IRRIGATION RISK MANAGEMENT
Dairy Farmer's Kit

Tailoring water entitlement to suit your business

January 2002

Prepared by

Rendell McGuckian
Tim Cummins and Associates Pty Ltd
Naturally Resourceful Pty Ltd

National Program for Irrigation Research and Development
(Land and Water Australia)

Murray Dairy

Murray Irrigation

Acknowledgments

This kit has been developed with valuable input from the following:

Geoff Akers, Murray Dairy, Dairy Farmer, Tallygaroopna

Stuart Brown, Farmanco

Neil Campbell, Dairy Farmer, Deniliquin

Lloyd Chesworth, Dairy Farmer, Tocumwal

Barry Croke, Dairy Farmer, Murray Dairy, Numurkah

Bruce Jones, Torrumbarry Water Services Committee, Dairy Farmer

Jenny McLeod, Murray Irrigation

Alan Lavis, Goulburn-Murray Water

Brett Tucker, Land & Water Australia

Thank you.

CONTENTS

INTRODUCTION

Every decision we make in life has a consequence, sometimes an upside and sometimes a downside. Risk management is about trying to foresee the risks associated with decision making to maximise the upside while minimising the potential downside.

A useful definition of risk management is: "The identification, assessment and control of those risks that threaten the assets or earning capacity of every organisation."

Businesses vary in their ability to take on risk. A recent analysis of dairy farms in Northern Victoria showed that some farmers had water entitlements of more than 6 ML/ha while their neighbours had less than 3 ML/ha[1]. Which is the right amount? The aim of this kit is to help you to decide what is appropriate for your farming situation.

Tailoring your exposure to water shortage and your exposure to water price fluctuations is a relatively new challenge. This kit is designed to help you manage that challenge.

Your own attitude to risk is an important one and this will be affected by your current business risk profile (eg debt levels), and the industry you are in and its exposure to risk (eg amount of price fluctuation).

Each of the main water trading industries in your catchment can influence the market price to buy water and availability of water to you. Both of which are likely to be key drivers of your own risk position.

The higher the level of entitlement you decide to hold, the more you will be sheltered from these influences. However, there can be a cost in having more capital tied up in the entitlement value.

In order to establish an appropriate level of water entitlement you need to consider what is driving your decisions concerning water, both now and in the future.

The kit provides case studies and structured worksheets for you to record your own figures in the kit framework. This should provide a pathway through the many decisions you must make in settling on the 'right' level of entitlement for your irrigation business. You will need to keep reviewing your decisions at least once every season.

Caution. This kit includes numbers as examples to demonstrate how the risk management frameworks can be used. The results of these examples are not generic and do not apply to all situations. It is important that you use your own business figures in this kit for it to be of value to you.

[1] Per effective hectare irrigated. Equivalent to 1 ha of perennial pasture and 0.5 ha of annual pasture.

SIX KEY QUESTIONS

At the end of the kit we aim for you to have thought through and have a framework for answering the following six questions.

- **How often will I be short of water?**
- **Over the long term, how much will it cost me to use temporary water trade to avoid being short of water?**
- **Over the long-term, am I better off trading permanent or temporary water?**
- **How much can I afford to pay for temporary water over the long term?**
- **How do the alternatives to water trade compare?**
- **What are the main drivers in my decisions?**

Each question is a chapter in this kit.

DEFINITIONS

The irrigation industry uses many different terms to describe the same things. More confusing still, one term can have several different meanings. This becomes especially important when comparing situations in different states. To help overcome the potential for confusion, we have adopted the following definitions for the terms used in this kit.

Water entitlement – The maximum volume of water the entitlement holder is entitled to use when the seasonal allocation is 100%. This is the long-term measure of the volume of water held. It is also variously called: permanent water; water right; licensed volume; high security water; or general security water.

Seasonal allocation – The proportion of water entitlement that is deemed available within a season. This may be adjusted up during the course of the season. It varies within the season, and between seasons, according to the amount of water available in the catchment.

Permanent trade - Trade in water entitlement. The rights for future use of that entitlement are transferred entirely to the buyer. It has seasonal variability. That is, one megalitre of entitlement will yield different allocations in different seasons.

Temporary trade – Trade in seasonal allocation. Because it involves only one season's allocation, it is not a variable volume. The buyer is able to use one full megalitre for each megalitre bought. However, at the end of the season, the rights for future use of the water entitlement revert to the seller.

Water price –The market price for water. This is the water-trading price paid by a water user to buy water on the open market. The price for permanently traded water is likely to be higher than the price for "temporary water."

Water charge – The annual service fee paid by irrigators to have water made available and delivered to them by water retailers or water authorities.

Water cost -The cost of water to the business. For temporary water, this is the same as the temporary water price. For permanent water, the water cost equals the interest on capital tied up in the business's water entitlement divided by the seasonal allocation.

Overdraw/Carryover - This refers to the ability of individual irrigators to draw against next year's water allocation or to carry-over unused water into next year. Currently this is only available in NSW.

1. HOW OFTEN WILL I BE SHORT OF WATER?

Firstly, you need to work out how much water you need to irrigate fully. Multiply the area of irrigated pasture you have by it's annual water requirement. This is shown in the example in Table 1 below.

Table 1 Estimating how much water you need to irrigate fully

Crop/Pasture	ha	My Water requirement	My Total water needed
Permanent pasture	40 ha X	8 ML/ha =	320 ML
Annual pasture	10 ha X	3 ML/ha =	30 ML
Total all ML			**350 ML**

The Appendix has blank worksheets, which are designed for you to fill in with your own farms figures.

The second step is to compare what you need with what your entitlement can provide.

Your entitlement will have a range of seasonal allocations attached to it, and these will vary with water availability in the catchment as well as the allocation method. Knowing how often you will get high allocations and how often you will get low allocations is crucial to determining the value of the water.

To help you determine your long-term average seasonal allocation we have developed six scenarios. These are common to all systems/catchments, and they relate to your seasonal allocation at the close of the season. This is usually higher than the opening seasonal allocation. In all but the worst droughts, you can expect that there will be storage inflows as the season progresses. Therefore, in most years, you will need to add an extra amount of allocation to the opening allocation to estimate your closing seasonal allocation. Water supply managers often give the probabilities for reaching different allocation levels at the time of their allocation announcements.

Table 2 Six scenarios for closing seasonal allocations

1	Very high	very high total seasonal allocation
2	Av to high	Average to high total seasonal allocation
3	Av to low	Average to low total seasonal allocation
4	Low	low total seasonal allocation
5	Very low	very low total seasonal allocation
6	Long term average	Long term average allocation

The six tables in Appendix 1 show the probabilities of getting different levels of seasonal allocation for each water supply system. For example, Victorian Murray irrigators will get 200% of their entitlement 60 years out of 100 and very low allocations for only 3 years in 100[2].

Because each State has very different allocation policies, the story is very different for those irrigators on the NSW Murray Irrigation District who's very high allocation is only 84% of entitlement and the probability of getting that is only 1 year in 100.

Be aware that these allocations are based on recent figures and may be high for long term planning. There are many unused allocations at present and it is expected that these will either be sold or developed over time. As this happens, seasonal allocations will gradually decrease.

Understanding the differences between catchments will help you to understand the market more fully, but the first step is understanding your own system. To start working through this kit, you will need to bring forward from Appendix 1 the table that best describes your system. An example is shown below.

Table 3 Indicative water allocation probabilities (for G-MW Murray)

Scenario for seasonal allocation	**Allocation (%)**	**Odds (%) or years in 100**	**Allocation ML per ML entitlement**	**Odds x allocation**
	a	b	c	b x c
Very high	200%	60%	2	1.20
Av to high	150-200 (176%)	10%	1.76	0.18
Av to low	130-150 (140%)	10%	1.4	0.14
Low	100-130 (116%)	17%	1.16	0.20
Very low	60-100 (76%)	3%	0.76	0.02
Long term average		100%		Sum above=1.74

After completing this section, you will have a guide as to how much water you need each year and be able to quantify how often, and by how much, your water needs will be different to seasonal allocations.

Using the allocations for your system from Appendix 1 you can work out how many megalitres you will have, and how many megalitres you will be short, for each of the six scenarios.

[2] It is important to note that in Victoria the allocation systems are changing due to Retail Entitlement Reform. This will provide two different entitlements; a high security entitlement and a medium security entilement. While this will alter the calculations you are about to do for closing seasonal allocations, it will also enable you to tailor water entitlement more closely to your needs.

The example in Table 4 looks at 200 ML of entitlement in the Victorian Murray. Probability indicates that this irrigator will have 50 extra ML of water for 60 years in of each 100, or 60% of the time.

Table 4 Estimating how much water you will have available

Scenario for seasonal allocation	Long term Odds (%) or years in 100	Allocation ML per ML entitlement	My Entitlement held	My Water allocation	Water needed to irrigate fully	Difference to ML needed
	From Table 3				From Table 1	
	a	c	b	d = b x c	e	f = d - e
Very high	60%	2	200 ML	400	350	50 extra
Av to high	10%	1.76	200 ML	352	350	2 extra
Av to low	10%	1.4	200 ML	280	350	70 short
Low	17%	1.16	200 ML	232	350	118 short
Very low	3%	0.76	200 ML	152	350	198 short
Long term average		1.74	200 ML	348	350	2 short

When opening seasonal allocations are low, most irrigation water suppliers now also announce the probabilities of the seasonal allocation being increased by the end of the season. In these circumstances, you can also use these short terms probabilities in Table 4 to estimate how many megalitres you will be extra or short in that particular season.

There is a blank worksheet at the end of this manual to assess your own allocation variability. You may like to try this now. This worksheet will help you answer the first question.

Q1. How often will I be short of Water?

