniques:

a) Shade and label in these water courses and water bodies

- Lake Eildon
- Nagambie Lake
- Waranga Basin
- Goulburn River
- Broken River
- East Goulburn Main Channel
- Cattanach Canal
- Stuart Murray Canal
- Murray River
- Waranga West Main Channel (section *located* in SIR)

b) Use small arrows to indicate the direction of flow of water in each of the water courses.

c) Extend the line representing the Murray River for 25 km upstream and downstream of the Catchment boundary

d) Draw in the boundary of Shepparton Irrigation Region (SIR). Note that SIR extends west into a neighbouring catchment. Label that catchment.

e) Locate and label the following towns

- Shepparton
- Nagambie
- Murchison
- Tatura
- Numurkah
- Kyabram
- Echuca
- Cobram
- Nathalia

f) Shade and label the area of Barmah Forest and other main areas of Red Gum forest.

g) Lightly shade in other forested areas of the Catchment.

h) Find out the major agricultural products grown in the catchment. Design an appropriate symbol for each agricultural land use, keeping the symbols small. Draw the symbols on your map to indicate the *location* and *distribution* of the products. Draw a blue circle or square around the symbols representing products grown on irrigated land. Do not forget to add the symbols and what they represent to the key.

i) Draw a small sketch map of Victoria showing the *location* of the Goulburn Broken Catchment within the state.





## Part B. Twenty Question Quiz

1. Which area of Victoria is known as the 'food bowl'?
2. List five different food products you have eaten in the past few days that you know came from the 'food bowl' and / or could have been grown there.
3. List some brands of food that are processed or packaged in the Shepparton *region*.
4. Why are these large food processors *located* there?
5. What is the one key factor for the *region* developing to become known as the food bowl?
6. Briefly outline three other important physical factors contributing to the development of the *region's* intensive agriculture.
7. Name the two major water storages on the Goulburn River. Apart from irrigation, name at least two other significant uses for those lakes
8. How is the irrigation water *distributed* from the water storages to the farms?
9. Name the organisation responsible for managing this *distribution* network.
10. What other industries are *spatially associated* with the irrigated agriculture and food processing?
11. The Goulburn River is a tributary of which river?
12. Describe the *location* of Goulburn Broken Catchment within the Murray Darling Basin and in Victoria.
13. Name the highest point in the catchment. Where is it *located*?

Compare the southern part or upper catchment to the northern (lower):

14. Which *region* of the catchment has the highest rainfall? What other climatic differences are there?
15. How is the topography different?
16. Explain the different distribution patterns of natural vegetation.
17. What human activities provide the economic base of the upper catchment?
18. Describe the *distribution* of population over the catchment.
19. Name two significant environmental issues in the lower catchment (Shepparton Irrigation Region). Why have they occurred?
20. What is the biggest single issue currently facing the *region*?



## Part B. Twenty Question Quiz - Answers

1. Which area of Victoria is known as the 'food bowl'?

*Northern Victoria – the irrigated region of the Goulburn Valley and extending along the Murray River to the Mildura area – around Shepparton it is approximately a triangular shaped region located between Echuca in the west to Yarrawonga in the east and Nagambie in the south. The term 'food bowl' is also often used for the Murray Darling Basin and the Mildura region. For the purposes of this activity consider the Shepparton Irrigation Region as the 'food bowl'.*

2. List five different food products you have eaten in the past few days that you know came from the 'food bowl' and / or could have been grown there.

*Fresh fruit – apples, pears, peaches, nectarines, apricots, cherries, plums depending on season*

*Canned fruit – most of above, especially stone fruits*

*Tomatoes – fresh or processed (canned tomatoes, sauce and paste, pasta sauces)*

*Dairy products – milk, cheese, yoghurt, butter*

*Meat – lamb, beef, pork*

3. List some brands of food that are processed or packaged in the Shepparton region.

*SPC Ardmona, Campbells Soups, Tatura Milk, Rosella and Continental (Unilever), Bonlac (Fonterra), Nestle, Kraft, Heinz, Dairyfarmers, Tasman Group (abattoirs)*

4. Why are these large food processors located there?

*Spatial association with agricultural production of raw materials; also availability of clean water required for processing; central location of the region for transport to major domestic markets (Melbourne, Sydney, Brisbane) and ports for export markets.*

5. What is the one key factor for the region developing to become known as the food bowl?

*Irrigation – first major infrastructure for irrigation in Australia; gravitational delivery; water from Goulburn system and Murray to lesser extent*

6. Briefly outline three other important physical factors contributing to the development of the region's intensive agriculture.

*Topography – flat to gently undulating, (advantage for gravity irrigation, cultivation)*

*Climate – winter – spring rainfall; cool to cold winters and warm to hot, dry summers therefore ideal growing and ripening conditions for range of crops.*

*Soil types -*

7. Name the two major water storages on the Goulburn River. Apart from irrigation, name at least two other significant uses for those lakes.

*Lake Eildon and Lake Nagambie. Other uses include recreation and tourism; urban water supply and supply of clean water to food processing and other industries; attractive environment and amenity for lifestyle in the area including attracting "tree changers"; although originally for irrigation now part of river flow management, including flood control.*

8. How is the irrigation water distributed from the water storages to the farms?

*Via the Goulburn River from Eildon to Nagambie, then through a network of earthen channels ranging from major carrier channels graduating down to networks of small channels taking the water to farms. The network is designed for gravity flow of the water.*

9. Name the organisation responsible for managing this distribution network.

*Goulburn Murray Water*

10. What other industries are spatially associated with the irrigated agriculture and food processing?

*Agricultural and irrigation machinery and equipment manufacture, installation, maintenance, sales; transport, freight and logistics; packaging.*

11. The Goulburn River is a tributary of which river?

*Murray River (the confluence is 10km upstream of Echuca)*

12. Describe the *location* of Goulburn Broken Catchment within the Murray Darling Basin and in Victoria.

*The Goulburn Broken is located in the south of the MDB and includes the most southern point of MDB and the point closest to Melbourne. The catchment occupies 2% of the land and contributes 11% of the water flow into the Murray Darling system.*

