Economic and social profiles and impact assessments for the Murray-Darling Basin Plan

Synthesis report

A report by the consortium of Marsden Jacob Associates, RMCG, EBC Consultants, DBM, and expert advisors

7 July 2010
Economic and social profiles and impact assessments in the Murray-Darling Basin

Marsden Jacob Associates
Financial & Economic Consultants

ABN 66 663 324 657
ACN 072 233 204

Internet: http://www.marsdenjacob.com.au
E-mail: economists@marsdenjacob.com.au

Melbourne office:
Postal address: Level 3, 683 Burke Road, Camberwell
Victoria 3124 AUSTRALIA
Telephone: +61 (0) 3 9882 1600
Facsimile: +61 (0) 3 9882 1300

Brisbane office:
Level 5, 100 Eagle St, Brisbane
Queensland, 4000 AUSTRALIA
Telephone: +61 (0) 7 3229 7701
Facsimile: +61 (0) 7 3229 7944

Perth office:
Level 6, 731 Hay St, Perth
Western Australia, 6000 AUSTRALIA
Telephone: +61 (0) 8 9324 1785
Facsimile: +61 (0) 8 9324 1751

Canberra office:
Suite 10, 11 McKay Gardens, Turner
ACT, 2617 AUSTRALIA
Telephone: 0466 831 566

Contact: Dr Jeremy Cheesman jeremy.cheesman@marsdenjacob.com.au
(Melbourne Office or 0414 765 739)

Rozi Boyle rozi.boyle@marsdenjacob.com.au
(Melbourne Office or 0407 800 593)


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The Murray-Darling Basin Authority commissioned this report, amongst a number of consultancy reports, to examine a range of different aspects of the socio-economic implications of reducing current diversion limits. These studies were conducted at specific points in time during the development of the proposed Basin Plan and aimed to analyse the likely implications of a range of potential scenarios for reducing long-term average diversion limits in order to inform the MDBA on options for setting Sustainable Diversion Limits and other aspects of the proposed Basin Plan.

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<tr>
<td>ABARE</td>
<td>Australian Bureau of Agricultural and Resource Economics</td>
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<tr>
<td>allocation (water)</td>
<td>The specific volume of water allocated to water access entitlements in a given season, given accounting period, defined according to rules established in the relevant water plan.</td>
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<td>BCC</td>
<td>Basin Community Committee</td>
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<tr>
<td>broadacre</td>
<td>Large-scale cropping (rice, cotton, grain etc.) In this report, the term refers to grain and fodder crops excluding cotton and rice.</td>
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<tr>
<td>BRS</td>
<td>Bureau of Rural Sciences</td>
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<td>Buy-back</td>
<td>Purchase of water for the environment. Buy-back may target allocations or entitlements, and may be undertaken by a range of entities. To date, most buy-backs have been by state government or Commonwealth agencies, but non-government organisations have also recently engaged in buy-back.</td>
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<tr>
<td>CEWH</td>
<td>Commonwealth Environmental Water Holder</td>
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<tr>
<td>COAG</td>
<td>Council of Australian Governments</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>Cth</td>
<td>Commonwealth (Australian) Government</td>
</tr>
<tr>
<td>DAFF</td>
<td>Department of Agriculture, Forestry and Fisheries (Cth)</td>
</tr>
<tr>
<td>DECCW</td>
<td>Department of Environment, Climate Change and Water (NSW)</td>
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<tr>
<td>DERM</td>
<td>Department of Environment and Resource Management (Qld)</td>
</tr>
<tr>
<td>dryland</td>
<td>Farming that is dependent on natural rainfall</td>
</tr>
<tr>
<td>DSE</td>
<td>Department of Sustainability and Environment (Vic)</td>
</tr>
<tr>
<td>DWLBC</td>
<td>Department of Water, Land and Biodiversity Conservation (SA)</td>
</tr>
<tr>
<td>EC</td>
<td>Exceptional Circumstances</td>
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<tr>
<td>entitlement (water)</td>
<td>A perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan.</td>
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<td>GMID</td>
<td>Goulburn Murray Irrigation District (Victoria)</td>
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<tr>
<td>GVAP</td>
<td>Gross Value of Agricultural Production</td>
</tr>
<tr>
<td>GVIAP</td>
<td>Gross Value of Irrigated Agricultural Production</td>
</tr>
<tr>
<td>ha</td>
<td>Hectares</td>
</tr>
<tr>
<td>LMRIA</td>
<td>Lower Murray Reclaimed Irrigation Area</td>
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<td>LTCE</td>
<td>Long Term Cap Equivalent</td>
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Volumes of water

Volumes of water referred to in this document are expressed as either megalitres (ML) or gigalitres (GL) where:

- One litre = 1 litre = 1 L
- One thousand litres = 1,000 litres = 1 kilolitre = 1 KL
- One million litres = 1,000,000 litres = 1 megalitre = 1 ML
- One billion litres = 1,000,000,000 litres = 1 gigalitre = 1 GL

As a point of comparison, 1 ML of water is approximately the amount of water need to fill an Olympic swimming pool.
Executive Summary

1. In January 2010 the Murray-Darling Basin Authority (MDBA) engaged a consortium led by Marsden Jacob Associates to develop economic and social profiles of 12 regional irrigation communities of the Basin (ES Figure 1), and to assess the social and economic impacts within these communities that may result from changed water availability as a consequence of the Basin Plan. The 12 irrigation regions nest within the sustainable yield regions defined by CSIRO.

2. This report is a synthesis of the project findings.

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**ES Figure 1. MDB Irrigation regions**

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**PROJECT RATIONALE**

3. The Basin Plan is likely to result in fundamental water reallocation in the Murray-Darling Basin. The Plan will secure the allocation of environmental water for 18 ecosystem and environmental assets of significance.

4. Sustainable Diversion Limits (SDLs) will cap the quantities of surface water and groundwater that can be taken from the Basin for consumptive use. These SDLs will be defined as the net water available after the watering requirements of key ecosystem and environmental assets have been met. Reflecting current over-use and over-allocation of the Basin’s water resources, the SDLs are anticipated to be capped at a level below current consumption.

5. Regional communities of the Basin may be significantly impacted by the introduction of the Basin Plan and the removal of water from the consumptive pool to meet the watering...
requirements of key environmental assets. Those communities based around irrigated agriculture stand to be impacted most.

6. The National Water Initiative and the MDBA separately recognise the importance of regional community consultation in national water reform. The Stakeholder Engagement Strategy of the MDBA specifically aims to create opportunities for people to provide input into the Basin Plan’s development. Understanding the likely responses of agricultural producers, agricultural sectors, and regional communities to a future with permanently reduced consumptive water is a fundamental feature of this consultation process. This understanding also is a key step towards developing evidence based policy in the Murray-Darling Basin.

7. The Murray-Darling Basin Authority is committed to developing the Basin Plan taking into regard the best available scientific, social, economic, and cultural knowledge and analysis. Towards this objective the MDBA has commissioned several socio-economic analyses. These include:

   a. the regional profiling and impact analysis reported herein. Like a benefit cost analysis, this regional impact analysis concentrates on the first round effects of SDLs on regional communities. The analysis also allows second round effects to be foreshadowed;
   
   b. modelling based on water trade and computable general equilibrium (CGE) representations of the Basin economy; and
   
   c. a review and evaluation of non-market values of environmental assets and ecosystem services of the Basin.

8. As recognised by the Authority, the work commissioned from the MJA consortium is a necessary and direct complement to these other socio-economic analyses. In particular, the regional profiling and impact analysis provides insights that regional CGE models cannot, including:

   a. a detailed understanding about the current situation of farms, farming sectors, and communities of the Basin;
   
   b. appreciation of the factors in addition to relative prices and profits that make farms, farm sectors, and regional communities more or less sensitive to SDLs, and condition these groups’ responses to SDLs; and
   
   c. an appreciation of the wide diversity of responses that may be observed between farms, farm sectors, and regional communities in response to the introduction of SDLs.

9. It is necessary for the MDBA to have a ground-level appreciation of the potential regional impacts of Sustainable Diversion Limits. The understanding is necessary if the Basin Plan is to be informed by the best available social, economic, and cultural knowledge and analysis. It is also necessary given that the MDBA is committed to active stakeholder consultation in the development of the Basin Plan. Singular reliance on CGE models of regional economies, or any single form of socio-economic analysis for that matter, cannot provide a complete picture of how the impacts of SDLs may be observed on the ground, nor how regional
communities may experience and deal with these impacts. Adequate understanding is gained from looking at the issues from multiple perspectives.

10. Moreover, farmers and communities of the Basin are not homogenous, and policy prescriptions may be ineffective or inefficient if they are treated as such. ABARE shows that during the past decade irrigators in the Basin have used a diverse range of short and long run strategies to cope with variable water supplies and drought. Other work in regional communities of the Basin shows that farm decisions are driven by many considerations other than prices and profit. These considerations include age and gender, indebtedness, physical constraints (soil type, region), farming objectives (lifestyle, commercial, intergenerational), self-identify, and community connectivity.

11. Finally, while the SDLs are not known at the time of writing, what is known is that the changes in consumptive water availability are likely to be large. It cannot be automatically assumed that farmers and communities of the Basin will respond to a step-change of substantive magnitude in purely rational and marginal ways. Regional consultation and ground-truthing is required for this understanding.

CONCEPTUAL FRAMEWORK

12. The framework adopted in this regional socio-economic profiling and impact assessment recognises that the vulnerability of a community (or farm or farm sector) to a change or shock can be understood in terms of the level of exposure to that shock, the sensitivity of the community to the change, and the community’s adaptive capacity.

a. **exposure** is the magnitude and nature of the potential shock of a specific change event. For the Basin’s farms, sectors and communities exposure begins with the quantum of the permanent reductions in the availability of irrigation water in each area as a result of the Basin Plan;

b. **sensitivity** measures the responsiveness of a socio-economic system to an exposure/change event. By definition, more sensitive systems are more responsive. Sensitivity will vary across farms and communities according to their characteristics. For instance, those communities with greater dependence upon irrigation water will likely show a larger reaction (sensitivity) to reductions in allowable take of water (exposure) than those communities not as dependent upon irrigation water;

c. the **adaptive capacity** of a socio-economic system describes the ability of the system to change/adapt to a shock or exposure. The sensitivity of a regional socio-economic system will be mediated by the community’s adaptive capacity. For example, all other factors equal, a community with lower community stress and more financial resources may have greater adaptive capacity to deal with exposure itself than a community experiencing higher stress, and with less financial resources;

d. **impact mitigation** refers to actions by government(s) and other external parties to mitigate (or exacerbate) the impacts on the affected entities. For example, governments may choose to provide different levels of support for transition and adjustment; and

e. the **vulnerability** of a socio-economic system equals the residual effects of an exposure event after coping and adaptation strategies have been implemented. This
residual vulnerability may be reflected in less financial resources available to deal with future shocks, lower personal wellbeing, or by the depletion of natural resources.

13. Our methodology also distinguishes between different types of impacts and strengths, i.e., human, social, natural, physical and financial. Basin households with greater diversity and stocks of these five forms of capital are more likely to be less sensitive and have greater adaptive capacity to deal with events, such as drought or permanently reduced water availability. These households have more resources to draw upon, and greater flexibility to substitute between different livelihood strategies in times of stress. Balance between these five types of capital is also important, as minimum levels of one type of capital may be necessary to effectively make use of others.

14. The conceptual framework (exposure, sensitivity, adaptive capacity, impact, impact mitigation and residual vulnerability) applies to any entity; in this case, the farms, the farm sector and the regional communities in our review.

PROJECT APPROACH

15. The objective was to assess each Basin community’s exposure, sensitivity, adaptive capacity, and residual vulnerability to reduced water availability. Consistent with the wider timetable and responsibilities of the MDBA to prepare the Basin Plan, the project was undertaken against a strict and tight timetable.

16. The four broad stages and their timing were:

   a. the development of draft community profiles based on existing data from ABARE, ABS and BRS surveys, the detailed expert knowledge of consortium members, and targeted interviews with key stakeholders (January-February 2010);

   b. face-to-face interviews with some 250 stakeholders and other informed persons across the 12 regions (March 2010);

   c. the large scale program of telephone surveys of irrigators, dryland farmers, businesses and community representatives (March 2010). The survey explored both factors determining sensitivity, and respondents’ anticipated responses to different magnitude of reductions in water availability; and

   d. project finalisation, including preparation of the draft report, briefings and workshops with MDBA, the Board and the MDBA’s Basin Community Committee, Basin Officials and the Ministerial Council (April-June 2010).

WATER AVAILABILITY AND REDUCTIONS

17. The MDBA will set SDLs having taken account of the water needs of key environmental assets, existing environmental holdings of water and water already committed to the environment as a result of committed buy-backs and efficiency programs.

18. In order to compare the outcomes of water availability scenarios across the entire MDB, and to take into account water savings from efficiency projects and buy-backs, it was necessary to
be able to express volumes on a common basis. This was done by converting the entitlements in each irrigation region to Long Term Cap Equivalent (LTCE) allocations.

19. We developed consistent estimates of LTCEs and of existing environmental water holdings and net future committed acquisitions. The committed buy-back and efficiency programs are of varying importance across the Basin but are particularly material for the GMID and therefore for the Basin’s dairy sector which is almost wholly located in the GMID.

20. We adopted and explored a common range of possible percentage reductions, i.e., permanent reductions of 20%, 40% and 60% in the case of the face-to-face interviews and 20% and 40% in the case of the telephone surveys.

21. Since entitlement holdings are public information, we provided regional level estimates of LTCEs for the interviews and their individual LTCEs to each (irrigator) respondent to the telephone surveys. Both the interviews and the surveys carefully explored adaptive responses to the prolonged drought and to possible future scenarios.

22. In both the interviews and the survey, reductions in LTCEs were referenced and calibrated against levels of water availability in the drought since 1996, noting that large reductions in LTCEs due to the introduction of SDLs would still leave irrigators with greater availability than they have experienced over the past decade or more.

23. Our analysis of the potential impacts of water availability reduction starts with the assumption of no compensation, including no transition support:

   a. the MDBA was unable to advise on clear assumptions regarding compensation and transition arrangements – since these details are not yet finalised and depend on decisions by other arms of government. As agreed, therefore, our analysis of the potential impacts started with the no compensation assumption, and then explored the mitigating impacts of different compensation and transitional arrangements;

   b. clearly, this is an extreme scenario; we expect that, given previous government behaviour, community expectations and the provisions of the Water Act 2007 (Cth), some compensation will occur, and there will be a range of supports for transition and structural adjustment; however

   c. what may occur under a scenario of ‘no impact mitigation’ is a necessary point of understanding, and is the ‘base case’ from which to evaluate the costs and benefits of targeted adaptation assistance programs.

24. For a hypothetically uniform percentage reduction in water availability from historical LTCEs, the GMID would face the smallest net reduction because of the large magnitude of existing and committed buybacks and water savings (ES Figure 2). In contrast, the Murrumbidgee, Sunraysia and the Riverland, in the southern systems, enjoy little offset to the gross reductions required under this uniform scenario. In the north, the Balonne and the Border Rivers would face the full brunt of a hypothetical uniform percentage reduction.

25. The 20%, 40%, 60% scenarios and the messages that the MJA consortium used to explain and test those scenarios were approved by the MDBA. The scenarios were not linked to possible
SDLs (of which the consortium had no knowledge); rather, they were intended to test a range of responses from irrigators, and flow-on effects in communities.

26. This approach allows responses/impacts to be assessed at different levels of reduction and for the MDBA subsequently to assess the projected levels of responses/impacts once their judgements on SDLs have begun to crystallise.

**ES Figure 2. Regional water availability scenarios as a proportion of LTCE**

Note: Water availability scenarios of 20%, 40% and 60% reduction with data from Table 5 and Appendix 3.

**WATER MANAGEMENT ARRANGEMENTS**

27. The reductions in water availability anticipated as a result of the Basin Plan will occur in the context of differing arrangements and mechanisms for water management, differing levels of over-allocation, differing initiatives and achievements by the state governments and regional communities and the differing impacts of the sustained drought. These multiple contextual factors will exacerbate or mitigate sensitivity and impacts to changed water availability. For instance:

a. single valley/source irrigation water supplies typically in the north of the Basin, compared with multiple, interconnected valleys in the southern interconnected systems involving the Murray, the Murrumbidgee and their tributaries. This ‘north-south’ divide affects the volatility or smoothness of flows from year-to-year and the geographical size and limits of markets for water trading. Other things being equal,
farms and regions located in the larger interconnected systems have more scope to adapt;

b. the choice of different reliability products when defining entitlements and allocation rules which is strongly correlated with, and drives, the choice of the type of irrigated agriculture. High security entitlements are required for permanent plantings. General security entitlements are associated with rice, cotton and other more opportunistic uses of water. High security may be preferred, but offsetting this, the crop choices imply fixed irrigation systems and issues of asset fixity when compared with the more flexible opportunistic irrigation systems associated with general security entitlements.

28. These and other differences combine to give distinct, local flavours to water management and the nature and sensitivity of responses to changed water availability. The key distinctions are between Victoria/SA and Southern NSW; and between the southern areas and the northern rivers.

INDICATORS OF SENSITIVITY

29. A common methodology was employed to evaluate indicators of sensitivity to the introduction of the Basin Plan:

a. as a first step we used the responses collected from the telephone survey to identify the statistically significant characteristics of farms that report that they will exit or change their on-farm practices as a result in reductions in water availability. While this analysis identifies the key indicators/drivers of sensitivity, it is apparent that these statistically significant indicators are by no means the whole story – a finding consistent with the heterogeneity and diversity of Basin farms and communities.

This first step confirms intuitive common sense and many of the observations provided during our face-to-face interviews with regional communities.

b. as the second step we then described how those factors (that are statistically important) these factors vary across sectors and regions to determine sensitivity. This evidence-based approach identifies the key indicators of sensitivity (ES Figure 3), allowed a ranking of relative sensitivity across sectors and regions, and the development of finer insights and nuances, particularly for regional communities.

c. our third step was to substantially enrich and extend these results and insights using further insights gained from the regional face-to-face interview program.
30. The MJA farm survey investigated which characteristics are linked to the decisions to exit or adjust compared with no change. Analysis of the farm survey shows that farmer sensitivity to permanent reductions in water availability increases with:

a. increasing dependency on irrigation water;

b. increasing financial stress, particularly indebtedness;

c. decreasing personal wellbeing and optimism; and

d. being a middle aged farmer.

31. These four indicators are associated with indicated higher rates of exit and higher rates of adaptation. Higher levels of education, particularly university degrees, also correlate significantly with higher likelihoods of adaptation.
32. The future of farming in the MDB depends to a significant extent on recruitment of new farmers, and retention of experienced farmers who are still young enough to farm. Our work found that, regardless of the type of farm they operate and the region they come from, farmers aged in their late 30s to early 40s through to 65 report significantly lower wellbeing and optimism than their younger and older counterparts. They are heavily indebted (particularly those aged late 30s-55), and report feeling time-pressured and financially stressed.

FARM SECTOR SENSITIVITY

33. The factors that make some farmers more sensitive to the introduction of SDLs also make some farm sectors more sensitive to SDLs. Thus, the sensitivity of a farm sector to SDLs increases with:

a. increasing farm sector water dependency;

b. increasing farm sector financial stress;

c. decreasing personal wellbeing and optimism of farmers in the sector; and

d. the proportion of middle aged farmers in a sector.

34. On these bases, our indicator analysis suggests that dairy, horticulture, and rice farmers are relatively more sensitive to the introduction of SDLs (ES Table 1).

**ES Table 1. Lead indicators of farm sector sensitivity**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Dairy</th>
<th>Horticulture</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm water dependency</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Increased farm area set up for irrigation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Higher farm assets in water entitlements</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Increased high security water</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Higher financial stress</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lower personal wellbeing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>


*Note: Cotton is not included in this indicator analysis due to insufficient survey responses from this sector.*

SENSITIVITY OF THE REGIONS

35. Regional communities are larger and more complex systems than farms and farm sectors. As a result, their sensitivity to changes in water allocations is more difficult to articulate. In addition, aggregate regional data can conceal importance of intra-regional differences, including the greater dependency of small towns on irrigated agriculture.
36. We have used three indicators to assess community sensitivity to water availability reduction: economic diversity, socio-economic condition, and the way the region’s farms would change as a result of reduced water availability. Each of these factors has different dimensions and correlates. Moreover, as a result, regional sensitivity to reduced allocations varies markedly across the Basin, but with significant uncertainties.

37. Irrigated agriculture is more central to some regional economies than others. In quantitative terms, irrigation dependence can be appraised using a suite of indicators including: the percentage of irrigated agriculture in total agricultural production; the estimated relative sensitivity of the irrigation sectors to SDLs; irrigation value chain integration; and economic diversity.

38. On these four quantitative measures, there is a clear north-south divide between the irrigation communities of the Basin (ES Figure 4). In the southern Murray and Murrumbidgee irrigation regions (excluding SA Murray below Lock 1), irrigated agriculture ranges from 79% to 92% of total agricultural production. In the northern regions of the Basin irrigation ranges from 15% to 52% of total agricultural production. Therefore, even allowing for drought impacts on regional irrigated output, regional communities of the south are likely to be more sensitive to the introduction of SDLs.

39. Socio-economic condition is a key indicator of a region’s ability to cope with shocks and change. Regions that have people with higher education, greater household wealth, better essential services, higher wellbeing and less social disadvantage are better positioned to cope with regional stresses than communities that have less of these things. These are generalisations that are more nuanced within each region; however, in quantitative terms, socio-economic disadvantage is a useful, readily available index. In these terms, SA Murray below Lock 1, Sunraysia, the Riverland in the southern systems, and the Macquarie, Namoi and Border Rivers have high levels of disadvantage (ES Figure 4).

40. These two indicators (water dependency and socio-economic disadvantage) are based on official data of the ABS. They are by no means the whole story however. But taken together, they indicate that SA Murray below Lock 1, Riverland, and Sunraysia may be particularly sensitive to permanent reductions in consumptive water.

41. The high sensitivity of the southern Basin communities tends to be confirmed when a wider set of indicators (ES Table 2) and insights from our regional face-to-face consultations are incorporated.
ES Figure 4. Estimates of the water dependency and socio-economic condition of the 12 regions


42. The way a region’s farms choose to adjust to reduced water availability is a critical driver of regional sensitivity because of the large differences in the input intensity of irrigation versus dryland farming, and the strength of links to regional economy.

43. Irrigated agriculture uses much less land and delivers greater flow-on employment and economic activity than dryland farming. It is an important employer in all regions (directly and indirectly through food and fibre processing) and as a source of wealth. Across the regions at least 75% of total farm operating expenditure takes place in the regional economy, typically within 50 kilometres of the farm gate; and almost all irrigated production is processed in the same region or a nearby region.

44. Thus, reducing the intensity of irrigated agriculture within a region, be it via dryland conversion, less intensive irrigation, or some other mechanism, will directly reduce economic activity in regional communities. The differences in intensity between an irrigation sector and dryland are greatest for horticulture and dairy and least for cotton and rice.
ES Table 2. Indicators of regional sensitivity

<table>
<thead>
<tr>
<th>Region</th>
<th>2006 irrigated agriculture &gt;50% total value of agricultural production</th>
<th>Sensitive irrigation sectors (dairy, rice, horticulture)</th>
<th>Value chain integration</th>
<th>Low economic diversity</th>
<th>Relatively lower socio-economic condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>✔</td>
<td>-</td>
<td>-</td>
<td>✔</td>
<td>-</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td>Gwydir</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>-</td>
</tr>
<tr>
<td>Lachlan</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>-</td>
</tr>
<tr>
<td>Namoi</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td>NSW Central Murray</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>-</td>
</tr>
<tr>
<td>Riverland</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Sunraysia</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>-</td>
<td>✔</td>
<td>-</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>


45. Our interviews also indicated that regional communities are vulnerable because of the drought. In addition to eroded capital reserves and employment, many regional people are disillusioned about irrigation farming and feel that the national vision of the MDB as a productive foodbowl has been lost. In some cases, regional people report feeling abandoned by governments and their capital city counterparts, and as a consequence are lacking confidence and self-esteem. People suggest that some regional towns and cities are sliding towards welfare-dependency.

46. For the cotton regions of Queensland and northern NSW, small towns, particularly those that are located further inland, tend to be more sensitive to potential reductions in water availability. The Balonne region in Queensland is notably sensitive, with approximately 36% of employment directly in agriculture – more than any other region in Queensland. People interviewed suggested that small cotton-dependent towns already have significant social issues, and also highly mobile workforces. People are concerned that these towns could lose these workers, lose critical mass for community services, and slide into welfare-dependency if cotton-related activity declines in the long-term.

47. For the rice regions of Murrumbidgee and Central Murray in NSW, the larger and smaller towns are highly sensitive to a loss in economic activity from rice farming. For example, Deniliquen has lost employment opportunities over past decades, and these have been exacerbated by the drought. Like the cotton towns, people in rice-based towns expressed concern about the potential prospect of losing their more skilled workers and their families.

\[1\] Note that the number of cotton respondents was too low to report results; in the base case (return to long-term allocations) exit rates would be close to zero (and many farmers would seek to expand); and the telephone survey did not include a 60% reduction scenario.
which in turn may reduce critical mass, and increase the challenge of sustaining businesses and providing community services.

48. **Dairy** is almost entirely located within the Victorian GMID regions. Over the past decades, in response to drought and commodity prices, around 40% of irrigated dairy farmers have left. Interviewees pointed to others being tired and operating with diminished capital. Despite these issues, people in the regions believe those dairy farmers remaining will expand "if they can get confidence". Across the GMID regions, farming and food processing are important sources of wealth and employment. Towns have varied exposure to the impacts of low water allocations. Towns with other industries such as tourism (around the Murray River and the Kerang Lakes) are more resilient to low water allocations, however tourism cannot replace agriculture as it is a minor part of the economy. Towns like Cohuna, with an economy that is primarily agriculture-based, are much more sensitive to negative impacts.

49. **Horticulture** is located across the Basin (but primarily in the southern regions), but is particularly important for Nyah to the border (including NSW and Victorian Sunraysia) and the SA Riverland. These regions also include extensive food processing and food-based tourism (including wine tourism) which increases their sensitivity to water availability. Farmers in these regions are significantly more worried about regional unemployment than farmers in other regions.

50. In the irrigation regions reviewed there was convincing evidence that current sectors were optimally located with regard to water availability, soils, climate, transport and processing infrastructure etc. For example, horticulture is suited to the soil types and high security water in the Riverland, while cotton is well suited to the northern NSW valleys with highly variable water availability.

51. Throughout the Basin, past investments, reforms, and the drought have driven irrigation towards best practice water use efficiency. As a result, people on the land see few opportunities to cost-effectively further increase technical water use efficiency, or to ‘make do’ with less water on-farm. However, in some areas there is potential to improve the delivery efficiency of irrigation supply systems and so absorb some reduction in total water diversions. This is more significant for the southern systems that have more reliance on shared supply infrastructure.

52. Our interview program suggested that irrigators see few apparent farming opportunities that can support the same level of employment and wealth creation as irrigated agriculture. Niche markets are open for a few growers; no simple change is appropriate or available to the majority.

53. Communities are highly varied in their social capital and ability to support and drive change. Smaller, more isolated communities, with greater dependence on irrigation, are more vulnerable to change.

**IMPACTS OF REDUCED WATER AVAILABILITY**

54. A broad conclusion drawn from our consultations is that removing 20% or more water from the consumptive pool without compensation would trigger widespread and large scale change within all irrigation regions in the Murray-Darling Basin.
IMPACTS OF REDUCED WATER ON FARMS AND FARM SECTORS

55. Based on our telephone survey and face-to-face interviews in the regions, the impacts of SDLs vary by sector.

56. The proportions of farmers from the telephone survey who indicated they would exit, adapt farming operations, or maintain the status quo following permanent reductions to their water allocations are set out by sector in ES Figure 5. These telephone survey results, combined with regional and sector insights from the face-to-face interview program suggest:

   a. Cotton would be proportionately affected by reduced water availability, with serious socio-economic flow-on impacts to remote cotton-dependent towns that often lack other economic activities, or future economic opportunities. Beyond 40% reductions in water availability, cotton production would contract and regions would lose processing capacity.

   b. Rice production tends to decline at a greater rate than the respective decline in water availability. That is, a 40% reduction in water availability will lead to a reduction of rice production by 60%. At around 40% water availability reduction rice production in southern to central NSW would be substantially undermined, and at 60% water availability reduction the rice sector largely would fail;

   c. Dairy is focused in the Goulburn-Murray Irrigation District (GMID) in northern Victoria (and to a lesser extent in the NSW Central Murray). The GMID region is the focus of major investment by governments and irrigators in irrigation efficiency and renewal, and buy-backs for the environment. The volume of water being saved for the environment under these initiatives is approximately equivalent to a 20% reduction in long-term water availability, potentially helping insulate the region from impacts from SDL-driven reductions in water availability. However, if reductions are greater than this point, the dairy sector will experience a serious decline and loss of confidence;

   d. Horticulture is focused in the Riverland and Sunraysia regions of South Australia, New South Wales and Victoria, but also occurs in other regions, such as NSW Central Murray and Murrumbidgee. Horticulture tends to have high production value per megalitre of water input. Faced with reduced water availability horticulture will be able to buy water on the market to make up for water availability shortfalls, or continue operation using very small relative volumes of High Security entitlements (NSW). However, at water availability reductions of 40% or more the viability of some community districts would be threatened. At a 60% reduction, horticulture would contract to a smaller industry, mostly located in private diverter areas.
ES Figure 5. Sectoral telephone survey responses to water availability scenarios

### Rice

- **Water availability reduction scenario**
  - -20%: 25% Seek to exit, 50% Change farming activities, 25% No change to farming activities
  - -40%: 52% Seek to exit, 36% Change farming activities, 12% No change to farming activities

### Dairy

- **Water availability reduction scenario**
  - -20% (regional: equivalent to reduction of 20% for individual farmers): 20% Seek to exit, 42% Change farming activities, 38% No change to farming activities
  - -40% (regional: equivalent to reduction of 40% for individual farmers): 30% Seek to exit, 38% Change farming activities, 30% No change to farming activities

### Horticulture

- **Water availability reduction scenario**
  - -20%: 30% Seek to exit, 32% Change farming activities, 37% No change to farming activities
  - -40%: 37% Seek to exit, 37% Change farming activities, 25% No change to farming activities

Notes:

1. Marsden Jacob Associates. 2010. Farm survey technical report. n=16 (-20% scenario). n=25 (-40% scenario). Note respondent numbers are low so this data should be treated with caution.
2. Marsden Jacob Associates. 2010. Farm survey technical report. n=50 (-40% scenario). n=47 (-60% scenario). Note that farmers were asked about -20% and -40% reduction; for the GMID, which is over 95% of dairy in the MDB, the...
extent of buybacks and efficiency savings is around 20% meaning that for most dairy farmers, a 20% reduction in available water for irrigation individually would equate to around a 40% reduction against LTCE allocations regionally, etc., so this graph's horizontal axis has been re-scaled accordingly.