1. OVER THE LONG TERM, HOW MUCH WILL IT COST ME TO USE TEMPORARY WATER TRADE TO AVOID BEING SHORT OF WATER?

In this chapter, you will quantify the cost of temporary water trading to fully meet the water requirements of your business. To do this you will need to estimate the market value of water for different allocation years. Historical figures can be a guide, but do not rely on them too much as the water market is rapidly changing and the patterns of the early trading years may not necessarily be repeated.

The following exercise helps you to estimate the cost to your business of annual water purchases. You have already worked out how many extra megalitres you need in Table 1. Using allocation factors and the odds of getting that allocation from Table 4 and combining this with your estimates for market values for temporary water for each of the 6 scenarios, you can find out the average annual cost of water purchases needed to meet your irrigation needs. An example of this is shown on Table 5 on the next page.

Table 5 assumes that the selling price for water is the same as the buying price to determine the long term average annual value of the entitlement.

The table shows that for this example it costs the business $638/year to buy temporary water. But this can vary between a cost of $12,870 in the driest years to an income of $500 from selling excess water in the wettest years.

Using this framework, you can test the change in your annual water purchase costs for different levels of entitlement.

There is a blank worksheet at the end of this manual to quantify your own cost of annual water purchases. You may like to try this now. If your answer is negative it shows that on average you will be selling more water than buying for the ML you need.

Once you have completed the worksheet you will be closer to answering the second question:

Q2. Over the long term, how much will it cost me to use temporary water trade to avoid being short of water?

Table 5 Assessing water trading costs for annual purchases

Scenario	Extra ML needed	Market Price of water[3] $/ML your estimate	Market value of water in that year	Odds %	Financial impact on business	
	Table 4, column f			Table 4, column a		
	a	b	c = a x b	d	e = c x d	
					sell	buy
Very high	50 extra	10	500	60% or 0.6	500x0.6=300	
Av to high	2 extra	25	50	10% or 0.1	50x0.1=5	
Av to low	70 short	35	2,450	10% or 0.1	2,450x0.1=245	
Low	118 short	40	4,720	17% or 0.17		4,720x0.17=802
Very low	198 short	65	12,870	3% or 0.03		12870x.03=386
Long term average	2 short			100%	Average impact of temporary trade to business = sum above purchases1188 less 550 from sales =**$638/year**	

You need to be mindful of whether your market price estimate in b includes a variable delivery charge (based on usage) when completing this table.

For example, if you have included a variable delivery charge in b above then the additional cost shown for water purchases in low allocation years can also be offset by water charges saved on the lower usage of your own permanent entitlement.

[3] Note the pool price for G-MW Murray varied between $15 to $60/ML in 1999/2000. For the Goulburn it varied from $8 to $90/ML. For G-MW there is no delivery charge included in the quoted market price of transferred sales water, you pay for this separately to G-MW when delivered.

1. OVER THE LONG TERM, AM I BETTER OFF TRADING PERMANENT OR TEMPORARY WATER?

This kit is all about helping you to decide at what point you are better off entering the market to either buy or sell water permanently relative to your other alternatives.

Buying permanent water is similar to buying land; you should do full farm budget and cash flow forecast first. You should also remember that different people can afford to pay different amounts. Because water entitlements are transportable, the water market is more like the share market than the land market. Water can be bought and sold by a range of different buyers; this influences both its price and its volatility.

Once you have taken account of the issues involved in owning water entitlements, it is relatively easy to work at how much a megalitre of water entitlement is worth to you. If this is different to the market price for permanent water, you may want to buy or sell permanent water.

A. TAKING ACCOUNT OF THE ISSUES INVOLVED IN OWNING WATER ENTITLEMENTS

Below are some of the aspects of a farm business that may influence your decision about buying or selling permanent water.

- **Interest costs.** When water is in excess you may be incurring an interest cost of owning water that is not being used. To date it has been cheaper to buy on the temporary market and use the capital to expand the rest of the business. You may not wish to tie up capital in water entitlement and would rather invest elsewhere and buy temporarily.

- **Skills.** Some people have good skills in getting water at the right price, but not all of us have that skill. If you do not have sufficient water trading skills to frequently enter the temporary market, then having more permanent water may be the better option for you.

- **Capital growth.** Whether you obtain your core water needs temporarily or permanently also depends on what you think permanent water prices will do in the future. In the Murray Basin, water prices have generally been tied to the performance of the rice and dairy industries as they use most of the water. Water prices are likely to fluctuate in line with the performance of these industries. If you believe these industries will improve in profitability then water values may increase to reflect this.

- **Flexibility.** You may be able to manage with a lower entitlement if you:

    - cannot readily use high seasonal allocations profitably because you have no extra land to irrigate.

    - have no way of storing water

- can easily reduce your irrigation area to cope with low allocations with no permanent damage to your income stream.

- **Farm development.** Do you want to establish more irrigation areas on your farm by converting dryland pastures over to irrigation?

- **Security.** Do you want extra security of water resources?

- **Cash flow.** What value do you place on the income stream that comes from selling on the temporary market when you don't require your full seasonal allocation?

Do any of these apply to your business?

A. CALCULATING THE VALUE OF PERMANENT WATER FOR MY BUSINESS

We can build on the same framework used to establish the cost of temporary water trading to work out how permanent water costs compare with temporary. This is shown in Table 6 below.

Table 6 Calculating long term value of temporary water from estimated trading prices.

Scenario	**Allocation ML per ML entitlement**	**Market Price of water[4] $/ML Less any delivery charge** your estimate	**Odds %**	**Weighted value per ML of entitlement[5]**	**Sum**
	Table 4, column c		Table 4, column a		
	a	b	c	a x b x c= d	
Very high	2	5	60% or 0.6	2x5x0.6=6	6
Av to high	1.76	10	10% or 0.1	1.76x10x0.1=1	2
Av to low	1.4	20	10% or 0.1	1.4x20x0.1=2	3
Low	1.16	35	17% or 0.17	1.16x35x0.17=7	7
Very low	0.76	50	3% or 0.03	0.76x50x.03=1	1

[4]. For G-MW you need to subtract the delivery charge to purchases of temporary water unless it is sales.

[5] Weighted by probability and market value. This calculation determines the average annual value per ML of entitlement. It multiplies the allocation by its market price by its probability for different scenarios.

Long term average	1.74		100%		Average annual value of entitlement = sum above **=$19/ML**

To compare the average annual value of entitlement with permanent water prices you will have to nominate an interest rate and a capital gain factor for your water entitlement.

In the example below an interest rate of 10% is the interest cost paid on debt to buy the water. Or if you are debt-free then it is the return on capital you might expect from the investment in water entitlement. However, in reality, the interest cost is the interest or opportunity cost of the money you have invested in water entitlements less any capital growth you expect in the value of your water entitlement.

For example, interest of 10% less capital gain in water value of 3% per year gives a net interest rate of 7%. If the business believes the capital gain in water value is 4% per year and is borrowing at 10% then the net interest cost expected is 6%. Some people may believe that water entitlement could fall in value in which case a negative capital gain may be used. Even if debt free you need to think about the alternative returns that other investments might pay (and their risk) as the opportunity cost for investing in water.

The worked example below illustrates that the interest rate you pay, (or nominate as a target if not borrowed) and the capital gain can have a strong influence on a decision.

Table 7 Estimating the value of permanent water entitlement against market price

Market value of permanent water *a*	**Interest rate** *you nominate b*	**Capital gain or loss** *You expect c*	**Net interest rate** *d=b-c*	**Annualised cost of market value for permanent water** *=axd*	**Decision influence if average annual value of entitlement is $19**
					This figure is from Table 6
$500	10%	3%	7%	500x7%=$35	Cheaper to buy temporary
$500	7%	3%	4%	500x4%=$20	Little difference between temp. or permanent
$700	10%	3%	7%	700x7%=$49	Cheaper to buy temporary
$700	7%	3%	4%	700x4%=$28	Cheaper to buy temporary
$1000	10%	3%	7%	1000x7%=$70	Cheaper to buy temporary
$1000	7%	3%	4%	1000x4%=$40	Cheaper to buy temporary

There is a blank worksheet at the end of this manual to compare permanent water prices with temporary water prices. You may like to try this now.

Once you have completed the worksheet you will be closer to answering the third question:

Q3. Over the long-term, am I better off trading permanent or temporary water?

1. HOW MUCH CAN I AFFORD TO PAY FOR TEMPORARY WATER OVER THE LONG TERM?

Over the long term, buying more water only makes sense if you are making money from the water. This section shows you how to work out much money you are likely to make from buying water. Knowing this can help you decide whether you should be buying or selling temporary water. It will also help you judge the appropriate price to pay over the long term.

You will make better water trading decisions if you know when you are trading above or below your optimum long-term average affordable price. The aim of this section is for you to be able to know what this price is, using estimates of operating surplus per ML.

The operating surplus per ML can be defined as the income less operating costs divided by the ML used to earn that income. Operating costs include both variable and overhead costs. (Therefore, it will be slightly lower than a gross margin per ML, which is income less variable costs).

Operating surplus/ML = Income – operating costs (both variable and overhead)

ML used to earn the above income

The operating surplus per ML indicates the dollars available to cover the annual cost of buying water. This cost can be an interest cost in the case of permanent water, or the purchase price in the case of temporary water.

There is a worksheet provided at the back of this book for you to calculate your operating surplus. You may like to follow this example through before doing your own. The framework used for this section is similar to that used in the *DNRE More Milk & Dollars Measuring Water Use Efficiency Guide.*

Income

Step 1. Calculate income per kg milk solids (fat + protein)

From your profit and loss statement, calculate total milk income (gross) for year

$ 200,000

From factory records, find out how total kilograms of fat and protein produced in the year

50,000 kg

Divide total farm income for the year by the total amount of fat and protein (milk solids in kg) produced in the same period

$ 200,000 ÷ 50,000 kg = 4 $/kg

Step 2. Calculate income from bought in (or from non milking area) supplements

How many tonnes of grain or pellets did you use in the year? Multiply by 95 to estimate the kg of fat plus protein produced from grain or pellets.