*In Victoria, the catchment is located in the north central region of the state. It occupies 10.5% of Victoria's land mass. The Goulburn is the state's longest river, flowing a distance of 500 km from its source near Mt Buller to the Murray.*

13. Name the highest point in the catchment. Where is it *located*?

*Mt Buller – altitude 1806 metres; in south east of the catchment in the Great Dividing Range.*

Compare the southern part or upper catchment to the northern (lower):

14. How is the topography different?

*The south east is mountainous with altitudes over 1000m. The landscape in the south west is hilly, 500-800m; in contrast, the northern plains are flat with low relief and an altitude of less than 150m.*

15. Which *region* has the highest rainfall? What other climatic differences are there?

*The mountainous area in the south east area has the highest rainfall, eg Lake Eildon's average annual rainfall is 861mm. The north of the catchment is much drier, eg. Tatura (near Shepparton) averages 496mm. Rainfall is variable across the catchment and less reliable in the north. Temperatures also vary with altitude and latitude, the northern region experiencing hotter summers. Evaporation rates are significant for the management of irrigation.*

16. Explain the different distribution patterns of natural vegetation.

*There is strong spatial association between the landform (altitude), settlement patterns and the distribution of remnant vegetation. The south east and hilly areas of the south west and central areas of the catchment have natural forest and woodland cover. Natural vegetation on the northern plains has largely been cleared for agriculture, infrastructure and urban settlement with the exception of Barmah Forest, the narrow strip of riverine forest and scattered pockets of remnant bushland. In total two thirds of the natural vegetation has been removed in the catchment.*

17. What human activities provide the economic base of the upper catchment?

*Natural resource based tourism; agriculture (grazing for meat and wool; wine production); timber harvesting (plantation and forest); aquaculture.*

18. Describe the *distribution* of population over the catchment.

*The catchment population is 203 000; 126 430 live in Shepparton Irrigation Region. About 60% live in urban centres and the remaining 40% in rural locations. SIR is more closely settled than the mid and southern regions*

19. Name two significant environmental issues in the lower catchment (Shepparton Irrigation Region). Why have they occurred?

*Salinity; loss of native vegetation and habitat – caused by clearing land for agriculture, early farming methods not suited to Australian conditions (environment, soils, climate), irrigation contributing to rising water tables.*

20. What is the biggest single issue currently facing the region?

*Currently (late 2007) the prolonged and most severe drought on record is the overwhelming issue (Is it climate change?). In the coming years water availability, competing and conflicting demands for water for different purposes and regions, its management, irrigation infrastructure upgrade and changing nature of irrigated agriculture will continue to challenge the community.*

## Activity 2: Irrigation Futures: exploring the scenarios

### Curriculum connections

Use of this learning and teaching activity may enable students to demonstrate elements of the Standards or VCE outcomes. Indications of relevant Victorian Essential Learning Standards Domains and Levels, and the VCE subjects and outcomes are provided to assist teachers make decisions about the appropriateness of the activity for their students.

Refer to Curriculum Connections pages which define the relevant elements of standards and outcomes in greater detail.

#### VCE

Geography Unit 3 Outcome 1  
Agricultural & Horticultural Studies Unit 4 Outcome 3

#### **Victorian Essential Learning Standards Domains and (Levels):**

Geography (6)  
Thinking Processes (6)

**Duration:** 2-6 hours.

**Setting:** The classroom

### Summary

This activity explores the issues and opportunities for the future of irrigated agriculture in northern Victoria through the use of scenarios developed by an Irrigation Futures research project that was conducted in Goulburn Broken Catchment. The activity exposes students to a practical example of scenarios methodology as a means of planning strategically for the future.

Use of the activity may assist students in VCE Geography Unit 3 better understand some of the issues associated with water management in Murray Darling Basin. Teachers and students of VCE Agricultural and Horticultural Studies may find the activity useful for Unit 4 work on sustainability.

### Student outcomes

This activity will enable students to:

- Develop further their understanding of the issues and opportunities for irrigated agriculture and the associated industries and communities
- Analyse and evaluate the economic, social and environmental causes and impacts on a region
- Classify and consider these factors at global, national, regional and local scales
- Explore a methodology that is widely used for considering future options and strategic planning
- Apply different tools and techniques

### Background notes for teachers

Refer to pages 10-23 for notes on scenario planning methodology and the Goulburn Broken Catchment.

This activity does require some knowledge of the Goulburn Broken Catchment, particularly the lower catchment or Shepparton Irrigation Region so it is recommended students complete at least one part of Activity 1 first or have other prior learning about the Region.

Use of the activity will introduce students to the methodology and enable the application of a modified version of the process to other issues, for example water management in your region, a local environmental issue, climate change in the region; or personal thinking and planning for students such as future career and study options.

### Materials

- Photocopies of the four scenarios attached (sufficient for students to work in groups of four on one scenario per group)
- Photocopies of the templates. (See Teaching Resources on Water and Food: thinking futures CD)
- Large sheets of paper

## The activity

1. Introduce the activity with discussion and explanation about the use of scenarios methodology, based on the information and resources provided on pages 10-13.
2. Brainstorm and list examples of issues or themes that the students consider are important in their futures. These might include current issues in the media such as public transport and road congestion; local, national and global environmental issues; social justice issues; the way people will work (maybe telecommuting). Retain the list for later use in another activity.
3. Organise students into groups of four and allocate one scenario to each group. Ensure all scenarios will be discussed and it does not matter if some or all scenarios are explored by more than one group.
4. In their groups students will investigate one scenario, summarising and presenting it in a graphic or diagrammatic form so they can describe and explain it in the sharing session.
5. Outline the following steps to the groups:
  - a. Discuss together what is required and agree on tasks for group members.
  - b. Read and discuss the allocated scenario ensuring that each member of the group understands it.
  - c. Produce diagrammatic summaries of the key points. Categorise or group the different impacts, issues and opportunities. The templates are provided to assist students identify the key themes. Make the diagrams large enough for them to be seen by the class when presented and add the scenario title.
  - d. Prepare a short presentation (set a time frame between 5 and 10 minutes) including use of the diagrams, to describe and explain the scenario to the rest of the class.
  - e. Prepare some questions to ask other groups during the presentations of the different scenarios.
6. Each group presents their scenario to the class.
7. Depending on the location of the school, the learning context and purpose of doing the activity, discuss and explore the scenarios further using one or more of the suggestions below. Students could continue working in their groups for some of these suggestions.
  - a. Ask students to project themselves forward to 2020 and / or 2030 and consider each scenario from the perspective of students their age living in the Shepparton Irrigation Region. What are the impacts on them as students? What are their post secondary study and career opportunities in the local area? How are their choices of food affected? What is their social and community life like?
  - b. Imagine life as a family in Melbourne or other large regional city. How does each scenario impact on them as consumers? Is the availability and cost of food affected? How?
  - c. Discuss and analyse the scenarios under the headings of Social, Environmental, Economic, Physical impacts and changes.
  - d. Analyse the factors influencing the scenarios and classify them by scale: global, national, regional, local. Consider the increasing impact of globalisation on Australian agriculture industries and how they and regional communities in Australia may respond.
  - e. Consider the implications of each scenario from the perspectives of some of the following in the SIR:

• Dairy farmers	• Lifestyle landowner grazing small herd of beef cattle
• Orchardists	• Farmer producing grain and fodder crops
• GMW irrigation infrastructure management	• CMA management of rivers and wetlands
• SPC Ardmona staff	• Owner of a retail business (eg clothing) in Shepparton

## Related LandLearn activities

'The Shepparton Irrigation Region – a natural food bowl' See [www.landlearn.net.au](http://www.landlearn.net.au) > curriculum activities > Food and Food production

## Extension activities

Activity 3 Futures thinking: planning for drier times

## Resources

The **Irrigation Futures of the Goulburn Broken Catchment** publications are available on the websites listed below. The scenarios in full and as dot point summaries are found in Final Report 3 – Perspectives of Future Irrigation

- Department of Primary Industries (Victoria) [www.dpi.vic.gov.au](http://www.dpi.vic.gov.au) Select Victoria Resources Online then search for 'Irrigation Futures Goulburn Broken Catchment'
- Land & Water Australia [www.lwa.gov.au/](http://www.lwa.gov.au/) Search for 'Irrigation Futures Goulburn Broken Catchment'
- CRC for Irrigation Futures [www.irrigationfutures.org.au/](http://www.irrigationfutures.org.au/) Search for 'Irrigation Futures Goulburn Broken Catchment'

Resources on scenario planning and futures thinking are listed on page 12 of this document, **Water and Food: futures thinking**

**myfuture** <http://www.myfuture.edu.au> Information about future trends of work in Australia is found on this site. Select the facts > Work and employment > Trends of work. Select **Australia's workforce 2005: jobs for the future** for scenarios on the future workforce.

## Scenario 1 - Moving on

**2005-2020:** The cost-price squeeze continues to drive agriculture. Bilateral free trade agreements help industries that are internationally competitive, but industries that focus on protected domestic markets are less viable. Expanding markets in Asia and USA help the dairy industry, while imports of processed products threaten the viability of the horticultural industry. Demand for biofuels and alternative energy sources create new opportunities for agriculture.

Climate change is increasingly evident. Annual rainfall declines, but the intensity of summer rainfall events increases. Average temperatures rise causing fewer chill hours. These changes in rainfall and temperatures severely impact on the yield and quality of horticultural products. Irrigation infrastructure within the region is reconfigured to manage the effects of water trade. Infrastructure is rationalised in some areas and enhanced in others.

The demand for residential properties in attractive areas moves inland as coastal properties become less affordable. Inland waterways are increasingly a focus for tourism.

Governments show preference for market forces to direct outcomes. They intervene only when market failure is significant, so exceptional circumstances support from government decreases.

Agriculture continues to adapt to declining terms of trade. Farms increase production by becoming larger and more efficient with new technologies. Smaller farms finding it difficult to adapt leave their industries. The number of dairy farms decreases from about 2000 in 2005 to 1200 in 2020, while average herd sizes increase from 250 to 480 cows. The value of agricultural production increases for all industries making the region's food processing companies attractive for takeovers by multinational corporations.

Small towns slowly decline as the demand for labour decreases. The small increase in the number of lifestyle residents cannot prevent banks, supermarkets and petrol stations closing. Communities are less willing to participate in voluntary activities so services dependent on volunteers, such as fire brigades and sporting clubs, are progressively disbanded or amalgamated.

**2020-2035:** International trade opportunities improve as trade barriers are removed and Asian markets expand. Trade is enhanced by improvements in communication technology. The marketing environment is highly competitive. Consumers are increasingly concerned for their own health and for the welfare of animals.

Irrigation water delivery infrastructure is privatised. The owners increase water tariffs and further rationalise infrastructure to obtain a commercial return on their investment. The region remains attractive to agribusiness investors due to relatively low land prices and the availability of water. The climate remains drier than the long-term average, with summer rainfall occurring in intense events. The drier climate reduces the risk of salinity to agricultural production and infrastructure.

Traditional agricultural industries continue, but to maintain their competitiveness, farms develop highly controlled systems that enable them to increase production and reduce waste. The dairy industry uses controlled rationing and automatic milking systems to increase productivity, while horticultural producers use hydroponic and controlled-environment technologies. The number of farms decreases due to the large financial investment required for highly controlled production systems. However the total value of agricultural production continues to increase.

Individual landholders are mainly responsible for land management. Tension arises between landholders when adjoining land uses are incompatible, or when neighbours perceive land management practices as inappropriate. Conflict also arises over environmental management.

Influence of the agriculture sector on governments and in the community declines, as the number of people involved decreases. The community places high value on leisure time. Location-based community groups are forced to consolidate their activities but electronic communities of interest flourish due to their flexible participation arrangements.

Throughout this scenario, the region remains prosperous, with low unemployment. The population grows steadily, with an increasing proportion aged over 50. Environmental impacts of agriculture are minimised though the use of technology.



## Scenario 2 - New Frontiers

**2005 – 2020:** Communications technologies radically change work. Workers telecommute to workplaces throughout the world, often from home offices located close to essential services in attractive areas such as near water or bushland. In the Goulburn Valley, properties near rivers and streams are in high demand.