REGIONAL IMPACTS

57. Across all irrigation regions the fundamental impact of SDLs will be a reduced intensity of economic activity within each region. The rate of reduction in economic activity depends on sensitivity of irrigation sectors in the region, the types of farm adaptation made in response to lower water allocations, and the relative contribution irrigated agriculture makes to regional agriculture and the regional economy. Farmer impacts will flow on to reduced economic activity and employment in the towns, particularly smaller towns. The following impacts are based on consideration of the extensive feedback obtained during the face-to-face interview program.

58. Across the cotton regions of northern NSW and the Queensland Lower Balonne:

   a. at 20% reduction in water for irrigation, the Lower Balonne will see investments in water use efficiency and some sale of entitlements where that is allowed. At 40% and 60% reduction in LTCEs, cotton expansion will reduce, farmers will become increasingly likely to exit, some properties will consolidate and cotton gins will start to close, with a decline in employment opportunities and increased migration of people from the region. People in the region see limited alternative employment opportunities in the Lower Balonne;

   b. the irrigation economies of Gwydir, Namoi, Border Rivers, Macquarie and Lachlan are highly dependent on cotton. A 20% reduction in water availability would see significant loss of economic activity in communities such as Goondiwindi. At 40% the economic impact would be major, and at 60%, would significantly undermine smaller cotton-based towns. Some interviewees were concerned that towns like Warren, Wee Waa and Moree, and to a lesser extent Narrabri, will be reduced to welfare-dependent towns with severe social problems; and

   c. the Lachlan and Macquarie also are highly dependent on cotton, but the larger urban centres of Dubbo, Forbes and Cowra have more diverse economies and would be relatively less impacted than smaller towns.

59. The Murray and Murrumbidgee will be particularly negatively impacted, even by relatively smaller reductions in water availability for irrigation, because those regions are dominated by rice. Murrumbidgee will be less affected, because of the higher number of entitlements per hectare for Murrumbidgee farms. Across these two regions:

   a. rice farms generally will struggle with a 20% reduction, and smaller farms would typically become unviable. Larger enterprises that can leverage economies of scale typically would attempt to restructure, including purchasing water entitlements or annual allocated water to maintain productivity; and
b. at a 40% reduction, the majority of rice farms would become unviable and the number of farmers would decline significantly. A permanent cut in water allocations of 60% would make rice farming unviable.

60. While rice farmers in the Murray and Murrumbidgee regions would try to adjust to changed water availability, their options are limited due to farm size, the level of irrigation development, soil types, and low rainfall. Farm consolidation may be problematic and will not be feasible in some regions.

61. The impact on horticulture in the Murray and Murrumbidgee would depend to a significant extent on the way the NSW government implements any SDL with respect to High Security. Generally however, horticulture is inflexible to water reductions:

a. at a 20% reduction, farmers will purchase or lease in water to offset their losses, dry off less productive plantings. A percentage will seek to exit horticulture farming; and

b. at a 40% reduction, farmers will continue to lease in or purchase water. The rate of exiting will increase, as will the drying off of unproductive plantings. Where possible, further investments in on farm irrigation water use efficiency will occur.

62. For the northern Victorian regions of Goulburn, Murray, Campaspe and Loddon (the GMID):

a. a 20% reduction in LTCE would represent an increase relative to drought, and would be met through buy-backs;

b. at 40% reduction in water availability, negligible water would be available for mixed and broadacre farming. The horticulture and dairy industries would experience some shrinkage. To offset reduced water allocations some farms would buy water from mixed farming and the NSW rice regions; and

c. at 60% reduction in water availability the GMID’s dairy industry would experience a serious decline and loss of confidence. Furthermore, the irrigation system would need to shrink to around half the scale assumed in the NVIRP business case. It is not certain that NVIRP would be economically viable in this scenario.

63. For the Nyah to border region (including NSW and Victorian Sunraysia) and the SA Riverland:

a. horticulturists would buy in water in response to a 20% LTCE reduction, and would dry off less viable plantings;

b. at 40% LTCE reduction, drying off would expand and some industries would be threatened with negative flow-on impacts into the community, which relies heavily on horticulture and food processing for economic activity; and

c. at 60% the industry would contract to private diverter areas, outside the historic irrigation districts, and the regional community would become increasingly welfare-dependent.
64. For the SA Murray below Lock 1:
   
   a. raised water levels in the river and the Lower Lakes would have a number of important social and economic benefits to the region in addition to the environmental benefit. Social and economic benefits of a healthier environment and higher water levels would be expected to include, among other things, benefits for experiential and eco-tourism, boating, and commercial fishing as well as enhanced optimism and wellbeing in the community;
   
   b. at 20% LTCE reduction changes would be moderate, although one milk factory may close; and
   
   c. at 40% LTCE or greater reduction, dairy on the reclaimed swamps would face serious adjustment; dairy by the Lakes has already largely converted to dryland so would be less affected. Horticulture in the region would largely close or leave the region, except for some boutique wineries with cellar-door sales.

65. Across the sectors, people suggest medium size farms are likely to be more adversely affected by reduced water availability. These farms are perceived to have the least capacity to adjust either via scale (larger farms) or via supplementation with off-farm income (smaller farms). Off-farm income generation is considered more feasible where the demands of running the farm allow time and/or financial freedom for at least one of the farm business partners (usually a spouse) to be away from the farm.

**IMPACT MITIGATION**

66. There is very substantial scope to mitigate the final impacts of the Basin Plan on irrigation farms, supply and marketing chains and communities. Conversely, there is substantial scope to exacerbate these impacts if wrong decisions are taken, or if right decisions are taken but poorly executed. Thus, the answer to the question, ‘what will the impacts of reduced water availability be on irrigation regions?’ is – it depends.

67. The net impact of reduced water availability for consumption on irrigators and Basin communities can be reduced by:

   a. reducing exposure (i.e., the scale and nature of the shock);
   
   b. reducing sensitivity;
   
   c. strengthening adaptive capacity;
   
   d. external programs and actions, particularly those to provide certainty to allow people plan and reducing impediments to structural adjustment; and
   
   e. directly addressing residual vulnerability.

68. Amongst those consulted during the face-to-face interview program, pro-rata reductions to allocations were viewed with antipathy. This antipathy is based, in part, on the pertinent observation that pro-rata reductions in LTCE allocations are likely to bite most aggressively into those farm enterprises that already fully utilise their water resources. Moreover, these farms tend to be highly leveraged, and run by more innovative and younger farmers.
69. Conversely, pro-rata reductions in LTCE allocations are likely to have least impact on farms that are less developed and less leveraged – typically, these farmers tend to be less productive, older, and close to retirement. It follows that a pro-rata reduction may maximise, rather than minimise, the impact on individual farmers and the future sustainability of irrigation communities.

70. Options to reduce the extent of exposure or shock from reduced water availability, discussed in detail in this report, include:

   a. securing environmental water from tributaries where the social and economic costs are relatively lower – preferably using the water market;
   
   b. investing in other (non-water-using) options to improve environmental condition and resilience of key environmental assets, reducing their water requirements;
   
   c. managing the portfolio of environmental water flexibly and adaptively to minimise the impact on the consumptive pool(s);
   
   d. purchasing, and compensating for, water for the environment – through programs such as buy-backs and investment in irrigation efficiency;
   
   e. ensuring regional people have an adequate understanding and the information they need to form an accurate perception of the magnitude and nature of the coming change;
   
   f. ensuring government policies and implementation programs are consistent, and build confidence and trust; and
   
   g. transitional arrangements such as timing and sequencing.

71. As noted recently by the Productivity Commission,\(^2\) economic models show very different impacts on regional communities according to whether compensation is paid or not for water that is removed from consumption (however that removal might occur). Relevant issues include:

   a. the divergence between the social value of water for environmental purposes, and the ability to purchase water in the market based on the Marginal Value Product of water;
   
   b. the concern that sellers are sometimes ‘desperate’ rather than ‘willing’, i.e., that the market is essentially unfair;
   
   c. the recognition that the value of the farm assets as a going concern is, in many cases, critically determined by the availability of water. Removing water may not merely reduce that value of water assets; it may substantially reduce the long-term productive capacity of the farm, and therefore the value of all assets – with flow-on effects to the regional community; and

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d. compensation based on prices observed now for relatively small trades in the current market may not be adequate if future prices rise as a result of the reassignment of potentially large volumes of water to the environment.

72. At one end of the spectrum of views, if markets are perfectly efficient and compensation for water removed is ‘full’, then water should flow to higher value uses. The result will be that:

a. regions where water has a relatively low value would experience transformation as water is traded out and resources are shifted to other uses; and

b. third party effects in regions that are net buyers of water may be negligible or positive. In these communities, the same amount of water flows in, the same level of agricultural activity occurs, water is a higher valued input and is thus used more efficiently, and the higher water value is passed on through output prices. Compared with the current situation, the main difference in this scenario is that some financial capital will leave the region when inter-regional trading takes place. Thus, the social fabric of these water importing regions may not be overly affected if the world conforms to this stylistic representation.

73. The other end of the spectrum of views emphasises the difficulties in smooth transition, market imperfections, and the loss of existing markets to foreign suppliers.

74. There is a range of reasons why markets may not be perfectly efficient, or compensation may not be ‘full’:

a. for example, as the MJA consortium’s survey results demonstrate, farmers are not a homogeneous group of people. Nor do they all have access to perfect information. Furthermore, their responses to exogenous change will vary reflecting their past experiences, their social view of themselves, their access to resources, their age, values that they place on farming apart from profit (e.g., lifestyle) etc.;

b. indeed, this variability of responses is in some ways a strength of farming communities, where social learning depends in part on seeing what works or does not work for your neighbours, and tailoring those responses to your own unique situation. In other words, farms are complex and inherently heterogeneous businesses; and

c. likewise, the ‘fullness’ of compensation will depend on the extent to which it reflects the total value of the foregone water to farmers, and to the community of the economic activity that is lost. This compensation value is typically greater than just water’s marginal productive value, and the prices currently being paid in water markets.

75. To the extent that markets are not efficient, or compensation for water lost is not ‘full’, then the pattern of externalities and distributional consequences will be more regionally dispersed, and the pattern of transformation will be less clear.

76. We make several points in relation to the process of transition to the Basin Plan becoming operable in 2014 (2019 in Victoria). Ultimately, in transitioning regional communities through the Basin Plan, the role of government lies in:

a. ensuring the water market operates efficiently;
b. redressing negative externalities arising from market operations; and  
c. ensuring government failures are minimised.

77. This is easy to state but difficult to do well. We suggest the following four are essential.

a. Ideally, the transitional assistance mechanisms for regional communities should be outlined in detail at the point when the SDLs are released.  
   It would be entirely inadequate for government to foreshadow a 20% or 40% reduction in water in the consumptive pool of a region and then be void about the specific mechanisms that will be employed to assist regional communities to adapt. There must be absolute clarity about:
   - volume of water required (the gap between environmental water holdings and state holdings and the water requirements of key environmental assets);
   - the mechanisms through which the gap will be recovered (i.e., the portfolio of water products the government will acquire to meet its obligations of the Basin Plan); and
   - the value of compensation for water recovered from the consumptive pool.

b. Adequate compensation for water surrendered is critical. On average horticulture, broadacre, dairy, and mixed production farm, water entitlements make up around 30% of the farm asset base. Reducing the allocation on these water assets without adequate compensation will directly impact on these farms’ asset base and gearing ratios:
   - for example, a permanent 20% reduction in water entitlement yield would reduce average farm assets by around 6%, assuming that greater scarcity of water does not drive up water market prices;
   - banks typically loan against farm water assets, and cutting water allocations to entitlements without adequate compensation would increase the risk that farms will breach or default on debt covenants; and
   - moreover, farm assets are water dependent (e.g., irrigation setup). Cutting into water directly will also likely erodes the value of fixed farm assets tied to water use.

c. We are in consensus with the Productivity Commission that there needs to be substantially more consideration given to the portfolio of water products the government builds to meet environmental watering requirements. Submissions from industry and irrigators on the role of government being in the market (which are consistent with more flexible leasing) should be a focus point of consultation.

d. Regional community adjustment should be targeted. The brunt will be felt by the irrigators, but they are likely to receive (direct or indirect) compensation for this brunt. Any fall-off of economic activity as a result of the Basin Plan will also be felt by
those in the irrigated agriculture value chain. These people are typically ‘outside the tent’ when it comes to compensation; they need to be included in community adjustment planning. We note this view, albeit with a somewhat different rationale, is consistent with that expressed by the Productivity Commission in their 2010 buy-back paper.

78. The scope of the Basin Plan does not necessarily include the exact mechanisms by which water will be recovered, the timeframe for water recovery, and the means by which regional communities will be supported to transition to sustainable futures under the Basin Plan.

79. These roles are spread across a number of government agencies, and a range of tiers of government (particularly state governments, who are responsible for the implementation of SDLs).

80. However, regional people will have a very strong need and desire to understand what the Basin Plan will mean for them. They will not get this understanding, however, until they know how SDLs will be implemented and how change will be managed. This uncertainty may cause avoidable anxiety and trigger resistance in regional communities. It would be a very significant, but again avoidable, constraint to wise investment decision-making and adaptation.

81. It is important that the details of the change process be communicated clearly to regional people – regardless of which agency or tier of government undertakes that task.

82. Given the multitude of agencies and tiers of government involved in effective and efficient transition, there will be a need for a clear leadership role across the various agencies and tiers of government, to set out a pathway to minimise negative impacts on regional communities. This role will also entail ensuring governments effectively support regional transition through implementation of the Basin Plan, and sending clear and constant signals to communities about the implications of the coming changes.
Section 1: Background

This Section includes:

- Introduction
- Conceptual framework
- Project approach
- Overview of irrigation and regions
- Water availability
1 Introduction

The Murray-Darling Basin Authority (MDBA) has been given the historic responsibility of preparing the Murray-Darling Basin Plan. The Basin Plan will provide an overarching framework for the integrated and sustainable management of the Basin’s water resources.

- Environmental water requirements will be set for environmental assets of significance taking into account (among other things) the precautionary principle.\(^3\)

- Sustainable Diversion Limits (SDLs) will cap the quantities of surface water and groundwater that can be taken from the Basin water resources. These SDLs will be set to ensure that the environmental watering requirements of key environmental assets are not compromised.

By these measures, the Basin Plan is the most ambitious and far-reaching integrated river basin planning exercise of its type in the world.

Current over-use and over-allocation of the Basin’s water resources\(^4\) mean that it is likely that both the Basin-wide SDL and the SDLs for some regions will be capped at levels below historic consumption. The Basin Plan will therefore be a landmark departure from the way the water resources of the Murray-Darling Basin have been historically managed. Reductions to the total quantity of water available for consumption will have direct and indirect impacts on Basin communities. Those Basin communities that are founded on irrigated agriculture are likely to be most affected.

The MDBA is committed to developing the Basin Plan taking into regard the best available scientific, social, economic, and cultural knowledge and analysis. Towards this objective, in January 2010 the MDBA engaged a consortium led by Marsden Jacob Associates (MJA) to undertake a socio-economic profiling and impact analysis of regional communities of the Basin, in the context of the Basin Plan.

The MJA consortium was engaged by the MDBA to provide detailed insight into:

- the resource, social, and economic context of key irrigation regions judged most sensitive to the introduction of SDLs;

- sensitivity of the irrigation region communities to the introduction of SDLs;

- likely adaptations that irrigation regions would undertake themselves in response to reduced water availability resulting from SDLs;

- how each regional community may be exposed to changes to water allocation in the context of the Basin Plan; and

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\(^3\) If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Refer Water Act 2007 (Cth) s4 ss2.

the range of adaptation responses that may occur in the region in response to changed water allocation in the context of the Basin Plan.

This report summarises and synthesises the key findings of the project in total. This synthesis report is one part of a wider set of deliverables and reports to the MDBA by MJA.

The purpose of this introductory chapter is to:

- establish the context for the socio-economic profiling and impact assessment project;
- establish the project need;
- outline the project deliverables and scope;
- introduce the MJA consortium members;
- acknowledge the support and input of a number of key people; and
- outline the structure and logic of this (synthesis) report.

1.1 The context: irrigation farming and water reform in the Murray-Darling Basin

Irrigated agriculture in the MDB makes a significant contribution to the national economy and is an important part of our national cultural identity. The Basin is Australia’s most important agricultural region – producing around one-third of the gross value of agricultural production. Even during drought, in 2005-06 the gross value of irrigated agricultural production within the Basin was estimated to be around $4 billion. On-farm, most irrigation water is used in cotton, rice, dairy and horticulture activities.

The Basin’s water resources and environments are under enormous stress as a result of past water allocation decisions, prolonged drought, natural climate variability, and emerging climate change.

In response to a growing national recognition of the water challenges facing Australia in general (and the Basin in particular), a national water reform agenda has developed over the past two decades.

The Water Act 2007 (Cth) strengthened the statutory basis for systemic reforms to the management of the MDB by establishing the MDBA and requiring the MDBA to prepare a Basin Plan, setting environmental water requirements and SDLs.

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7 Ibid.

The SDLs will be implemented through state water resource plans developed in accordance with the requirements of the Basin Plan. The new state water resource plans will be implemented progressively as existing plans expire. As a result, the commencement dates for SDLs as a replacement for the Cap varies from 2014 to 2019.\(^9\)

### 1.2 Project need

The Basin Plan may trigger substantial change in regional communities of the Basin. Some of these changes will be observable, such as on-farm structural adjustment. Other significant changes may be less directly observable, for example the possibility of increasing distress within irrigation communities and irrigation families.

Understanding how SDLs may affect the social and economic situation of regional communities, particularly those based around irrigated agriculture, is central to this understanding, to the development of the Basin Plan, and to the development of efficient and effectively targeted transitional arrangements.

Lower diversion limits will mean significant changes for some regional communities. Regional people will need to adapt to these changes. They will need to come to terms with what the introduction of SDLs means for themselves, their sector, and their regional communities.

Those connected to irrigated agriculture generally will be directly affected by the Basin Plan’s introduction. Those directly affected will include the irrigators themselves, and people connected to irrigators such as irrigation families, communities, or businesses up- or downstream in the irrigated agriculture value chain.

During the drought, farmers in the Basin and irrigation communities coped using a wide range of responses. These adaptation strategies are often unique to a sector, region, or community.

Moreover, farmers and business owners in the Basin are heterogeneous, and this heterogeneity systematically affects the decisions they make about the way they run their operations. For example, age, indebtedness, and enterprise objectives (lifestyle, commercial, intergenerational) have all been shown to affect how Basin farmers and regional businesses run their operations, and respond to shocks such as drought.\(^10\)

The observed diversity between regions, communities, and farmers of the Basin shows that real understanding of the prospective social and economic impacts of SDLs must be informed by detailed evidence-based socio-economic analysis of the regions that will be impacted.

A key question is how farmers and irrigation communities would respond to known permanent policy-based reductions in irrigation water. Such responses may be distinctly different than those observed in response to drought, which is a temporary and probabilistic event.

In addition, where there is uncertainty, lack of communication, and objectives other than profit maximisation, it follows that farmers and irrigation communities may not respond in narrowly

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\(^{9}\) *Ibid.*

rational, marginal and profit-maximising ways to what is an unprecedented, permanent step-change in water available for consumptive uses.

On these grounds, evidence-based socio-economic analysis is needed for the MDBA and governments to understand the social and economic situation of Basin communities, and the potential effects of the Basin Plan on regional communities. Accordingly, the MDBA identified a primary need for this project.

The specific focus of the project work was at the regional and local scale, and on irrigation communities of the Basin.

1.3 Relationship to other work

As noted, the purpose of this project was to provide the MDBA with profiles of irrigation farms, irrigation sectors and regional communities, and an understanding of how exposure to reductions in water availability may affect them.

This project is part of a wider set of complementary projects, commissioned by the MDBA, aiming to assess the likely socio-economic implications of reducing water availability on communities from the Basin to the local scale. In particular, the MDBA commissioned ABARE to undertake regional economic modelling using computerised general equilibrium (CGE) models.

A key difference between the two approaches are that MJA’s work places strong emphasis on the heterogeneity and differences in sensitivity and impacts whilst the ABARE modelling adopts the familiar, more stylised approach and assumptions of the CGE models, i.e., that farmers:

- are rational, risk neutral, profit maximisers;
- are homogeneous within a sector and region (such as horticulture in Riverland). This assumption reduces the water allocation model to a decision involving a handful of producers (for example one each for horticulture, broadacre, livestock, dairy and other farm types); and
- can adopt a limited number of strategies in response to tightening water constraints.

A second difference is that MJA’s work is based on understanding the current situation, sensitivities, early impacts and potential mitigating actions in response to the shock of reduced water allocations at the farm sector and local community level. In contrast, the CGE modelling approach operates primarily at the sector level and, by definition, seeks to trace through impacts after all adjustments have been made.

A third difference is that our socio-economic work concentrates on first round impacts of SDLs, and allows some tracing to second round social and economic impacts. CGE models seek to trace\(^{11}\) enable the impacts of an exposure event to be modelled throughout an entire economy.

\(^{11}\)We say ‘seek to trace’ as there is a considerable body of evidence that suggests CGE models have a history of being relatively poor economic forecasting tools. In part, this stems from the fact that CGE models are simulation tools, not forecasting tools per se. See for example:

Both approaches have relative strengths and weaknesses. By themselves, neither provides perfect insight into the socio-economic impacts of reduced water availability. Combined, both serve to reduce uncertainty, provide insights, and improve understanding of the upper and lower bounds of likely impacts.

### 1.4 Project deliverables

The MDBA required that the project deliver the following:

1. A report outlining the proposed conceptual framework and methodology for undertaking the social and economic impact assessments, including an outline of the quantitative and qualitative data to be used.

2. Advice and information on how this project can contribute to an overall assessment of the social and economic implications of setting alternative SDLs and the proposed Basin Plan.

3. Initial findings and observations, based on existing data and reports, presented in a discussion paper within 8 weeks of commencing the project. These initial findings will aim to stimulate early consideration of the likely consequences of SDL options, with the information being primarily for the use of the Authority.

4. Up to 20 workshops in regional locations throughout the Basin designed to both present, test and gather feedback on existing information as well as gather new information from stakeholders.

5. Up to 32 draft community profiles (18 sustainable yield regions and 14 local districts as agreed with the Authority).

6. A detailed draft report on the project outlining the approach and methods used as well as data sources, providing a compilation of the assessments of the likely economic and social impacts of setting various SDL options on the identified Basin communities, and providing a synthesised review and summary of the overarching findings and results.

7. A detailed final report incorporating feedback from the Authority on the draft report. The precise content and format of the final report will need to be agreed with Authority staff.

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The failure of economic models to accurately forecast economy wide dynamics is broadly attributable to (1) limitations of data used (prices, input-output tables, elasticities, representations of trade) (2) limitations of the analysis framework (assumptions of rational actors, optimising behaviour, competitive markets, and flexible relative prices) or (3) a combination of (1) and (2).

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12 This was later varied to also include the SA Murray below Lock 1. Note also that the Loddon, Campaspe, Goulburn and Murray irrigation regions in Victoria were addressed together in a single community profile as the Goulburn Murray Irrigation District (GMID)
8. Up to 32 final community profiles.

The project work of the MJA consortium delivers on the above requirements. We detail the framework and methodology of our work in Chapters 2 and 3.

Importantly, the work set out in this report has been ground-truthed by interviews and surveys of regional communities. This evidence-based approach provides an assurance that the socio-economic work provides a reasonable reflection of social and economic status of Basin regional communities, and of how individuals in the regions have stated they would respond to permanent reductions to regional water availability, in the context of the Basin Plan.

1.5 The MJA consortium

The project requirements necessitated a multidisciplinary approach. Marsden Jacob Associates identified and brought together a multi-disciplinary consortium of experts in their fields. Consortium members were:

**Marsden Jacob Associates** (MJA) is a leading specialist consultancy providing economic, strategic and public policy advice to government and the private sector across Australia. Over more than fifteen years MJA has been a forefront advisor on all major water and irrigation water reforms in Australia, and has worked continually in the Basin over this time.

Marsden Jacob Associates were project architect and project manager.

**RMCG** is a highly respected consultancy based in Bendigo and Melbourne. RMCG specialise in sustainable use of water and other natural resources in rural and regional communities. RMCG brought extensive prior experience directly relevant to this project, and have wide ranging networks in the Basin, developed through a long history of engagement with major irrigation companies (Sunraysia, Lower Murray Water, Murray Irrigation Limited, Goulburn Murray Irrigation District), industry sectors, and Councils of the Basin.

**Environment & Behaviour Consultants (EBC)** is a specialised social research and social planning consultancy. EBC has been deeply involved in evaluating the social impacts of water reforms in the Murray-Darling Basin. This work includes significant studies of the social implications of permanent water trading, water buy-backs, and of State water sharing plans.

**DBM Group** is a full service market research consultancy with a national field force of more than 400 interviewers. The company conducts more than 700,000 telephone interviews, 80,000 Internet surveys, and 500 focus group discussions each year. BDM was responsible for undertaking the phone surveys of Basin communities.

**Dr Anthony Hogan** is a Research Fellow at the National Centre for Epidemiology and Population Health, the Australian National University. He is a leading Australian authority evaluating the social impacts of increasing dryness on Australian communities. His work includes completing the largest ever participatory investigation of the exposure of Australian farmers to increasing dryness.

**Geoff McLeod** is a qualified agricultural scientist with extensive operational, management and extension experience. He has spent most of the past 24 years working in the Basin in the area of management and strategic planning of natural resources.
Geoff is actively involved in running a commercial cropping and grazing property in southern NSW. This hands-on experience provides an added dimension to his understanding of natural resource management.

Tim Cummins has qualifications in horticulture and has worked with rural communities for more than 20 years with experience in policy development, strategic planning and conflict resolution. The majority of Tim’s work has centred on Basin communities.

1.5.1 Roles and responsibilities

The consortium key member roles are set out in Table 1.

Table 1. Roles and responsibilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Key role/s</th>
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</thead>
<tbody>
<tr>
<td>Peter Jacob</td>
<td>MJA</td>
<td>Project director</td>
</tr>
<tr>
<td>Rozi Boyle</td>
<td>MJA</td>
<td>Project manager</td>
</tr>
<tr>
<td>Dr Jeremy Cheesman</td>
<td>MJA</td>
<td>Project architect, telephone survey leader</td>
</tr>
<tr>
<td>Dr John Marsden</td>
<td>MJA</td>
<td>Project review</td>
</tr>
<tr>
<td>Jim Binney</td>
<td>MJA</td>
<td>Team leader, Queensland</td>
</tr>
<tr>
<td>Matthew Toulmin</td>
<td>RMCG</td>
<td>Design and management of face-to-face interview program, Team Leader Macquarie and SA Murray below Lock 1</td>
</tr>
<tr>
<td>Nigel McGuckian</td>
<td>RMCG</td>
<td>Team Leader Northern Victoria</td>
</tr>
<tr>
<td>Charles Thompson</td>
<td>RMCG</td>
<td>Team Leader Nyah to the border and SA Riverland</td>
</tr>
<tr>
<td>Geoff McLeod</td>
<td></td>
<td>Team Leader Southern NSW</td>
</tr>
<tr>
<td>Tim Cummins</td>
<td></td>
<td>Team Leader Border Rivers, Gwydir, and Namoi</td>
</tr>
<tr>
<td>Dr Mark Fenton</td>
<td>EBC</td>
<td>Project design</td>
</tr>
<tr>
<td>Dr Anthony Hogan</td>
<td>ANU</td>
<td>Project design</td>
</tr>
<tr>
<td>Dr Russell Blamey</td>
<td>DBM</td>
<td>Telephone survey delivery</td>
</tr>
</tbody>
</table>

1.6 Acknowledgements

The MJA consortium wishes to acknowledge the support and guidance of the MDBA, its staff and its Board.
The MDBA’s Basin Community Committee was similarly supportive providing key input in the project’s early stages, identifying key individuals for the early scoping meetings in the regions, the contact lists for the face-to-face interviews, and assisting with the testing of the telephone survey, and providing feedback and interaction on earlier reports and drafts.

The water businesses across the irrigation regions encouraged and assisted irrigators to participate in the telephone survey. Likewise, a number of farming industry bodies and other regional organisations assisted in ensuring that the perspectives of their constituents were heard.

We thank all of the individuals who participated in the face-to-face interviews and in the telephone surveys.

### 1.7 Structure and outline of this report

This synthesis report contains four sections.

Section 1 (chapters 1 to 6) outlines the conceptual framework, the project approach and methodology, and the current situation of the irrigation farms, sectors, regions and their communities. This section concludes by outlining the magnitude of consumptive water use, the extent of already committed water buy-backs by governments for environmental purposes, and an indication of how these compare with specified reductions.

Section 2 (chapters 7 to 9) examines the drivers of sensitivity to reduced water availability at the farm sector and community level. This investigation draws on the face-to-face interviews and the major telephone survey. The sensitivity evaluation is reported in three chapters dealing with the sensitivity of farms, farm sectors, and regional communities.

Section 3 (chapters 10 and 11) sets out the expected impacts and adaptation responses to specified scenarios for reductions in water availability of between 20% and 60%. These chapters draw directly on face-to-face interviews in each locality and on our telephone survey. Chapter 10 is dedicated to the evaluation of farm and farm sector impacts, and Chapter 11 to regional community impacts.

Section 4, a single chapter, considers options for mitigating the impacts of reduced water availability. Options considered include reducing the size and/or nature of the reduction, reducing sensitivity and strengthening adaptive capacity.

Key Points are provided at the start of those chapters that set out sensitivity, impacts and impact mitigation options (i.e., chapters 7 to 12).
2 Conceptual framework

2.1 Vulnerability and adaptive capacity assessment

The vulnerability of a community (or farm or farm sector) to a change or shock can be understood in terms of the level of exposure to that shock, the sensitivity of the community to the change and the community’s adaptive capacity (Figure 1).\(^\text{13}\)

*Exposure* is the magnitude and nature of the potential shock of a specific change event. For the Basin’s farms, sectors and communities exposure begins with the quantum of the permanent reductions in the availability of irrigation water in each area as a result of the Basin Plan.\(^\text{14}\) The permanent reductions in consumptive allocations are not expected to be uniform across the Basin.