_____40___ t x 95 (51 kg fat+41 kg protein) = ___3,800_____ kg milk solids

How many tonnes of bought in hay did you use? Multiply this figure by 59 to estimate the kg of fat plus protein produced from hay.

_____100____ t x 59 (33 kg fat +26 kg protein)= _____5,900_____ kg

How many tonnes of bought in dry matter silage did you use? Multiply this figure by 74 to estimate the kg of fat plus protein produced from dry matter silage.

(Pit silage is 33% dry matter while round bale silage is 45% dry matter)

_____100___ t x 74 (44kg fat + 33 kg protein) = _____7,400_____ kg

Add these all together to get the kilograms produced from bought in feed.

_____3,800____ kg + ____5,900_____ kg + ___7,400_____ kg = ____17,100_____ kg

Multiply kilograms of bought in feed by the income per kg calculated in Step 1 to give the proportion of income that was produced from supplements.

_____17,100____ kg x _____4____ $/kg = $____68,400_____

Step 3. Calculate proportion of farm income that was produced from irrigation.

Subtract income ($) from supplements from total farm income ($) to give the proportion of income produced from irrigation

$_____200,000_____ - $___68,400_____ = $__131,600_____

Calculate ML of irrigation water used in the year _____330_____ ML

Divide income from irrigation by number of ML to give income for each ML used

$____131,600_____ ÷ ____330_____ ML = _____399_____ $/ML

Operating costs

Step 4. Calculate operating costs from irrigation

From profit and loss, look up the total farm expenditure for year. Subtract costs that are not operating costs such as interest, lease costs, temporary water purchases, rent, payment to partners, superannuation, depreciation and any capital expenditure (eg lasering) that have been included in the total expenditure.

You will be left with your farm operating costs; it should include variable costs such as labour, feed, fertiliser, contractors, fuel, repairs and maintenance, water charges, rates, electricity, chemicals, consultants, and overheads such as office, accountant, legal.

$ 170,000 - $ 55,000 = $ 115,000

Less feed costs (include $ feed freight)

$ 115,000 - $ 35,000 = $ 80,000

Less dryland farming operating costs (estimate costs for dryland part of farm if significant).

$ 80,000 - $ 3,000 = $ 77,000 operating costs for irrigation

Step 5. Calculate operating surplus from irrigation

Subtract operating costs from irrigation (Step 4) from income from irrigation (Step 3)

$ 131,600 - $ 77,000 = $ 54,600

Step 6. Calculate operating surplus from irrigation/ML

Divide operating surplus from irrigation (Step 5) by number of ML of irrigation water used in the year (Step 3)

$ 54,600 ÷ 330 ML = 165 $/ML

In high rainfall areas (>500mm/year) the operating surplus can be inflated because rain increases production. Therefore, the final figure needs to be adjusted down so that it only reflects the surplus due to irrigation. A simple way of approximating the value of irrigation is to estimate the percentage of production caused by irrigation and multiply the operating surplus per ML by this amount. For example, if total production would be 33% if there was no irrigation then 67% is due to irrigation and the operating surplus needs to be multiplied by 67%.

For areas of rainfall > 500 mm multiply by % productive capacity caused by irrigation =

$$\frac{165}{} \text{ \$/ML} \times \frac{67}{100}\% = \frac{111}{} \text{ \$/ML}$$

Step 7. Calculate the long term average price you are prepared to pay for water after considering capital and owners labour costs

In the long term, it is important to cover capital costs and owners' labour costs. You need to do a full farm budget to calculate your own figures for this, particularly for farm expansion. But the following figures may be useful as a guide:

After covering labour and capital costs, there is generally about 25% to 50% of the operating surplus available for water purchase. This figure will vary enormously between farms.

Use the figure of 25% of the operating surplus if the capital costs associated with using the water purchased will be high, for example when new equipment or a new layout is needed.

Use 50% if there is existing spare capacity within your farm to expand irrigation and production with little extra capital and if the owner has the time to manage the expansion and the need for extra profit is high.

$$\frac{111}{} \text{ \$/ML} \times \frac{50}{100}\% = \frac{55}{} \textbf{ \$/ML}$$

This final figure determines how much you can pay for water on average over the long term and perhaps whether you should sell. Individual farms have an enormous variability in their operating surplus per ML even within the same enterprise and area. That is why different farms can afford different prices for water.

If your final figure is well above long term water prices then you have a relatively large surplus and so you may consider buying, but if your figure is well below then you may struggle in the long term to survive and may be better off selling water.

Put simply, if your final figure is significantly higher than the annual cost of buying water then it may be worth buying water and expanding. If it is much lower then it may be worth selling some water.

This method is a useful guide when seasonal allocations are close to average, the situation in extreme years such as very low or very high allocation years is quite different. **Therefore this approach should not be used in extreme years**. Instead the partial budget approach should be used as outlined in Chapter 2.

In any case, operating surplus does not account for changes such as water prices throughout the season. Using a partial budget can be a better way of comparing water purchase prices and can be updated as things change.

Besides, neither operating surplus nor gross margins (which are income less variable costs per megalitre) account for the capital investment or owner's labour per megalitre. This is very high for some enterprises, especially permanent horticulture, which makes it hard to expand or contract the irrigated area.

There is a blank worksheet at the end of this manual to help you to calculate your own operating surplus. You may like to try this now.

Once you have worked out your own operating surplus you would be able to answer the fourth question:

Q4. How much can I afford to pay for temporary water over the long term?

2. HOW DO THE ALTERNATIVES TO WATER TRADE COMPARE?

Each time you buy temporary water, the maximum price you should pay for that water will depend on the value of the next best alternative to purchasing water. Therefore, you need to consider what these options are and how much they will cost.

For example, an option might be to not buy water and to dry an area off and reduce production instead. When this option is studied in more detail, you may find that while variable costs are reduced by cutting back on area, fixed costs remain the same and this will dramatically reduce profitability. At the same time, you also need to be careful that you do not pay more for water than you can afford.

Therefore, you need to be able to compare the costs and benefits of those options, over more than one season and to understand how those costs might vary throughout the season. At the same time, you also need to be aware of the potential dangers involved in making decisions in isolation.

Partial budgets can be used to compare all these options with each other. Market prices for water vary through the year so you will need to update your partial budget as things change.

i. Identifying your options

Except for the very driest of years, seasonal allocations are likely to rise during the year. The closing allocation is therefore usually higher than opening seasonal allocation. It is difficult to predict what the final allocation will be, but water authorities have started to give probabilities for different levels of allocation. You should consider these probabilities when calculating your likely total seasonal allocation.

When you believe that water will be scarce you have several options. For example, (tick the ones that apply to you):-

- ❑ Buy more water
- ❑ Increase your irrigation efficiency
- ❑ Use supplementary feed (bought in feed) as a substitute
- ❑ Use groundwater or recycled drainage water as a substitute
- ❑ Irrigate a smaller area
- ❑ Sell water, if market prices are high enough to justify irrigating even less area
- ❑ Do nothing and hope for an allocation increase later in the season
- ❑ Change your enterprise mix to get more $ per ML
- ❑ Overdraw on next year's allocation (NSW only).

On the other hand, when water is plentiful and the seasonal allocation is in excess of your requirements, you can:

- Store water on-farm for later use
- Sell water
- Do nothing
- Irrigate a larger area
- Lease more ground to use extra water (eg share crop)
- Plan to carry over allocation until the next seaon (NSW only).

To help you choose your best option we have included a partial budget table so that the impacts of each option can be compared. A partial budget helps you to compare the cost of the substitutes with the cost of buying extra water. You can also estimate the cost of using drainage water, or groundwater using the partial budget.

i. Using a partial budget to help choose your best option

In a partial budget, you estimate the impact on your business of implementing each option. The impact is measured by calculating the extra costs for this option, the extra income generated, and the change in profit. This is illustrated in the diagram below.

Change in income ($/ML income x no. ML change)	Less	**Change in costs** (operating plus capital)	Less	**Change in owners labour cost**	Less	**Impact in future years** (eg recovery cost)	Equals	**Change in Profit**

For any one year, you can use a partial budgeting worksheet to work out the marginal profit per ML for the action that you wish to carry out. If this is lower than the water price then it pays to do this option rather than buy, but remember to consider any flow-on impacts into future years.

Your partial budget will also need to be updated as the season progresses. As well as the market price for water changing, the value of water to you may change. For example, the dry matter produced per ML in spring may be higher than other times of the year.

For a once-off purchase, the maximum you should pay for water is the value of the next best alternative to purchasing water.

A sample partial budget is included over the page comparing some options when a farm is 100 ML short of water and when it has 100 ML surplus water compared to an average or 'normal' year. The options for action are described in the second column. When short of water, the suggested options are to dry off an area of irrigated pasture and buy in feed, to buy more water or to dry of some milking cows. When there is surplus water, the options are to sell that water or to irrigate more pasture.

Column a. Change in no. of ML used compared to normal year

If the action you are testing involves more or less water than your 'normal' long-term seasonal average this is the difference between the ML you expect to be used versus the 'normal' year. *In the worked example, this ranges from –100ML to +100ML.*

Column b. Change in income

If the action you are testing involves lower production than your 'normal' long term average this is the difference between the $ expected versus that 'normal' year. It refers to gross income before any expenses. Think about your income per ML as discussed in chapter 1. and multiply this with the no. of ML from above to work this out. = $/ML X ML change.

For example, when the option involves drying off cows there is a loss in income from loss of production (-$40,000) but this could be reduced if some of the these cows were sold.

Change in operating cost

If the action you are testing involves lower or higher operating costs than your 'normal' long term average, this is the difference between the $ cost expected versus that 'normal' year.