Urban communities and lifestyle residents are politically influential and express concerns for the environment, animal welfare, personal health and food safety. Governments respond by increasing regulation on farming and creating zones of industrial agriculture. Agricultural industries have restrictions on the location and nature of developments. Practices such as harvesting, spraying and tillage are also tightly controlled so that lifestyle residents are not adversely affected.

Free trade agreements with international trade partners provide agriculture with new markets. However, Australia loses markets in the Middle East due to our alliance with the United States and our involvement in conflicts. Middle Eastern conflicts continue to cause oil prices to rise.

Governments introduce further water reforms. Interstate water trade is permitted and environmental flow entitlements increased. The availability of water is relatively low as the climate remains drier than the historical average.

Agricultural businesses struggle to adapt to the changes and many small farmers leave the industry. New regulations increase production costs substantially and only large, very efficient businesses can afford to comply. These farms are highly focused on production and have little time or money to invest in environmental improvements. The apple and pear industry is decimated by an outbreak of fire blight. The farm-gate value of agricultural production declines. Lifestyle residents purchase increasing amounts of land and water so the value of both rapidly increases. Some farmers fund their retirement by selling their properties to new lifestyle residents. These residents bring income, ideas and energy, and they strongly influence local authorities and agencies. Schools grow and a range of vibrant community groups contributes to the region which remains prosperous although the economy is less dependent on agriculture.

**2020-2035:** Technological developments mean laboratories can create cheap, attractive foods from basic carbohydrates. To lower the cost of raw ingredients, such as grains and pulses, governments permit the use of genetically modified organisms (GMOs) for agriculture. Some affluent consumers continue to demand real food; however it is increasingly difficult to supply authentic food products that are GMO free.

Continuing conflict in the Middle East encourages investment in biofuel production to secure energy supplies, particularly for the transport industry.

The climate continues to dry, reducing the amount of water for irrigation. The barrages at the mouth of the Murray River are removed to improve the health of the river, freeing up water entitlement for irrigators and the environment and lifting the limits on salt disposal from the region.

Urban and lifestyle residents are not satisfied with environmental improvements achieved by the regulation of agriculture and encourage governments to purchase farming land for environmental purposes. Buffer zones between industrial agriculture and lifestyle zones are created, and agricultural zones are further divided to create GMO free farms.

Agriculture production changes significantly. The traditional dairy and horticultural industries are smaller because of the growth in laboratory foods. Some producers survive as boutique authentic food farmers. Cropping industries expand to supply raw materials for laboratory food and biofuel industries. In traditional irrigation areas, the limited availability of large farms suitable for cropping causes large volumes of water to be traded out of the region to southern New South Wales and north-western Victoria.

The salinity risk decreases as regional watertables drop due to the dryer climate and less irrigation. The area of native vegetation increases through the development of buffer zones. The population grows with the influx of lifestyle residents. Community groups are strengthened by new membership, particularly new retirees who have time to volunteer. The region continues to prosper with a reduced reliance on agriculture.

## Scenario 3 - Pendulum

**2005-2020:** Green parties hold the balance of political power at both state and federal levels. Governments purchase irrigation water entitlements from Victoria and remove all barriers to interstate water trade. To manage the associated social impacts, governments also support changes to irrigation infrastructure and properties. Irrigation is no longer available to some areas so farms are amalgamated and resold as larger dry-land farms.

The Kyoto Protocol is ratified and similar agreements follow. Governments establish markets to trade environmental credits and services, first carbon, but later including biodiversity. These markets provide farmers with opportunities to diversify. Planting of native vegetation becomes a commercially attractive investment. Global demand for fossil fuels exceeds available supplies, so energy prices rise. Production of biofuels improves the economic outlook for the cropping industry.

The loss of water from the region causes a substantial decrease in the area of irrigated agriculture. The value of farm production declines, particularly in livestock and cropping and the number of related supporting businesses drops. Less confidence in all agricultural industries results in reduced investment on farms. The remaining farms are larger and try to improve their viability with a more flexible approach to managing their land and assets, and by seeking long-term supply contracts. Processors invest in developing improved or new products to increase profitability.

The health of the environment improves substantially. Fisher people report increasing catches of native species and the region becomes a focal point for bird watchers from throughout Australia. Less use of irrigation results in lower watertables and the risk of salinity decreases.

Divisions between rural and urban areas intensify as rural communities resent ill-informed attitudes of urban communities, particularly about the environment. Prosperity declines and many shops in the towns close. Population growth slows to a minimum as young people leave the region to seek employment elsewhere.

**2020 –2035:** A new conservative federal government, concerned with reinvigorating regional economies, believes that increased environmental flows are not worth the economic cost. It takes control of the management of water and reallocates water entitlements from the environmental reserve through auctions on the open market. Proceeds are used to rebuild irrigation infrastructure in partnership with irrigator co-operatives.

The region experiences a long period of higher than average rainfall. Floods occur in successive years, inundating large areas, and enabling full irrigation allocations for the first time in many years.

Economic reforms in China include floating its currency on the open market. The value of the Australian dollar weakens considerably and Australian agricultural products become increasingly competitive in all Asian markets.

Internationally, consumers are increasingly concerned about possible side effects of genetically modified foods on health. Australian governments continue a ban on the use of genetically modified organisms in agriculture, creating new export opportunities for producers.

Regional agriculture industries grow again, including Irrigated production. The expansion is carefully planned so that irrigation occurs only in the most suitable areas, with appropriate technologies. Farms use a range of production systems for a variety of products as industries target different market niches. Boutique cheese factories and pick-your-own horticultural producers emerge to cater for domestic markets. This redevelopment creates abundant employment opportunities but low population growth in 2005 - 2020 means a shortage of labour, so slowing development. International and domestic migrants are attracted to the region by the possibility of making their fortune in an expanding economy.

Environmental controls for managing the impact of irrigated agriculture are strongly enforced, however the increasing irrigation and above-average rainfall result in rising watertables and increasing salinity risks. The wetter conditions enable vegetation to thrive and aquatic biodiversity to prosper. Native fauna slowly colonise revegetated areas, as do introduced pests.

The region slowly regains its former prosperity.