*Sensitivity* measures the responsiveness of a socio-economic system to an exposure/change event. By definition, more sensitive systems are more responsive. Sensitivity will vary across farms and communities according to their characteristics. For instance, those communities with greater dependence upon irrigation water will likely show a larger reaction (sensitivity) to reductions in allowable take of water (exposure) than those communities not as dependent upon irrigation water.

The *adaptive capacity* of a socio-economic system describes the ability of the system to change/adapt to shock or exposure. The sensitivity of a regional socio-economic system will be mediated by the community’s adaptive capacity. For example, all other factors equal, a community with lower community stress and more financial resources may have greater adaptive capacity to deal with exposure itself than a community experiencing higher stress, and with less financial resources.

*Impact mitigation* refers to actions by government(s) and other external parties to mitigate (or exacerbate) the impacts on the affected entities. For example, governments may choose to provide different levels of support for transition and adjustment.

The *vulnerability* of a socio-economic system equals the residual effects of an exposure event after coping and adaptation strategies have been implemented. To ensure this

\(^{13}\) Relative literature on the assessment of vulnerability and adaptive capacity assessment (including for drought and climate change), includes:


distinction is understood, this report sometimes will refer to vulnerability as residual vulnerability.

The residual effect to a shock following a community’s own adaptations to the exposure is the residual vulnerability. This residual vulnerability may be reflected in reduced financial resources available to deal with future shocks, lower personal wellbeing, or by the depletion of natural resources.

Similar frameworks have been used to evaluate the community and regional level adaptive capacity and vulnerability of Basin farmers to drought and climate change.\(^{15}\)

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**Figure 1. The conceptual approach of this report**

Our methodology also distinguishes between different types of impacts and strengths, e.g., human, social, natural, physical and financial.

Basin households with greater diversity and stocks of these five forms of capital are more likely to be less sensitive and have greater adaptive capacity to deal with events, such as drought or permanently reduced water availability. These households have more resources to draw upon, and greater flexibility to substitute between different livelihood strategies in times of stress.

Balance between these five types of capital is also important, as minimum levels of one type of capital may be necessary to effectively make use of others.\textsuperscript{16}

The conceptual framework (exposure, sensitivity, adaptive capacity, impact, impact mitigation and residual vulnerability) applies to any entity; in this case, the farms, the farm sector and the regional communities.

\textsuperscript{16} Nelson, R.; Kokic, P; Crimp, S; Meinke, H and Howden, S.M., 2010.
3 Project approach

The objective was to assess each Basin community’s exposure, sensitivity, adaptive capacity, and residual vulnerability to reduced water availability. This chapter describes the project approach.\textsuperscript{17}

MJA’s approach was to populate the conceptual framework described in the previous chapter in four broad stages (Figure 2). These were:

- the development of draft community profiles based on existing data from ABARE, ABS and BRS surveys, the detailed expert knowledge of consortium members, and targeted interviews with key stakeholders (January-February 2010);

- in-depth face-to-face structured interviews with some 250 stakeholders and other informed persons across the 12 regions (March 2010);

- the large scale program of telephone surveys of irrigators, dryland farmers, businesses and community representatives, (March 2010). The survey explored both factors determining sensitivity, and respondents’ anticipated responses to different magnitude of reductions in water availability; and

- project finalisation, including preparation of the draft report, briefings, workshops with MDBA, the Board and the MDBA’s Basin Community Committee, Basin Officials and the Ministerial Council (April-June 2010).

Consistent with the wider timetable and responsibilities of the MDBA to prepare the Basin Plan, the project was undertaken against a strict and tight timetable.

The draft community profiles established an initial benchmark of understanding of regional communities in the Basin. They were provided to the MDBA as part of the week 8 project deliverables (chapter 1.4). The MDBA approved the draft community profiles for release as part of the regional face-to-face interview program.

To extend and update the evidence base, detailed face-to-face interviews with key informants, and a large scale telephone survey of Basin households was undertaken across the selected regional and local Basin communities (excluding SA Murray below Lock 1).

The common objectives of the interviews and the surveys were to:

- validate, extend and enrich the draft regional and community profiles through direct consultation with key informants and individuals in the 12 selected regional and local Basin communities;

\textsuperscript{17} This study focuses on reduced consumptive water for irrigation. Reduced consumptive water also will affect urban water users in the irrigation regions. During our regional interviews, local government authorities and urban water authorities noted in a number of cases that the Water Act 2007 (Cth) makes reference to critical human water needs, and argued that this should include human needs for recreation, social cohesion and socio-economic – for example, water for gardens and recreation and sporting facilities - which traditionally have not had a high policy priority in times of drought. These interviewees noted that the loss of access to water for these uses during the drought has had a very high social and economic cost for regional communities.
obtain detailed information from the farms, businesses and communities in the regions about the nature of past, current and prospective adaptation and adjustment strategies adopted (so as to assist in understanding the vulnerability and resilience of selected Basin communities);

gain new qualitative and quantitative information about social, cultural and economic values and uses associated with the Basin water resources (so as to better understand the vulnerability and likely adaptations of regional communities to permanent reduction in water availability);

in particular irrigator sectors, would respond to permanent changes to regional water allocations; and

to understand how regional communities and sectors, in particular farm sectors and regional communities, would respond to permanent changes in regional water allocations.
Figure 2: Project approach

Sources:
- Pre-consultation consultations
- ABS
- ABARE
- BRS
- CSIRO

Regional context Profiles
- Resource context
- The region's community
- The regional economy
- WRM context

Vulnerability profiles
- Regional water dependence
- Community dependence on water
- Social resilience to change in water allocation

Adaptation Pathways
- Supply reliability thresholds and responses
- Adaptation constraints
- Adaptation assistance
- Regional examples of adaptation

Regional water supply scenarios

18 sustainable yield regions

None

Draft regional profiles

11 target regions

Draft community profiles provide the reference basis for 200+ structured key informant interviews in 20 regions. Regional consultations close information gaps, add regional insight, refine and validate community profiles, identify strategic (regional and sectoral) responses to SDLs, understand interplay between five capitals and strategic regional responses.

1,500+ surveys of Basin households. To include communities, irrigators, and businesses. Surveys provide insight about five capitals, regional values and preferences, and how irrigators would respond to changed water allocations caused by SDLs.

Report

Sustainable yield region profiles and cursory impact assessment

Detailed regional profiles for 11 regions
Synthesis report on socioeconomic impact assessment of SDL options
3.1  Stage 1: development of draft profiles

The key output of the project’s first stage was draft profiles of the 18 sustainable yield regions, and for the 12 selected regional and local Basin communities identified in chapter 4.3. The draft community profiles were developed by drawing on and developing earlier socio-economic assessment work performed by ABS, ABARE, and BRS for the MDBA.

The ABS/ABARE/BRS work was augmented with information and intelligence gained:

- by consortium members as a result of more than 100 years of collective work experience in the Murray-Darling Basin;
- through consultation with Basin Community Committee members associated with each region;
- through targeted literature reviews, and media database searches; and
- via a targeted pre-consultation with key opinion leaders in each district. These stakeholders were informed about the exercise being undertaken by the MDBA; identified key regional informants to be interviewed during the main interview program; and identified issues for inclusion in the draft community profiles.

3.2  Stage 2: face-to-face interviews

As agreed by the MDBA, these face-to-face interviews sought to understand how regions and irrigation sectors of the regional economy would respond to permanent reductions in the order of 20%, 40% and 60% of the long-term cap equivalent (LTCE).

The supply reduction scenarios were discussed as no compensation, no transitional support scenarios. That is, interviewees were told that the regional water allocations would be reduced, but were not told that they would be compensated for this reduction by some mechanism.\(^{18}\)

Clearly, this is an extreme scenario. Previous government behaviour, community expectations, and the risk sharing provisions of the Water Act 2007 (Cth) suggest that some compensation will occur within regions via some mechanism.

However:

- what may occur under a scenario of no impact mitigation is a necessary point of understanding, and is the base case from which to evaluate the net benefits of impact mitigation programs, such as structural adjustment support; and
- as recently noted by the Productivity Commission,\(^{19}\) substantial uncertainty currently exists over how the risk sharing provisions of the Water Act will be applied. For instance, will

\(^{18}\) In our regional consultations and the phone interviews we discussed water reductions. We did not indicate that compensation for the water reduction would be forthcoming from any source. It is possible that some interviewees have assumed that some form of compensation would be forthcoming, and factored this assumption in to their response. However, we think these respondents are in the minority; our results, and the conclusions drawn from these results, would not be substantively altered as a result.
compensation be paid simply on the basis of the value of the pre-existing or resulting market price for water, or on the basis of the loss of income or reduction in the value of all farm assets affected, or some other basis?

Simply stated, there is currently no basis for specifying and/or estimating how much compensation (financial or other) water holders and regional communities might be expected to receive for water that is reallocated from them to meet the environmental watering requirements of the Basin Plan. For these several reasons the supply reductions were discussed in terms of ‘no impact mitigation’.

The face-to-face interviews in each of the 12 selected regional and local Basin communities was managed by a team of two to three people with a Team Leader with extensive experience working in each region, and established relationships with irrigation and government stakeholders in each region.

The interviews sought to cover individuals in each district from:

- the Basin Community Committee (who were also asked to advise on interviewee options);
- the main irrigation supply organisation;
- key influential informed farmers (both irrigators and graziers);
- regional representatives of sectoral bodies such as Dairy Australia, Cotton Australia etc.;
- local government (both officers and Mayors);
- Catchment Management Authorities;
- local irrigation associations;
- large commercial irrigation companies (Auscott etc.);
- food processing companies and other supply chain organisations;
- regional representatives from key state agencies (DPI etc.);
- rural finance advisers; and
- other regional figures with relevant expertise.

Significant organisations were briefed on the project and the purpose of the interviews and survey and arrangements for engagement of local and regional representatives confirmed. These briefings and discussions included:

- Cotton Australia;
- NSW Irrigators Council;

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• NSW Farmers Association;
• NSW State Water;
• Australian Floodplain Association; and
• state government agencies such as DSE in Victoria and DNR in NSW.

The face-to-face interviews served to obtain input from strategic stakeholders and other informed individuals in the 12 regional and local Basin communities. These consultations clarified how regional communities and sectors of these communities may strategically respond to permanent changes in irrigation water availability in each region. The regional face-to-face interviews were complemented and extended by MJA’s telephone surveys.

3.3 Stage 3: telephone surveys

The purpose of the telephone surveys was to provide a fresh, consistent statistical data base to allow MJA to evaluate:

• the characteristics and levels of the five capitals (human, social, natural, physical, and financial) within the farms, sectors and communities, and how these differ between regions;
• how individual farms and business within the regions had adjusted their operations in response to drought;
• how individual farms and businesses within the regions may adjust their farm/business operations in the future in response to permanent reductions in water availability for consumptive uses of 20% and 40% assuming no compensation occurs for the reduction to the consumptive pool;
• whether systematic and policy relevant cause/effect relationships existed between individual levels of human, social, natural, physical, and financial capital and the adaptive responses of individuals to permanent changes in regional water availability; and
• regional preferences for allocating more or less water to the environment out of the consumptive pool.

Four separate surveys were developed covering:

• irrigators;
• dryland farmers;
• businesses; and
• community members.

The irrigator survey drew upon the memberships of the local irrigation water supply businesses with the exception of the Condamine Balonne where it was necessary to rely on randomly selected telephone numbers.
Note that, at the discretion of the MDBA, a telephone survey was not undertaken in the SA River Murray below Lock 1; this region was incorporated into the project towards its conclusion.

Methodological details of the surveys, and detailed results, are set out in Part 3: Telephone Survey.

3.4 Stage 4: briefings and project finalisation

Project finalisation included finalisation of the 18 sustainable yield regional profiles, the 12 regional profiles, and the preparation of this project synthesis report.

During May and June, MJA prepared a draft report and undertook a series of briefings on the project methods and key findings. We briefed the Murray-Darling Basin Authority Board; the Basin Community Committee; the Murray–Darling Basin Officials Committee; MDBA staff; and the Murray–Darling Basin Ministerial Council.

3.5 Discussion of our approach

At the outset of the project, we were clearly aware of:

- the importance of demonstrating the validity of our project findings; and
- the obvious risk posed by ‘rent seeking’ behaviour by people who our brief required us to consult with.

Our project approach was designed to ensure that the validity of regional consultation findings was ensured and could be demonstrated, and that rent seeking (or inadvertent over-statement of impacts) would be detected and controlled for in our findings.

Broadly, validity is the extent to which a test measures what it is supposed to measure and is bias free.

In our work, and in relation to the water supply scenarios in particular, two types of validity are important:

- the degree to which a measure is correlated with other measures that it is theoretically predicted to correlate with (i.e., convergent validity); and
- the degree to which conclusions about causal relationships can be made (e.g., cause and effect), based on the measures used (i.e., internal validity).

In our work the clearest rent seeking risk is that regions may overstate the negative effect of SDLs on their community. If such overstatement were accepted by governments as truth, the region may be overcompensated (either via less severe SDLs being imposed or through over-allocation of structural adjustment assistance) when SDLs are introduced.

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20 In formal terms, ‘rent seeking’ involves manipulation by an individual in order to bring about an uncompensated transfer of goods or services from another person or persons to one’s self as the result of a favourable decision on some public policy.
As outlined above, our approach drew heavily on the Stage 1 development of regional profiles and sector profiles that used published data (by ABS, ABARE, industry organisations etc.) and also used the extensive experience of Team Leaders.

We designed our approach to minimise risk and bias in several complementary ways:

- the internal validity of the face-to-face interview process depended on its leadership by highly experienced Team Leaders (with a total of over 100 years’ experience in their farming sectors and regions) who were able to scrutinise and, where appropriate, test interviewee responses;

- multiple separate interviews were conducted, and results compared between them to identify any inconsistency. These comparisons indicated that the interview responses were highly internally consistent. Where inconsistencies were identified they were promptly followed up;

- the internal validity of the telephone survey process depended on best practice statistical design\(^21\) (including sample size, respondent selection etc.), the use of split samples for the water availability scenarios (i.e., people were asked randomly about responses to 20% or 40% reduction compared to the long-term average, but not both), and ‘reality testing’ of findings to ensure consistency with evidence available elsewhere (e.g., comparison of the findings for horticulture vs. rice, as horticulture is known to be more likely to buy water in response to scarcity\(^22\)); and

- triangulation of the results between the sector and regional profile analysis, the interviews, and the telephone survey. In particular, the responses to water availability scenarios from the interviews and the telephone survey were highly mutually consistent.

Accordingly, we believe that the risk of our work overstating regional impacts has been minimised, and our results are highly valid. Our results complement other methods of analysing potential future regional impacts, as discussed in chapter 1.3.

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\(^{21}\) This included:
- pre-testing and cognitive testing of the survey instruments;
- between regions, the use of weighted sampling to skew sample numbers towards the most intensive irrigation regions;
- within regions, the use of random sampling where possible;
- the use of follow up and debriefing questions to confirm respondents’ understanding of the survey; and
- the use of split sample design to test the water supply scenarios.

4 Overview of irrigation and regions in the Basin

4.1 Irrigated agriculture in the MDB

As noted, this report focuses on irrigated agriculture and its connection to regional communities.

The objective of this chapter is to overview the six main water using irrigation sectors in the Murray-Darling Basin. These are: 23

- cotton;
- rice;
- dairy;
- annual and perennial horticulture;
- mixed farming; and
- broadacre farming.

In this chapter we provide an summary overview of each sector. This overview includes farm profiles compiled from the farm telephone survey results.

Figure 3 shows the geographical distribution of the main irrigation sectors and other land uses in 2000-01.

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23 More detailed information on these six sectors is provided in Appendix 1 of this report.
Figure 3. Broad agricultural land use in the MDB, 2000-01

4.2 Sectoral overview

4.2.1 Cotton

Cotton is an opportunistic annual crop. Most cotton growers operate mixed cropping properties where cotton is the most profitable crop in a rotation including winter wheat. On these farms the area of cotton planted is decided once the annual water allocation is announced.

Around two-thirds of Australia’s cotton is grown in the northern valleys of NSW and southern Queensland, where there is considerable variation between seasons in the level of rainfall and water available for irrigation. The main cotton production area in NSW covers the Gwydir, Namoi and Macquarie Valleys, with cotton also grown along the Barwon and Darling Rivers and the Lachlan and Murrumbidgee Rivers. In Queensland, cotton is predominantly grown in the Darling Downs, St George, Dirranbandi and the Macintyre Valley regions.

Historically, the area under cotton production grew rapidly from the 1970s (typically less than 50,000 ha) to peak in the late 1990s at over 500,000 ha. In 2008-09, approximately 160,000 hectares were cropped in New South Wales and Queensland. This is approximately half the area cropped during recent non-drought years.  

Cotton farms are typically medium sized, around 360 hectares, and family run. Family-run cotton farms typically operate as mixed enterprises. Corporate cotton producers include Auscott, Queensland Cotton, and Namoi Cotton. These enterprises are typically vertically integrated operations. For example, Namoi Cotton operates as a fully integrated ginning, marketing, warehousing and shipping organisation. Smaller cotton producers benefit from the existence of these large corporate enterprises as willing buyers and marketers for their products, even in the face of considerable annual variation in their production.

Cotton products include lint, cottonseed and linters. Lint, or raw cotton fibre, is processed into yarn and fabric. Cottonseeds are typically crushed for oil and meal. Cottonseeds can also be fed to livestock and poultry. Linters (short fibres that remain after ginning) are used to produce goods such as bandages and cotton buds.

Cotton lint yields were in the range of 2 tonne per hectare in 2008-09. These yields are amongst the highest in the world. Australian cotton yields have trended significantly upwards in recent years. For the 25 years to 2009, average cotton yields in Australia increased approximately 1.5-fold. Much of the yield improvements are attributed to breeding.

Australian cotton is primarily sold onto the international market where it has a reputation as a high quality product. Approximately 98% of Australian cotton production is exported, with combined cottonseed and cotton lint accounting for between 4 and 14% of world trade of cotton.

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in the period 2005-06 to 2008-09. Between 2004-08 Australian cotton exports accounted for between 0.51% and 2.44% of world production. Export revenue from cotton totalled $500 million in 2008-09 (a drought year). During non-drought years Australian cotton exports generate in excess of $1 billion in revenue.

Throughout the drought, there has been significant variation in the scale of plantings, with a general downward trend (Figure 4). Much of the area established in recent years has been somewhat ‘opportunistic’ where a cotton crop is established only when sufficient water is available via allocations, carryover or trade. When water is not available landholders have been continuously diversifying and adapting into other production (crops or livestock).

![Figure 4. Cotton: trends in national area harvested and yields](image)


The immediate response of the sector to the recent dry sequence has been to reduce the area under cultivation. This has seen the area fall by an order of magnitude from a high in excess of 500,000 ha in 2000-01 to around 50,000 ha in 2007-08.

Water use efficiency, principally in terms of the cotton produced per ML of total water use, has improved steadily over time. In the Queensland Murray-Darling Basin in 2010, research indicates that 84% of all irrigation was carried out by furrow irrigation, 14% overhead spray (lateral move and centre pivot), 1% drip and microspray and 1% other spray. There has been gradual adoption of pressurised irrigation in some regions, but for the great majority of irrigators the reliability of the water is already too low to justify the major capital investment involved in conversion from furrow. Pressurised irrigation also brings with it the risk of increasing energy costs over time. Drip irrigation generally is not favoured for the heavy cracking clay soils common in the floodplain areas.

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Current research by the National Centre for Engineering in Agriculture indicates that broadacre irrigated production on the floodplains of the Queensland Murray Darling Basin accounts for about 80% of irrigated production overall. The percentage of cotton varies, being 69% of irrigated crop area in 2001-02 but only 53% in 2005-06. Broadacre irrigation excluding cotton accounted for 10% in 2001-02 and 25% in 2005-06. In the more intensive areas, pasture for livestock occupies about 12% of irrigated area, grapes, fruit and vegetables 7%, and other agriculture 3%.

Individual irrigators have diversified from high reliance on cotton into other niche crops such as lupins, sorghum and chickpeas and some have concentrated more on winter cereal crops. None of these alternative sectors has the same return as from cotton, none provide employment or processing at the same level across the district, and none provides the same established market access however.

**Farm profile**

Twelve cotton farmers were surveyed during the phone interview. Results are not presented as a consequence.

### 4.2.2 Rice

Australian rice varieties and farming techniques are substantially different to those in other parts of the world, such as Asia, as Australian farmers have adapted to unique climate conditions.

The first commercial rice crops were grown in the Murrumbidgee Irrigation Area in 1924. Since then the industry has expanded throughout the Murrumbidgee valleys of NSW, and the Murray valleys of NSW and Victoria.

Over the past three decades in non-drought conditions, between 100,000 to 150,000 hectares of rice have been cropped in these regions each year. Annual production has been in excess of 1 million tonnes.

In non-drought years, the rice production industry generates an economic benefit of approximately $4.8 billion to national economy, including annual sales revenue and the flow-on impacts of economic production.

In non-drought years, on average 50%\(^{28}\) of the rice production is exported as value-added branded products to over 70 countries. The medium grain rice grown in the NSW Riverina is regarded as a high quality product worldwide.

Rice production in the Basin has been significantly constrained by the drought. The area under production fell in 2007-08 to 2,200 hectares and 8,100 hectares in 2008-09. Rice yields also fell to about 8.2 and 7.7 tonnes per hectare in 2007-08 and 2008-09, respectively, approximately a 20% decrease compared to 9.8 tonnes per hectare in 2005-06.\(^{29}\) The decline in both farmed area and yield was also evident in a 97% decrease in total value of production from $280 million in 2005-06 to $7 million 2007-08.

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During periods of low allocation, rice tends to be grown by larger farm businesses that have the capacity to consolidate small water allocations from a number of landholdings. There have been examples during the past three years of groups of growers combining small volumes of allocated water to produce a single larger area of rice.

There are around 2,000 family operated farm businesses growing rice in the Murrumbidgee valleys of NSW and the Murray valleys of NSW and Victoria. These farms are only allowed to produce rice on approved ‘heavy clay’ soils, which minimise seepage losses. More than three metres of heavy, continuous clay is required for unrestricted rice growing.

Rice is grown as part of a mixed farming system, using a rotation cycle across the farm over four to five years. This system means rice growers maintain water savings, have increased soil nutrients, and achieve higher yields by international standards.

Following the harvesting of rice sufficient moisture is retained in the soil profile to plant another crop, either a wheat crop or pasture for animals. This form of rotation is the most efficient in natural resource and agricultural terms.

From 1996 to 2006, Australian rice growers achieved improvements in their water use efficiency, reducing water demand by 60%. In 2005-06, the rice industry used approximately 1.3 ML per tonne of rice produced, or 12.4 ML/ha. This translates to an average gross value of irrigated production of $220 per ML.

The rice industry is typically vertically integrated. For example, SunRice, the company that owns and operates most of the extensive rice storage and processing facilities, is mainly owned by current and former rice growers. The company also operates a large stockfeed and companion animal feed manufacturing business (CopRice) with plants in the Riverina and Victoria.

**Farm profile**

The farm survey includes responses of 48 rice farmers (Appendix 4).

Standard deviations show substantial variation in rice farm characteristics. However, the ‘representative farm’ profile bears out the main messages of rice discussed above. For the rice farms surveyed:

- the average farm holds roughly 4 general security water entitlements per hectare set up for irrigation;
- during 2008-09, rice farmers were net sellers of their general security water entitlements. Approximately 75% of all respondents surveyed had sold or leased out water during the past production year;
- approximately 60% of total farm assets are held as water entitlements;
- the average gross margin return on assets during the past five years has been 1%. After accounting for non operating expenses, this level of gross margin return is insufficient to maintain a viable farm over the long run;

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the average annual EC payment was approximately $42,000. Approximately half of farms surveyed earned off farm income;

- rice farms are conservatively geared, with farm debt averaging 22% of total farm assets. Low returns over the past five years will significantly constrain the ability of many farms to service debt. Cashflow, not gearing, appears to be the fundamental financial problem; and

- the personal wellbeing of the rice farmers surveyed was marginally below the range of national norms. There was substantial deviation around this mean however. Approximately 10 percent of farmers reported personal wellbeing below the normal range.\(^{31}\) On average, rice farmers are moderately optimistic about their futures in the region they produce in. Again however, there is substantial deviation around this mean optimism.

### 4.2.3 Dairy

The majority of the dairy industry in the Murray-Darling Basin (MDB) is located in the lower MDB, covering an area north of the Great Dividing Range in Victoria to the Murrumbidgee River in New South Wales and the Murray Region of South Australia. The overwhelming majority of dairy production occurs in the northern Victorian Goulburn Murray Irrigation District (GMID). The total dairy herd in the region is estimated to be about 1 million cows, with a milk yield of 5 to 6 kL per cow per annum. The yields per cow have been increasing over the last five years. Dairy also occurs in NSW Central Murray and the SA Murray region below Lock 1.

The industry experienced a major shock in December 2008 when dairy prices crashed as a result of the global financial crisis. The crash saw major milk companies announce milk price step-downs in the order of 40% for the second half of the financial year. This had a significant impact on farms, many of whom had locked in for the year that would have provided a margin at the opening milk prices, but would result in losses at the lower milk price.

There are approximately 2,600 dairy farms operating in the lower MDB, making up 32% of all dairy farms in Australia.\(^{32}\) These farms produced 2.8 billion litres of milk in 2005-06, with a total value of agricultural production of $670 million.\(^ {33}\) By 2008-09 the milk production had declined by about 25% to 2.1 billion. In 2005-06 the industry used about 0.2 ML per kilolitre of milk produced and generated a value of production of $180 per ML used.

The predominant trend in the dairy industry over the last forty years has been declining farm numbers and increasing average farm size, as farms strive to improve productivity. This trend was particularly evident in Victoria during the 1980s and 1990s when farm numbers dropped by one third, but production more than doubled (Figure 5).

During the 1990s, whenever a dairy farm exited the industry most of the land, water and herd resources would be absorbed by remaining dairy businesses as they grew their operations. In the past decade this trend has not continued and the land, water and herd resources from exiting farms have not been retained in the Basin dairy industry. This has seen a drop in the total milk production.\(^ {31}\)

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\(^{31}\) Which is 60-90 points, see Cummins, Robert; Davern, Melanie; Okerstrom, Erik; Lo, Sing Kai and Eckersley, Richard. 2005, "Special Report on City and Country Living," Australian Unity Wellbeing Index Report 12.1.


\(^{33}\) ABS, 2006, MDB database; Water and the Murray-Darling Basin - A Statistical Profile, 2000-01 to 2005-06
production from northern Victoria which has been driven by the lack of irrigation water, milk prices, and the lower level of confidence amongst farmers continuing in the industry.

The lower milk volume has resulted in surplus processing capacity in the region which has subsequently seen the rationalisation of manufacturing infrastructure. Recent changes include the scaling down of the Nestlé site in Tongala and Kraft Strathmerton site, and the recent closure of the Murray Goulburn Leitchville site (February 2010).

The current drought sequence has led to a significant change in the feeding systems commonly adopted across the dairy sector. In the past, farms were able to fully irrigate perennial pastures, and so home-grown feed typically ranged from 60% to 70% of the farm’s total feed requirements. During the last ten years of reduced water availability, there has been a move away from perennial pasture to more flexible feeding systems, with an increased in production on-farm of annual crops, lucerne and annual pastures.

The change in the type of home-grown feed base has also coincided with an increase in the level of feed bought from other farmers. Even though the fodder grown on farm has shown increased productivity (in tonnes/ML), total home feed production has still declined due to the lack of water. The increased reliance on bought-in feeds and the changed home-grown fodder base has increased the complexity of the farming systems. It has also increased their cost.

![Figure 5. Victorian milk production and farm numbers](image)

Source: Dairy Australia.

Border check (‘flood’) irrigation is the predominant form of irrigation for pasture on MDB dairy farms. Historically, border check systems often used water inefficiently. Over recent decades, the
water use efficiency of border check irrigation has improved; a well-designed border check system can be over 85% efficient, due to innovations such as laser grading, high flow rates, water recycling etc.

In addition, over recent years of low water allocations, farmers have moved away from growing perennial pasture (which needs irrigation over summer) towards growing annual crops that have their irrigation demand during the cooler months of autumn and spring. Combined with increased use of brought-in feed and partial mixed-ration based systems, dairy farmers have changed their feeding practices to help manage the risk of low water availability.

Dairy has been a net seller of water at times of low allocations when water market prices are high, as they are able to replace the water with bought-in feeds. This is a season-by-season decision which is influenced by:

- the price of allocations on the water markets;
- the milk price;
- the cost of feed substitutes; and
- the level of individual farm water use efficiency.

There is significant dairy manufacturing capacity and infrastructure in the lower MDB, with businesses producing dairy products for the domestic and export markets. There are 13 major dairy facilities in the region including milk processing, dairy product manufacturing and milk collection plants. Downstream processing and manufacturing of dairy farm output employs an estimated 2,700 people in the southern MDB.  

The medium to long-term outlook for dairy demand remains positive. Accordingly, it is reasonable to assume that milk prices will be at levels that will enable dairy farming to continue to out-compete mixed farming businesses, but not horticulture, for water.

**Farm profile**

Respondents from 96 dairy farms were surveyed as part of the phone interview program.

Standard deviations show substantial variation in farm characteristics (Appendix 4). However, the ‘representative farm’ profile bears out the main messages of the dairy sector discussed above. For the dairy farms surveyed:

- the average farm size is less than 345 hectares. Approximately 70 percent of farm area is set up for irrigation;
- respondents hold both high and low security water entitlements, with approximately 1.5 high security entitlements held per low security entitlement. On average, dairy farms held approximately 1.8 high security entitlements per hectare irrigated;

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34 ABS Census of Population and Housing 2006.
in the 2008-09 production year, dairy farmers were net importers of irrigation water, with approximately half purchasing water. One in four dairy farms sold or leased out water during the same period;

the farms surveyed had average annual gross margins over 2004-09 of roughly $74,000. Again, there is wide dispersion around this average, as shown by the standard deviation of gross margins, which is $453,000. After accounting for non-operating expenses, including interest repayments, capital depreciation, and returns to management, the average gross margin returns are likely insufficient to maintain a viable dairy farm;

the average annual EC payment was almost $75,000. Approximately 1 in 2 dairy farms earned off farm income;

dairy farms are conservatively geared, with farm debt averaging 21% of total farm assets. Low returns over the past five years will significantly constrain the ability of many farms to service debt. Cashflow, not gearing, appears to be the fundamental problem.

on average, a dairy farm’s water entitlements make up 35% of total farm assets;

the personal wellbeing\(^{35}\) of the dairy farmers surveyed was within the range of national norms, on average. There was substantial deviation around this mean however. Approximately 20% of dairy farmers reported personal wellbeing below the normal range;\(^ {36}\) and

on average, perennial horticulture farmers are moderately optimistic about their futures in the region they produce in. Again however, there is substantial deviation around this mean optimism.