Operating costs are both variable and overhead costs. Overhead costs are unlikely to change but variable costs almost certainly will. It includes items such as paid labour, water charges, power, seed, fertiliser, feed, but not capital costs such as water purchase, land rent, leases, interest, depreciation or capital repayments.

Drying off pasture and cows has a lot less impact on operating costs (save $1000 on fertiliser and labour) than drying off pasture and buying supplementary feed (spend $14,000 on feed).

Change in capital cost

If the action you are testing involves lower or higher capital cost than your 'normal' long term average this is the difference between the $ cost expected versus that 'normal' year.

It includes items such as temporary water purchase or sale, land rent, leases, interest, depreciation. It does not include capital repayments or income from sale of permanent water as this should be shown in saved or earned interest.

In the example, the option of buying more water when short results in increased capital costs of water purchase and interest payments on overdraft of $4,400.

Column c. Change in total cost

The total of the changes in operating and capital costs above.

Column d. Change in $ owners labour

You will want to make sure that you do not end up selecting an option that means more work for the owners for little benefit. Therefore, you should include an amount for the extra work the owners would have to do or extra time that is saved compared with a 'normal' year.

In this example, the only option that increased labour costs was to increase the irrigated area. This accounts for the extra labour required to prepare the new area, irrigate more area and cut more hay.

Column e. Impact next year and future years

Make an estimate of the recovery cost for next year and any future recovery costs that may be associated with the action you are considering. This does not allow for a discounted cash flow (i.e. time value of money).

If an option is to dry off pasture, there will be a future cost to rehabilitate this pasture and this must be included in the budget.

Column f. Change in profit $

This is the likely impact on your bottom line for each option.

Subtract the changes in costs from the change in income to get the change in profit or marginal profit. For the options when 100ML short of water, buying water has the least negative impact on the business.

Revised annual profit

This is the effect on the change in profit on a 'normal' year' profit. This will test whether your business could survive a given loss.

In this example the 'normal profit' was $40,000 and the revised annual profit varies between -2,400 to 35,6000 depending on the option chosen for the 100 ML short fall.

Marginal profit $ per ML

This is the profit divided by the number of ML. It is an important figure against which to assess your water trading prices.

In the example provided, for 100 ML water shortfall the best alternative was to purchase water, or to overdraw on next year if possible. The price of water would need to increase substantially before you would choose to dry off pasture.

There is a blank worksheet at the end of this manual to do your own partial budget. You may like to try this now.

Once you have identified you own options run your own partial budget you can answer the fifth question:

Q5. How do the alternatives to water trade compare?

Example scenario	**Options different to base case**	**Change in ML used** (ML)	**Change in Income** ($)	**Change in total costs** (capital + operating)($)	**Change in value of owners' labour**($)	**Impact next year & future**($)	**Change in profit**($)	**Revised annual profit**($)	**Marginal profit/ML** ($/ML)
	Describe the Action	*a*	*b*	*c*	*d*	*e*	*f =b-c-d-e*	*40,000 + f*	*f/a*
Typical normal year	Average seasonal allocation used and usual trading and ML 'sales' usage	0	0	0	0	Nil	0	40,000	0
100 ML short of water	Dry off pasture to meet allocation available maintain production with extra feed	-100	0 will replace with feed	14,000 extra feed bill -1,000 saved fertiliser & labour 1,300 more interest -2,000 saved water charge =12,300	0	12.5 ha pasture rehab. =$1,500	-13,800	26,200	-138
	Buy 100 ML at $40/ML	0	0	4,000 water cost plus 400 extra interest =4,400	0	0	-4,400	35,600	-44
	Dry off 12 ha & reduce no. milkers	-100	-40,000 Some saving from sale of cows?	-1,000 saved fertiliser & labour 3,900 more interest on overdraft -2,000 saved water charge = 900	0	12.5 ha pasture rehab. =$1,500 restocking cost?	-42,400	-2,400	-424
100 ML extra water	Sell 100 ML at $12/ML	0	$1,200	$-120 less interest	0	0	1,320	41,320	+13
	Irrigate more annual pasture area	+100 ML	0	-10000 Reduced feed, 2,000 extra water charge +4000 More fertiliser, hay cutting =-4,000	1000	0	3000	43,000	+30

1. WHAT ARE THE MAIN DRIVERS FOR MY WATER TRADING DECISIONS?

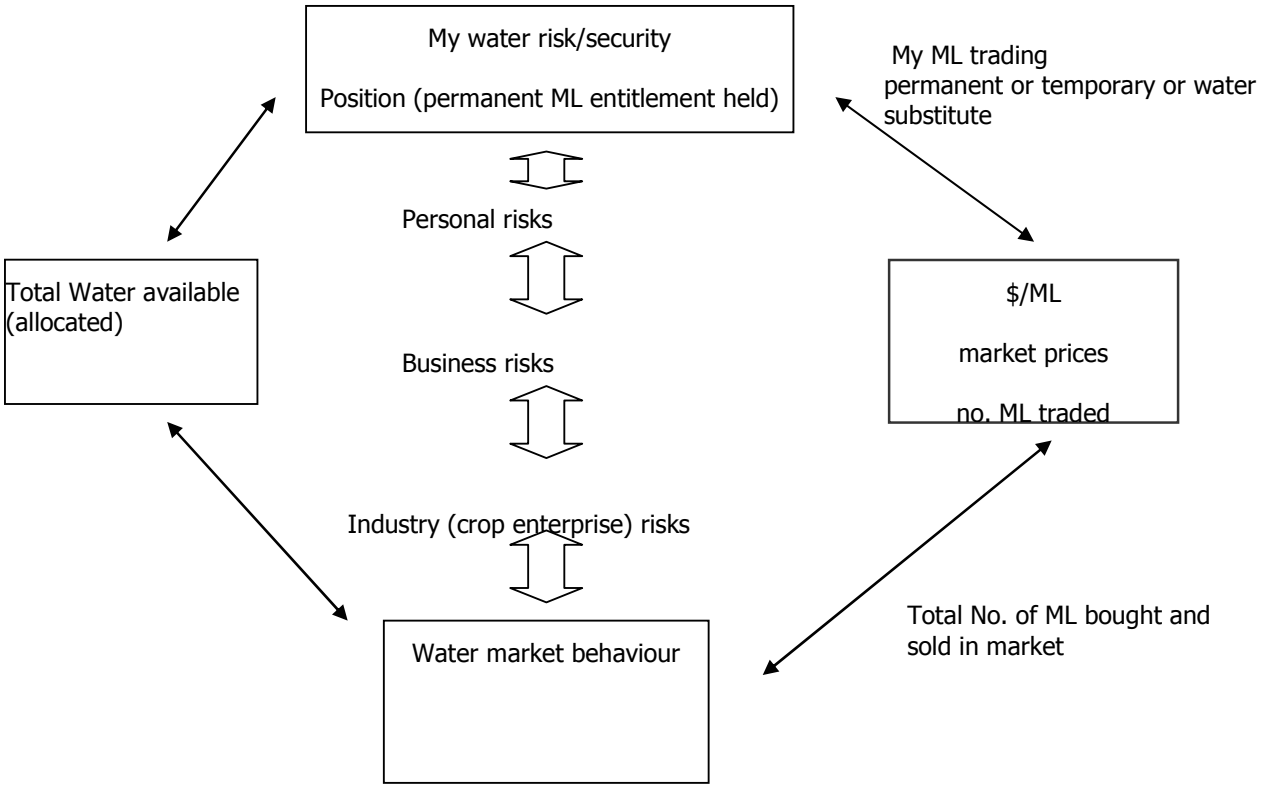
Whenever you think about buying or selling water, you are thinking about the security of your business enterprise. You are also thinking about your water security.

So far in this kit, we have looked at water trading decisions from the context of how your business operates. In this section, you will take a broader look at your place in the water market. You will start by picturing all of the things that influence your water security position, and then you will explore each of them in more detail.

A. IDENTIFYING THE OVERALL INFLUENCES ON YOUR WATER SECURITY

Your own water security position is influenced by a combination of personal, business and industry influences. The diagram below illustrates these influences and the relationship between them:-

Figure 1 Influences on water security



The diagram shows that you water security/risk position as measured by the amount of permanent entitlement you hold is influenced by a number of factors.

Your own attitude to risk is an important one and this will be affected by your current business risk profile (eg debt levels), and the industry you are in and its exposure to risk (eg amount of price fluctuation).

In turn, the industry risk profile in combination with other irrigation users in your catchment can influence the water market price and availability of water. Both of which are likely to be key drivers of your own risk position.

The higher the level of entitlement you decide to hold, the more you will be sheltered from these influences. However, there can be a cost in having more capital tied up.

In order to establish an appropriate level of water entitlement you need to consider what is driving your decisions concerning water, both now and in the future.

B. RECOGNISING YOUR OWN PERSONAL RISK PREFERENCES

A key part of risk management is understanding your own preference for risk.

Choice and the management of risk is a very personal process. Some people live their lives avoiding risk (risk averters) while others revel in calculating the odds and taking chances (risk preferrers). Trying to impose the decisions or the risk management regime of a risk preferrer on a risk averter, and vice versa, will not work and could jeopardise their entire business.

In the dairy industry, a high risk-preferrer may be a high input producer with a high reliance on bought-in feeds and a high debt load. These producers have a high capital investment in feed systems and storage, high stocking rates and are exposed to risks on the input side, especially the price of feed.

If you are risk averse, you will tend to have more permanent water for a given area. You will be less reliant on feed supplements, and you may be driven by a desire for lower debt.

Almost any business choice has an upside and a downside and your view on the size of the risks you take is a very personal one.

At the end of the day, our decisions are made on a mix of "the numbers" and what our "gut" tells us. Both are important. We ignore our intuition at our peril; we can all think of examples where our intuition proved correct and the logical explanation only became apparent later.

Are you a risk averter or a risk preferrer?

Would you enjoy more risk or less risk than your business currently presents?

Does this make you want to increase or decrease your permanent water entitlement?