## Scenario 4 - Drying Up

**2005 - 2012:** A major recession in the United States of America causes the value of the US dollar to decline. US agricultural products become increasingly attractive in international markets and encroach on traditional Australian markets for dairy, meat and grain products. China begins to control international export markets for labour-intensive and high-value horticultural products, while importing land-intensive bulk agricultural commodities.

Agricultural producers in the region lose many of their export markets and face increasing competition in domestic markets. These industries seek market niches to maintain viability. Horticultural industries focus on high-quality fresh fruit for the domestic market, while the dairy industry attempts to capitalise on markets for value-added products, such as “nutraceuticals”.

**2013 - 2020:** The region experiences an extended period of severe drought. Record low rainfall over many years sees irrigation allocations below 100 per cent for 5 consecutive years, with the lowest allocation of 30 per cent.

Governments remain willing to support and provide financial assistance to communities experiencing exceptional hardship. Across the wider community the sense of egalitarianism declines with people less willing to help out those in need. However, local communities are drawn together to battle through the adverse conditions.

Agriculture producers experience extreme hardship. Initially, all producers scale back production to match their available water. As the drought continues, many are forced to sell assets to make ends meet, while others rely on government assistance to put food on the table. Agricultural production in the region is decimated. Many producers leave the industry, some willingly, while others are forced off the land by banks foreclosing.

Governments introduce a moratorium on the payment of irrigation infrastructure charges to reduce the financial burden on agricultural producers. Irrigation infrastructure rapidly deteriorates as investment in maintenance and redevelopment is put on hold.

Low rainfall and limited irrigation causes the regional watertable to decline. Tributaries of the Goulburn River dry up completely and minimum environmental flows are not delivered for two consecutive years. Populations of fish and aquatic birds decline and recreational activities, including fishing, are restricted to minimise damage to ecosystems.

Regional population growth drops to zero as young people leave the region to seek employment. Divisions exist in the community between those with wealth and employment and those without.

**2020 - 2035:** The global economy experiences a period of strong growth. Many Asian and South American countries become increasingly affluent as the balance of wealth across the globe becomes more uniform. Increased global affluence enables the World Trade Organization to agree to remove all agricultural production subsidies.

International and domestic consumers increasingly demand food with credence values, particularly those offering health benefits and produced using natural genetic stock. The Australian government ban on genetically modified organisms ensures producers have a competitive advantage in international markets. Governments provide assistance to rural communities to rebuild and take advantage of market opportunities, by investing in infrastructure to support agricultural production. Conditions for agricultural production improve substantially. Above average rainfall allows full allocations of high-reliability irrigation entitlements and some allocations of medium-reliability entitlements.

Agricultural industries cautiously expand and intensify production systems. Many producers choose to invest in greenfield developments in preference to redeveloping in areas with poor-quality infrastructure. Private and public companies invest in agricultural businesses on the expectation of long-term growth and profitability. The livestock industry is particularly successful at expanding production to capture new market opportunities, due to its relatively low capital requirements. The value of production of all agricultural industries grows substantially.

## Activity 3: Futures thinking: planning for drier times

### Curriculum Connections

Use of this learning and teaching activity may enable students to demonstrate elements of the Standards or VCE outcomes. Indications of relevant Victorian Essential Learning Standards Domains and Levels, and the VCE subjects and outcomes are provided to assist teachers make decisions about the appropriateness of the activity for their students.

Refer to Curriculum Connections pages which define the relevant elements of standards and outcomes in greater detail.

#### **Victorian Essential Learning Standards Domains and (Levels):**

Geography (6)  
Science (6)  
Civics and Citizenship (6)  
Thinking Processes(6)

**Duration:** 2 - 4 hours.

**Setting:** The classroom

### Summary

The activity encourages consideration of the consequences of a drier climate. It can be used to introduce a unit of study on climate change or water use and management or other themes related to sustainable futures.

### Student outcomes

Students will be able to:

- Consider the consequences of a drier climate at an individual level and for the community
- Share and discuss ideas with others to further develop and expand their own thinking
- Use a futures wheel to graphically present their ideas.
- 

### Background notes for teachers

See pages 10-12 for notes on scenario planning methodology.

A futures or consequences wheel is a graphic organiser that has a future event in a circle in the centre. Consequences from this first event are placed in a second circle, and consequences of those in a third, and so on. Each of the circles explores the effects or consequences in greater detail. This organiser can help students understand the relationships between cause and effect, actions and reactions. After Step 5 in the activity, there is opportunity to develop a rich learning task using scenario planning methodology and / or other strategies to encourage students to consider sustainability and the future they want.

### Materials

- Futures wheel template, either photocopied for students or drawn on whiteboard / large sheet of paper for them to copy.
- The list developed from Step 2 of Activity 2 (optional - if the class has completed it)