4.2.4 Horticulture

The main perennial (permanent) horticultural crops grown in the MDB include wine grapes, table grapes, dried fruit, almonds and nuts, stone and pome fruit. Crops generally are high-value, when not in over-supply. The significant oversupply in the wine grape sector currently is causing major economic hardship amongst growers.

Approximately one-third of Australia’s perennial horticulture is located in the southern Murray-Darling Basin. The major growing regions in the Murray-Darling Basin include the Goulburn Valley of Victoria, the Murrumbidgee Irrigation Area of New South Wales, the Sunraysia district of Victoria/NSW, the Riverland region of South Australia. Perennial horticulture farms in these regions are typically less than 100 hectares in size.

The established horticultural regions of the Basin have a number of competitive advantages making them suitable for a range of horticultural crops. Advantages include soil type, climate, infrastructure, and access to skilled labour and regional transport hubs.

\(^{35}\) For a discussion of the personal wellbeing index used, see Appendix (ref).

\(^{36}\) Which is 60-90 points, see Cummins, Robert; Davern, Melanie; Okerstrom, Erik; Lo, Sing Kai and Eckersley, Richard. 2005, “Special Report on City and Country Living,” Australian Unity Wellbeing Index Report 12.1.
Perennial horticulture businesses are capital intensive to establish and have a long lead-time to full production. Crops may live from 12 to 50 years, depending on type, and require highly reliable water in order to maintain plant health.

The need for high reliability water supplies has resulted in perennial horticulture developing in areas of high reliability entitlement, such as NSW high security and Victorian high reliability water. Larger producers typically locate on river in order to manage water diversions privately. Smaller producers typically locate within irrigation districts, where irrigation water is piped or channelled to the farm gate.

Between 1996-97 and 2000-01, the area of perennial horticulture plantings increased significantly in the Murray-Darling Basin. The period saw a 78% increase in fruit and nut trees and a 77% increase in grape plantings, comprising mostly wine grapes. This expansion continued from 2001 to 2009 especially in Sunraysia with almonds.

Between 2007 and 2010, drought water allocations and suppressed commodity prices (particularly for red wine grapes) reduced the area of perennial horticulture plantings. The plantings removed mostly were wine grapes and older citrus plantings. In some districts, such as Sunraysia, the area of perennial horticulture plantings has been reduced by up to 30 percent. Across all regions, the average reduction in permanent plantings is in the range of 10 percent and 20 percent.

Investment in the perennial horticulture industry is currently low due to uncertainty on future water availability and commodity prices. Expansion in perennial plantings in the main perennial horticulture regions of the Basin has slowed significantly.

The combination of drought, suppressed farm gate prices, and other structural factors have resulted in the horticulture sector broadly being under continued pressure to amalgamate properties or develop greenfield sites to achieve economies of scale. This is less so for labour-intensive crops such as hand-picked fruit crops like table grapes and stone fruit. In older districts, where there are smaller properties, growers are becoming more dependent on off-farm income and are moving to higher value crops.

Profitability is highly variable across perennial horticultural crops, and is related to international competition and the relative value of the Australian dollar (Box 1).
Box 1: Performance and outlook for perennial horticulture

**Wine grape** profitability has fallen significantly, from the 1990s to current highly negative levels due to a combination of the high cost of water purchases and low grape prices. Oversupply in the wine grape sector currently is causing major economic hardship amongst growers. Profitability of wine grapes is expected to remain low until the current over-supply is corrected.

The industry estimates that at least 20% of bearing vines are surplus to requirements, and large areas have already been abandoned in Sunraysia. In 2009, wine grape growers in the Murray Valley (Murray-Darling and Swan Hill wine regions) dumped or left 30,000 tonnes of wine grape on vine due to over-supply.

The 2008 Australian regional wine crush survey for Murray-Darling and Swan Hill suggests that white varieties will continue to be in oversupply. The most recent ABARE forecasts suggest the decline in national production is projected to lead to a gradual recovery in domestic wine grape prices in real terms toward 2014-15, although prices in real terms will remain low in historical terms.

**Citrus** production has remained relatively stable, with a high reliance on exports to the USA. In 2009 exports to the USA were impacted by competition from Chile. Australia has a competitive advantage in the international market for fresh citrus as it can export high quality fresh navel citrus when these fruits are out of season in the northern hemisphere. Moreover, local producers enjoy a degree of natural import protection as a result of high transport costs.

Output of Navel and Valencia oranges in the Basin has followed dynamics of the Australian market, with Valencia progressively being replaced by Navel production. These production dynamics have occurred in response to price signals in international markets.

ABARE forecasts suggest that Australian citrus prices will decline over the mid-term in international markets as producers come under price competition from other southern hemisphere producers such as South Africa, Brazil and Peru.

**Table grape** profitability can be volatile. Despite this, there has been expansion in the industry in recent years. This industry is working on further export market access into Asia, especially China, which would see further significant growth.

**Dried fruit** had many years of low, but stable, prices and recently an improvement in profitability. In a reversal of the past trend, a gradual transition from some wine grapes to dried fruit is expected.

Global prices of dried vine fruit are likely to fall in real terms in the medium to long-term as the major world producers, such as Turkey and Iran, increase production efficiency through greater use of mechanisation and improved production methods. Production in emerging producing countries, such as China, can also be expected to grow into the future.

Consequently, productivity improvements will assume particular importance for Australian producers in the medium term. Only by improving productivity so that price competitiveness is maintained or improved will Australian exporters be able to capitalise on emerging opportunities in Asia where growing incomes may

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lead to increased demand for premium quality fruit.

The Australian almond industry is undergoing rapid expansion, and is one of the fastest growing horticulture sectors in Australia. On a percentage basis, Australia is the fastest growing almond industry in the world (10% per annum). Australia currently produces around 3% of world almonds, in a market that is heavily dominated by California (82%).

To 2014, global demand for almonds is expected to grow at a rate of around 7% per annum. Continued droughts in California are reducing yields of that exporter. Approximately 30% of all bearing almond trees in California are over 20 years of age and are therefore decreasing in productivity. Therefore, global demand for almonds is forecast to exceed supply capacity by 2014, placing upward pressure on almond prices.

Australia is able to service niche export markets that seek a reliable, high-quality product. There is a growing demand for Australian almonds from India, Europe, Japan, Hong Kong, New Zealand and Middle East.

The GFC and collapse of MIS schemes has slowed new planting activity in Australia, and is likely to continue to do so in the near future.

The stone fruit and pome fruit sectors have experienced volatile profitability levels, although the area planted to these crops has remained relatively stable. There has been some reduction in canning varieties in the Goulburn Valley e.g. pears. The future is strong if they can afford to invest in new technology.

The indicative production and irrigation water requirements for wine grape, table grape, dried grape, citrus, and almond are summarised in Table 2.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Wine grape</th>
<th>Table grape</th>
<th>Dried grape</th>
<th>Citrus</th>
<th>Almond</th>
</tr>
</thead>
<tbody>
<tr>
<td>t/ha</td>
<td>16 (15-20)</td>
<td>15 (14-17)</td>
<td>9 (8-10)</td>
<td>21 (20-25)</td>
<td>3.5 (3-5)</td>
</tr>
<tr>
<td>ML/ha</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>12</td>
<td>15.5</td>
</tr>
</tbody>
</table>

All of the perennial horticulture sectors have implemented changes to reduce their water usage in the past decade. Substantial investments have been made on farm to increase technical irrigation water use efficiency (that is maximise ‘crop per drop’ via technology) through the use of precision, mainly drip and micro-drip, irrigation. The water use efficiency of drip technologies is typically above 85 percent, depending on climate and soil type. Irrigation timing based on soil moisture testing technology is also in widespread use.

A second major strategy has been to reduce the overall volumes of water applied (that is, to maximise crop per drop through leaner irrigation management practices). During the drought, deficit irrigation has been practiced in many regions. These practices can be effective in the short-term in minimising demand but is not a sustainable practice as irrigation rates are now less than required to ensure a leaching fraction. This risk is that this will lead to a build of salinity within the root-zone, undermining the productive capacity of the soil into the future.

The critical issue for all perennial horticulture is to ensure that the enterprise has sufficient water to meet the requirements of established plantings. Low water allocations have forced enterprises to choose between ‘dry or buy’.

During the last few years of low allocation perennial horticultural industries have therefore been large buyers of temporary annual allocations as a route to access additional water to meet the gap between entitlement and allocation. Some growers are even selling permanent water entitlement (to keep their debt levels down) at the same time as buying temporary water annually for higher value plantings.

There is a significant regional processing industry associated with perennial horticulture, including wineries, canneries, packing sheds and other processing, packaging, marketing and transport activities.

Each perennial horticulture crop industry has an organised research and development and extension program through Horticulture Australia Limited, and ongoing improvements in labour and productivity are expected. Growers are also implementing new practices for improving fruit quality.

**Farm Profile**

Respondents from 227 perennial horticulture farms were surveyed as part of the phone interview program, including 88 grape farmers and 42 citrus farmers.

Standard deviations show substantial variation in farm characteristics (Appendix 4). However, the ‘representative farm’ profile bears out the main messages of the perennial horticulture discussed above. For the farms surveyed:

- the average farm size is less than 100 hectares. Approximately 70 percent of farm area is set up for irrigation;
- respondents predominantly hold high security water entitlements. Grape producers hold 7.6 high security water entitlements per irrigated hectare on average (significant at 1%). Citrus producers hold 6.5 high security entitlements per irrigated hectare (also significant at 1%);
- in the 2008-09 production year, horticulturalists were net importers of irrigation water. Almost two thirds of respondents purchased or leased in water, compared to 1/5 being sellers;
- almost 90% of farms use drip or micro-drip precision irrigation. Moreover, approximately half of all respondents use soil moisture monitoring technology to decide when to irrigate;
- the farms surveyed had average annual gross margins over 2004-09 of roughly $9,000. After accounting for non-operating expenses, including interest repayments, capital depreciation,
and returns to management, these gross margin returns are insufficient to maintain a viable farm. The $432,000 standard deviation around the mean gross margin shows there is substantial variation in gross margin returns between the farms surveyed;

- the average annual EC payment was $15,000. Approximately 1 in 2 farms earned off farm income. Earlier work by ABARE suggests off farm income in the range of $40,000 per annum for horticulture farms in the Basin. Combined, these results show the significant contribution that off farm income, and to a lesser extent EC payments, makes towards keeping horticulture farms viable during the past five years;

- perennial horticulture farms make a significant and direct contribution to their regional economies. Effectively all operating costs are expended within 50 kilometres of the farm gate. Horticulture farms are a significant employer of seasonal labour, employing approximately 10 employees on average (during harvest);

- horticulture farms are conservatively geared, with farm debt averaging 25% of total farm assets. Low returns over the past five years will significantly constrain the ability of many farms to service debt. Cashflow, not gearing, appears to be the fundamental problem;

- on average, a perennial horticulture farm’s water entitlements make up one third of total farm assets; and

- the personal wellbeing of the horticulture farmers surveyed was within the range of national norms, on average. There was substantial deviation around this mean however. Approximately 1:5 farmers reported personal wellbeing below the normal range. On average, perennial horticulture farmers are moderately optimistic about their futures in the region they produce in. Again however, there is substantial deviation around this mean optimism.

4.2.5 Annual horticulture

The main annual horticultural crops grown in the MDB include potatoes, lettuce, melons, sweet corn, fresh and processing tomatoes, onions, pumpkins, carrots and asparagus (noting that asparagus is a perennial plant).

The Murray and Murrumbidgee valleys, Border Rivers and GMID are all important for annual horticulture.

Production and processing of crops is labour intensive, with produce generally being perishable and therefore requiring timely harvest and delivery to markets.

Key characteristics of the industry include:

- low barriers to entry for smaller producers. Production has high risk with volatile returns, although commodities have high value;

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40 For a discussion of the personal wellbeing index used, see Appendix (ref)
41 Which is 60-90 points, see Cummins, Robert; Davern, Melanie; Okerstrom, Erik; Lo, Sing Kai and Eckersley, Richard. 2005, “Special Report on City and Country Living,” Australian Unity Wellbeing Index Report 12.1.
the sector comprises a few large scale producers, generally with private irrigation infrastructure, plus a large number of smaller producers in the older established community supplied districts;

- production and processing of crops is labour intensive;

- products are generally perishable requiring timely harvest and delivery to markets;

- the area of planting varies according to expected market returns and contracts;

- there is growing consumer demand for fresh vegetables and for clean, high quality produce for healthy eating; and

- there is increasing international competition from imports to the domestic market, particularly processed vegetables, and pressure in export markets.

### Farm profile

The farm survey included 12 annual horticulture farms. This number is too small to warrant presentation of a farm profile.

#### 4.2.6 Mixed farming and broadacre

In addition to the dominant water-using sectors (cotton, rice, dairy and horticulture), irrigation farming in the MDB includes a spectrum of other farm types mainly growing different mixes of grain crops and fodder, and/or running livestock (mainly sheep and cattle).

Broadacre farmers occur across the MDB. The term ‘broadacre’ may be used to include cotton and rice; in this report, it refers to grain and fodder crops excluding cotton and rice.

Farmers who identified as broadacre and livestock farmers (excluding rice) in the MJA telephone survey typically locate across the Namoi, Gwydir, Lachlan, Macquarie and Central Murray regions of NSW.

Farmers who identified as mixed farmers typically are located in the Queensland Lower Balonne and NSW Central Murray regions.

A further key difference between those farmers who identified as ‘mixed’ and those who identified as ‘broadacre and livestock’ may be seen in Figure 6. ‘Mixed’ farmers have much smaller farms.
Farm profile

Broadacre farms

Respondents from 71 broadacre farms were surveyed as part of the phone interview program. The ‘average’ broadacre farm:

- was in excess of 1,000 hectares. Roughly 25% of the farm area was set up for irrigation, which is consistent with the general observation that these farms combine irrigation and dryland production;
- hold mainly general security water. Again, this is consistent with these farms being opportunistic producers of irrigation crops. In other words, they do not rely on irrigation for their farm viability;
- in the 2008-09 production year broadacre farmers were net sellers of irrigation water;
- the farms surveyed had average annual gross margins over 2004-09 of roughly $9,000. Again, there is wide dispersion around this average, as shown by the standard deviation of gross margins. After accounting for non-operating expenses, including interest repayments, capital depreciation, and returns to management, the average gross margin returns are likely insufficient to maintain a viable broadacre farm over the long run;
- the average annual EC payment to broadacre farms was almost $35,000. Approximately 1 in 2 broadacre farms earned off farm income;

broadacre farms are conservatively geared, with farm debt averaging 15% of total farm assets. Low farm returns over the past five years will significantly constrain the ability of many farms to service debt. Cashflow, not gearing, appears to be the fundamental problem; on average, broadacre farms’ water entitlements account for 16% of total farm assets; and the personal wellbeing of the dairy farmers surveyed was marginally higher than the national, on average. Approximately 10% of broadacre farmers reported personal wellbeing below the normal range. On average, broadacre farmers are moderately optimistic about their futures in the region they produce in.

Mixed farms

Respondents from 83 mixed farms were surveyed as part of the phone interview program. The ‘average’ mixed farm:

- was 570 hectares. The standard deviation on farm size is 1,409, showing that mixed farm size varies significantly. Roughly 30% of the farm area was set up for irrigation, which is consistent with the general observation that these farms combine irrigation and dryland production;
- hold mainly general security water. Again, this is consistent with mixed farms being opportunistic producers of irrigation crops. In other words, they do not generally rely on irrigation for their farm viability;
- in the 2008-09 production year broadacre farmers were ‘mixed’ buyers and sellers of water, with approximately 30% selling water and 40% purchasing water;
- the farms surveyed had average annual gross margins over 2004-09 of roughly $38,000. Again, there is wide dispersion around this average, as shown by the standard deviation of gross margins. After accounting for non-operating expenses, including interest repayments, capital depreciation, and returns to management, the average gross margin returns are likely insufficient to maintain a viable mixed farm over the long run;
- the average annual EC payment to broadacre farms was approximately $9,000. Approximately 1 in 2 mixed farms earned off farm income;
- consistent with all other farming sectors, mixed farms are conservatively geared, with farm debt averaging 15% of total farm assets. Low farm returns over the past five years will significantly constrain the ability of many farms to service debt. Cashflow, not gearing, appears to be the fundamental problem.
- on average, water entitlements account for 26% of mixed farms’ total assets; and the personal wellbeing of the mixed farmers surveyed was on par with the national average. Approximately 8% of mixed farmers reported personal wellbeing below the normal

42 For a discussion of the personal wellbeing index used, see Appendix (ref).
43 Which is 60-90 points, see Cummins, Robert; Davern, Melanie; Okerstrom, Erik; Lo, Sing Kai and Eckersley, Richard. 2005, "Special Report on City and Country Living," Australian Unity Wellbeing Index Report 12.1.
44 For a discussion of the personal wellbeing index used, see Appendix (ref).
range. On average, broadacre farmers are moderately optimistic about their futures in the region in which they farm.

4.3 Overview of regions

The regional and local Basin communities that are most likely to be affected by SDLs were selected for detailed profiling and situation analysis. These were:

- Queensland Lower Balonne;
- NSW and Queensland Border Rivers;
- NSW Namoi;
- NSW Gwydir;
- NSW Macquarie;
- NSW Lachlan;
- NSW Murrumbidgee;
- NSW Central Murray;
- Victoria’s Campaspe, Loddon, Goulburn and Murray irrigation districts (which were addressed in an integrated manner as the Goulburn Murray Irrigation District or GMID);
- Nyah to the border (including NSW and Victorian Sunraysia);
- the South Australian Riverland; and
- the SA Murray below Lock 1 (which includes the Lower Lakes).

The 12 irrigation regions nest within the sustainable yield regions defined by CSIRO (Table 3, Figure 7).

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45 Which is 60-90 points, see Cummins, Robert; Davern, Melanie; Okerstrom, Erik; Lo, Sing Kai and Eckersley, Richard. 2005, "Special Report on City and Country Living," Australian Unity Wellbeing Index Report 12.1.

46 For the purposes of this report the Nyah to border region is defined as the area supplied by the Murray River from Nyah to the South Australian border and the Lower Darling within the Murray Weir pool. The two major regional towns are Mildura in Victoria and Wentworth in New South Wales. The region also is often referred to as Sunraysia.
Table 3. Irrigation Regions examined and related CSIRO sustainable yield regions

<table>
<thead>
<tr>
<th>MJA Irrigation Region (≤ SY Region)</th>
<th>SY Region</th>
<th>SY Region water use$^1$ (GL/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>Condamine</td>
<td>951</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>Border Rivers (NSW)</td>
<td>201</td>
</tr>
<tr>
<td></td>
<td>Border Rivers (QLD)</td>
<td>251</td>
</tr>
<tr>
<td>GMID (Goulburn-Murray Irrigation District)</td>
<td>Campaspe</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Goulburn Broken</td>
<td>1,585</td>
</tr>
<tr>
<td></td>
<td>Loddon</td>
<td>312</td>
</tr>
<tr>
<td>GMID + Nyah to border including Sunraysia</td>
<td>Murray (VIC)</td>
<td>1,665</td>
</tr>
<tr>
<td>Gwydir</td>
<td>Gwydir</td>
<td>352</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Lachlan</td>
<td>502</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Macquarie</td>
<td>512</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Murrumbidgee</td>
<td>2506</td>
</tr>
<tr>
<td>Namoi</td>
<td>Namoi</td>
<td>544</td>
</tr>
<tr>
<td>NSW Central Murray + Nyah to border including Sunraysia</td>
<td>Murray (NSW)</td>
<td>1,773</td>
</tr>
<tr>
<td>Riverland</td>
<td>SA Murray</td>
<td>740</td>
</tr>
<tr>
<td>SY regions that did not include MJA Irrigation Regions</td>
<td>Barwon Darling</td>
<td>197</td>
</tr>
<tr>
<td></td>
<td>Eastern Mt Lofty Ranges</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Lower Murray-Darling</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Moonie</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Ovens</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Paroo</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Warrego</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Wimmera</td>
<td>81</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>12,541</td>
</tr>
</tbody>
</table>

Source: MDBA 2010.
The population, value of production and major urban centres of each of the 12 regions is shown in Table 4. Note the gross value of irrigated agricultural production (GVIAP) from drought years, is significantly lower than GVIAP from non-drought years.
Table 4. Population, urban centres and GVIAP of key irrigation regions

<table>
<thead>
<tr>
<th>Irrigation Region</th>
<th>Population (approx.)</th>
<th>Key cities/towns</th>
<th>GVIAP $m (drought, 2006 unless indicated otherwise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>3,800</td>
<td>St George and Dirranbandi</td>
<td>220</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>49,650</td>
<td>Inverell, Glen Innes, Goondiwindi, Stanthorpe and Tenterfield</td>
<td>350</td>
</tr>
<tr>
<td>Gwydir</td>
<td>25,350</td>
<td>Moree, Ashley, Bingara, Garah, Gravesend, Pallamallawa, Rowena, Upper Horton, Uralia, and Warialda</td>
<td>171</td>
</tr>
<tr>
<td>Namoi</td>
<td>88,300</td>
<td>Tamworth, Gunnedah, Narrabri, Wee Waa and Walgett</td>
<td>231</td>
</tr>
<tr>
<td>Macquarie</td>
<td>47,000</td>
<td>Dubbo, Narromine, Warren, Trangie, and Nyngan</td>
<td>Not available</td>
</tr>
<tr>
<td>Lachlan</td>
<td>100,000</td>
<td>Cowra, Forbes, Parkes, Young, Condobolin, West Wyalong and Hillston</td>
<td>165</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>75,000</td>
<td>Wagga Wagga, Griffith, Leeton, Hay, Darlington Point and Coleambally</td>
<td>195</td>
</tr>
<tr>
<td>Central Murray</td>
<td>35,000</td>
<td>Deniliquin, Finley, Jerilderie, Moulambdae and Wakool</td>
<td>320</td>
</tr>
<tr>
<td>Goulburn-Murray Irrigation District (Campaspe, Loddon, Goulburn and Vic Murray)</td>
<td>134,460</td>
<td>Shepparton, Swan Hill, Echuca, Kerang, Cohuna, Pyramid Hill and Boort</td>
<td>1,530</td>
</tr>
<tr>
<td>Nyah to border (incl. NSW &amp; Vic Sunraysia)</td>
<td>60,000</td>
<td>Mildura and Wentworth</td>
<td>600 (2008-9)</td>
</tr>
<tr>
<td>Riverland</td>
<td>33,000</td>
<td>Renmark, Loxton, Barmera, Berri and Waikerie</td>
<td>300 (2008-9)</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>33,000</td>
<td>Murray Bridge, Goolwa, Tailem Bend, Meningie, Langhorne Creek, Mannum</td>
<td>85</td>
</tr>
</tbody>
</table>

Sources are identified in each irrigation region profile in Part 2a: Community profiles (irrigation regions).

Irrigation regions tend to be dominated by one particular sector (with some exceptions). Horticulture is predominant in SA, NSW and Victoria in the regions around Mildura, with the regions around Mildura and Shepparton having the largest incidence of perennial horticulture. Irrigation dairying in the MDB overwhelmingly occurs within the GMID regions. Rice farming systems are concentrated in southern NSW. The more northerly regions tend to be dominated by cotton. The implication is that the sensitivity to, and impact of, changes in water availability at the sector level will drive through to influence impacts at the region/community level.
Figure 8 shows the gross dollar value of irrigated agricultural product of these sectors in 2005-06. As is evident from these Figures, agricultural sectors often are regionally concentrated. The implication of this sectoral concentration is that the sensitivity to, and impact of, changes in water availability at the farm sector and regional community levels will often be synonymous.

Source: MJA analysis of ABS 2006 Agricultural Census data. Note 2006 was a drought year, with reduced irrigation allocations compared to non-drought years, resulting in reduced GVIAP across sectors. For instance, ABARE has estimated that the recent drought reduced GVIAP for rice by around 70%, and by around 47% for cotton (Simon Hone, Adam Foster, Ahmed Hafi, Tim Goesch, Orion Sanders, Daniel Mackinnon and Brenda Dyack, 2010, Assessing the future impact of the Australian Government environmental water purchase program. ABARE research report 10.03, April).
5 Water availability and reductions

Key Points

This chapter addresses the exposure of the irrigation regions to potential reductions in water availability.

Exposure is the extent of a potential change to a socio-economic system. In the context of this study, exposure is the size of potential SDLs.

As a first step, this chapter sets out the baseline water availability. This is the long-term cap equivalent allocations for each irrigation region.

Buy-backs and irrigation modernisation reduce potential exposure to SDLs. Accordingly, in the second section of this chapter, regional SDLs are calculated net of water recovered through the Restoring the Balance buy-back program and the Sustainable Rural Water Use and Infrastructure program.

The calculation of net SDLs only includes buy-backs and efficiency savings that have already been committed to. The volume of water to be recovered through these existing commitments is particularly significant in the Goulburn-Murray Irrigation District and, to a lesser extent, the NSW Central Murray region.

MJA was not apprised of potential SDLs in order to undertake this study.

Accordingly, the third step in this chapter is to set out the series of water availability reduction scenarios MJA used in order to understand the range of possible responses from farmers and regional communities.

Those scenarios are 20%, 40% and 60% water availability reduction compared with the long-term cap equivalent allocation (LTCE).

The MDBA will set SDLs having taken account of the water needs of key environmental assets, existing environmental holdings of water and water already committed to the environment as a result of committed buy-backs and efficiency programs.47

In order to compare the outcomes of water availability scenarios across the entire MDB, and to take into account water savings from efficiency projects and buy-backs, it was necessary to be able to express volumes on a common basis. This was done by converting the entitlements in each irrigation region to Long Term Cap Equivalent (LTCE) allocations.

The purpose of this chapter therefore is to:

- provide consistent estimates of existing water availability;
- indicate the magnitude of existing and committed environmental water holdings and the extent to which these holdings may mitigate the net change in position for irrigation farms and other water holders; and
- outline the stylised scenarios for water reduction that were used in our interviews and discussions in the regions.

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47 Murray-Darling Basin Authority, 2009, Basin Plan Fact Sheet 3: Sustainable diversion limits (SDLs) and the impacts of environmental water purchases. MDBA, September.
5.1 Irrigation region water availability

The MDBA advised that historic river flow patterns and volumes available will be used as a basis for the provision of water supply for the identified environmental assets.\(^{48}\) Historic volumes available are described in terms of Long-Term Cap Equivalents (LTCE) for each region.\(^ {49}\) Surprisingly, this information is not uniformly available and was therefore estimated by the MJA Team Leaders, and tested in the face-to-face interview program, including the pre-consultation stage. This baseline water data is provided in Table 5. Note that Table 5 includes groundwater information where available, but this is not included in the estimated totals per region.

5.1.1 Methodological issues in estimating LTCEs

Collating consistent LTCEs data for every regions encountered several sources of complexity.

First, the total entitlements for each region was not always available – particularly for northern MDB regions, and for the Riverland (because South Australian entitlements along the Murray tend to be reported collectively).

For the northern MDB regions, as discussed in chapter 6.1.2, annual and seasonal rainfall and river flows are significantly more variable relative to the Southern Basin. Moreover, far less of the water in the northern Basin is subject to system regulation. Further, water management plans, particularly in Queensland, have a briefer history, and trade is less well-developed than in the southern MDB. The practical upshot of these factors is that entitlement figures are not always readily available in the northern regions, and also that a single volumetric figure needs to be understood in the context of the extreme variability of those systems.

The second source of complexity was accessing Cap Factors to convert entitlements to LTCE allocations. The methodological issues here are outlined in Appendix 3.

The estimates of the LTCEs have been thoroughly scrutinised, including by responsible state agencies. Moreover, our interview and survey results are robust against potential revision in these figures because invariably interviewees related water availability scenarios in terms of proportions relative to the drought and the long-term.

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\(^{48}\) However the irrigation regions that were the focus of this assignment are a subset (in most cases) of the surface water catchments that were used by CSIRO as ‘Sustainable Yield’ regions, with other water used within each Sustainable Yield region, but outside the irrigation region, potentially including unregulated and ground water and floodplain harvesting.

\(^{49}\) LTCEs are defined to reflect a constant level of irrigation and infrastructure development. The LTCEs are averages and do not reflect season-to-season variability. Although such variability information is available and can be measured through ‘exceedence curves’ it was recognised that this would add several degrees of complication and complexity to our discussions and interviews with irrigators and other stakeholders. The issues of variability were therefore introduced and explored qualitatively only.
### Table 5. Irrigation water availability by region.