C. ASSESSING YOUR BUSINESS'S RISK PROFILE

Each business is unique. Table 8 looks at the physical, financial and personal aspects that may be influencing your attitude to water security risk. Tick the boxes for each of the influences on your business then total each of the three columns.

Table 8 Assessment of influences on business risk

Type of Influence	**Potential influence on you water risk position**	**YES (& easily)** Comfortable with temporary trading to meet shortfalls	**Maybe**	**NO (or difficult)** Prefer more permanent water to increase security
Physical	I can dry off large areas of lower value annual pasture/crops to cope with a low allocation			
	I can dry off irrigation with little extra recovery costs in future years			
	I can easily handle large amounts of extra bought in feed if required			
	I can easily access water market to buy extra water when needed			
	I can sell entitlement without losing services from irrigation provider such as affecting water rationing			
Financial	I believe temporary water is cheap compared to permanent water averaged over dry and wet years			
	I spend more than 10% of my total farm income on interest and leases (not including capital repayment)			
	I have above average operating surplus per ML for my industry			
	I believe that there will be little capital growth in the value of permanent water			
Personal	I have the skills to trade and enjoy regularly trading water			
	I am comfortable with the idea that in some years I will be looking to supplement my water allocation			
	Add up the number of ticks in each column			

If you have more ticks in the YES column, it suggests that you a risk preferrer.

If you have more ticks in the NO column, it suggests you are more risk averse and you value a higher level of water security.

What other influences need thinking about?

Has working through this section made you want to increase or decrease your permanent water entitlement?

A. ASSESSING YOUR INDUSTRY'S APPROACH TO RISK

Apart from understanding your personal approach to risk, and your business's capacity to deal with risk, it is also important to understand how your industry in general responds to the risk of water shortage. Similarly it is important to understand how your industry compares with the other major water using industries A range of irrigation industries influences the water market; the important characteristics of the main ones are shown in Table 9 following.

A key implication of the differences in industries is that in a year of very low seasonal allocations the cost of losses in subsequent years for dairy and horticulture will mean that they will pay more for water, while low value croppers and broad acre grazers may choose to sell. These sellers will lose crop income in that year, but not necessarily have carryover costs in subsequent years.

The performance of the rice and dairy industries has been the main driver of water prices in the southern part of the Murray Darling Basin. These industries are likely to continue to dominate water trading. Therefore, the profitability of rice and dairy will influence future water prices. Horticulture while having a higher profit per ML is still a very small player in terms of volumes used or traded.

The trend in permanent water trading so far has been that water is moving from industries that make a low profit per megalitre towards the buyers who make a higher profit per megalitre. The sellers are more likely to be willing to trade off some security for a lower cost in owning water entitlement.

Even within the dairy industry, there is a wide range in performance of properties with both buyers and sellers participating in the water market.

Table 9 Risk drivers for different irrigation industries

Industry	Gross Income/ML	Dominant risk factor	Impact of lack of irrigation supply	Capacity to use surplus water
Broad acre grazing Beef and sheep	< $100 /ML	Cost of water	Relatively low crop loss as each farm has annual pasture areas not irrigated	Some - by irrigating extra annual pasture Difficult to respond quickly to changes in water availability due to inability to change stock levels
Lower Value Annual Croppers Rice	$100 - $300/ML	Potential to vary the planted area	Relatively low crop loss as crops are not planted if water is not available	Some - by planting extra crops and low labour requirement per ML
Medium Value Croppers Grains and oilseeds	$400 - $600/ML	Potential to vary the planted area	Relatively low crop loss as crops are not planted when there is no water available	Large – by using on-farm storages and then sowing more crop
Higher Value Annual Croppers Cotton	$800-$2000/ML	Need for consistent output	Relatively high crop loss Hold contracts to supply consistent quantities of produce	Limited - by increasing the planted area
Permanent agriculture Dairy	$200 - $600/ML	High fixed costs	Relatively high crop loss as plants are already in the ground and drought damage cannot be avoided Impact of drought can reduce production in subsequent seasons	Limited - by increasing the planted area (the enterprise capacity is usually constrained by a limiting resource other than water eg land area or herd size)
Permanent horticulture Orchards and vineyards	$1,000 to $5,000/ML	High fixed costs	Very high crop loss in current and subsequent years	None

A. UNDERSTANDING YOUR PLACE IN THE TRADING MARKET

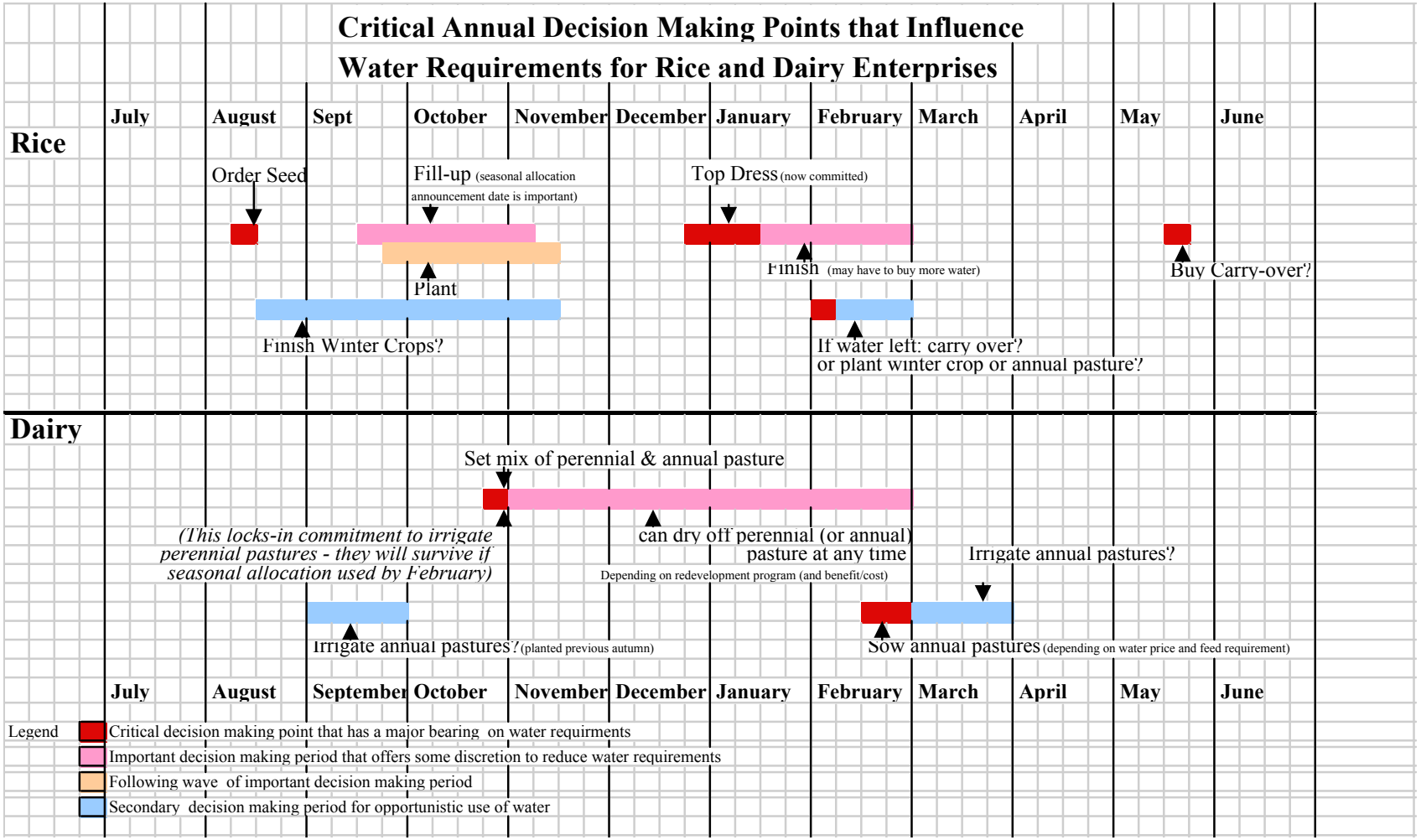
The chart on the next page illustrates the schedule of operations for the major traders of water (rice and dairy). It may be useful to know when buyers and sellers may be 'locked' in or might be considering selling or buying. On the other hand, it is important to note that Appendix 2 suggests that there is not a strong relationship between these critical decision making points and market activity.

At this stage, the biggest drivers of temporary trade seem to be price, seasonal conditions and seasonal allocation announcements. Time of purchase doesn't necessarily match time of use. It is possible that dairy farmers are becoming more confident in the market. Risk preferrers who do not have sufficient water for their total seasonal requirements can delay their purchase in the hope that seasonal allocations will rise and prices will drop or that early Autumn rains may arrive.

How does will this section influence the timing of your water trading decisions?

You should now be able to answer the sixth question:

***Q6. What are the main drivers in my water trading decisions**?*


Critical Annual Decision Making Points that Influence
Water Requirements for Rice and Dairy Enterprises
July
August
Sept
October
November
December
January
February
March
April
May
June
Rice
Order Seed
Fill-up (seasonal allocation announcement date is important)
Top Dress (now committed)
Finish (may have to buy more water)
Buy Carry-over?
Plant
Finish Winter Crops?
If water left: carry over?
or plant winter crop or annual pasture?
Dairy
Set mix of perennial & annual pasture
(This locks-in commitment to irrigate perennial pastures - they will survive if seasonal allocation used by February)
can dry off perennial (or annual) pasture at any time
Depending on redevelopment program (and benefit/cost)
Irrigate annual pastures?
Irrigate annual pastures? (planted previous autumn)
Sow annual pastures (depending on water price and feed requirement)
July
August
September
October
November
December
January
February
March
April
May
June
Legend
Critical decision making point that has a major bearing on water requirments
Important decision making period that offers some discretion to reduce water requirements
Following wave of important decision making period
Secondary decision making period for opportunistic use of water

1. MONITORING AND REVIEWING YOUR DECISIONS

"What would have happened if…?" When you ask yourself this question, it is not "crying over spilt milk", it is learning.