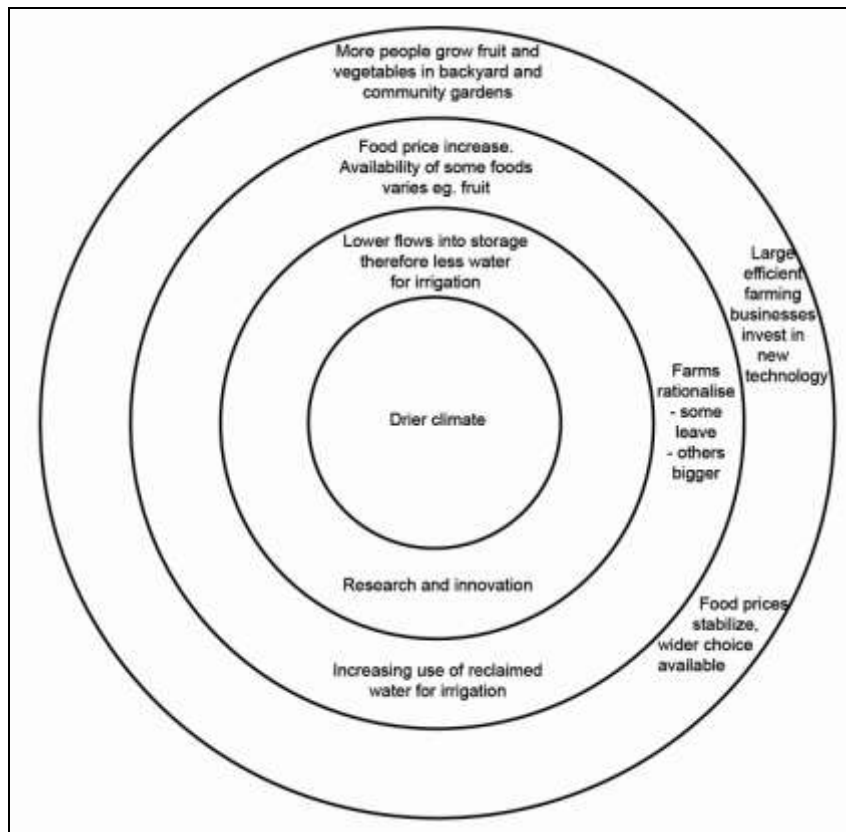


Figure 1 Futures Wheel: the effects of a drier climate on food production - an example to start the discussion

## Introduction

Use the list of quotes on page 41 to introduce and promote discussion about the risk associated with predicting the future.

Scenario planning or futures thinking (including use of techniques such as a futures wheel) is not about predicting the future but exploring options based on important influencing factors and their consequences or implications.

## The Activity

1. Brainstorm with the class about the drier climate predicted for Australia. What will the climate be like in your area in 10 / 15 /20 years time?

Use the Think, pair, share approach for the next steps.

2. Ask students to work alone at first and to think about the implications of a drier climate for them. Encourage them to think of positive as well as negative consequences, to think creatively and 'outside the square'. Further brainstorming with the whole class may help start the thinking. Questions and prompts might include:
  - Will their favourite sports be affected? How?
  - They will probably be working in 10 to 15 years. What effects might a drier climate have on their proposed career? On the world of work generally?
  - As consumers, what are the implications for the availability and processes of food production?
  - How will the local environment / industry / community be affected?
  - What innovations and new technology are developed in response to the drier climate



3. Students then work with a partner to share and expand their ideas. If students are not familiar with using a futures wheel, explain the process and ask students to consider their ideas as a chain of consequences or implications, and work in pairs to create a futures wheel for two different consequences.
4. The pairs of students then combine to form groups of four. They share, discuss, add to and refine their futures wheels to present to the rest of the class. Suggest to groups that they combine their ideas and prepare a 'final draft' for sharing with the class.
5. Each group presents their futures wheels which may be further refined following input and sharing with others.

The next stage will depend on the purpose and learning context in which the activity has been used. If Activity 2 has been used then the list developed in Step 2 will be useful here.

Some suggestions:

- In small groups, students develop a series of scenarios or stories (four is considered a useful number) for their community or region and its response to climate change. Using their futures wheels and the class discussion, identify some key themes or issues that each scenario should address, for example local industry and economic base, availability of water for households, community facilities such as sporting grounds and parks, food production and availability, response to higher temperatures such as starting work and school earlier, population movement to mountains.  
Discuss the scenarios and ask students to reflect individually about their personal responses, to consider what actions they may want to take now to help move towards their preferred future.
- Students work in their groups to discuss and investigate what their community might look like in 2020 (or a selected year), then, for example:
  - produce a newspaper with editorial, feature article, letters to the editor, sports page for a day in that year
  - produce a video clip describing an aspect of their life
  - create a MySpace page, or write a story or song lyrics as a 16 year old.
- Use the activity to introduce the topic of climate change or as part of a unit or rich learning task.
- Develop the theme further to reflect on and explore the concepts of and challenges to a sustainable future.
- Have students work in groups to investigate some of the consequences they have identified in greater depth and to make recommendations for planning and actions government, community and individuals can take to manage the changes.
- Work backwards. Students examine the available climatic data for your location and consider if and how the climate or weather patterns have changed over time. They could interview older community members to find out what changes they may have noticed in their lifetimes. Does the data support their observations? In what ways? Give examples.

## Resources

Information about using *brainstorming*, *think*, *pair*, *share* and *futures wheel* can be found on the VCAA website at <http://vels.vcaa.vic.edu.au/index.html> under Quick Links select Teaching and Learning Resources then select Brainstorming and Graphics Organisers.

Information about climate change, predicted climate changes in regions of Australia and climatic data over time is available on:

- Bureau of Meteorology website <http://www.bom.gov.au> Select Climate from the horizontal menu and follow the links.
- Climate Change in Australia <http://www.climatechangeinaustralia.com.au>

(continued over)



- CSIRO <http://www.csiro.au/>

- 1) Search for the Media Release 'Australian rainfall – a view of the future' (Oct. 4 2007)
- 2) Follow the link to Climate Change in Australia: technical report 2007. Do not be daunted by the 148 page length, there are summaries in manageable chunks under headings, for example 'Key findings'.

For resources on scenario planning and futures thinking, see page 12 of this document.

## **Related LandLearn activities**

Creating Sustainable Futures See [www.landlearn.net.au](http://www.landlearn.net.au) > resources > Creating Sustainable Futures

## Predicting the future: it's risky!

### Historical quotes about the future

*"640 K ought to be enough for anybody"*

Bill Gates, founder of Microsoft and world's wealthiest man (1981)

*"I think there is a world market for about five computers".*

Thomas J. Watson Jr., chairman of IBM (1943)

*"There is no reason for any individual to have a computer in their home."*

Kenneth Olson, founder of Digital Equipment Corporation (1977)

*"The world potential market for copying machines is 5000 at most."*

IBM to the founders of Xerox as it turned down their proposal (1959)

*"Almost all of the many predictions now being made about 1996 hinge on the Internet's continuing exponential growth, but I predict the Internet will soon go spectacularly supernova and in 1996 catastrophically collapse."*

Robert Metcalfe, founder of 3Com and inventor of Ethernet (1995)

*"The Americans think we need of the telephone, but we do not. We have plenty of messenger boys."*

Sir William Preece, chief engineer of Britain's Post Office (1876)

*"The phonograph has no commercial value at all."*

Thomas Edison (1880s)

*"Guitar music is on the way out."*

Decca Records, declining to record a new group called The Beatles (1962)

*"Radio has no future."*

Lord Kelvin (1897)

*"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will."*

Albert Einstein (1932)

*"The horse is here to stay, but the automobile is only a novelty - a fad."*

President of the Michigan Savings Bank, speaking to Henry Ford's lawyer, Horace Rackham.