<table>
<thead>
<tr>
<th>Region</th>
<th>LTCE allocation volume (GL, approx, rounded)</th>
<th>Drought average use (GL, July 2002 to June 2009)</th>
<th>Number of irrigators (number, approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>405&lt;sup&gt;b&lt;/sup&gt;</td>
<td>165</td>
<td>165 approx ex. overland flow</td>
</tr>
<tr>
<td>▪ St George Irrigation Scheme</td>
<td>79.8 (mean annual diversion)</td>
<td>65</td>
<td>115 approx</td>
</tr>
<tr>
<td>▪ Lower Balonne Water Management Area</td>
<td>274 (mean annual diversion)</td>
<td>101</td>
<td>50 approx</td>
</tr>
<tr>
<td>▪ Overland flow (across Lower Balonne)</td>
<td>53 (mean annual diversion)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Border Rivers</td>
<td>400&lt;sup&gt;c&lt;/sup&gt;</td>
<td>250&lt;sup&gt;d&lt;/sup&gt;</td>
<td>570</td>
</tr>
<tr>
<td>Gwydir</td>
<td>390&lt;sup&gt;e&lt;/sup&gt;</td>
<td>160</td>
<td>150</td>
</tr>
<tr>
<td>Namoi</td>
<td>240&lt;sup&gt;f&lt;/sup&gt;</td>
<td>80</td>
<td>690</td>
</tr>
<tr>
<td>▪ Groundwater (not included in LTCE surface water) (excluding 59GL Supp)</td>
<td>190</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Macquarie</td>
<td>390&lt;sup&gt;g&lt;/sup&gt;</td>
<td>100&lt;sup&gt;h&lt;/sup&gt;</td>
<td>800&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lachlan</td>
<td>335&lt;sup&gt;j&lt;/sup&gt;</td>
<td>35</td>
<td>500</td>
</tr>
<tr>
<td>▪ General Security</td>
<td>305</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>▪ High Security (Irrigation)</td>
<td>31</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>▪ Groundwater (not included in LTCE surface water)</td>
<td>291</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>1,540&lt;sup&gt;k&lt;/sup&gt;</td>
<td>670</td>
<td>1,500</td>
</tr>
<tr>
<td>▪ General Security</td>
<td>1,210</td>
<td>340</td>
<td></td>
</tr>
<tr>
<td>▪ High Security (Irrigation)</td>
<td>332</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>▪ Groundwater (not included in LTCE surface water)</td>
<td>83</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Central Murray</td>
<td>1,085&lt;sup&gt;l&lt;/sup&gt;</td>
<td>380</td>
<td>~1,600</td>
</tr>
<tr>
<td>▪ General Security</td>
<td>1,040</td>
<td>340</td>
<td></td>
</tr>
<tr>
<td>▪ High Security (Irrigation)</td>
<td>46</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>▪ Groundwater (not included in LTCE surface water)</td>
<td>83</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>GMID</td>
<td>2,000</td>
<td>1,000</td>
<td>12,600 (includes ~5,000 small irrigators)</td>
</tr>
<tr>
<td>Nyah to Border (incl. NSW &amp; Vic Sunraysia)</td>
<td>700&lt;sup&gt;m&lt;/sup&gt;</td>
<td>500</td>
<td>3,500</td>
</tr>
<tr>
<td>Riverland</td>
<td>344&lt;sup&gt;n&lt;/sup&gt;</td>
<td>291&lt;sup&gt;o&lt;/sup&gt;</td>
<td>3,000&lt;sup&gt;p&lt;/sup&gt;</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>133&lt;sup&gt;q&lt;/sup&gt;</td>
<td>86.5&lt;sup&gt;r&lt;/sup&gt;</td>
<td>492&lt;sup&gt;t&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Sources and notes to table: see over page.
a) LTCEs are approximate, rounded estimates. The data in this table come from a number of sources. These are cited, except in some cases where they are based on the MIA consortium’s prior experience. All data were tested in regional interviews. Please note that flow variability in the Northern MDB is very high, so LTCE or averages should be used with caution.


Also pers. comm. Craig Cahill, State Water Corporation, Water Delivery Manager Northern, April 2010

Also pers. comm. Craig Cahill, State Water Corporation, Water Delivery Manager Northern, April 2010

g) NSW WSP

h) State Water data at 10% average allocation for General Security Entitlement.

i) State Water records 600 licensed diverters. However, 7 of these are the off-river schemes, each of which has 25 members.


n) South Australia has a long-term average diversion Cap for All Other Purposes (i.e., purposes apart from supply to country towns and Adelaide, and irrigation in the Lower Murray Swamps) of water from the River Murray of 449.9 GL/year. Around 90% of this is for irrigation and it is estimated that around 85% of water use is upstream of Lock 1. For the purposes of this project LTCE entitlements needed to be apportioned between the Riverland and the region below Lock 1 in SA. Accordingly, 344 GL LTCE was estimated as the entitlement volume for Riverland (449.9 × 0.9 × 0.85) and 61 GL (449.9 × 0.9 × 0.15) to the region below Lock 1 (plus the Lower Murray Swamps irrigation entitlement of 72GL/year). However, it is important to note that this apportionment between the two regions is approximate and in practice, it changes yearly as entitlements are traded, so the data used in this report may not be appropriate to be used for other purposes. Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

o) Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA. It is important to note that the apportionment between the two regions is approximate and in practice, it changes yearly as entitlements are traded, so the data used in this report may not be appropriate to be used for other purposes.

p) Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

q) South Australia has a long-term average diversion Cap for All Other Purposes (i.e., purposes apart from supply to country towns and Adelaide, and to irrigation in the Lower Murray Swamps) of water from the River Murray of 449.9 GL/year. Around 90% of this is for irrigation and it is estimated that around 85% of water use is upstream of Lock 1. For the purposes of this project LTCE entitlements needed to be apportioned between the Riverland and the region below Lock 1 in SA. Accordingly, 344 GL LTCE was estimated as the entitlement volume for Riverland (449.9 × 0.9 × 0.85) and 61GL (449.9 × 0.9 × 0.15) to the region below Lock 1 (plus the Lower Murray Swamps irrigation entitlement of 72GL/year). However, it is important to note that this apportionment between the two regions is approximate and in practice, it changes yearly as entitlements are traded, so the data used in this report may not be appropriate to be used for other purposes. Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

r) In practice, many farmers could not physically access allocated water during the drought (the region was in drought later than much of the Basin, from about 2005) due to low water levels in the river and Lower Lakes. Average allocation was around 84 GL based on an average for the 2002-2009 period of 70%, but this ranged between average annual allocations of 18% (2008-09) and 100%. However, it is important to note that the apportionment between the two regions north and south of Lock 1 in SA is approximate and in practice, it changes yearly as entitlements are traded, so the data used in this report may not be appropriate to be used for other purposes. Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

s) Diversions below Lock 1 have been significantly constrained from 2008 due to low water levels and poor water quality.

t) Water on the Lower Murray Swamps is held by Irrigation Trusts on behalf of multiple individual irrigators, so the total number of separate irrigators is higher.
5.2Existing environmental water holdings and net future acquisitions

The Basin Plan will specify the water requirements for the Basin’s key environmental assets. Where water has already been acquired by the Commonwealth Environmental Water Holder (CEWH) that water will be taken into account and will reduce the amount of additional water that must be obtained for the environment. It is the magnitude of the net additional acquisition of water that bears on the magnitude of the social and economic impacts of the introduction of SDLs. This is illustrated hypothetically in Figure 9.

The magnitude of the gap between the CEWH’s current and committed holdings, and the holdings required to meet the environmental watering requirements of key environmental assets, therefore has substantial bearing - and this will vary across the regions (Figure 10).

The task of estimating the magnitude of the CEWH’s current and committed holdings in terms of LTCEs is also described in Appendix 3 and the results are shown in Figure 10.

The Productivity Commission has suggested that after accounting for water to be recovered through the two acquisition programmes (RTB and the SRWUI), the CEWH may already hold more than enough water to exceed the lower bounds of what some commentators (such as the Wentworth Group) have called for in terms of minimum flows necessary to achieve a moderate probability of achieving a healthy river system. If this were the case, and the environmental watering requirements of the Basin Plan were to be consistent with the minimum flow requirements of the Wentworth Group, then the exposure of regional communities to the introduction of SDLs could in fact be minor in some cases.

The committed buy-back and efficiency programs are of varying importance across the Basin but are particularly material for the GMID – and therefore for the Basin’s dairy sector which is almost wholly located in the GMID.

Overall, existing commitments to water savings for the environment are around 20% of the LTCE for the GMID. Thus, if a standard 20% reduction in consumptive water were to apply uniformly across the Basin, the GMID would face no new net reduction. Similarly, a gross reduction of 40% would be reduced to a reduction of 20% in net terms once committed efficiency savings were recognised.

Inspection of Figure 10 indicates that if a uniform reduction of, say 20%, of the LTCEs were required, then the GMID would already have achieved that level of reduction and adjustment. Note, however, that the mitigating effect of existing and committed environmental holdings becomes less important for the GMID – and all other regions – as the size of the reduction in the consumptive pool increases from, say, 20% to 40%.

These points were well understood by all involved in the relevant GMID community consultations, but could not be incorporated into the telephone survey. As noted, the telephone survey explores how each irrigator would respond to reductions of 20% and 40% from their historical LTCE. Our firm and considered judgements is that the individual survey respondents answered these questions from a farm level perspective and did not take account of savings from the NVIRP.

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project or other programs. Thus, we interpret the survey results as referring to a further reduction of 20% and 40% after the efficiency savings have been acknowledged or equivalently a reduction of 40% or 60% from the unadjusted historical LTCE. For the purpose of presenting our results we have adopted the latter option for the GMID and dairying.

Figure 9. Hypothetical pathways to achieve SDLs

Notes: A: Pre-SDL allocation.  
B: if the SDL requires an additional 20% allocation to the environment, it may be met by reducing the supply to all entitlements.  
C: the impact on entitlements may be offset by purchase of water for the environment.

Source: Based on Murray-Darling Basin Authority, 2009, Basin Plan Fact Sheet 3: Sustainable diversion limits (SDLs) and the impacts of environmental water purchases. MDBA, September.
Figure 10. Regional water availability scenarios as a proportion of LTCE

Note: Water availability scenarios of 20%, 40% and 60% reduction with data from Table 5 and Appendix 3.

In summary:

- there is approximately 7,985 GL (LTCE) of irrigation entitlements within the irrigation regions;
- the majority of this water (58%) is held within the NSW Central Murray, NSW Murrumbidgee, and Victorian GMID irrigation regions;
- buy-backs totalling approximately 830 GL (LTCE) either have been made or have been committed within the irrigation regions as a whole, with 69% of these occurring within the Victorian GMID and NSW Central Murray irrigation regions; and
- entitlement transfers from irrigation efficiency programs to the environment are still being planned across many regions so have not been included in this analysis. In the regions where irrigation efficiency programs have been committed to, that is in the Victorian GMID in particular, efficiency savings for the environment from NVIRP Stage 1 are significant at 4%, and later stages may increase this substantially.
The foregoing discussion does not consider the impact of water trading on exposure. A number of the irrigation regions in the southern Basin are interconnected and can trade with each other. As discussed in chapter 6.1.2, there is limited or no inter-valley trade in the northern Basin.

The potential for water trade to enable farmers to mitigate impacts of reduced water availability is considered in the discussion of sensitivity and impacts in Sections 2 and 3 of this report.

5.3 Water availability scenarios

We adopted and explored a common range of possible percentage reductions, i.e., permanent reductions of 20%, 40% and 60% in the case of the face-to-face interviews and 20% and 40% in the case of the telephone surveys.

These surface water diversion reduction scenarios were designed to cover a broad range from a small to large change in water availability, in order to assist with the understanding of likely adaptation strategies irrigation farmers would employ, and the barriers to adopting those strategies. when major adaptations and impacts are likely to occur.

The scenarios being used, and the messages that the MJA consortium used to explain and test those scenarios, were approved by the MDBA. The scenarios were not linked to possible Sustainable Diversion Limits (of which the consortium had no knowledge); rather, they were intended to test a range of responses from irrigators, and flow-on effects in communities.

This approach allows response/impacts to be assessed at different levels of reduction and for the MDBA subsequently to assess the projected levels of response/impacts once their judgements on SDLs have begun to crystallise.

For a hypothetically uniform percentage reduction in water availability from historical LTCEs, the GMID would face the smallest net reduction because of the large magnitudes assigned existing and committed buybacks and water savings. In contrast, the Murrumbidgee Sunraysia and the Riverland in the Southern systems enjoy little offset to the gross reductions required under this uniform scenario. In the North, the Balonne and the Border would also face the full brunt of a hypothetical uniform percentage reduction (Figure 10).
6 Water management, over-allocation, reform and drought

The reductions in water availability anticipated as a result of the Basin Plan will occur in the context of differing arrangements and mechanisms for water management, differing levels of over-allocation, differing initiatives and achievements by the state governments and regional communities and the differing impacts of the sustained drought.

These multiple contextual factors have a pervasive effect - mitigating or exacerbating the sensitivity to changes in water availability, first-round impacts, adaptive capacity and the resulting residual vulnerability of the Basin’s farms and communities.

The purpose of this chapter is to review these contextual factors and their implications. Because these contextual factors are pervasive, e.g., affecting not merely the levels of sensitivity but also impacts and adaptive capacity, this discussion is placed ahead of the subsequent sections which deal with sensitivity, impacts and impact mitigation.

6.1 Differences in water management

Differences in the institutional and management arrangements for water allocations drive farm and regional sensitivity and adaptive capacity to reduced water availability. Relevant differences include:

- single valley/source irrigation water supplies typically in the north of the Basin, compared with multiple, interconnected valleys in the southern interconnected systems involving the Murray, the Murrumbidgee and their tributaries. This ‘north-south’ divide affects the volatility or smoothness of flows from year-to-year and the geographical size and limits of markets for water trading. Other things being equal, farms and regions located in the larger interconnected systems have more scope to adapt;

- the choice of different reliability products when defining entitlements and allocation rules. For instance, Victorian and South Australian water entitlements have higher security and reliability than NSW general security. On the other hand, NSW high security entitlements are more reliable than Victorian water entitlements:
  - this distinction is important because it is strongly correlated with, and drives the choice of, the type of irrigated agriculture. High security entitlements are required for permanent plantings. General security entitlements are associated with rice, cotton and other more opportunistic uses of water;
  - thus, there are two offsetting factors. The holding of high security entitlements in itself reduces sensitivity to climate, seasonal variation and possibly, the reduction in water availability due to the imposition of SDLs. However, the very direct association between high security entitlements and permanent plantings means that the holding of high security entitlements is a key indicator of permanent plantings and fixed farm systems when compared with the more opportunistic farm systems associated with general and lower security entitlements;
the provision of common infrastructure by irrigation authorities/businesses vs. the provision on site of own private infrastructure; and

- the source of water and weather systems. The northern parts of the Basin receive summer rains and have higher volatility in water availability from year to year than the southern parts. The latter rely on winter westerly low-pressure systems for rainfall. These low-pressure systems, historically at least, were more reliable.

These differences combine to give distinct, local flavours to water management and the nature and sensitivity of responses to changed water availability. The key distinctions are between Victoria/SA and southern NSW; and between the southern areas and the northern rivers.

### 6.1.1 Victoria/South Australia and southern New South Wales

Victoria and South Australia have developed irrigated sectors that rely on relatively secure water, mainly permanent dairy pastures and fruit orchards. As a result, Victoria and SA historically have had a conservative approach to the management and allocation of water.

By contrast, NSW developed an alternative approach based more around annual crops - particularly rice. A small volume of High Security water was set aside for permanent plantings, but the large majority of the entitlement was deemed General Security.\(^\text{51}\)

Rice was able to expand and contract the area under cultivation in any season to match the available water supply. Accordingly, under this strategy, High Security was guaranteed first rights of access to any water - but then the approach was to maximise the productive capacity in any season by allocating the full allocation of General Security. This sacrificed potential security in following seasons by maximising production in the year in question.\(^\text{52}\)

These very different water management strategies between the two major states in the Basin generated very different adaptation experience at the farm level:

- in Victoria and SA, irrigators built businesses around a high reliability water product with the state taking responsibility managing that security. Dairy farmers with high reliance on access to water were at significant risk when allocations fell below 100%. This prompted the extensive development of the water market in northern Victoria as a route to make up any short-fall, even though this exposed the irrigators to higher costs; while

- in NSW, High Security entitlement was protected in all seasons, but most irrigators with General Security were accustomed to a variable allocation, with experience of managing the risks between seasons. Most built businesses with a mix of crops and activities that gave some additional resilience in the face of varying water availability.

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\(^{51}\) In 2006, in the NSW Murray and Lower Darling, of the total entitlement, 180GL was High Security while 1,669GL was General Security.

\(^{52}\) Department of Natural Resources NSW, 2006, *Background to water management in the NSW Murray and Lower Murray-Darling river systems*, p16.
6.1.2 The southern systems and the northern valleys

The other important distinction to make is between the southern systems and the northern valleys of NSW and Queensland. The differences in approach have a significant effect on the decisions taken by irrigators and government agencies both in years of high allocation and years of low flows.

The Basin’s southern systems are characterised by:

- integration across multiple valleys, with the potential to manage risk by substitution;
- large-scale public/socialised infrastructure (dams, supply systems etc.) with a central role for state agencies in water management decisions and so a concentration on ‘regulated’ and managed water products and environmental flows;
- small property-scale storages. Irrigators are therefore mainly customers and recipients of water products managed and delivered by a large external entity; and so
- an expectation of regular allocations in most years - allowing the development of permanent plantings and long-term consistent irrigation activities.

The valleys of northern NSW and southern Queensland, by contrast, are notable for:

- separate, independent valleys with little integration or opportunity for risk management between catchments;
- highly variable rainfall and flows - far more so than in the southern valleys;
- more recent development, with greater reliance on private water storages and only a percentage of the total water in any year provided from public storages;
- multiple water products, with overland flows and unregulated diversions as important as regulated entitlements; and so
- opportunistic irrigation and variable levels of production between seasons, with a need to generate high returns in good years to carry enterprises across poor years. A mobile and transient workforce became accustomed to moving between locations depending on where the greatest work was to be found.

Irrigators in the southern systems, therefore, have been more reliant on consistent allocations delivered by large external agencies.

The northern valleys have a longer history of adapting to changed circumstances, with individual irrigators expecting to take the lead in decisions and with less deference towards agencies as the source of solutions. Businesses and the workforce are used to managing change and adjusting to what resources are available.

In the southern systems, where rivers are ‘regulated’ and flows are relatively less variable, it is relatively easier to understand long-term average water availability and relate this to the impact of increasing environmental watering.
This model does not work so well in the northern systems. When rainfall and river flows are far more variable, and far less of the water is subject to system regulation. Irrigators have not been used to a regular, steady annual ‘take’ – they have been opportunistic, expanding and contracting diversions of different sorts as situations change. The variability in long-term water availability makes averages less meaningful for the northern valleys.

In addition, the regions along the Murray and Murrumbidgee can trade – that is, the Murrumbidgee, NSW Central Murray, GMID, Nyah to the border (including NSW and Vic Sunraysia) and SA Riverland irrigation regions.

There is no inter-valley trade 53 for:

- Lachlan (stops at Cumbung Swamp);
- Macquarie (there is minor trade between Macquarie and Cudgegong);
- Namoi;
- Gwydir;
- Border Rivers; and
- Lower Balonne.

6.2 Historical water reform, over-allocation and drought

Historical water reform – which specifically includes water reforms that are still being implemented – has, among other things, taken (often over-allocated) water away from irrigation in order to increase the sustainability of the resource and protect the environment.

As such, historical water reform is a key driver of sensitivity to further reductions in water for consumptive purposes.

This sub-section provides a brief outline of key state-based reforms that have affected the availability of water for irrigation. State-based reforms have been connected, in many cases, to the national water reform agenda driven through the Council of Australian Governments (CoAG) and the National Water Initiative.

In each state, there have been substantial reforms over recent decades that have allowed increased water trading and provided in institutional, market and allocation arrangements that allow water to move to higher-value uses in many cases. Farmers are increasingly sophisticated when it comes to using the water market to manage risk. For example, in dairy regions, some farmers have moved from owning water to relying on annual trade – thereby freeing up capital.

However, at the same time, the increasing awareness of limits to sustainable extraction of ground and surface water, and the need for environmental watering, has tended to result in reduced allocations to irrigation.

In other words, SDLs will be introduced into regions where – quite apart from drought - there is already a history of governments moving water away from farming to the environment, and of farmers adapting to reduced water availability for irrigation. These reductions in entitlements to halt further increases in, and begin reducing, over allocation have since 1996 coincided with the long and pervasive drought. This context will substantively influence the sensitivity and adaptive capacity of irrigation farms and regions.

In NSW and Victoria, these reforms were undertaken in part to implement the Murray-Darling Basin Cap. The Cap was developed to limit diversions from rivers in order to protect river health. An interim Cap was imposed in 1995, and permanent Cap for NSW, Victoria and South Australia was implemented from 1997.\(^{54}\) For NSW and Victoria, the Cap is defined as the volume of water that would have been diverted under 1993-94 levels of development.

There is a view among many irrigation farmers that governments keep ‘moving the goalposts’ and failing to acknowledge the impact of, and the agreements made with farmers during prior reforms.

6.2.1 Queensland

Queensland delivered its framework for water reform in the Water Act 2000 (Qld) which instituted a two part water planning process:

- Water Resource Plans are prepared first, and provide a strategic framework for allocating and managing water. Their intended outcomes include (among other things) establishing the balance between water made available for consumption and water provided for aquatic ecosystem health; and establishing strategies for achieving these outcomes, including environmental flow objectives and water allocation security objectives. In addition, they include criteria for preparing Resource Operations Plans in each part of a catchment (licence conversions, water sharing rules, water trading rules); and

- Resource Operations Plans implement the framework and detail day-to-day rules for managing an area’s water resources.

Systems are not explicitly identified as over-allocated or overused in Queensland water plans.\(^{55}\)

The only Queensland catchment focused on as an irrigation region by this project is the Lower Balonne, which lies in the south of the Condamine-Balonne. It is considered by many stakeholders – particularly downstream water users in NSW – to be over-allocated,\(^{56}\) although this view is not universal.


At the current level of development 53% of surface water in the Condamine-Balonne is diverted for use, which CSIRO regards as an extremely high level of use. Groundwater extraction is high in the Upper Condamine, where it exceeds recharge in more than 90% of years.\(^{57}\)

In 2004, the Queensland Government released its Water Resource Plan for the Condamine-Balonne. It effectively set diversions at the September 2000 moratorium level of infrastructure development with relatively minor adjustments through flow event management.\(^{58}\)

Queensland’s Resource Operations Plan for the Condamine –Balonne was released in 2008, and updated in 2010 to include the Lower Balonne.\(^{59}\) The ROP is a ‘no growth plan’ which means there is no increase in the average volume of water available to be taken in the plan area. As a result, the nominal volumes for some water allocations increased or remained the same, but for a greater number, the nominal volumes have been reduced. However, in some instances, the reductions in the nominal volumes have been offset by increases in overland flow entitlements held by the entitlement holder.\(^{60}\)

### 6.2.2 New South Wales

Thirty-one Water Sharing Plans were commenced in 2004 concentrating on the regulated systems across NSW and the most active groundwater systems.

In New South Wales, the impact of reforms in general has been greater for groundwater and surface water diversions where the level of development has been the greatest.

For surface water, generally the WSP limit reflects the MDBC Cap on Diversions with some added reductions for river health. The MDB Cap was set at the level of diversion for the 1993-94 level of development. For a number of valleys, historic use had not exceeded 100% of entitlement, so it was not to be expected, initially at least, that the Cap would constrain irrigation. Rather it was designed to constrain, at a valley level, further irrigation diversions (and hence development).

There were exceptions to this. In some valleys, historic use of surface water by some irrigators, or groups of irrigators, had exceeded the levels that were reflected in the Cap. In particular, in the NSW Murray, in the decade leading up to 1995 average use had been 110% of entitlement in the Murray Irrigation Limited (MIL) area. The Cap-based limit on diversions meant that MIL irrigators needed to purchase water on the market to make up the shortfall in their irrigation demands.

Furthermore, since the WSPs were introduced in 2003-04, the drought has resulted in most WSPs being suspended. Reduced water availability has meant that the Cap has had limited practical

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effect on these valleys. A return to non-drought conditions might be expected to trigger further irrigation development by irrigators who historically had not used their full allocations. This will then cause announced allocations to all irrigators in the valley to be reduced in order to achieve compliance with the WSP limit. As such, the WSP limit and the Cap would become a real constraint. In fact, it appears that because of the impact of drought, some irrigators are not yet aware of the level of long-term limit that the WSP has imposed on diversions.

A major groundwater adjustment process was implemented in 2007 and 2008, with the development of water sharing plans for a number of groundwater management units in NSW.

Prior to this, bore licences were issued in perpetuity and without any restriction on extraction. During the 1980s, restrictions on volumes were introduced, but extractions were still beyond what is now considered to be sustainable.

The allocation policy now being implemented across New South Wales has the aim of ensuring that total abstraction from an aquifer system does not exceed the sustainable limit (including environmental needs). In the absence of specific data for any particular catchment the sustainable yield is set at 70% of long-term average annual recharge. The groundwater sharing plans are being implemented progressively over the course of a decade (to 2017 or 2018).

This is having the effect of significantly reducing groundwater for irrigation, in those regions where groundwater is important. These include parts of the Murrumbidgee (groundwater extraction in the mid and upper regions along the Murrumbidgee River, the Murrumbidgee Alluvium, was reduced by around 13% on 2004-05 levels), the Murray (extraction in groundwater region N16 in NSW Central Murray was reduced by around 33%) and the Lachlan (extraction from the Lower Lachlan aquifer was reduced by about 50%). Significant reductions also occurred in other catchments including the Gwydir, Namoi and Macquarie.

Given the scale of the reductions in future diversions allowed under the WSPs, a short-term temporary measure was introduced allowing additional diversions over and above the licensed accesses volumes. These are called Supplementary Water Access Licences and provide a buffer to the step change in licensed diversions. They provide an additional volume that decreases by 10% a year for a ten year period before being cancelled.

The volumes involved are significant and confirm the extent of the reductions introduced by the WSPs. For example, figures for the Gwydir, Namoi and Macquarie are provided in Table 6.

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Table 6. Access and supplementary licences, selected NSW catchments

<table>
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<tr>
<th>Valley</th>
<th>Access Licences (ML)</th>
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<td>Namoi</td>
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<td>Macquarie</td>
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</table>

Based on:

6.2.3 Victoria

In Victoria, reform over the last decade saw implementation of a package that:

- separated Sales Water as a independent lower security entitlement;
- separated water entitlements from land;
- unbundled the ‘Water Access Share’ which represented the ownership of the water in storage from the Delivery Share which was a share of the right to use the delivery infrastructure to have that water delivered; and
- promoted active water trading to help facilitate adjustment and drive water to best use.

Decisions about water resource management in northern Victoria were reached through extensive consultation and engagement. This included the exercise in 1997 called _Sharing the Murray_ and more recently the _Northern Region Sustainable Water Strategy._

In the Victorian Sunraysia within the Nyah to border region, there is a strong feeling amongst growers that the region has already negotiated a water sharing arrangement with the environment as part of _Sharing the Murray_ when Victorian irrigators gave up access to sales water.

Traditionally, dairy properties across the GMID were accustomed to receiving 130-150% of entitlement. Allocations above 100% were possible due to the presence of large volumes of water being held in ‘sleeper’ or ‘dozer’ entitlements, that were not generally used. As part of the development of a water market for Victoria over the past two decades, the explicit decision to recognise entitlement rather than historic usage as the basis for defining future water right reduced the effective annual allocations to regular users and meant they then had to source the balance from the markets or invest in greater water use efficiency.

As part of the 2004 reform package that created new lower reliability water entitlements, Victoria implemented the ‘80:20 Sales Deal’ that entailed allocating 20% of the new entitlement to the environment in northern Victoria. This new environmental entitlement was intended to provide...
an average of 120 GL of water to help restore flows in the Murray, associated wetlands, and the Goulburn, Loddon and Campaspe rivers.  

More recently, in 2009, the Victorian Government announced that it would:

- increase system reserves to ensure distribution systems can be relied upon to deliver water when and where it is needed, even in severe droughts;
- improve the value of carryover as a tool to manage the risk of water scarcity by introducing arrangements to decrease the risk of entitlement-holders losing water they have carried over in full allocation years;
- change the rules to allow exemptions from the 4% limit on trade out of irrigation districts when purchases are linked to modernisation programs;
- implement legislation that was passed in September, 2009 that removed the 10% limit on ownership of water shares by non-landholders; and
- clarify the timing of final allocations and how the irrigation season could be shortened during extreme droughts to provide greater certainty for entitlement-holders.

Victoria now is implementing a major irrigation reform program under the Northern Victoria Irrigation Renewal Program (NVIRP). This is a $2 billion investment to transform the supply system to meet the demands of the future irrigators across the region. It is based on:

- fully automating the major supply channels. This will cover some 40% of the previous supply system and provide near on-demand access to water at high volume;
- requiring all properties supplied off this ‘Backbone’ to be through private connections. 25% of farms are already supplied directly off the ‘Backbone’ and NVIRP is funding the construction of new connections for all other properties. Many smaller properties at a distance from the backbone will be retired from the system; and
- generating considerable water savings that will be returned to the environment and enhance the security of future irrigation supply (75 GL in Stage 1).

### 6.2.4 South Australia

In 1969, a cap was imposed on the maximum volume of water that could be extracted for irrigation in SA. The state-imposed cap on entitlements had a significant impact on development in South Australia compared with the upstream states. This cap was subsequently reduced by 30GL.

During the 1970s, reforms included:

- progressive conversion of all irrigation licences in South Australia from an area basis to a volumetric basis; and

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- metering of all private diverter pumped irrigation systems on the River Murray.

The irrigation trust diversions were metered as part of major rehabilitation programs (predominantly during the late 1980s and 1990s) and all remaining significant irrigation systems (predominantly the Lower Murray Reclaimed Swamp gravity irrigation areas) have been metered since 2008.

A program to replace open irrigation channels in the irrigation trust areas along the SA Murray with pressurised pipeline systems commenced in the early 1970s. Most of this investment occurred in the Riverland, but in the region below Lock 1 this process included the Mypolonga irrigation area near Murray Bridge. A total of 9.6GL was saved through this rehabilitation process of which 0.6GL was downstream of Lock 1 in the Mypolonga Irrigation District.

The Cap for South Australian River Murray diversions established under the Murray-Darling Basin Agreement in 1994 was set at 90% of the existing entitlements, effectively reducing the security of all existing licences. Despite this, the MDBA noted in 1995:

*The different irrigation crops in the various States are reflected in the States’ policies on security. South Australia, where horticultural crops predominate, entitlements are effectively 100 per cent secure.*

This is consistent with the general view in the Riverland, identified through the face-to-face interviews conducted for this project, that there is legislative protection of 100% allocation. While irrigators believed that this was instituted in the *Allocation Plan for the River Murray Prescribed Watercourse 2004*; a review of this plan identified no such provision (note the 2004 Plan was replaced in 2009).

South Australian diversions consistently are within the MDB Cap. Amendments have been made to the *River Murray Water Allocation Plan* to unbundle water rights into separate instruments from 1 July 2009. In the past, water rights and approvals have been reflected on a single water licence.

South Australian River Murray licences are predominantly ‘high reliability’ - but there are some differences in how much water is assigned to them in drought circumstances, and in eligibility for carryover, and there are some transfer and use restrictions that apply in some circumstances. The classes have been established to reflect these differences.

Under the basic sharing provisions of the Murray-Darling Basin Agreement, South Australia is entitled to receive a minimum volume of 'entitlement' water from the upper States (1,859GL per year).
Less than a third of South Australian irrigation entitlements are held by infrastructure operators on behalf of member irrigators. Most irrigation is by direct diversion by private irrigators.\textsuperscript{71} The largest operator in the region is the Jervois Irrigation Trust on the Lower Murray Swamps.