It is important to evaluate your risk management decisions. How do you know if you made the right decision? You need to be able to measure your progress so you do not make the same mistake twice and so you can build on the success of your risk management.

As you make predictions each year and record what actually happened you will be building up your understanding on the water market for your business. You can:

- Compare budget figures to actuals
- Update your budget figures
- Assess how you feel about your position regularly as the water environment and rules continue to evolve.

APPENDIX 1. CLOSING SEASONAL ALLOCATION PROBABILITIES FOR SIX DIFFERENT VALLEYS

Victorian systems have been modified to take into account policy change outlined in the Victorian Government White Paper in 2004. There are many unused allocations at present and it is expected that these will either be sold or developed over time. As this happens, seasonal allocations will gradually decrease and the tables represent our estimates for long term allocations.

NSW allocations have not been included.

Table 1 Indicative water allocation probabilities for Victorian Murray (Goulburn-Murray Water)

Scenario for seasonal allocation	**Allocation (%)**	**Odds (%) or years in 100**	**Allocation per ML entitlement (ML)**	**Odds x allocation**
	a	b	c	b x c
Very high	129%	0.75	1.29	0.97
Av to high	115 - 128 (118%)	0.06	1.18	0.07
Av to low	107 - 114 (108%)	0.04	1.08	0.04
Low	100-106 (102%)	0.12	1.02	0.12
Very low	60-100 (76%)	0.03	0.76	0.02
Long term average		100%		Sum above = 1.23

Table 2 Indicative water allocation probabilities for Victorian Campaspe (Goulburn-Murray Water)

Scenario for seasonal allocation	**Allocation (%)**	**Odds (%) or years in 100**	**Allocation per ML entitlement (ML)**	**Odds x allocation**
	a	b	c	b x c
Very High	189%	0.68	1.89	1.29
Av to high	132 - 188 (149%)	0.11	1.49	0.16
Av to low	118-131 (120%)	0.05	1.20	0.06
Low	100-117 (116%)	0.16	1.05	0.17
Very low	60-99 (76%)	0	0.76	0.00
Long term average		100%		Sum above = 1.68

Table 3 Indicative water allocation probabilities for Victorian Goulburn (Goulburn-Murray Water)

Scenario for seasonal allocation	**Allocation (%)**	**Odds (%) or years in 100**	**Allocation per ML entitlement (ML)**	**Odds x allocation**
	a	b	c	b x c
Very high	(156%)	0.44	1.56	0.68
Av to high	124-155 (134%)	0.15	1.34	0.20
Av to low	114-123 (115%)	0.08	1.15	0.09
Low	100-113(104%)	0.3	1.04	0.31
Very low	60-100 (76%)	0.03	0.76	0.02
Long term average		100%		Sum above = 1.31

2 APPENDIX 2. COMPARING TRADING PATTERNS WITH ANNUAL CRITICAL DECISION MAKING POINTS

It may be useful to understand at what stages of the season other market players are making business decisions that lock them in to a set water requirements. In theory, this information may help you to make better trading decisions[6]. On the other hand, the water market is still quite immature and it is not yet clear whether these business decisions are a major driver of trading patterns.

The information on the following pages aims to give you a good basic understanding of when your competitors for water face critical decision making points. In the case of rice and dairy enterprises, these decision making points have also been plotted against the volumes of water traded on both the Northern Victorian, and Southern Riverina, Water Exchanges.

---

[6] In developing this kit, the following contemporary publications on water trade have been reviewed. All are silent on the issue of critical decision making points within the water trading cycle. However, Marsden Jacob (1999) and Rendell McGuckian *et al* (1999), make reference to the importance of this information.

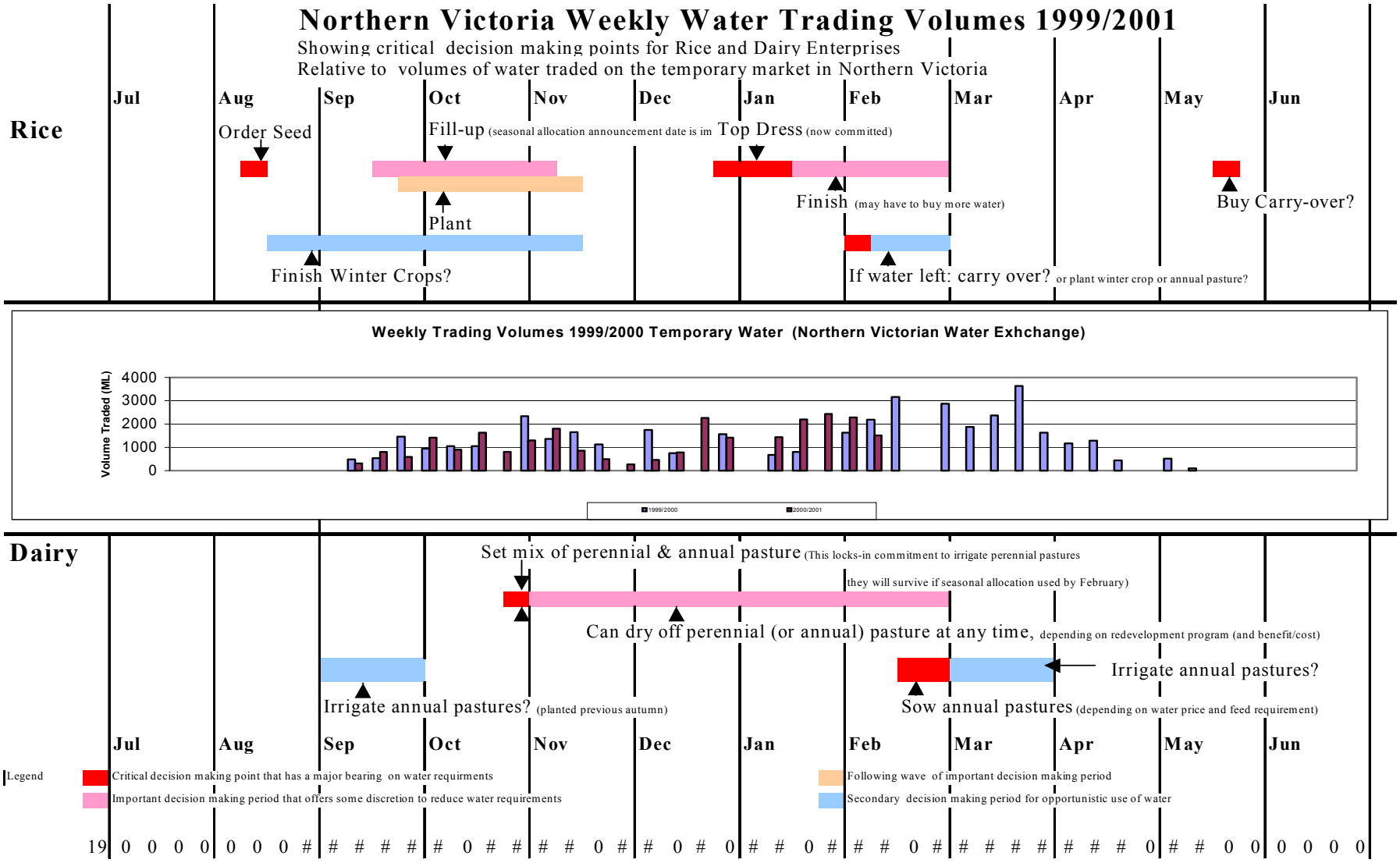
Bjornlund, H. and McKay, J. (2000a) *Are Water Markets Achieving a More Sustainable Water Use*, Proceedings from the Xth World Water Congress, Melbourne, March.