Rackham ignored the advice, invested \$5000 in Ford stock, and sold it later for \$12.5 million.

*"That the automobile has practically reached the limit of its development is suggested by the fact that during the past year no improvements of a radical nature have been introduced."*

Scientific American (Jan. 2, 1909)

*"Man will not fly for 50 years."*

Wilbur Wright to brother Orville after a disappointing flying experiment in 1901. (Their first successful flight was in 1903.)

*"Television won't last "Television won't last because people will soon get tired of staring at a plywood box every night."*

Darryl Zanuck, movie producer (1946)

(Source:<http://www.permanent.com/quotes.htm> )

Note: These quotes were used during the introductory workshops in the Irrigation Futures of the Goulburn Broken Catchment project.

## Activity 4: Scientists at Work

### Curriculum Connections

Use of this learning and teaching activity may enable students to demonstrate elements of the Standards. Indications of relevant Victorian Essential Learning Standards Domains and Levels are provided to assist teachers make decisions about the appropriateness of the activity for their students.

Refer to Curriculum Connections pages which define the relevant elements of standards and outcomes in greater detail.

#### **Victorian Essential Learning Standards Domains and (Levels):**

Economics (6)  
Science (6)

**Duration:** 1-2 hours. Part B varied.

**Setting:** The classroom or library preferably with computer access, or computer lab.

### Summary

Through use of this activity in conjunction with others in this resource, or in the context of other Science learning activities, students investigate science-related occupations. Together with Activity 2, it looks at scientists taking a different approach to addressing a vital community issue – an approach that draws on the expertise from a range of disciplines and is applicable to other problems.

### Student outcomes

This activity will enable students to:

- Develop their understanding and knowledge of the diverse nature of science-based careers
- Explore some of the opportunities available to young scientists who are willing to 'take the risk'
- Investigate different pathways to science-related careers.

### Background notes for teachers

LandLearn has collected many profiles of people working in diverse careers associated with sustainable agriculture and natural resource management. One example is included here; others are accessible on the LandLearn website: [www.landlearn.net.au](http://www.landlearn.net.au). The most recent can be found in the Newsletters published since Term 4 2006.

### Materials

A range of career profiles, either in print or digital via internet access.

### The Activities

#### A. Career profiles

Students could work in pairs or small groups to consider these and similar questions for a range of profiles. See Resources for sources of profiles to use.

1. Discuss with the class perceptions and stereotypes of scientists and engineers. Consider the way they are presented in the media, television shows and movies.
2. Discuss the students' own knowledge and perceptions of scientists and engineers. Record for later reference.
3. Read David's profile and discuss the following:
  - a) Take a count – who has heard of the occupations of hydrologist and systems analyst? Discuss the result. For those who answer in the positive – how and where? For the negative – consider why?

- b) Does David fit the students' perceptions and images of scientists or engineers? In what ways?
  - c) How is his role different to those perceptions and images? What is unusual or unexpected?
  - d) What opportunities does David have in his current role?
4. List the subjects a person might enjoy, the interests and characteristics they might have to consider a role like David's as a career.
  5. Investigate other work opportunities for hydrologists and systems analysts.
  6. Consider similar questions for other profiled scientists.

## B. Science in the local community

1. Investigate the careers for scientists and environmental engineers in your community. Invite them to speak about their work to your class.
2. Arrange excursions to science based workplaces. Have students interview the staff and build a library of profiles and make them available on the school's website.
3. Arrange work experience and job shadowing with scientists. Encourage students to photograph or video scientist at work to share their experience and learnings with others in class.
4. At the workplaces, students should also look at the pathways and careers of other staff who work with scientists. For example, on the Irrigation Futures project David worked with geographers, economists, farmers, environmental managers and agriculture extension staff.

## Resources

- **myfuture** – Australia's career information service <http://www.myfuture.edu.au>  
A very comprehensive site where students can investigate careers, training and education requirements, the skills and personal attributes required for any role.  
If you are using Activity 4 in conjunction with Activities 2 and / or 3, then information about future trends of work for Australia is found on this site. Select the facts > Work and employment > Trends of work. Select **Australia's workforce 2005: jobs for the future** for scenarios on the future workforce.
- **ONTrack Real Skills Rural Future** <http://www.ruralskills.com.au/Ontrack/>  
This site contains career and training information about work in sectors associated with rural and agriculture industries.

## Related LandLearn Resources

- **LandLearn** [www.landlearn.net.au](http://www.landlearn.net.au)      There are more career profiles and some worksheets available on the website.
- **Water and Food: futures thinking.** The Teaching Resources associated with this publication are available on CD from LandLearn. They include profiles of other staff who contributed to the Irrigation Futures project and who work in roles associated with irrigated agriculture.

## Career Profile: David

**Name:** David

**Title / role:** Hydrologist and systems modeller

**Location:** Department of Primary Industries, Tatura

### Course studied

A combined Environmental Engineering and Science degree at The University of Melbourne

### Description of work undertaken:

It is more than hydrology. The work involves conceptualising how parts of the world work and representing it with computer models. It is office-based at a computer but also involves interacting with teams of colleagues to draw on their views of the world for the modelling.



David has recently worked on a project called Irrigation Futures of the Goulburn Broken Catchment which explored different scenarios for the future of the region, in particular the future for irrigated agriculture. He worked with a team including other research scientists (in soil and water management for example), economists, farmers, social scientists, geographers (GIS), extension staff (who work with farmers to implement research based natural resource management strategies at farm and community levels).

The work was interesting and enjoyable because of its value to agricultural based industry in the region, the potential for the application of scenario planning methodology to other issues and some personal challenges and highlights. David found this work challenging to his engineering background because there was no defined problem, rather a collection of ideas, and one of the highlights was the change in thinking of participants, for example the attitude to lifestyle farmers.