\textsuperscript{71} Pers. comm. Diane Favier, DWLBC, June 2010 to MJA.
Section 2: Sensitivity to change

In this section of three chapters, we address the question “what makes a Basin farm, a Basin farm sector, and a Basin regional community more sensitive to permanent changes in consumptive water availability?”

Sensitivity has been defined as the responsiveness of a socio-economic system to an exposure/change event. More sensitive systems are those that are more responsive to an exposure/change event.

The three chapters in this Section address in turn what the drivers or indicators of sensitivity are at the farm, farm sector and community level. We employ a common methodology across the three chapters: as a first step we use the data collected from the telephone survey to identify the statistically significant characteristics of farms that report that they will exit or change their on-farm practices as a result in reductions in water availability. While this analysis identifies the key indicators/drivers of sensitivity, it is apparent that these statistically significant indicators are by no means the whole story – a finding consistent with the heterogeneity and diversity of Basin farms and communities.

This first step confirms intuitive common sense and many of the observations provided during our face-to-face interviews with regional communities.

The second step is that having identified those factors that are statistically important, we can then describe how these factors vary across sectors and regions to determine sensitivity. This evidence-based approach allows both a ranking of relative sensitivity across sectors and regions, and the development of finer insights and nuances, particularly for regional communities.

Sensitivity to SDLs as mapped out is based on the assumption that all other factors that may affect farm operations will remain relatively constant, in this analysis at current levels. In particular, sensitivity understood assuming that commodity prices and the cost of farm inputs remain similar to those expected by each sector over the long-term (for instance, a milk price of about $0.35/litre, a rice price of about $400/tonne, a cotton price of about $450/bale). Increased commodity prices would make higher water prices more affordable, and increased input costs would make higher water prices less affordable, all other things being equal.
Each chapter therefore begins with a stylised description of our findings and then moves to a description of how the indicators of sensitivity vary across the regions and sectors.

Discussion of the magnitude of the impact of SDLs at the farm, farm sector, and regional community levels is contained in section 3.

Sensitivity to change is conditioned by the stocks and structure of human, financial, social, natural, and physical capital that an individual or community holds. Households in the Basin that have greater diversity and stocks of these five capitals are likely to be less sensitive and have greater adaptive capacity to deal with SDLs, as they have more resources available to them and more substitution options. The same logic holds for irrigation sectors, and for regional communities.

The evidence-grounded indicators/drivers of sensitivity that have been identified by our analysis and applied and reviewed in this section are shown in Figure 11. They measure what we know, based on our knowledge of the regions, from regional consultations, and the farm, business, and community surveys, and are significantly correlated with sensitivity. As noted, they do not explain all of the diversity and heterogeneity in decisions to exit or adapt. Much of this understanding can only be gained through qualitative insights.

Figure 11. Indicators of sensitivity to changing irrigation water availability in the MDB
7 Farmer sensitivity to change

**Key Points – Farmer Sensitivity**

Farmers are a diverse group of people operating diverse businesses. Farmers – even within the same sector and region - do not exhibit uniform sensitivity to change, and will not respond in the same way to external shocks.

MJA’s telephone survey of 1000+ farmers completed as part of the project establishes a rich profile of Basin farmers and their expected responses to reductions in water availability. This includes information about each farmer’s concerns for their region and their farm, their farm operations, their water holdings, water trading activity, irrigation setup and management, their financial situation, and their personal wellbeing and sense of connection with their regional community.

Statistical analysis of the farm survey results shows which specific characteristics of the farm and farmer are strong indicators of a farmer’s sensitivity to permanent changes in water allocation.

The specific characteristics that make some farmers more sensitive to the introduction of the Basin Plan were true of all irrigators that we surveyed, irrespective of the type of farm they run and the region they operate in.

In this chapter we discuss the indicators that we found make farmers more sensitive to SDLs, irrespective of the farm type they operate, and the region they operate in. These are: farm dependency on irrigation water; farm financial stress; personal wellbeing and optimism; and farmer age.

MJA’s telephone survey of 1000+ farmers completed as part of the project establishes a rich profile of Basin farmers and their expected responses to reductions in water availability. It includes information about each farmer’s concerns for their region and their farm, their farm operations, their water holdings, water trading activity, irrigation setup and management, their financial situation, and their personal wellbeing and sense of connection with their regional community.

All irrigation farmers were asked how they would respond to permanent changes in water allocations as a result of the Basin Plan. Broadly, we sought to understand whether, in response to permanent reductions in water availability, irrigators would:

- actively seek to exit farming.
- remain in farming and change their farm operations in some way as a consequence of their having less water; or
- remain in farming and not change their farming operations.

Those irrigators that would remain on farm and not change their operations are, by definition, the least sensitive to the introduction of SDLs. Farmers who change their farming operations or who actively seek to exit farming are comparatively more sensitive to the introduction of permanently reduced water availability.

Our statistical analysis of the farm surveys investigated which characteristics are linked to the decisions to exit or adjust compared with no change.

In this chapter we discuss the indicators that we found make farmers more sensitive to SDLs. More detail on the farm survey and its results is contained in the accompanying irrigator survey technical report.

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73 More detail on the farm survey and its results is contained in the accompanying irrigator survey technical report.
The statistical analysis confirms many practical and common sense observations. Sensitivity is higher with each of the following indicators (Table 7).

Table 7. Lead indicators of farmer sensitivity

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Decision to exit farming</th>
<th>Decision to adjust farming</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increased dependency on irrigation water</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. Increased financial stress, particularly indebtedness</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3. Decreased personal wellbeing and optimism</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4. Being a middle aged farmer</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Source: MJA analysis.*

These four indicators are associated with higher sensitivity, either the stated intention to seek to exit farming or the stated intention to adapt the farm. Higher levels of operator education, particularly university degrees also correlate significantly with higher likelihoods of adaptation.

Farmers are a diverse group of people operating diverse businesses. Farmers – even within the same sector and region - do not exhibit uniform sensitivity to change, and will not respond in the same way to external shocks.

The statistical analysis of the farm survey results shows which specific characteristics of the farm and farmer are strong indicators of a farmer’s sensitivity to permanent changes in water allocation.

The specific characteristics that make some farmers more sensitive to the introduction of the Basin Plan are true of all irrigators that we surveyed, and are independent of the type of farm they run and the region they operate in.

We outline these high-level findings in greater detail below.

### 7.1 Findings on sensitivity indicators at the farm level

#### 7.1.1 Sensitivity increases with farm dependency on irrigation water

Farm irrigation water dependency is a fundamental indicator of sensitivity to reduced water allocation. All other factors being equal, a farm whose viability is more dependent on irrigation water will be more sensitive to the introduction of SDLs.

Our work in the Basin suggests four measures of farm irrigation water dependency are key indicators of a farmer’s sensitivity to the introduction of SDLs. These are:

- the percentage of total farm area set up for irrigation;
the value of water entitlements as a percentage of the farm’s asset base;

- water costs as a percentage of farm operating cost; and

- the security of the water entitlement held.

**Sensitivity increases with the area of total farm set up for irrigation; the percentage water assets; and percentage farm operating costs**

Irrigators who have a larger proportion of their farm area set up for irrigation also typically have a larger percentage of farm assets held in water entitlements. For these same farmers, water costs are a larger percentage of the farm operating budget.

Our statistical analysis of the farm survey work shows that irrigators with larger percentages of their farms set up for irrigation, or who hold a greater percentage of farm assets in water entitlements, are more sensitive to water availability reduction. That is, they would be more likely to change farming operations or seek to exit farming in response to reductions in the yield on their water entitlements.

These results make intuitive sense. The area set up for irrigation, the percentage of farm assets held in water entitlements, and the percentage of farm operating costs that are water costs, are all proxies for farm water dependency. All other factors constant, as farms become more dependent on irrigation water for their viability, they become more exposed to reductions in water allocations. This increasing exposure makes these farmers more sensitive to water reductions.

The relative importance of water assets to overall farm assets has a direct bearing on sensitivity to reduced water availability. A reduction in water asset value, if not adequately compensated, would significantly impact on farm assets and gearing. Banks typically loan against farm water assets, and cutting long-term average water allocations to entitlements (or cutting entitlements) without taking this into account would increase the risk that farms will breach or default on debt agreements.

**Sensitivity is higher amongst high security water holders**

The farm survey shows that irrigators holding high security water entitlements would be more likely to seek to exit or adapt farming in response to water reductions than those farmers holding general security allocations.

Irrigators with high security water entitlements typically run farms that are less able to cope with variable water supplies. They hold high security water entitlements because of the supply reliability these entitlements provide. Their farms are built on the expectation of high supply reliability.

Faced with permanent reductions in water availability, these irrigators would have to adjust their operations to the lower water supply. While water trading would play a role in mitigating this impact, the farm survey results suggest proportionately more irrigators holding high security water entitlements would seek to exit.
Irrigators who hold general or low security water allocations have set up their farms to operate with variable water supplies. These farms already have some flexibility built in to their farm operations to manage uncertain water supply. As a result, when faced with the prospect of permanent reductions to water supplies, farmers holding more general security entitlements would not be as compelled to change farming operations or to seek to exit their farms.

7.1.2 Sensitivity increases with farm financial stress

Farmers who report higher farm financial stress — and higher total farm debt relative to their sector — are more sensitive to reductions in water allocations. As water allocations are reduced, these farmers would be more likely to seek to exit farming or alter their farming operations.

Farm financial stress is a key consideration for most farmers coming out of drought. Concern about overall farm financial stress is high amongst the 809 irrigators surveyed. Farm returns to assets have been nil or negative on average over the past five years. Many farms have survived the drought on a combination of EC payments and off farm income, and by running down farm equity.

Farmers in the Basin are, on average, conservatively geared but cashflow poor. On average, the gearing of irrigation farms is just under 20%. By business standards this is a conservative gearing. However, it should be noted that this average debt position conceals high variability between farmers.

The ability of farms to service debt is constrained by the low or negative margins across all farm sectors. These low farm margins, combined with the drought, are likely to make farmers unwilling to take on higher debt. In turn, this may constrain the ability of farmers to continue to increase farm productivity through capital investment.

7.1.3 Sensitivity increases with decreasing farmer wellbeing and optimism

Farmer wellbeing was measured using Deakin scores. Optimism was scored on a five-point scale.

Irrigation farmers with progressively lower wellbeing and optimism levels were significantly more likely to indicate they would exit farming if water availability were reduced. This result is a fundamental one. It shows that, irrespective of the farm they operate and the region they operate in, subjectively assessed personal wellbeing lies at the core of the decisions that farmers make about their farming futures.

The average personal wellbeing of the Basin irrigation farmers surveyed lies within the national norms. Average scores for subindices measuring satisfaction with personal relationships, community connectivity, and personal safety were very high (>80%) compared to national norms. Collectively, these results show the importance, and the greater strength, of community relationships in rural farming communities relative to urban communities.

In part, community strength comes from time spent in the region. Irrigators surveyed typically come from families that had lived in the region for several generations, and they had personally lived and farmed in the region for the majority of their lives. As the number of years irrigators have lived and worked in the region increased, so do their community connectedness and personal wellbeing.
Time, financial stress and personal situation are also clearly related to the personal wellbeing of irrigators in the Basin. Farmers who reported higher time or financial stress or were widowed or divorced had lower personal wellbeing scores.

Overall, the 809 irrigation farmers surveyed are reasonably optimistic about their futures in farming, scoring an average of 3.3/5. As one would expect, farmer optimism and their personal wellbeing are strongly related to each other. Moreover, the factors that relate to farmers reporting higher personal wellbeing (such as higher community connectivity, lower time stress, and lower financial stress) also explain higher optimism.

7.1.4 Sensitivity increases amongst middle aged irrigators

Age is a key determinant of a irrigator’s decision to stay on farm and adjust operations, or to seek to exit farming in response to permanent reductions to water entitlement yields. Our statistical analyses of the farmer survey responses show that:

- farmers aged 36-65 are significantly more likely to change their farm operations in response to changed water allocations; and
- farmers aged 45-65 are significantly more likely to actively seek to exit farming in response to changed water allocations.

The future of irrigated farming in the MDB depends to a significant extent on recruitment of new farmers, and retention of experienced farmers who are still young enough to farm.

The farming population in the Basin is ageing. The average age of irrigators surveyed during our work was 55 years, which is consistent with ABS data. Moreover, the age distribution of farmers surveyed also matched 2006 ABS census data for the farm sector. Less than 5% of the irrigators surveyed were under the age of 35.

Farmer age is a key differentiator across all forms of farm capital, and of regional concerns:

- respondents over the age of 65 report lower levels of concern about economic prosperity in the region, unemployment, levels of community participation, access to public transport, and community stress than younger counterparts.
- progressively younger farmers have higher levels of farm debt and gearing, and a lower overall percentage of farm ownership;
- using farm revenue and operating costs as yardsticks of farming intensity, younger farmers work their farms harder; that is, progressively younger farmers have higher revenue and operating costs per hectare farmed;
- farmers in the 36-65 years age group report significantly lower personal wellbeing and optimism in the future than farmers under the age of 35, and farmers over the age of 65 (Figure 12). The same farmers also report significantly lower optimism about their future in the region. These comments are relative to the scores of other farmers:
  - farmers in the 36-65 year age group have wellbeing scores within the range of national norms, and are optimistic (average score of 3.5 on a scale of 5);
comparatively however, farmers under the age of 35 and over 65 have wellbeing scores above the upper bound of national norms, and are very positive about their future in the region (with an average optimism score 4 out of 5); and

- the incidence of low personal wellbeing (i.e., farmers reporting wellbeing scores of less than 65) is greatest amongst those aged in the early forties to mid sixties.

Collectively, we conclude that these results tell a compelling story about the role that farmer age will play in the farm decisions that are made in the face of permanent water cutbacks. Farmers under the age of 35, and those above the age of 65, are more likely to stay on farm but not change their operations. It is likely that these two groups will have very different reasons for this response. Farmers under the age of 35 and above the age of 65 likely have very different reasons for staying on farm, and for not changing their farm operations. Farmers aged in their late 30s through early 60s have their own reasons for seeking to exit or reconfigure their farming operations.

**Irrigators over the age of 65**

Farmers over the age of 65:

- have lower levels of farm debt, higher rates of farm ownership, high personal wellbeing scores, high optimism, and significantly lower ratings of concern on several of the regional and farm issue scales;
- per hectare farmed, generate significantly lower revenue and have lower costs than their younger counterparts; and
- are more likely to stay on farm but not change their farming operations in response to changed water availability.

Combined, these factors suggest that, in general, older farmers are less sensitive to potential reductions in water availability because they have built up sufficient financial capital to not need to alter their farm operations. Because they do not run their farms at maximum capacity they likely have free capacity in their existing farming systems to absorb the shock of reduced water availability.
Connection to land and place also is likely to play a strong part in these farmers’ preference to continue farming. Farmers over the age of 65 have typically farmed all of their lives, and identify strongly with being a farmer in their community. Retaining this farmer identity may play an important role in these farmers’ preference for staying on farm.

Irrigators under the age of 35

Farmers under the age of 35 typically:

- have entered farming during the worst prolonged drought in the Basin in 100 years;
- have higher farm debt and gearing then their older counterparts;
- are working their farms as hard as, or harder than their older counterparts; and
- have substantially higher optimism in the future, and higher average personal wellbeing scores than their older counterparts, excepting those in the 65 year plus range.

Young farmers may be less sensitive than farmers aged in their late 30s to early 60s because, by virtue of entering farming during the drought, they have set up their farming operations to be lean, water efficient, and drought resistant. In addition, they have youth on their side. These young farmers see a good future ahead in farming; they know they have plenty of time to make a success of farming, so are prepared to face some difficulties in the years ahead.
Irrigators aged around 40 to early 60s

Farmers aged in their late 30s to early 40s through to early 60s are under pressure:

- unlike their younger counterparts, farmers aged 40-60 typically made capital investments in the farm before the drought, and have now borne the full brunt of the drought downturn. Generally, the drought has forced them to restructure their farming operations, and/or significantly reduce the level of farming operations. Either way, these farmers have generally drawn down farm equity to stay on the farm;

- they have less time left (compared to younger farmers) to recover the equity they have lost through the drought. Many have been worn down by the drought. This, combined with other pressures, may leave them with lower personal wellbeing scores relative to their peers, and cause them to have less optimism about their futures in farming; and

- accordingly, these farmer face a pointed decision about whether, when faced with a permanent future of significantly less water, they should stay in farming and attempt to recover, or exit and try to make a success of something else with the time and capital that they have left.

Results of our modelling suggest that, faced with permanent reductions in water availability, a greater percentage of farmers in the 40-60 year age range would exit farming, and a lesser percentage would stay on farm, redouble their efforts, and restructure.

7.1.5 Farm size does not increase sensitivity

Statistical analysis of the survey results does not show that smaller farms, relative to their sector, were more sensitive to potential water availability reductions than larger farms.
8 Sensitivity by sector

### Key Points – Sectoral Sensitivity

#### Cotton:
- is a highly adaptable annual crop; the area planted is readily reduced in response to water availability;
- has variable access to rainwater and groundwater. Rainfall is greater in the northerly valleys. Groundwater access progressively is being heavily curtailed by water reforms in NSW;

#### Rice:
- is also an adaptable annual crop. However, the level of rice production tends to decline at a greater rate than the respective decline in water availability. That is, a 40% reduction in water availability will lead to a reduction of rice production by 60%;
- will only purchase water if growers feel they can increase the return by around 50%. This means that if crop profitability is high enough and water is affordable, water will be bought to supplement low allocations; but if the price of water is higher (often in response to low allocations), and/or crop profitability is lower, rice farmers will sell their water – often to horticulture or dairy;
- is more likely to be grown in the Murrumbidgee Valley than the Murray Valley when water allocations are low;

#### Dairy:
- over the last forty years has seen declining farm numbers and increasing average farm size;
- has seen low milk prices and high water prices (in response to low allocations) lead to increased farmer debt, decreased milk production, and rationalised processing capacity. Irrigation efficiency has increased, fodder productivity has increased, and farmers increasingly balance the cost of growing feed themselves, with the cost of buying it from mixed farmers;
- will benefit from the investment in the NVIRP irrigation upgrades in northern Victoria, where most of the MDB’s dairy farms are located;

Annual horticulture manages water efficiently; water is a small component of input costs and the response of annual horticulture to low allocations is to buy water;

#### Perennial horticulture:
- profitability is highly variable across the different crops and is related to international competition and the relative value of the Australian dollar. Water is a relatively small input cost for many crops;
- critically focuses on ensuring that there is sufficient water to meet the requirements of established plantings. Low water allocations have forced enterprises to choose between “dry or buy”; 
- across the sector has implemented changes to reduce water usage. There is continued pressure in the perennial horticulture sector to amalgamate properties or develop greenfield sites to achieve economies of scale; and
- in the Murrumbidgee and NSW Sunraysia historically has had high levels of entitlements per ha; the NSW regions therefore tend to be net sellers of water allocation. Victorian Sunraysia and the Riverland have had to buy water in recent years and so are relatively more sensitive to reduced allocations.

### 8.1 Introduction

The factors that make some farmers more sensitive to water availability reduction also make some farm sectors more sensitive to water availability reduction. Thus the sensitivity of a farm sector to water availability reduction increases with:

- increasing farm sector water dependency;
- increasing farm sector financial stress;
• decreasing personal wellbeing and optimism of farmers in the sector; and
• the proportion of middle aged farmers in a sector.

This chapter examines the sensitivity of major irrigation farm sectors of the Basin using these factors. By way of introduction Table 8 summarises the characteristics of the most sensitive irrigation farm sectors.

### Table 8. Lead indicators of farm sector sensitivity

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Dairy</th>
<th>Horticulture</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm water dependency</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Increased farm area set up for irrigation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Higher farm assets in water entitlements</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• Increased high security water</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Higher financial stress</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Lower personal wellbeing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>


### 8.2 Findings on sensitivity indicators at the sector level

#### 8.2.1 Rice, horticulture, and dairy have the highest dependency on irrigation water

In the previous chapter we showed that farms that are more sensitive to potential reductions in irrigation water availability are those with:

• a larger percentage of total area set up for irrigation;
• holding a greater percentage of farm assets in water entitlements;
• incurring a larger percentage of operating costs as water expenditure; and
• holding high security water entitlements (or equivalent in SA).

All other factors equal, these farms would be more likely to adjust their farm operations or seek to exit farming when faced with permanent reductions to the yields of their water entitlements.

Applying the same measures of irrigation dependence to the farm sectors of the Basin, rice, horticulture, and dairy are the sectors with the greatest dependency on irrigation water. By this yardstick, these farm sectors therefore are the most immediately sensitive to the introduction of water availability reduction.
Percentage of land made up of irrigation

As a percentage of total farm area, dairy farmers surveyed had the highest percentage of total farm area set up for irrigation (70%), followed by horticulture and rice farms (Figure 13). Broadacre and mixed cropping and livestock enterprises have significantly less farm area set up for irrigation than other farm types.\footnote{Significant to rice and horticulture at the 10% level.}

\footnote{Significant at the 1% level.}
Figure 13. Irrigated land on farm, by sector

Top: farm area and irrigated farm area. Bottom: % of farm area that is irrigated.


Water assets as percentage of total farm assets

Amongst irrigators, a high percentage of regional farm wealth is bound up in water assets. For the 809 irrigation farmers surveyed, water entitlements make up 35% of total farm assets on average (Figure 14).\textsuperscript{76}

Basin rice farmers surveyed held approximately 60% of total farm assets in water entitlements. By this measure, rice farmers are relatively more sensitive to any reduction in long-term water availability that would decrease the value of their water assets.

**Figure 14. Water assets as a proportion of total farm assets**


**Security of water entitlements**

As discussed in chapter 7.1.1, farmers holding high security water entitlements are more sensitive to permanent yield reductions on their water entitlements. These irrigators own high security water entitlements because of the surety they provide, and their farms are structured on this high supply reliability expectation. Their farms are less able to cope with reduced water availability than farms that hold general security water entitlements; the latter farms are set up to operate with variable irrigation water supplies.

Our survey analysis shows that by this water dependency measure, perennial horticulture and dairy farmers are most sensitive to the introduction of water availability reduction:

- dairy farmers (mostly in Victoria’s GMID regions) and perennial horticulture farmers (with the largest numbers in Sunraysia and the Riverland) hold significantly greater proportions of high security entitlements than all other regions;
- on average, perennial horticulture farms hold roughly 7 high security water entitlements per irrigated hectare, while dairy farms hold an average of 2.5 high security entitlements per irrigated hectare;  

Note that SA entitlements are included as high security for Riverland.
• rice farmers hold much greater volumes of general security water entitlements than other sectors, and have relatively very small numbers of high security entitlements; and

• the other farming sectors have relatively small high security water holdings compared to general security, but less general security entitlements than rice.

8.2.2 The rice farming sector appears to be under greater financial stress

In chapter 7.1.2, we showed that farmers who report higher farm financial stress\(^\text{79}\) and higher total farm debt relative to their sector are more sensitive to reductions in water allocations. As water allocations are reduced, these farmers are more likely to seek to exit farming or alter their farming operations.

Across sectors, rice farmers reported significantly higher scores of subjective financial stress than other sectors. However, since this is a self-assessment, it is not clear that their assessment necessarily meant they were faring worse than other farming sectors. Indeed, the general financial situation of rice farmers was broadly consistent with other irrigated agriculture sectors of the Basin.

In our statistical analysis of the farm survey results, gearing and rates of return on assets of rice farmers were not significantly different from those of other farming sectors. All farming sectors are currently relatively conservatively geared, and average rates of return on farm assets have been close to nil on average over the past five years across all sectors (Figure 15).\(^\text{80}\)

8.2.3 Wellbeing and optimism is lower amongst rice, dairy, and horticulture farmers

Farmer wellbeing was measured using Deakin scores\(^\text{81}\) and optimism was scored on a five-point scale.\(^\text{82}\)

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78 Note this ratio is based on the reported irrigated area, and does not account for area that may have been dried off or temporarily taken out of service during the drought.

79 The farm financial stress index was based on the aggregate of each respondent’s expressed level of concern about farm cashflow, commodity prices, input prices, interest rates, and cashflow.

80 Note these debt to asset ratios are based on December 2009 prices for water entitlements. By March 2010, these prices have dropped back by 20 percent in some regions. Falling prices are due to the rains, and the government being out of the water market.

81 The Deakin Wellbeing Index measures subjective wellbeing. It comprises seven questions relating to satisfaction with life domains, such as ‘health’ and ‘standard of living’. Each question is answered on a 0-10 scale of satisfaction. The scores are then combined across the seven domains to yield an overall Index score, which is adjusted to have a range of 0-100. A considerable body of research has demonstrated that most people are satisfied with their own life. In Western nations, the average value for population samples is about 75 percentage points of satisfaction. That is, on a standardised scale from 0 (completely dissatisfied) to 100 (completely satisfied) the average person rates their level of life satisfaction as 75. The normative range of wellbeing is tightly grouped around the average, between from about 72 to 76 points.

82 Optimism was measured by asking respondents to indicate the extent to which they agreed with the statement “Generally I feel optimistic about my future in the region”. Responses were based on a five point scale with higher optimism corresponding to higher scores. Average optimism for the farmers surveyed was 3.5, indicating overall optimism. Optimism differs between regions and farm types and age, with these differences being highly correlated with scores on the Deakin wellbeing index.
As discussed in chapter 7.1.3, the average personal wellbeing of the Basin irrigation farmers surveyed lies within the national norms. Average scores for subindices measuring satisfaction with personal relationships, community connectivity, and personal safety are very high (>80) compared to national norms. Collectively, these results show importance and greater strength of community relationships in rural farming communities relative to urban counterparts.

Controlling for age and regional differences, rice, dairy, and horticultural farmers score significantly lower\(^83\) on Deakin and optimism scores than other sectors, including dryland.

**Figure 15. Asset and debt positions by sector**

*Top: Value of farm assets and debt. Bottom: Debt : Asset ratio*


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\(^{83}\) Significant at the 10 percent level.
**Figure 16. Wellbeing and optimism by sector**

The normative range for Deakin wellbeing is between 73 and 76.

Source: Marsden Jacob Associates, 2010. Farm survey technical report. Note that sample sizes less than 30 (Balonne and Gwydir) have been removed.

Deakin wellbeing scores of rice farmer averaged around 69 points, dairy around 73 points, and horticulture around 72 points. Note that these are within or near the normative bounds.

Deakin scores below 65 are taken to be indicative of persons at risk. In our survey of Basin farmers 1 in 4 rice farmers reported Deakin scores below 65 points, compared to 1 in 5 dairy and horticulture farmers.

**8.2.4 Farmer age does not differ by sector**

We have seen (in chapter 7.1.4) that age is a key determinant of a farmer’s decision to stay on farm and adjust operations, or to seek to exit farming in response to permanent reductions to water yields. Our work suggests that the age profiles of farmers in the Basin do not differ systematically by sector.

**8.3 Sensitivity indicators by sector**

This sub-section of the chapter provides an overview of the indicators of sensitivity in each sector. It discusses key aspects of inherent sensitivity to water availability, and lessons about adaptability from the recent drought. Lessons from the current drought are used carefully, with an
understanding that coping with drought will be different than adapting to long-term reductions in water, given that droughts tend to end eventually.

This sub-section focuses on four key sectors of cotton, rice, dairy and horticulture. As noted previously, other, less-dominant sectors occur within the Basin too; this sub-section also touches on the relationship with other sectors, where relevant. It focuses on the farm sectors themselves, with some reference to flow-on sensitivity to regional communities.

Looking across the key irrigation sectors:

- **cotton** production has declined in response to drought, and cotton processing in the Gwydir has been negatively affected as a result of the sale of Twynam’s water. Cotton has been buffered from drought impacts by the availability of groundwater for some farmers, but over the next five to seven years that access will diminish sharply as a consequence of NSW government reforms;

- **rice** production has been severely affected by drought. Many rice growers have seen a dramatic reduction in their on-farm revenue, with a consequential reduction in off-farm processing capacity. Most of the rice mills in southern NSW have been closed or temporarily taken out of service. Most rice growers have had to rely on dryland agriculture and diversification into a range of wider crops, and have sold or leased-out water (Figure 17);

- **dairy** milk production has declined during the drought, and farmer debt has risen. Historically, dairy farming has been more profitable than the mixed cropping and rice sectors, from whom dairy has bought water (Figure 17). The major responses to drought by dairy have been to implement flexible feeding systems to respond to low water allocations. This involves a change in the traditional feed base from perennial pasture to annual crops and increasing use of feeds bought-in from other farmers;

- **annual horticulture** mostly has had access to water markets (subject to allocations, and allocation timing) and has used this access during the recent dry seasons to secure water to maintain levels of production (Figure 17). This has been the major response to drought. The sector is driven more by other input costs and other market factors, rather than water; and

- **perennial horticulture** has been a large buyer of temporary annual allocations during the drought (Figure 17). Some growers are even selling permanent water entitlement (to keep their debt levels down) at the same time as buying temporary water annually for higher value plantings. By contrast, some growers have dried-off previous plantings. This has led to large areas of abandoned vines and trees, especially in Sunraysia, the Riverland and the Goulburn Valley. The plantings removed were mostly wine grapes and older citrus plantings. Horticulture growers report lower levels of life satisfaction than other farmers.
Figure 17. Water market behaviour by sector, 2008-09

Source: Marsden Jacob Associates, 2010. Farm survey technical report. Note each farmer may have bought and sold water, therefore, the total for each sector may be greater than 100%.

8.3.1 Cotton

As discussed in chapter 4.2, cotton is a highly adaptable annual crop; the area planted is readily reduced in response to water availability. It provides a range of flow-on employment opportunities in the cotton-growing regions.

The immediate response of the sector to the recent dry sequence has been to reduce the area under cultivation. This has seen the area fall by an order of magnitude from a high in excess of 500,000 ha in 2000-01 to around 50,000 ha in 2007-08.

Water use efficiency, principally in terms of the cotton produced per ML of total water use, has improved steadily over time. In the Queensland Murray-Darling Basin in 2010, research indicates that 84% of all irrigation was carried out by furrow irrigation, 14% overhead spray (lateral move and centre pivot), 1% drip and microspray and 1% other spray. There has been gradual adoption of pressurised irrigation in some regions, but for the great majority of irrigators the reliability of the water is already too low to justify the major capital investment involved in conversion from furrow. Pressurised irrigation also brings with it the risk of increasing energy costs over time. Drip irrigation generally is not favoured for the heavy cracking clay soils common in the floodplain areas.