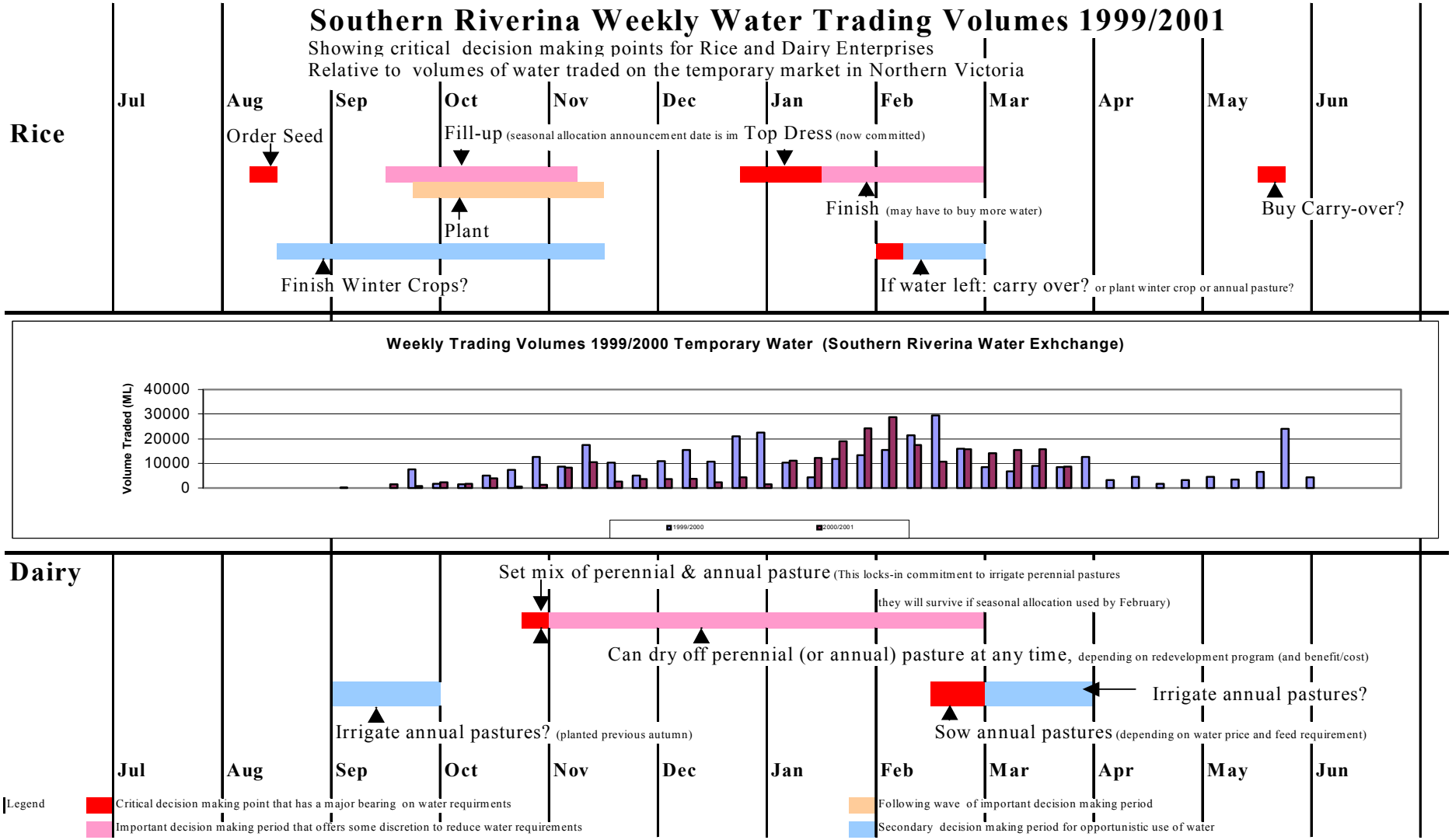
Bjornlund, H. and McKay, J. (2000b) *Problems with NCP water market policies in three Australian States 1995-2000 and elements of solutions – the 'Duty toward Water'.* Proceedings form the 1st Australian Natural Resources Law and Policy Conference, Canberra, March, 179-188.

Marsden Jacob (1999): *Water Trading Development and Monitoring*. Report to the Department of Land and Water Conservation, Marsden Jacob & Associates, Camberwell, Victoria.

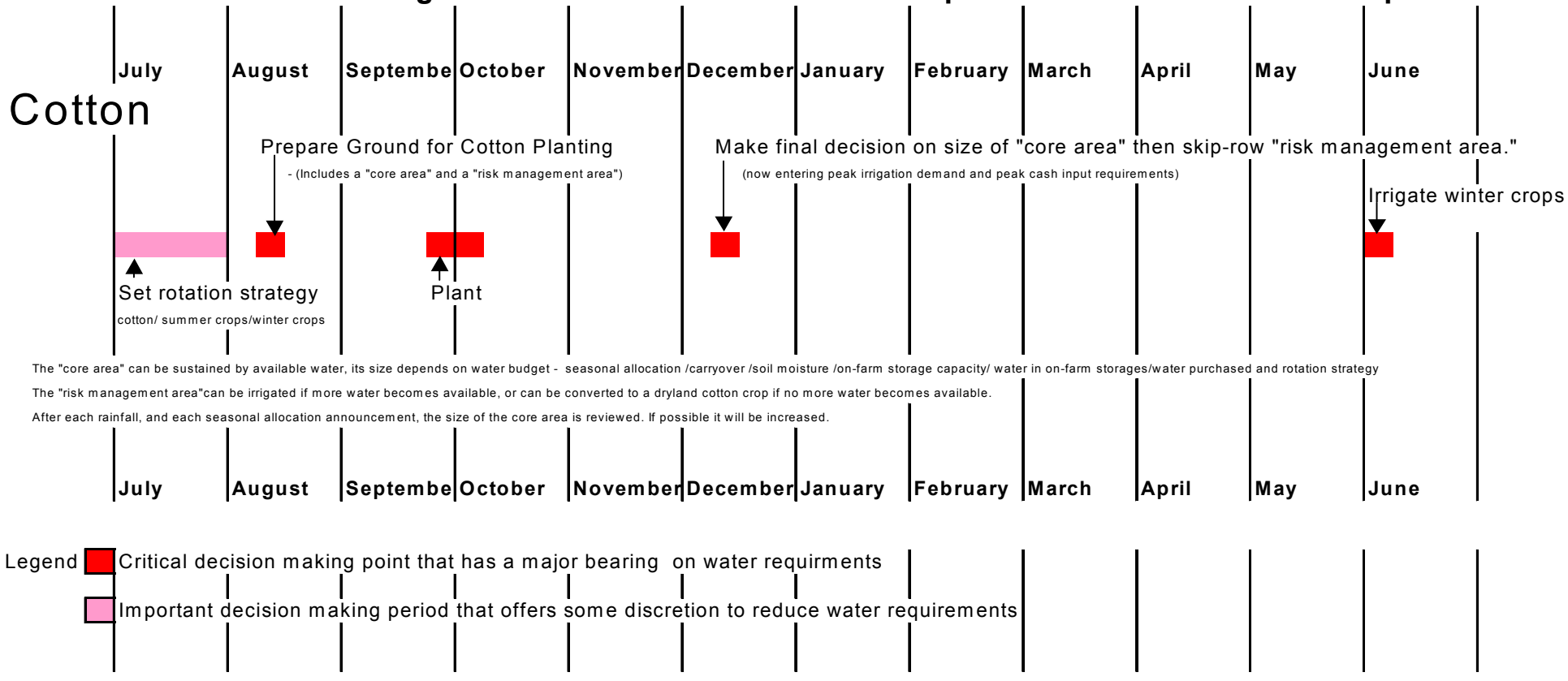
Rendell McGuckian, Tim Cummins & Associates and Read Sturgess & Associates (1999), *Irrigation Risk Management in Current and Future Water Policy Environments.* Final report to Land and Water Resources Research and Development Corporation, Canberra.

Young, M., MacDonald D.H., Stringer, R. and Bjornlund, H. (2000) *Inter-state Water Trading: A Two Year Review,* Murray-Darling Basin Commission, Canberra.

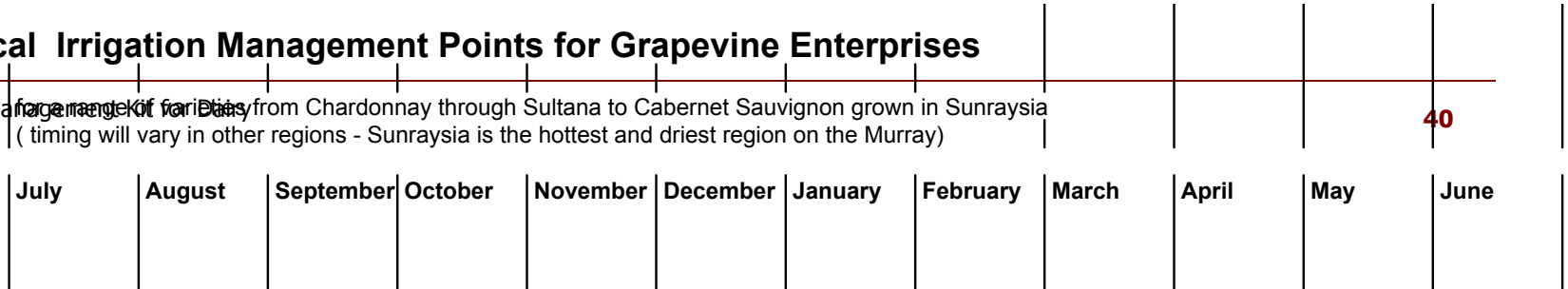

Northern Victoria Weekly Water Trading Volumes 1999/2001
Showing critical decision making points for Rice and Dairy Enterprises
Relative to volumes of water traded on the temporary market in Northern Victoria
Rice
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Order Seed
Fill-up (seasonal allocation announcement date is im
Top Dress (now committed)
Plant
Finish (may have to buy more water)
Buy Carry-over?
Finish Winter Crops?
If water left: carry over? or plant winter crop or annual pasture?
Weekly Trading Volumes 1999/2000 Temporary Water (Northern Victorian Water Exhchange)
Volume Traded (ML)
4000
3000
2000
1000
0
1999/2000
2000/2001
Dairy
Set mix of perennial & annual pasture (This locks-in commitment to irrigate perennial pastures
they will survive if seasonal allocation used by February)
Can dry off perennial (or annual) pasture at any time, depending on redevelopment program (and benefit/cost)
Irrigate annual pastures?
Irrigate annual pastures? (planted previous autumn)
Sow annual pastures (depending on water price and feed requirement)
Legend
Critical decision making point that has a major bearing on water requirments
Important decision making period that offers some discretion to reduce water requirements
Following wave of important decision making period
Secondary decision making period for opportunistic use of water


Southern Riverina Weekly Water Trading Volumes 1999/2001
Showing critical decision making points for Rice and Dairy Enterprises
Relative to volumes of water traded on the temporary market in Northern Victoria
Rice
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Order Seed
Fill-up (seasonal allocation announcement date is im
Top Dress (now committed)
Plant
Finish (may have to buy more water)
Buy Carry-over?
Finish Winter Crops?
If water left: carry over? or plant winter crop or annual pasture?
Weekly Trading Volumes 1999/2000 Temporary Water (Southern Riverina Water Exhchange)
Volume Traded (ML)
40000
30000
20000
10000
0
1999/2000
2000/2001
Dairy
Set mix of perennial & annual pasture (This locks-in commitment to irrigate perennial pastures
they will survive if seasonal allocation used by February)
Can dry off perennial (or annual) pasture at any time, depending on redevelopment program (and benefit/cost)
Irrigate annual pastures?
Irrigate annual pastures? (planted previous autumn)
Sow annual pastures (depending on water price and feed requirement)
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Legend
Critical decision making point that has a major bearing on water requirments
Important decision making period that offers some discretion to reduce water requirements
Following wave of important decision making period
Secondary decision making period for opportunistic use of water