As a result of this work, land and water managers in the region can plan and make changes to the way things are done, for example the Catchment Management Authority is considering the future management of groundwater pumping.

The other exciting aspect of the work is the opportunity to apply the learning about scenario planning to other projects. The team has now commenced a project on the impact of climate change in south west Victoria.

David is currently completing his PhD which he has been able to combine with his work at DPI. He has used a traditional modelling approach, integrating science and 'on-ground' experience to assess the effectiveness of catchment management at a location in the Shepparton Irrigation Region.

### Advice to students

Study what you like and are good at. Grab opportunities that come your way as you never know where they will lead.

Somewhat ironically, one opportunity that came David's way during work placement was to look at the risk of dam wall failure at Lake Eildon due to floods.

### What careers have other graduates from your course entered?

Project management and consulting with companies such as Deloitte; engineering and other roles in government and private organisations (EPA, DSE, DPI, SKM); specific projects such as modelling the dynamics of water flow in Gippsland Lakes; and farming.

## Glossary

<b>biofuels</b>	Fuels created from biological materials including plants, animal waste, wood, vegetable and other plant oils,
<b>chilling requirement chill hours</b>	Fruit and nut trees have a chilling requirement. It varies between varieties within a kind of fruit and is defined as the accumulation of hours below 7°C. It promotes normal growth and bloom following the dormant or winter period. Extremely mild winters may mean the chilling requirement is not met and will result in uneven bloom and fruiting.
<b>credence values</b>	Attributes or values that are believable or substantiated. In the context of agriculture and food production credence values include environmental sustainability, animal welfare and ethical production, food safety and “clean, green” food. Credence values are increasingly important to consumers and so influence production and marketing, locally and globally.
<b>farm gate gross value</b>	The value of the farm product when it leaves the farm; the price farmers receive for their produce without deducting inputs (the costs of production).
<b>fire blight</b>	A contagious, bacterial disease which affects a range of fruit trees including apple and pear. There is no single effective treatment. Fire Blight seriously affects fruit production worldwide and is present in North America, UK, Europe, Middle East and New Zealand. Australia is free of the disease and fruit growers have fought to have restrictions on the import of fruit maintained, particularly apples from New Zealand, to protect the local industry.
<b>lifestyle residents</b>	Residents (local or new) who purchase land (usually small lots) to live on for reasons other than making a living from farming. Land adjacent to rivers and lakes, on the coast, in or near bushland, with attractive views, within about two hours from a major city or close to a regional centre is most popular. In such areas there is often loss of productive agricultural land to lifestyle residents (“sea or tree changers”).
<b>megalitre</b>	One million litres or 1000 cubic metres. (A good analogy for students is the approximate amount of water in an olympic size swimming pool.)
<b>nutraceuticals</b>	A term coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice, MD, it can be defined as "a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disease." Some have enhanced levels of nutrients through manufacturing (examples include milk or orange juice with added calcium), others have natural levels (for example omegas in oily fish).
<b>pan evaporation</b>	The amount of water which evaporates from an open evaporation pan. The rate of evaporation depends on factors such as cloud cover, air temperature and wind speed. It is measured by the addition or subtraction of a set amount of water, then calculating how much water has evaporated from the pan.
<b>soil acidity</b>	Acid soil has a pH below 7.2. It is a natural process, but hastened by some farming practices. It builds up due to excess nitrogen moving through the soil.
<b>soil sodicity</b>	Sodicity is caused by the presence of sodium attached to clay in the soil. It becomes a problem when there is sufficient sodium to affect soil structure making soils difficult to manage and susceptible to degradation such as erosion.



<b>water trade</b>	<p>Water entitlements can be bought and sold both on a temporary and permanent basis. Selling water entitlement on a temporary basis means the buyer gets the use of that water for the current season only and the seller retains ownership of the water entitlement. Selling water on a permanent basis means that ownership of the entitlement goes to the buyer.</p> <p>Water can be bought and sold through the water exchange, the use of water brokers or privately between irrigators.</p>
<b>brainstorm</b>	An individual and collaborative process used to generate a large number of ideas and encourage creative thinking; to be effective it requires a supportive and positive classroom culture
<b>futures wheel</b>	A graphic organiser that places a future event in a circle in the centre of a series of circles. Consequences from this first event are placed in a second ring, then a third, and so on. The futures wheel encourages students to consider implications and consequences of events and actions.
<b>think, pair share</b>	A co-operative learning process where students work individually first, then pair with another to discuss and expand their work together. Their ideas are shared with a larger group or the whole class

# Resources

## Print

Casinader, N. et al **A Place for Geography Book 3** (1998) Ch 5 *Agriculture 2050: A Future Problem Solving Approach* and Ch 6 *Urban Life: A Sustainable Future*.

Hanna, D. & Fagan, A. **Agriculture and Land Management Fieldwork Kit** (2001) DNRE (now out of print but check your library)

Kriewaldt, J. (Editor) **Geography in SOSE 2 – issues in managing environments** (2001) Macmillan [includes sections on managing water as a resource, the Murray Darling Basin and climate change]

**New Perspectives** (2006) Geography Teachers Association of Victoria

**Our Dry Continent** A resource book for teachers for National Science Week 2006. Australian Science Teachers Association

**The Essence of Geography - Using Spatial Concepts** (2005) Geography Teachers Association of Victoria

**RipRap** River and Riparian Lands Management Newsletter. (Available free. Subscribe for the print version or download at [www.rivers.gov.au](http://www.rivers.gov.au) > Publications & Products)  
Edition 30 June 2006 includes an article about a West Australian research project on irrigation management and water savings.

**Innovation in Irrigation** Brochure and video available from the Natural Heritage Trust  
[www.nht.gov.au](http://www.nht.gov.au)

## Internet

**Victorian Resources Online** <http://www.dpi.vic.gov.au/dpi/index.htm> > Victorian Resources Online

**Goulburn Broken Catchment Authority** <http://www.gbcma.vic.gov.au/>

**Goulburn Murray Water** <http://www.g-mwater.com.au/>

**Murray Darling Basin Commission** <http://www.mdbc.gov.au/> Select Basin Kids for student resources

**myfuture** <http://www.myfuture.edu.au>