Craig Baillie, Justine Baillie, David Wigginton, Erik Schmidt, Peter Watts, Rod Davis, Michael Scobie and Ben Muller, 2010, An appraisal to identify and detail technology for improving water use efficiency in irrigation in the Queensland Murray-Darling Basin. Presentation delivered by the National Centre for Engineering in Agriculture and the University of Southern Queensland, Goondiwindi, 29 March.
Current research by the National Centre for Engineering in Agriculture indicates that broadacre irrigated production on the floodplains of the Queensland Murray-Darling Basin accounts for about 80% of irrigated production overall. The percentage of cotton varies, being 69% of irrigated crop area in 2001-02 but only 53% in 2005-06. Broadacre irrigation excluding cotton accounted for 10% in 2001-02 and 25% in 2005-06. In the more intensive areas, pasture for livestock occupies about 12% of irrigated area, grapes, fruit and vegetables 7%, and other agriculture 3%.

Individual irrigators have diversified from high reliance on cotton into other niche crops such as lupins, sorghum and chickpeas and some have concentrated more on winter cereal crops. None of these alternative sectors has the same return as from cotton, none provide employment or processing at the same level across the district and none provides the same established market access.

The industry has also invested in research and development to enhance yields in order to boost production from the reduced area harvested. Productivity has increased over the last ten years.

**Regional differences**

The more southerly cotton-growing valleys of the Lachlan and Macquarie have suffered more from the dry sequence than the more northerly valleys, as they have greater reliance on regulated systems and less access to summer rains.

The catchment areas for the Lachlan and Macquarie generally are to the east, which has seen a greater reduction in rainfall than the more westerly plains. Wyangala Dam, which supplies the Lachlan, held just 4.5% of capacity in December 2009. As a result irrigators in the Lachlan have received close to zero allocations for the last five years. They also have little access to summer rain.

By contrast, the Gwydir valley has had significant summer rains, equivalent to 1 ML/ha watering, and also can access a range of river flows rather than just regulated entitlements. Buy-backs in the Gwydir affecting cotton have been significant, because Twynham has sold its water entitlements to the Commonwealth (Box 2).

The sensitivity of the cotton regions during dry seasons also is affected by their relative access to groundwater. In many regions the area of cotton planted has relied heavily on the availability of groundwater. Table 9 sets out the aggregate volumes available under the relevant groundwater sharing plans.
Table 9. Groundwater availability in cotton regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Groundwater Available (ML/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lachlan</td>
<td>100,000</td>
</tr>
<tr>
<td>Namoi</td>
<td>86,000</td>
</tr>
<tr>
<td>Macquarie</td>
<td>65,500</td>
</tr>
<tr>
<td>Gwydir</td>
<td>32,200</td>
</tr>
</tbody>
</table>


Under this analysis, the relative water resource access of the different regions is a mixed story:

- the Lachlan relies on regulated surface water flows that have been most affected by reduced rainfall and inflows. It has good access to groundwater;
- the Macquarie has had marginally higher allocation levels than the Lachlan and has reasonable access to groundwater;
- the Namoi has access to larger groundwater reserves and has access to a wider range of surface water flows; while
- the Gwydir has higher summer rainfall that adds to the surface water access, but the valley has less access to groundwater.

However, it should be noted that groundwater access will decrease over the coming five to seven years as a result of NSW government water reforms (chapter 6.2.2).
Box 2. The Collymongle cotton gin

In 2006 Queensland Cotton acquired the Collymongle cotton gin at Collarenebri in the Gwydir region, as part of a $25 million purchase of three NSW cotton gins from the Twynam Group.\(^\text{85}\)

The deal gave Queensland Cotton exclusive rights to gin Twynam’s upland cotton crop grown in the ginning zones for the next five to six years, and rights to market Twynam’s cotton over the same period. Twynam was to be Queensland Cotton’s key supplier of cotton in the region.

In May 2009 Twynam sold its river water entitlements to the Commonwealth government under the *Restoring the Balance in the Murray-Darling Basin* program.\(^\text{86}\)

In June 2009, *The Land* reported that the Collymongle Mill effectively was useless now that Twynam’s capacity to grow cotton had been substantially reduced as a result of the water sales.\(^\text{87}\)

*The Land* went on to say:

> “Thirty jobs at the northern NSW site will also go unfilled even if better cotton markets and dryland crop opportunities encourage some rain-grown plantings in the area at a future date.

> According to Cotton Australia chief executive, Adam Kay, 50 gigalitres of water was taken from the Gwydir Valley – the largest cotton producing valley in Australia – equating to 50,000 cotton bales of production...

> A cotton equipment supplier, Rob Dugdale, Cotton Growers Services, Wee Waa, expected two of his workers to soon be unemployed because of the “gut-shot to rural communities”.

### 8.3.2 Rice

Rice farming systems (described in chapter 4.2.2) are highly sensitive to water availability reductions for two reasons. First, while the farming system has other components (it is a mixed farm), the economic engine is rice. Second, the level of rice production tends to decline at a greater rate than the respective decline in water availability. That is, a 40% reduction in water availability will lead to a reduction of rice production by 60%. This response is due to:

- high annual water prices resulting in farmers deciding to sell their allocated water rather than grow rice;

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- Low allocations of General Security early in the season creating uncertainty about seasonal water supplies at rice sowing time in October; and

- Available water being used to irrigate winter crops sown the previous autumn.

In addition, as noted in chapter 8.2.2, rice farmers are relatively indebted and hold a high proportion of assets as water assets – further increasing their sensitivity to reduced water availability. Rice farmers also report relatively low wellbeing and optimism (chapter 8.2.3).

Circumstances specific to individual irrigation farms will determine whether a grower uses available water to grow rice. These include the relative viability and risk of growing other enterprises and the skills and resources available to the farm business. Minimal quantities of rice were grown in the Murray Valley during the drought years when water allocations were below 20%, and only relatively small quantities of rice were grown in the Murrumbidgee Valley when water allocations were below 20% (as noted below, Murrumbidgee Valley irrigation farms generally have a higher number of water entitlements per hectare).

During periods of low allocation, rice tends to be grown by larger farm businesses that have the capacity to consolidate small water allocations from a number of landholdings. There have been examples during the past three years of groups of growers combining small volumes of allocated water to produce a single larger area of rice.

The water market has been, and is expected to continue to be, used by growers as a source of water to complement seasonal allocation levels. The extent to which the water market is used to supplement allocations will be dependent upon assumed crop profitability/ML and the price of water.

As a rule of thumb, growers will only purchase water if they feel they can increase the return by around 50%. This is to accommodate production risk and the staged crop payment which occurs over a 14 month period. That is, water will be purchased at an annual price of up to about $150/ML if the gross margin/ML is assessed to be above $225/ML.

For example, in 2009-10 many growers assessed that a crop grain price of approximately $400/tonne would lead to a gross margin of around $200/ML. The water price at the time of sowing was in the range of $180 – $220/ML. Very few growers (approximately 350) took the decision to plant rice while many others decided to sell their allocated water, as they would earn a more immediate and certain return.

Rice is (like cotton) another annual crop where the area planted and harvested varies between seasons, depending on the relative allocation that season of General Security entitlement. Most rice growers operate mixed cropping properties, often growing a winter wheat crop on the residual moisture available in the rice bay.

The primary response to drought therefore was to plant less rice. As a result, rice production has declined dramatically in response to low water availability since 2002-03 (Figure 18).
In other words, many rice growers have seen a dramatic reduction in their on-farm revenue, with a consequential reduction in off-farm processing capacity. Most of the rice mills in southern NSW have been closed or temporarily taken out of service. Most rice growers have had to rely on dryland agriculture and diversification into a range of wider crops.

**Regional differences**

At times of low water allocation, it is likely that a larger area of rice will be grown in the Murrumbidgee Valley than the Murray Valley. This is due to a number of factors to the advantage of the Murrumbidgee, which include:

- a higher number of water entitlements historically issued and held per hectare;
- more favourable growing conditions, which lead to higher average crop yields; and
- access to earlier allocation announcements. This provides a longer lead period to take decisions on planting intentions.

**8.3.3 Dairy**

The dairy sector is described in section 4.2.3. As discussed in that section, the predominant trend in the dairy industry over the last forty years has been declining farm numbers and increasing average farm size, as farms strive to improve productivity. This trend was particularly evident in Victoria during the 1980s and 1990s when farm numbers dropped by one third, but production more than doubled.

Most dairy in the MDB is in northern Victoria. Up until the early 2000s, the trend in northern Victoria followed a similar pattern to the broader Victorian trend. However, in the last seven
years limited access to water has meant that farms have needed to purchase supplementary feeds, which has increased the cost of production and impacted on farm profitability.

Increasing cost of production as a result of low water allocations and subsequent higher feed prices has been the major cause of the financial pressure on farms, including relative to other Victorian dairy farms outside the MDB.  

Average farm debt in the sector increased by 41% from $367,000 to $520,000 in the period 1999-00 to 2007-08. As noted in chapter 8.2.2, dairy farmers tend to have debt: asset ratios above 20%; the survey undertaken by MJA for this study reported average farm debt among dairy farmers in 2008-09 at around $690,000.

Current industry developments include:

- **Scale**: Farms continue to follow trends of increasing in size to achieve economies of scale and to implement new technology. The low water allocations and financial pressure on farms have slowed the rate of growth.

- **Investment**: Farms have continued to invest in improvements in irrigation efficiency. Limited water availability has seen farms focus their efforts on their most water efficient areas of the farm. Milk companies continue to invest in milk processing facilities to improve efficiencies. However, there is rationalisation of surplus manufacturing capacity in response to reduced milk volumes.

- **Innovation**: The major responses to drought have been to implement flexible feeding systems to respond to low water allocations. This involves a change in the traditional feed base from perennial pasture to annual crops and increasing use of bought in feeds. There is also potential for farms to implement improved technology through the on farm irrigation efficiency program (when available) and linking with the Northern Victorian Irrigation Renewal Project (NVIRP) in the GMID.

The current drought sequence has led to a significant change in the feeding systems commonly adopted across the dairy sector.

In the past, farms were able to fully irrigate perennial pastures, and so home-grown feed typically ranged from 60% to 70% of the farm’s total feed requirements. During the last ten years of reduced water availability, there has been a move away from perennial pasture to more flexible feeding systems, with an increased in production on-farm of annual crops, lucerne and annual pastures.

The change in the type of home-grown feed base has also coincided with an increase in the level of feed bought from other farmers. Even though the fodder grown on farm has shown increased productivity (in tonnes/ML), total home feed production has still declined due to the lack of water. The increased reliance on bought-in feeds and the changed home-grown fodder base has increased the complexity of the farming systems. It has also increased their cost.

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89 ABARE Farm survey data 1999-00 to 2007-08.
The change has also been driven by the need to meet highly competitive world milk prices. The only route to this is to increase size to win economies of scale and so reduce unit costs of production. A move to ‘cut and carry’ rather than perennial pasture also helps achieve this objective.

Historically, dairy farming has been more profitable than the mixed cropping and rice sectors. The growth of the industry has come at the expense of the mixed farming enterprises, as dairy has bought up water from this sector (Figure 17). Mixed farming enterprises also provide services to the dairy sector in the form of feed as well as agistment for young stock and dry cows.

Dairy has been a net seller of water at times of low allocations when water market prices are high, as they are able to replace the water with bought-in feeds. This is a season-by-season decision which is influenced by:

- the price of allocations on the water markets;
- the milk price;
- the cost of feed substitutes; and
- the level of individual farm water use efficiency.

The medium to long-term outlook for dairy demand remains positive. Accordingly, it is reasonable to assume that milk prices will be at levels that will enable dairy farming to continue to out-compete mixed farming businesses, but not horticulture, for water.

**Regional differences**

The great majority of the irrigated dairy farms in the Lower Murray-Darling Basin are located in the GMID in northern Victoria.

The GMID has a relative advantage now in that it has access to the $2 billion investment in infrastructure upgrades through NVIRP. This will enhance the levels of service available at the farm-gate, and so allow adoption of greater automation and higher efficiency watering regimes, promoting productive efficiency and profitability.

The SA River Murray below Lock 1 is the next biggest dairy region (albeit less than 10% of total MDBA irrigated dairy production in 2006). Sensitivity within that region depends upon location:

- dairy farms that irrigate from the Lower Lakes have experienced structural adjustment during the drought that has largely resulted in a transition to dryland farming, with some remnant irrigation; the residual sensitivity of these farms post-drought to further water reductions is low. They are not likely to return to large-scale irrigation even if water availability were to return to historical levels; and
- dairy farms on the reclaimed swamps in the LMRIA are significantly more sensitive to further reductions in allocation, as discussed further in chapter 10.3.
8.3.4 Annual horticulture

The sector covers horticultural crops that are grown on an annual basis. The focus is predominantly on vegetables although it includes a few fruit crops such as melons.

There is growing consumer demand for fresh vegetables and for clean, high quality produce for healthy eating. At the same time, there is increasing international competition from imports to the domestic market, particularly processed vegetables, and pressure in export markets.

The industry is in a period of re-adjustment due to increased international competition, especially for processed product.

The fresh vegetable market is expanding with population growth and is less exposed to international competition. However, competition is increasing in some of Australia’s main export markets, with a resulting loss of market share.

There was a 45% increase in the area planted between 1996-97 and 2001-02, with major increases in the larger growing regions. However, the planted area fluctuates between seasons dependent on expected demands and prices.

The profitability of vegetable growing is enormously variable, with both high losses and high profits possible between seasons, crop types, markets and enterprises. In recent years the growth of the industry has reversed due to imports from New Zealand, China, South Africa and South America (particularly processed vegetables). The fresh vegetable market is expanding with population growth and is less exposed to international competition. However, competition is increasing in some of Australia’s main export markets, with a resulting loss of market share.

Developments currently occurring within the industry include:

- **scale**: An increasing trend to larger scale businesses to spread overhead costs, and risks;
- **relocation of investment**: Fresh vegetable production historically has been located close to urban centres. However, increasing competition for land on the urban fringes is encouraging relocation to areas of suitable capability away from urban settlement; and
- **innovation**: Mechanisation and supply chain innovations are key to future competitiveness.

Annual horticultural crops will always be a highly competitive industry with tight margins, due to the low entry costs. For most annual horticulture, water costs are a relatively small component of total costs and therefore production is not highly sensitive to water price. Annual horticultural crops therefore will be overall buyers of water during times of shortage, particularly for higher value commodities.

Growers of lower value crops may sell permanent water when market prices are high instead of planting crops. Alternatively the high level of mobility of the industry will mean that it can also choose to relocate to other, lower-price regions with higher levels of water availability.

The drought has had little effect on the established irrigation application technologies. The processing tomato sector is now largely grown under drip irrigation. Potatoes and onions are often grown on centre pivot systems in the Riverland on large scale private schemes. Lettuces generally require overhead sprays for seedling establishment, cooling and final crop presentation.
In each case there is significant inertia to change and the sector has been able to buy its way out of low allocations. This price pressure has not been enough to drive any substantial change in technology.

Annual horticulture uses relatively little water and tends to use it efficiently. Most of the annual horticulture regions have had access to water markets and have used this access during the recent dry seasons to secure water to maintain levels of production. This has been the major response to drought.

Within industry sectors, asparagus, melons, pumpkins and fresh tomatoes tend to be smaller scale producers often in older districts and these have been most affected by low water availability. In 2009-10 with increased water availability (but still below 100%) and land available from dried off areas of perennial plantings, many Riverland and Sunraysia growers have been planting vegetables.

Potatoes, processing tomatoes, onions, carrots tend to be larger scale producers. Large scale enterprises can spread and lower risks through use of forward price contracts, multiple regions of production and multiple crop types.

**Regional differences**

Murrumbidgee, with higher reliability of water and higher per hectare entitlements, has been less affected by low water availability than other horticulture regions.

Riverland, with very low allocations, has been most affected. Riverland growers feel aggrieved that they were ineligible for State Government assistance for water purchases that was made available to growers with perennial horticultural crops.

### 8.3.5 Perennial horticulture

There is continued pressure in the perennial horticulture sector to amalgamate properties or develop greenfield sites to achieve economies of scale. This is less so for labour-intensive crops such as hand-picked fruit crops like table grapes and stone fruit. In older districts, where there are smaller properties, growers are becoming more dependent on off-farm income and moving to higher value crops.

Investment in the industry currently is low due to uncertainty on future water availability and commodity prices. Commodity prices will vary depending on the exchange rate, fallout from the demise of managed investment schemes, and lower risk approaches being taken by investors. As a result, expansion in perennial plantings has slowed.

The area of permanent plantings increased significantly between 1996-97 and 2000-01 (78% increase in fruit and nut trees and 77% increase in grapes – mostly wine grapes). This expansion continued from 2001 to 2009 especially in Sunraysia with almonds. For example, the area of irrigation in Sunraysia expanded by around 75% from 1997 to 2009 and now supports an estimated 64,000 ha of perennial horticulture.
Low water allocations reduced the area of permanent plantings in the period 2007 – 2010. In some districts the area of plantings was reduced by up to 30% and overall by 10% to 20%. The plantings removed mostly were wine grapes and older citrus plantings.

Profitability is highly variable across perennial horticultural crops, and is related to international competition and the relative value of the Australian dollar.

All parts of the sector have implemented changes to reduce their water usage. The major strategy has been to reduce the overall level of water applied. This can be effective in the short-term in minimising demand but is not a sustainable practice as irrigation rates are now less than required to ensure a leaching fraction. This risk is that this will lead to a build-up of salinity within the root-zone, undermining the productive capacity of the soil into the future.

Wine grape profitability has fallen significantly, from the 1990s to current highly negative levels due to a combination of the high cost of water purchases and low grape prices. The significant oversupply in the wine grape sector currently is currently causing major economic hardship amongst growers. Profitability of wine grapes is expected to remain low until the current oversupply is corrected. The industry estimates that at least 20% of bearing vines are surplus to requirements, and large areas have already been abandoned in Sunraysia.

Citrus production has remained relatively stable, with a high reliance on exports to the USA. In 2009 exports to the USA were impacted by competition from Chile.

Table grape profitability can be volatile. Despite this, there has been expansion in the industry in recent years. This industry is working on further export market access into Asia, especially China, which would see further significant growth.

Dried fruit had many years of low, but stable, prices and recently an improvement in profitability. In a reversal of the past trend, a gradual transition from some wine grapes to dried fruit is expected.

Almonds were planted in large areas in the late 2000s, funded by Managed Investment Schemes. The market is expected to grow driven by population growth in developing countries e.g., China and India. The planted area has expanded six-fold since the year 2000 with more than 80% yet to reach full maturity.

The stone fruit and pome fruit sectors have experienced volatile profitability levels, although the area planted to these crops has remained relatively stable. There has been some reduction in canning varieties in the Goulburn Valley e.g., pears. The future is strong if they can afford to invest in new technology. This results in improved production and returns per ML but it takes high levels of capital at around $45,000 per ha for high density plantings. Imports from China, America, and New Zealand are a threat. It is likely that many growers will drop out if they do not have the capital or energy to change if there is less water.

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90 RMCG estimate.
91 Almond Board Australia.
Historically, growers of perennial horticulture generally have been:

- sellers of water allocations due to the high level of entitlement held per ha, especially in NSW; and
- buyers of entitlement (permanent buyers) for new developments. This has also triggered temporary sales in the period up to full orchard maturity.

The critical issue for all perennial horticulture is to ensure that the enterprise has sufficient water to meet the requirements of established plantings. Low water allocations have forced enterprises to choose between ‘dry or buy’.

During the last few years of low allocation perennial horticultural industries have therefore been large buyers of temporary annual allocations as a route to access additional water to meet the gap between entitlement and allocation (Figure 17). Some growers are even selling permanent water entitlement (to keep their debt levels down) at the same time as buying temporary water annually for higher value plantings.

On the other hand some growers have taken the decision to dry-off previous plantings. This has led to large areas of abandoned vines and trees, especially in Sunraysia, the Riverland and the Goulburn Valley. In some districts the area of plantings has been reduced by up to 30% with an average reduction of 10% to 20%. The plantings removed mostly were wine grapes and older citrus plantings. This response also reflects the current over-supply in wine grape.

Currently the wine grape industry is contracting and is a net seller. Other perennial horticultural industries are not likely to be major buyers or sellers in the short to medium term.

Regional differences

The level of water entitlements available for perennial crops varies largely by location. This is a significant factor in determining the relative sensitivity of the individual regions (Table 10).

<table>
<thead>
<tr>
<th>Region</th>
<th>Average Entitlement (ML/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunraysia, Vic</td>
<td>9</td>
</tr>
<tr>
<td>Sunraysia, NSW</td>
<td>14</td>
</tr>
<tr>
<td>Murrumbidgee, NSW</td>
<td>12</td>
</tr>
<tr>
<td>Riverland SA</td>
<td>Varied</td>
</tr>
</tbody>
</table>

Source: MDBA

Sunraysia experienced a large expansion in almonds, olives, vegetables and wine grapes in the 1990s to early 2000s. This was underpinned by the purchase of permanent water. Riverland also expanded with the purchase of entitlement for wine grapes and almonds. In each case the level of purchase was predicated on an assumption of 100% allocation.

Victorian Sunraysia and the Riverland have therefore had to buy water to maintain plantings during recent low water allocation years (35% in Victoria and 18%, plus supplementary SA government purchases, in South Australia during 2008-09). Businesses face the double pressure of
increased costs from having to purchase additional allocation water at the same time as international markets and over-supply drive down revenue.

This combination of factors means that these areas will be sensitive to any future reduction of water availability.

There was also growth in the Murrumbidgee wine sector during the 1990s. This growth was underpinned by the removal of planning controls that allowed vine plantings on large area farms and enabled the conversion of General Security to High Security water entitlements.

NSW Sunraysia and the Murrumbidgee both hold high levels of water entitlements per ha and their High Security water entitlement has a higher level of security than the equivalent product in other states. As a result the NSW regions have remained able to sell both entitlement and allocations during this drought period. This means that they will be more resilient in the face of a reduction in water availability.

Other horticultural growers in NSW face a similar situation, as High Security entitlements are allocated their full requirement as a priority and levels of entitlement are usually generous, based on earlier irrigation technologies and so yielding a surplus under drip.
9 Sensitivity of irrigation regions

Key Points - Regional Sensitivity

Regional communities are larger and more complex systems than farms and farm sectors. As a result, their sensitivity to changes in water allocations is more difficult to articulate. In addition, aggregate regional data can conceal importance of intra-regional differences, including the greater dependency of small towns on irrigated agriculture.

We have used three indicators to assess community sensitivity to water availability reduction: economic diversity, socio-economic condition, and the way the region's farms would change as a result of reduced water availability. Each of these factors has different dimensions and correlates. Moreover, as a result, regional sensitivity to reduced allocations varies markedly across the Basin, but with significant uncertainties.

Irrigated agriculture is more central to some regional economies than others. In quantitative terms, irrigation dependence can be appraised using a suite of indicators including: the percentage of irrigated agriculture in total agricultural production; the estimated relative sensitivity of the irrigation sectors to SDLs; irrigation value chain integration; and economic diversity.

On these four quantitative measures, there is a clear north-south divide between the irrigation communities of the Basin. In the southern Murray and Murrumbidgee irrigation regions (excluding SA Murray below Lock 1), irrigated agriculture ranges from 79% to 92% of total agricultural production. In the northern regions of the Basin irrigation ranges from 15% to 52% of total agricultural production. Therefore, even allowing for drought impacts on regional irrigated output, regional communities of the south are likely to be more sensitive to the introduction of SDLs.

Socio-economic condition is a key indicator of a region’s ability to cope with shocks and change. Regions that have people with higher education, greater household wealth, better essential services, higher wellbeing and less social disadvantage are better positioned to cope with regional stresses than communities that have less of these things. These are generalisations that are more nuanced within each region; however, in quantitative terms, socio-economic disadvantage is a useful, readily available index. In these terms, SA Murray below Lock 1, Sunraysia, the Riverland in the southern systems, and the Macquarie, Namoi and Border Rivers have high levels of disadvantage.

Irrigated agriculture uses much less land and delivers greater flow-on employment and economic activity than dryland farming. It is an important employer in all regions (directly and indirectly through food and fibre processing) and as a source of wealth – across the regions at least 75% of total farm expenditure takes place in the regional economy. Almost all irrigated production is processed in the same region or a nearby region.

The way a region's farms choose to adjust to reduced water availability is a critical driver of regional sensitivity because of the large differences in the input intensity of irrigation versus dryland farming, and the strength of links to regional economy. The differences in intensity between an irrigation sector and dryland, are greatest for horticulture and dairy, and least for cotton and rice.

Our interviews also indicate that regional communities are vulnerable because of the drought. In addition to eroded capital reserves and employment, many regional people are disillusioned about irrigation farming and feel that the national vision of the MDB as a productive foodbowl has been lost. In some cases, regional people report feeling abandoned by governments and their capital city counterparts and as a consequence are lacking confidence and self-esteem. People suggest that some regional towns and cities are sliding towards welfare-dependency.

9.1 Introduction

People living in irrigation-dependent towns believe they are particularly sensitive to reduced water availability. In particular, many small businesses in rural towns feel vulnerable to reduced water availability due to the indirect flow-on effects from the irrigation sector.

Regional communities are larger and more complex systems than farms and farm sectors, and their sensitivity to changes in water allocations is more difficult to articulate as a result. No single measure captures a region's total dependency on irrigated agriculture. Moreover, available data that can be used to indicate regional irrigation water dependency has inherent limitations, for example, aggregate regional data can conceal importance of the greater dependency of small
towards regional water dependence needs to be assessed with reference to a range of indicators.

Our evaluation of regional community sensitivity to reduced water availability is based on two driving factors. Each of these factors contributes towards mediating the direct impacts of lower water availability on regional irrigated agricultural systems, and regional communities as a consequence. These three main factors are:

- **economic diversity**: more diversified regional economic systems are more likely to be able to absorb shocks to the irrigation sector. Conversely, regions whose economies depend largely on irrigated agriculture and its value chain will be more sensitive to shocks to that system, such as the introduction of SDLs; and

- **socio-economic condition**: the broader socio-economic condition of a region is also a key indicator of the region’s ability to cope with shocks. Regions having people with higher education, greater household wealth, better essential services and the like are better positioned to cope with regional stressors than communities that have less of these things.

This chapter is organised as follows:

- in the following section we examine quantitative indicators of community sensitivity. These quantitative indicators establish an order of magnitude relative significance of irrigated agriculture within each regional socio-economic system. Analysis in this section is based largely on farm survey and Census data; and

- much of the richness of regional communities cannot be explained with simple indicators however. Accordingly, section 9.3 is a detailed qualitative analysis of regional sensitivity to the Basin Plan. Discussion and views expressed in this section are largely based on the regional interview program.

### 9.2 Indicators of community sensitivity

#### 9.2.1 Regional economic dependency on irrigated agriculture

*Prima facie*, regions that rely on irrigated agriculture for the bulk of their economic activity will be more sensitive to the introduction of water availability reductions than regions that are less reliant on irrigated agriculture. This is a truism. The challenge is to understand, rank and assess the sensitivity of the relevant communities.

In the previous chapter we saw that results of the farm survey suggest that the rice, dairy, and horticulture sectors are relatively more sensitive to cuts in their water allocations than other irrigated sectors. By logic, regional community impacts of SDLs will be greater in the regions that these more sensitive sectors are concentrated in.

Regional community dependency on irrigated agriculture is assessable using a complement of indicators, being:

- the value of regional irrigated agricultural production relative to total agricultural production;
- the percentage of the regional population that is directly employed in irrigated agriculture versus dryland agriculture;
- the value of regional economic activity that directly results from irrigated agriculture activity; and
- more broadly, how important is the contribution of irrigated agriculture relative to other sectors of the regional economy, such as retail trade, manufacturing, education.

The first three of the above indicators gauge the relative importance of irrigated agriculture to the regional economy, compared to total agricultural activity. The last indicator(s) gauge the relative importance of irrigated agriculture to the total regional economy.

By these measures, regions with higher dependency on irrigated agriculture are the Southern irrigation regions on the Murray and Murrumbidgee rivers, i.e., NSW Central Murray, Murrumbidgee, GMID, SA Murray below Lock 1, Riverland, and Sunraysia (Table 11).

**Table 11. Indicators of regional dependency on irrigated agriculture**

<table>
<thead>
<tr>
<th>Region</th>
<th>Irrigated agriculture &gt;50% total value of agricultural production</th>
<th>Sensitive irrigation sectors (dairy, rice, horticulture)</th>
<th>Value chain integration</th>
<th>Low economic diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GMID</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gwydir</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lachlan</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Namoi</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NSW Central Murray</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Riverland</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Sunraysia</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Source: Marsden Jacob Associates, 2010.*

On these four quantitative measures, there is a clear north-south divide between the irrigation communities of the Basin (Figure 19). In the southern Murray and Murrumbidgee irrigation regions (excluding SA Murray below Lock 1), irrigated agriculture ranges from 79% to 92% of total agricultural production. In the northern regions of the Basin irrigation ranges from 15% to 52% of total agricultural production. Therefore, even allowing for drought impacts on regional irrigated output, regional communities of the south are likely to be more sensitive to the introduction of SDLs.

Socio-economic condition is a key indicator of a region’s ability to cope with shocks and change. Regions that have people with higher education, greater household wealth, better essential
services, higher wellbeing and less social disadvantage are better positioned to cope with regional stresses than communities that have less of these things. These are generalisations that are more nuanced within each region; however, in quantitative terms, socio-economic disadvantage is a useful, readily available index. In these terms, SA Murray below Lock 1, Sunraysia, the Riverland in the southern systems, and the Macquarie, Namoi and Border Rivers have high levels of disadvantage (Figure 19).

These two indicators (water dependency and socio-economic disadvantage) are based on official data of the ABS. They are by no means the whole story however. But taken together, they indicate that SA Murray below Lock 1, Riverland, and Sunraysia may be particularly sensitive to permanent reductions in consumptive water.

*Figure 19. Estimates of the water dependency and socio-economic condition of the 12 regions*


**Contribution of irrigated agriculture to regional agricultural production**

Irrigated agriculture makes a significant contribution to total agricultural product in each of the communities profiled. There are marked differences in the relative contribution that irrigated agriculture makes to total regional agricultural output however.

As demonstrated in Table 12:
judged on the value of regional output, irrigated agriculture was relatively more important in the Southern Basin than Northern Basin during 2005-06. Irrigated agriculture accounted for roughly 80% or more of total agricultural product in southern regions. In the southern Basin therefore, all other factors constant, reduced irrigation water availability would be expected to have a greater impact on regional communities; and

moreover, the southern regions of Riverland, Murrumbidgee, GMID, Sunraysia, and NSW Central Murray have higher concentrations of sectors that are relatively more sensitive to reduced water availability, as defined in the previous chapter. For example:

- 86% and 72% of the total value of agricultural product coming out of the Riverland and Sunraysia regions respectively is from horticulture;
- roughly 62% of the total value of regional agricultural production in Murrumbidgee stems from rice and horticulture production;
- 60% of total value of agricultural product in GMID is provided by dairy and perennial horticulture; and
- half of the total agricultural production value in the NSW Central Murray region is from rice and horticulture.