Critical Decision Making Points that Influence Water Requirements for Cotton Enterprises



Critical Irrigation Management Points for Grapevine Enterprises



(timing will vary in other regions - Sunraysia is the hottest and driest region on the Murray)

3 APPENDIX 3. BLANK WORKSHEETS

Table 16 Estimating how much water you need to irrigate fully

Crop/Pasture	ha	Water requirement ML/ha	Total water needed ML=ha x ML/ha
Permanent pasture			
Annual pasture			
Total all ML			

Table 17 Indicative water allocation probabilities (for my System)

Scenario for seasonal allocation	Allocation (%)	Odds (%) or years in 100	Allocation ML per ML entitlement (ML)	Odds x allocation
	a	b	c	b x c
Very high				
Av to high				
Av to low				
Low				
Very low				
Long term average		100%		Sum above=

Table 18 Estimating how much water you will have available

Scenario for seasonal allocation	Odds (%) or years in 100	Allocation ML per ML entitlement	My Entitlement held	My Water allocation	Water needed to irrigate fully (same each year)	Extra ML needed
	a	b	c	d = b x c	e	f = d - e
Very high						
Av to high						
Av to low						
Low						
Very low						
Long term average	100%					

Q1. How often will I be short of Water?- My answer

_____

Table 19 Assessing water trading costs for annual purchases

Scenario	Extra ML needed	Market Price of water $/ML your estimate	Market value of water in that year	Odds %	Financial impact on business of temporary trade	
	a	b	c = a x b	d	e = c x d	
					Sell water	Buy water
Very high						
Av to high						
Av to low						
Low						
Very low						
Long term average				100%	Average impact of temporary trade to business = sum above purchases_____less _____from sales=**$_____/year**	

:*Q2. Over the long term, how much will it cost me to use temporary water trade to avoid being short of water?*
Answer =

_____

What's the worse year and how often does it occur?

Answer =

Table 20 Assessing value of temporary water

Scenario	Allocation ML per ML entitlement	Market Price of water $/ML less water charge your estimate	Odds %	Weighted value per ML of entitlement
	a	b	c	d = a x b x c
Very high				
Av to high				
Av to low				
Low				
Very low				
Long term average			100%	Average annual value of entitlement = sum above **=$___/ML**

Transfer from previous tables of same colour

Table 21 Estimating the value of permanent water entitlement against market price

Market value of permanent water	Interest rate	Capital gain or loss expected	Net interest rate	Annualised cost of market value for permanent water	Decision influence if average annual value of entitlement is $__
					This figure is from Table 20
a	b	c	d=b-c	e=a x d	
$__					
$__					
$__					
$__					
$__					
$__					

Once you have completed the worksheet you will be closer to answering the third question:

Q3. Over the long-term, am I better off trading permanent or temporary water?

_____

_____

Q4. How much can I afford to pay for temporary water over the long term?

Income

Step 1. Calculate income per kg milk solids (fat + protein)

From your profit and loss statement, calculate gross milk income for year $_____

From factory records, find out how total kilograms of fat and protein produced in the year

_____ kg fat + _____ kg protein = _____ kg fat+protein

Divide total farm income for the year by the total amount of fat plus protein produced in the same period

$_____ ÷ _____ kg = _____ $/kg

Step 2. Calculate income from bought in supplements

How many tonnes of grain or pellets did you use in the year? Multiply by 95 to estimate the kg of fat plus protein produced from grain or pellets.

_____ t x 95 = _____ kg milk solids

How many tonnes of hay did you use? Multiply this figure by 59 to estimate the kg of fat plus protein produced from hay.

_____ t x 59 = _____ kg milk solids

How many tonnes of dry matter silage did you use? Multiply this figure by 74 to estimate the kg of fat plus protein produced from dry matter silage.*(Pit silage is 33% dry matter while round bale silage is 45% dry matter)*

_____ t x 74 = _____ kg milk solids

Add these all together to get the kilograms produced from bought in feed.

_____ kg + _____ kg + _____ kg = _____ kg milk solids

Multiply kilograms of bought in feed by the income per kg calculated in Step 1 to give the proportion of income that was produced from supplements.

_____ kg x _____ $/kg = $_____

Step 3. Calculate proportion of farm income that was produced from irrigation.

Subtract income ($) from supplements from total farm income ($) to give the proportion of income produced from irrigation

$_____ - $_____ = $_____

Calculate ML of irrigation water used in the year_____ ML. Divide income from irrigation by number of ML irrigation used to give income for each ML

$_____ ÷ _____ ML = _____ $/ML

Operating costs

Step 4. Calculate operating costs from irrigation

From profit and loss, look up the total farm expenditure for year. Subtract costs that are not operating costs such as interest, lease costs, temporary water purchases, rent, payment to partners, superannuation, depreciation and any capital expenditure (eg lasering) that have been included in the total expenditure.

You will be left with your farm operating costs; it should include variable costs such as labour, feed, fertiliser, contractors, fuel, repairs and maintenance, water charges, rates, electricity, chemicals, consultants, and overheads such as office, accountant, legal.

$_____ - $_____ = $_____

Less feed costs (include $ feed freight)

$_____ - $_____ = $_____

Less dryland farming operating costs (estimate costs for dryland part of farm if significant).

$_____ - $_____ = $_____ operating costs for irrigation

Step 5. Calculate operating surplus from irrigation

Subtract operating costs from irrigation (Step 4) from income from irrigation (Step 3)

$_____ - $_____ = $_____

Step 6. Calculate operating surplus from irrigation/ML

Divide operating surplus from irrigation (Step 5) by number of ML of irrigation water used in the year (Step 3)

$_____ ÷ _____ML = _____$/ML

In high rainfall areas (>500mm/year) the operating surplus can be inflated because rain increases production. Therefore, the final figure needs to be adjusted down so that it only reflects the surplus due to irrigation. A simple way of approximating the value of irrigation is to estimate the percentage of production caused by irrigation and multiply the operating surplus per ML by this amount. For example, if total production would be 33% if there was no irrigation then 67% is due to irrigation and the operating surplus needs to be multiplied by 67%.

For areas of rainfall > 500 mm multiply by % productive capacity caused by irrigation =

$$\text{_____\$/ML} \times \frac{\text{_____\%}}{100} = \text{_____\$/ML}$$

Step 7. Calculate the long term average price you are prepared to pay for water after considering capital and owners labour costs

In the long term, it is important to cover capital costs and owners' labour costs. You need to do a full farm budget to calculate your own figures for this, particularly for farm expansion. But the following figures may be useful as a guide:

Use the figure of 25% of the operating surplus if the capital costs associated with using the water purchased will be high, for example when new equipment or a new layout is needed.

Use 50% if there is existing spare capacity within your farm to expand irrigation and production with little extra capital and if the owner has the time to manage the expansion and the need for extra profit is high.

$$\frac{\text{\_\_\_\_\_ \$/ML} \times \text{\_\_\_\_\_ \%}}{100} = \textbf{\_\_\_\_\_ \$/ML}$$

Put simply, if your final figure is significantly higher than the annual cost of buying water then it may be worth buying water and expanding. If it is much lower then it may be worth selling some water.

Q3. How much can I afford to pay for temporary water over the long term?

My Answer _____

Q5. How do the alternatives to water trade compare?

Example scenario	**Options different to base case**	**Change in ML used** (ML)	**Change in Income** ($)	**Change in total costs** (capital + operating)($)	**Change in value of owners' labour**($)	**Impact next year & future**($)	**Change in profit**($)	**Revised annual profit**($)	**Marginal profit/ML** ($/ML)
	Describe the Action	*a*	*b*	*c*	*d*	*e*	*f =b-c-d-e*	*normal budget profit+ f*	*f/a*
Typical normal year	Average seasonal allocation used and usual trading and ML 'sales' usage	0	0	0	0	Nil	0		0
__ ML short of water									
__ ML extra water									

Example scenario	**Options different to base case**	**Change in ML used** (ML)	**Change in Income** ($)	**Change in total costs** (capital + operating)($)	**Change in value of owners' labour**($)	**Impact next year & future**($)	**Change in profit**($)	**Revised annual profit**($)	**Marginal profit/ML** ($/ML)
	Describe the Action	*a*	*b*	*c*	*d*	*e*	*f =b-c-d-e*	*normal budget profit+ f*	*f/a*
Typical normal year	Average seasonal allocation used and usual trading and ML 'sales' usage	0	0	0	0	Nil	0		0
__ ML short of water									
__ ML extra water									

Q4. How do the alternatives to water trade compare?

_____

_____

Table 22 Assessment of influences on business risk

Type of Influence	Potential influence on you water risk position	YES (& easily) Comfortable with temporary trading to meet shortfalls	Maybe	NO (or difficult) Prefer more permanent water to increase security
Physical	I can dry off large areas of lower value annual pasture/crops to cope with a low allocation			
	I can dry off irrigation with little extra recovery costs in future years			
	I can easily handle large amounts of extra bought in feed if required			
	I can easily access water market to buy extra water when needed			
	I can sell entitlement without losing services from irrigation provider such as affecting water rationing			
Financial	I believe temporary water is cheap compared to permanent water averaged over dry and wet years			
	I spend more than 10% of my total farm income on interest and leases (not including capital repayment)			
	I have above average operating surplus per ML for my industry			
	I believe that there will be little capital growth in the value of permanent water			
Personal	I have the skills to trade and enjoy regularly trading water			
	I am comfortable with the idea that in some years I will be looking to supplement my water allocation			
	Add up the number of ticks in each column			

Has working through this section made you want to increase or decrease your permanent water entitlement?

_____

Q6. What are the main drivers in my water trading decisions?

Personal

Business

Industry

Critical decision points through the season