Those regions that have a combined high relative dependency on irrigated agriculture and sensitive irrigation sectors (rice, horticulture, and dairy) are likely to be more sensitive to changes in regional water availability due to SDLs than those regions that do not have this combination.

In interpreting Table 12, the key column of information is the central column which shows the share of irrigation production in total agricultural production in each region. This shows a clear north – south divide: the irrigation communalities on the Murray and Murrumbidgee where irrigation ranges from 79% to 92% of total agricultural production; and the irrigation enterprises in the northern systems where irrigation ranges from 15% to 52% of total agricultural production.

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92 Table 12 shows: 1. the value of agricultural production during drought, and therefore probably understates the regional importance of irrigated agriculture in non-drought conditions, particularly for cotton and rice; and 2. that even in drought years, production values in irrigation regions in the southern connected Basin were not substantially buffered by dryland farming.
## Table 12. Importance of irrigated agriculture to regional agricultural economy, gross value agricultural product

<table>
<thead>
<tr>
<th>Region</th>
<th>Total value of agricultural production $</th>
<th>Value of irrigated agriculture production $</th>
<th>Irrigated agriculture's contribution to total agricultural production %</th>
<th>Sectoral irrigated agriculture contribution to total agricultural production %</th>
<th>Dairy</th>
<th>Horticulture</th>
<th>Cotton</th>
<th>Livestock</th>
<th>Rice</th>
<th>Mixed and other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>$ 57,477,620</td>
<td>$ 62,885,321</td>
<td>52%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>49%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>$425,626,236</td>
<td>$349,170,424</td>
<td>45%</td>
<td>-</td>
<td>-</td>
<td>5%</td>
<td>20%</td>
<td>10%</td>
<td>-</td>
<td>11%</td>
</tr>
<tr>
<td>Gwydir</td>
<td>$333,091,253</td>
<td>$163,566,491</td>
<td>33%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Namoi</td>
<td>$464,157,319</td>
<td>$230,939,448</td>
<td>33%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>24%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lachlan</td>
<td>$945,055,346</td>
<td>$164,916,855</td>
<td>15%</td>
<td>-</td>
<td>5%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>$ 56,652,049</td>
<td>$368,149,792</td>
<td>87%</td>
<td>-</td>
<td>35%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>22%</td>
</tr>
<tr>
<td>NSW Central Murray</td>
<td>$126,103,817</td>
<td>$476,196,024</td>
<td>79%</td>
<td>-</td>
<td>28%</td>
<td>-</td>
<td>10%</td>
<td>20%</td>
<td>17%</td>
<td>1%</td>
</tr>
<tr>
<td>GMID</td>
<td>$276,417,930</td>
<td>$1,255,461,577</td>
<td>82%</td>
<td>41%</td>
<td>20%</td>
<td>-</td>
<td>-</td>
<td>11%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sunraysia</td>
<td>$ 90,168,843</td>
<td>$403,201,498</td>
<td>82%</td>
<td>-</td>
<td>72%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Riverland</td>
<td>$ 31,257,678</td>
<td>$367,698,333</td>
<td>92%</td>
<td>-</td>
<td>86%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6%</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>$133,641,224</td>
<td>$85,117,635</td>
<td>39%</td>
<td>5%</td>
<td>-</td>
<td>-</td>
<td>11%</td>
<td>-</td>
<td>-</td>
<td>25%</td>
</tr>
</tbody>
</table>

Source: ABS, 2006. Agricultural Census. Note: only shows sectors with GVIAP contributing to 5% or more of regional agricultural production. Data not available for Macquarie.
Direct employment in irrigated agriculture versus total agriculture

The labour requirements of agricultural enterprises typically differ. For example, horticulture farms, especially those where hand harvesting is required, generally require more labour than other sectors.

On farm employment makes a significant contribution to regional economies and communities. Changes in the level of irrigated agricultural activity in a region will affect employment demands of these farms, rendering communities more sensitive to the on farm changes.

The MJA farm survey assessed the full time, part time and seasonal labour requirements of irrigated and dryland farm sectors of the Basin. Analyses of these farm survey results suggest that:

- dryland and irrigated farms employ roughly the same number of full time, part time, and seasonal workers, on average (Table 13). Inspection of the substantial diversions around these averages indicates substantial variation exists however, in particular for horticulture farms; and

- on a per hectare basis, irrigated farms employ more seasonal, full time, and part time employees than dryland enterprises (Figure 20). In particular, horticulture and mixed farms employ several times more full time, part time, and seasonal employees than dryland farms.

Assuming that most full time and part time labour originates from within the region, a general broad conclusion can be drawn that reducing the intensity of irrigation farming within a region (either through dryland conversion or reduction in irrigated farming intensity) will generally reduce the regional demand for agricultural labour. The shift in labour demand will be especially notable in horticulture regions including Sunraysia, Riverland, and to a lesser extent the NSW Central Murray, Murrumbidgee, and the GMID.

Table 13. Total farm employees by sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Full time employees</th>
<th>Part time employees</th>
<th>Seasonal employees</th>
<th>Total employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryland agriculture</td>
<td>1.1</td>
<td>1.3</td>
<td>1.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Broadacre ex. Rice</td>
<td>1.5</td>
<td>1.1</td>
<td>2.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Cropping and livestock</td>
<td>2.0</td>
<td>1.2</td>
<td>2.4</td>
<td>5.5</td>
</tr>
<tr>
<td>Dairy</td>
<td>1.9</td>
<td>1.1</td>
<td>0.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Horticulture</td>
<td>1.8</td>
<td>0.9</td>
<td>3.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Livestock</td>
<td>1.0</td>
<td>1.1</td>
<td>1.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Rice</td>
<td>1.7</td>
<td>0.8</td>
<td>0.8</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Relative contribution of irrigated agriculture to regional economic activity

Agricultural enterprises make important contributions to stimulating regional economies and communities. They purchase inputs for their farming operations in regional towns and centres, and provide outputs that regional industries process, warehouses stock, and regional transportation industries move to end markets.

Our farm survey results show that farmers in the Basin typically purchase around 75-85% of their farm inputs within 50 kilometres of their farm gate (Figure 21). Across all farm types and all regions excepting Gwydir, the farm survey results showed that expenditure in local towns (i.e., a town within 15 km of the farm) accounts for around 55% of total farm expenditure. A further 20-30% of farm expenditure then occurs in a regional centre (towns with a population greater than 10,000), typically the closest regional centre to the farm.
On a per hectare basis, irrigated agriculture farms of the Basin typically generate more revenue and incur more costs per hectare than dryland farms. This general truism that irrigated agriculture is more intensive than dryland agriculture is supported by the MJA farm survey results (Figure 22). These results clearly demonstrate the marked difference in production intensity between irrigated and dryland farming in general, and between horticulture, dairy, and dryland agriculture in particular. While cotton is missing from this picture, it is likely that on a per hectare basis cotton generates revenues and expenditures that are similar that of rice.

The per hectare analysis highlights a fundamentally important point that on a per hectare basis irrigation farming produces far greater economic opportunities for regional economies than dryland farming. On a per hectare basis, dryland farming:

- requires less labour;
- incurs less operating expenditure; and
- produces lower value output.

The practical upshot of the general lower intensity of dryland farming is that, all other factors constant, any substitution out of irrigated agriculture into dryland agriculture will reduce regional economic activity over the longer run. Regional economic activity will reduce as a result of converted farms purchasing less labour and capital inputs from regional towns and centres, and by producing lower value output.

### 9.2.2 Regional economic diversity

*Prima facie*, the sensitivity of regions whose economies are not highly concentrated around irrigated agriculture will be lower than regional economies that are concentrated around irrigated agriculture.

Arguably the best indicator of the relative importance of irrigated agriculture to a regional economy is its share of gross regional product (GRP). The Australian Bureau of Statistics does not estimate GRP however. In order to get a broad understanding of the relative importance of irrigated agriculture in regional economies, we therefore used ABS regional employment data as a proxy indicator of the relative importance of irrigated agriculture to regional economies.
Figure 23 suggests that, excluding SA Murray below Lock 1, direct employment in irrigated agriculture is greatest in the Southern interconnected regions of the Basin. In these regions, irrigated agriculture employs 8% or more of the total regional workforce. By this broad measure, the total regional economies in the South of the Basin are more dependent on irrigated agriculture than those in the mid and north of the Basin.


9.2.3 Qualitative dimensions of sensitivity by region

The sensitivity of regional communities to changes in regional water availability will in part be determined by their overall general socio-economic condition. Intuitively, those regions with ‘better’ socio-economic condition can be expected to cope ‘better’ with changes, given they have more socio-economic resources available to them.

A region’s ‘socio-economic condition’ can be broadly understood using Socio-economic Indices for Areas (SEIFA). SEIFA indices rank geographic areas across Australia in terms of their socio-economic characteristics. The SEIFA indices are created by combining information collected in the five-yearly Census of Population and Housing. These concepts are abstract and difficult to measure, so the indices aim to capture these abstract concepts by combining information that is related to the concept.

The SEIFA indices are rankings. Each index ranks different geographic areas of Australia according to a 'score' that is created for the area based on characteristics of people, families and dwellings within that area.

For all of the indices, relative disadvantage is associated with a low number.
Two of the SEIFA indices are used to assess the general socio-economic condition of Basin regions:

- the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) summarises information about the economic and social resources of people and households within an area, using measures of relative advantage and disadvantage measures. IRSAD is based on sub-measures including household income, internet connection, occupation, and education; and

- the Index of Education and Occupation (IEO) focuses on the general level of education and occupation-related skills of people within an area. This index reflects the general level of education and occupation-related skills of people within an area. There are nine measures included in this index. The education information in this index includes qualifications achieved and whether further education is being undertaken. The occupation information in this index includes occupations that require a high level of skills, occupations that require a low level of skills, as well as unemployment.

A SEIFA score is created using information about people and households in a particular area. This score is standardised against a mean of 1000 with a standard deviation of 100. This means that the average SEIFA score will be 1000 and the middle two-thirds of SEIFA scores will approximately fall between 900 and 1100. Regions with scores falling below 900 are considered to be relatively disadvantaged.

The IRSAD and IEO scores of the regions are virtually identical, and only the advantage and disadvantage score is presented here as a result. Figure 24 shows that relatively more disadvantaged regions include SA Murray below Lock 1, Macquarie Valley, Sunraysia, Riverland, Namoi, and Border Rivers. Approximately a quarter of these regions populations are significantly disadvantaged. In SA Murray below Lock 1, almost 60% of the population is significantly disadvantaged. Prima facie, gauged by this index, these regions may be at a comparative disadvantage in terms of their ability to adapt to regional stressors.
9.3 Regional sensitivity

The remainder of this chapter gauges the sensitivity of each irrigation region based on feedback obtained during the regional consultation program. For more detail, please refer to Part 2a: Community profiles (irrigation regions).

9.3.1 Qld Lower Balonne

Farm-level sensitivity

The Queensland Lower Balonne irrigation region is dominated by cotton.

While there is technically some scope for further water use efficiency in the Lower Balonne, commercially viable water use efficiency opportunities are limited, particularly given policy uncertainties and the prohibitive capital cost of many remaining options. As most irrigators are now utilising soil moisture testing and efficient application timing, the most likely viable water use efficiency option is to deepen on-farm storages (reducing proportional evaporation losses).

Opportunities for diversification into higher value crops (margins per ML) are agronomically possible. However, these options are commercially limited by a lack of competitive advantage in the Lower Balonne and access to capital. In addition, these markets tend to be very small and
wholesale crop changes would likely result in significant reductions in prices received (due to oversupply).

Community sensitivity

The population of the Lower Balonne region is 3,800 people and declining.

The recent drought has already resulted in population decline, specifically in areas such as Dirranbandi. This has already resulted in a decline in some community services and there is a significant concern amongst the community that the permanent introduction of SDLs would trigger further declines and permanent losses of key services (e.g. health clinics and schools).

9.3.2 Qld/NSW Border Rivers

Farm-level sensitivity

Broadacre furrow irrigation farming, principally cotton, is the major irrigated enterprise in the Border Rivers irrigation region, with cereal crops, fodder crops, fruit and vegetables also grown in different parts of the catchment.

There is some scope to increase fruit and vegetable production in the upper reaches of the region, but much depends on access to markets and transport economics. These are finite domestic markets already being met by irrigators from areas with comparative advantages.

Lucerne and fodder production in the middle reaches might continue to increase in response to growth in the feedlot industries.

Nonetheless, it is highly unlikely that these enterprises will make significant inroads into the dominance of the cotton broadacre furrow irrigation industry. Moreover, the outlook for cotton production is good. When cotton prices are above $450/bale no other irrigated broad acre crop is as profitable, providing there is sufficient water to support that production.

Community sensitivity

The population of the Border Rivers region is approximately 49,500.

The Border Rivers is highly dependent on water, because agriculture, particularly irrigated agriculture, is a major driver in the economies of Goondiwindi, Stanthorpe and several smaller towns. The larger towns have relatively diverse economies. Of these, Goondiwindi and Stanthorpe are more irrigation-dependent towns likely to be affected significantly by any move to lower sustainable diversion limits. Several smaller towns are even more vulnerable. Because agriculture is the predominant employer directly and indirectly, any negative impact to that sector also will take its toll on the next largest regional employment sectors, retailing, and health and community services.

The Border Rivers and the Upper Condamine are the only two working rivers in the MDB given a ‘moderate health’ rating by the Sustainable Rivers Audit. With only 12.6% of its catchment behind dam walls, the Border Rivers essentially is a free-flowing system. No new licences have been issued since the early 1990s, and there has been no increase in extractions since 1998 following a
policy decision to this effect by the Premiers of New South Wales and Queensland. At 61%, the Border Rivers has the highest percentage of pre-development end-of-system flows of any of the developed catchments in the Basin. It also has robust environmental flow rules, with a 10,000 ML starting threshold and an absolute minimum of 25% of the total volume of a flow event passing through the system. In a major flood, over 90% of the water flows downstream into the Barwon-Darling system.

The smaller irrigated agricultural towns are working towns adapted to the variability of water availability; people move if irrigated agriculture is not providing work. Other small towns, such as Boggabilla and Mungindi, have large Indigenous populations with strong links to country. The residents of these towns tend to stay in the region during the good and bad times, living through bad times in expectation of employment returning to the region.

Reduced water availability because of drought has significantly reduced economic activity in the region over the past nine years. One of the five cotton gins in the region has been mothballed as a result of the drought, while the others are running well below optimum levels.

The most immediate issue for the region – which will influence sensitivity to SDLs – is the potential for business recovery following the drought. The economic prospects for broadacre irrigated production are reasonably sound, but those prospects cannot be realised without water. After several years of low incomes, the proportion of irrigators with high debt levels will find it extremely difficult to recover from the drought.

9.3.3 NSW Namoi

Farm-level sensitivity

Cotton is the major irrigated enterprise in the Namoi irrigation region, but cereal crops, fodder crops, fruit and vegetables are also grown in different parts of the catchment.

Water dependence in the Namoi is high, due to the importance of irrigated cotton to the region.

Water use efficiency, in terms of the cotton produced per ML of total water use, has been improving steadily. There has been gradual adoption of pressurised irrigation, but for many irrigators the reliability of the water is already too low to justify costly capital investment. Pressurised irrigation also brings with it the risk of increasing energy costs over time. Drip irrigation is not suited to the cracking clay soils common in many areas.

There is some scope to increase fruit and vegetable and fodder production in the upper and middle reaches of the region. Nonetheless, it is highly unlikely that these enterprises will make significant inroads into the dominance of the cotton industry. Moreover, the outlook for cotton production is good, if there is sufficient water to support that production.

Community sensitivity

The Namoi is an agricultural region. Dominated by one large town, Tamworth, which has a diverse economy, the Namoi also encompasses several medium-sized service centres such as Gunnedah and Narrabri. Gunnedah currently is experiencing a mining boom. Mining is also having a growing influence on Narrabri, but as Narrabri is more irrigation-dependent it is more likely to be affected
by the move to SDLs. Several smaller towns are even more vulnerable. Because agriculture is such a large employer, any impact to that sector also will take a toll on the next largest regional employment sectors: retailing; and health and community services.

The smaller irrigated agricultural towns are working towns adapted to the variability of water availability; people move if irrigated agriculture is not providing work. Other small towns, such as Wee Waa and Walgett, have large Indigenous populations with strong links to country. The residents of these towns tend to stay in the region during the good and bad times, living through bad times in expectation of employment returning to the region.

Reduced water availability because of drought has significantly reduced economic activity in the region over the past five years. A study of the impacts of drought on Wee Waa by the Cotton Catchment Communities CRC\textsuperscript{93} provides a stark illustration of this. It found that the gross turnover of surveyed businesses had fallen from $116 million to $56 million over six years. Like many rural communities, 95\% of local businesses in Wee Waa said they rely on a healthy agricultural and cotton industry. As a consequence of the drop in local business turnover, the wider impacts on the community have been significant. Drought led to job losses of both permanent and casual positions with casual employment suffering a 40\% reduction. As a result of the job losses, two thirds of these employees left the region, contributing to a 21\% decline in student enrolments at local schools.

The most immediate issue for the region at present is the potential for business recovery following the drought. The economic prospects for irrigated cotton are strong, but those prospects cannot be realised without water. After several years of low incomes, those irrigators with high debt levels may struggle to recover from the drought.

9.3.4 NSW Gwydir

Farm-level sensitivity

As with the neighbouring Namoi, cotton is the major irrigated enterprise in the Gwydir irrigation region, but cereal crops, fodder crops, fruit and vegetables also are grown in different parts of the catchment.

Water dependence in the Gwydir, therefore, also is high, due to the importance of irrigated cotton to the region.

There is scope to triple high value horticultural production (pecans, olives and citrus) in the region, but this would still account for a very small percentage of the total volume of water used. It is highly unlikely that any other enterprise will make significant inroads into the dominance of the cotton industry. Moreover, as previously noted, the outlook for cotton production is good, providing there is sufficient water to support that production.

As with the neighbouring Namoi region:

the most immediate issue in the region at present is the potential for business recovery following the drought. The economic prospects for irrigated cotton are strong, but those prospects cannot be realised without water. After several years of low incomes, those irrigators with high debt levels may struggle to recover from the drought; and

• water use efficiency, in terms of the cotton produced per megalitre of total water use has been improving steadily. There has been gradual adoption of pressurised irrigation in some regions, but for many irrigators the reliability of the water is already too low to justify costly capital investment. Pressurised irrigation also brings with it the risk of increasing energy costs over time. Drip irrigation is not suited to the cracking clay soils common in many areas.

Community sensitivity

The Gwydir region’s population is approximately 25,350 people.

The Gwydir is an agricultural valley. Agriculture is responsible for more than twice as much employment as any other sector in the local economy. Moree is by far the largest service centre, with an economy that is also focussed on agriculture. Irrigated crops, particularly cotton, account for about one third of all agricultural inputs.

The limited diversity of the local economy means that out-migration of workers, and their families, provides the main adjustment to prolonged periods of poor returns – especially when jobs are readily available elsewhere. For example, significant migration occurred in the droughts of the mid 1990s and mid 2000s, and 1,741 people moved out of Moree Plains Shire in the census period between 2001 and 2006. More people have left since 2006. The smaller agricultural towns in particular are working towns and people move away if there is no work.

By contrast, the region’s large Indigenous population, who have strong links to country, tend to stay in the region during the good and bad times. During bad times, they live in expectation of employment returning to the region. Consequently, the Indigenous population is getting larger in both absolute and proportionate terms.

Because agriculture is such a large employer, any impact on that sector also affects the next largest regional employment sectors: retailing; and health and community services.

Reduced water availability, caused by the combination of drought and the Commonwealth Government buy-back, has significantly reduced economic activity in the region over the past five years. Most of the nine cotton gins are running well below optimum levels. One is said to have become unviable since Twynam sold their water to the Commonwealth Government (see Box 2, page 85).

9.3.5 NSW Macquarie

Farm-level sensitivity

Agriculture is the dominant enterprise outside Dubbo and the level of activity, employment and wealth creation are all highly dependent on irrigation.

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94 Cotton Catchment Communities CRC, 2009, Social and Economic Analysis of the Moree Community.
Reduced rainfall since 2001-02 has had a significant impact on all sectors of the rural economy, affecting both dryland and irrigated sectors. The level of activity in the cotton sector has been seriously affected, falling from 57,000 ha planted in 2000-01, at an allocation of 100%, to less than 10,000 ha over the last seven years, when allocations have averaged 10%. The ability even to maintain that area has relied on access to groundwater, as well as carryover between seasons and water trading.

Much of the entitlement in the valley is held by seven off-river irrigation schemes. The majority do not meet best practice in water delivery efficiency. They have not been able to operate over recent years, when allocations fell below 20%. They will require major rationalisation and modernisation to be sustainable. This is likely to involve a contraction in scale and a greater density of operation closer to the river. DEWHA has recently announced funding of $162 million for upgrading of three schemes, which will also generate further water savings of around 48 GL.95

Cotton remains an optimal choice for irrigation in the valley as a high value crop with the ability to vary the area planted each year to match a highly variable water resource. The cotton sector has demonstrated continuing productivity gains over the last five years, with higher yields per ML applied and per hectare grown. This has helped offset some of the impact of the reduced allocations.

No alternative sectors in the region can match the returns available from cotton in terms of levels of employment, profitability or certainty of market access. However, all growers are now planning for a future with a more diverse, if less profitable, mix of crops including winter wheat, sorghum and chickpeas. Other irrigators are exploring options such as citrus and vegetables, but the scale of opportunity here is limited.

Almost all cotton in the valley is grown using furrow irrigation. This can be close to best practice in terms of water use efficiency on the heavier soils of the region when combined with soil moisture monitoring. Drip irrigation may benefit sandy porous soils, but is expensive to install and has higher running costs. It is unrealistic to expect the major capital expenditure required for this to expand, when future water allocations are uncertain.

Community sensitivity

The Macquarie irrigation region comprises an area of some 13,000km² in central west New South Wales covering three council areas - Dubbo City and the shires of Narromine and Warren. The area has a total population of 47,000 people, of whom 37,000 live in the City of Dubbo.

Outside Dubbo, the region is highly reliant on agriculture for employment and wealth creation, with most employment in the irrigation districts especially in cotton.

The region is also a centre for cereal cropping and is famous for its Merino sheep studs.

Agriculture supports a wide range of services in the public and private sectors for the Macquarie region.

95 Senator the Hon Penny Wong, Media Release 83/10, Infrastructure Rolls Outs in Macquarie River Catchment, 13 April 2010.
Drought-driven reduction in the level of activity in cotton has directly impacted on the wider regional economy and the social fabric of the community, with the local centres losing population and key services in both the public and private sectors. Recent closure of major irrigated corporate properties has shaken the confidence of the community. The town of Warren is on a knife-edge in terms of continued viability. Any further reduction in the level of services will have particular effects for the local Indigenous community.

The community understands the importance of the Macquarie Marshes as a key environmental asset, as the majority of the marshes are in private hands. The debate centres around how this asset is to be best managed, and the relative importance of more water or better grazing practice for its future health. Increased flows will also generate economic benefits for the graziers who own and manage the large majority of the floodplain and marshes.

9.3.6 NSW Lachlan

Farm-level sensitivity

The severity of the drought has limited irrigation primarily to groundwater use and small quantities of High Security water in the Lachlan.

Groundwater access is limited to the upper and lower regions along the Lachlan River. Only a small proportion of farms have access to both surface and groundwater.

The drought has severely impacted farm businesses reliant on surface irrigation water, with General Security allocations falling from an average of 76% prior to the drought to 3% over the period 2002 - 2009. There has been a major downsizing of the lucerne and cotton industries as a result of the drought.

As a direct result of the drought, farms are accessing Exceptional Circumstances provisions at one of the highest rates in NSW.

The horticulture industry has been reliant on groundwater and High Security water to maintain high value markets.

Some intensive irrigated farm businesses have established major long-term high-value supply contracts with food retailers and processors.

There is scope for improved farm water use efficiency of around 10% in the short-term. This improvement in water use efficiency would enable most enterprises to offset predicted climate change impacts.

The Jemalong Irrigation Area was formed in the early 1940s as a government irrigation area and supplies water to 100 farms. Jemalong Irrigation is preparing a modernisation plan that is anticipated to achieve relatively small savings. There is scope for water savings in low allocation years by piping stock and domestic water rather than using the channel system for delivery.

Community sensitivity

The population of the Lachlan region is approximately 100,000, including 600 farm businesses.
Irrigated agriculture is a major economic driver within the upper Lachlan upstream of Jemalong Weir and the lower Lachlan around Hillston. Vegetable, horticultural, cotton and specialist lucerne producers in the upper and lower catchment have a high dependency on irrigation.

The economies of the major urban communities of Forbes and Cowra are moderately dependent on irrigated agriculture. Hillston is highly dependent on irrigated agriculture.

The population within the larger urban centres has been stable in recent years, with mining being an important source of off-farm income and employment. The Condobolin and Hillston communities have been impacted by the drought to a greater extent as cotton was a significant source of local employment.

Most post-farm gate processing is undertaken outside the region, except for individual large horticultural businesses, which undertake processing and packaging on-farm.

9.3.7 NSW Murrumbidgee

Farm-level sensitivity

The Murrumbidgee Irrigation Area was formed in 1924 as a government irrigation area and the Coleambally Irrigation Area was constructed as a government irrigation area between 1960 and 1970.

Major enterprises in the Murrumbidgee include rice, wine grapes, citrus and vegetables and other tree crops in mid-Murrumbidgee region (Griffith, Leeton and Coleambally), with winter crops and annual pastures in western and southern areas.

Rice and horticulture producers make up around 90% of the farm businesses and have a high (total) dependency on irrigation. While drought allocations have been low compared to historic levels, the Murrumbidgee was buffered relative to other regions (such as the Murray) because entitlements were based on relatively high historic allocations of 1,300-1,400 ML per broadacre farm (6-7 ML/ha) and 12 ML/ha for horticulture blocks.

Groundwater access is limited to the mid and upper regions along the Murrumbidgee River. Only a small proportion of farm businesses have access to both surface water and groundwater.

There is limited scope for farm transformation for Murrumbidgee Irrigation and Coleambally Irrigation farms due to the size of the farms, the level of irrigation development, the generally poorly-drained soils and low rainfall. Most farms are too small to become viable dryland farm businesses.

The drought has severely impacted on broadacre mixed rice and non-rice irrigation farms since 2002, with General Security allocations falling from an average of 83% prior to the drought to 32% over the period 2002 – 2009.

As a direct result of the drought over 30% of farms are accessing Exceptional Circumstances provisions.

The horticulture industry has been shielded from the drought due to almost full annual allocations of High Security water entitlements.
There is scope for improved farm water use efficiency of around 10% in the short-term although this may incur greater energy costs. Approximately 75% of both citrus and wine grapes are irrigated using micro-irrigation application technology. Murrumbidgee and Coleambally Irrigation modernisation (currently being planned) is estimated to achieve savings on conveyance losses.

There is scope for water savings by piping stock and domestic water to some of the larger farms in the far west of the region.

Community sensitivity

The region’s population is approximately 75,000 people.

Irrigated agriculture is the major economic driver within the region. The major urban communities of Griffith, Leeton, Darlington Point and Coleambally have a high dependency on irrigated agriculture.

Post-farm processing of irrigated agricultural produce is a major economic driver and involves rice processing, wineries, citrus processing, sugar plums, tomatoes and (more recently) almond packing sheds.

The wine makers association estimates that there is over $2 billion worth of regional investment in wine processing facilities in the Griffith area. SunRice has established two rice mills, a flour mill and a stock food processing plant and 13 aerated grain storages within the Murrumbidgee valley. National Foods is currently enhancing its citrus juice processing facility in Leeton which will become the major facility for the company in southern Australia. In addition, there is bulk transport of grain and horticulture products, a national distribution transport centre in Leeton, a large number of fruit packing sheds and a beef feedlot and a major poultry enterprise, both of which source most of their grain feedstuff requirements from the irrigated area.

Service provision and post farm gate processing are the major economic drivers of the mid Murrumbidgee region. Griffith has approximately 370 businesses, the majority of which provide direct services to irrigated agriculture. Griffith is now the largest wine producing area in Australia, processing over 400,000 tonnes of wine grapes annually and employing 1,000 people on a full time equivalent basis. Associated with this processing is a major transport industry, warehousing and services that maintain and upgrade the processing facilities. Griffith also supports significant tourism centred on the wine industry.

There are six major fruit packing facilities within the Griffith-Leeton area and over 40 smaller packing facilities. The majority of the fruit is transported to the Sydney basin. It is estimated that around 2,100 full time equivalent jobs are associated with the citrus production and post farm processing. A citrus juice processing facility at Leeton currently employs 60 people and is being expanded. Citrus will be transported from the Murray Valley and the Riverland for processing in the upgraded facility. The rice industry head office is located in Leeton and the industry has major milling facilities at Leeton and Coleambally. The industry also operates a flour mill, grain storage centres and a stockfeed manufacturing facility in the region. More recently a specialist biscuit factory has been opened at Murami, employing 50 people. A national distribution transport centre has been established in Leeton, employing approximately 60 people and the NSW Department of Industry and Infrastructure employ in excess of 100 people at its research and extension facilities within the region.
The Leeton shire has reported unemployment being higher than the state average, reflecting the reduced rice production and feedlot production due to the drought and reduced water availability.

Murrumbidgee Irrigation is a significant employer in Murrumbidgee Irrigation area and Coleambally Irrigation is a significant employer in the Coleambally community.

9.3.8 NSW Central Murray

Farm-level sensitivity

Major enterprises in the Central Murray region include mixed farms growing rice, winter crops and pastures for livestock production and dairying in mid Murray region (Finley, Deniliquin, Wakool), citrus in the south west (Barham), and winter crops and pastures for livestock fattening.

Irrigated agriculture is the major economic driver within the region. The urban communities of Deniliquin, Finley, Jerilderie, Moulamein and Wakool have a high dependency on irrigated agriculture. Around 90% of businesses in these centres are directly reliant on irrigated agriculture.

Rice and dairy producers make up around 75% of the farm businesses and have a high dependency on irrigation.

Groundwater access is limited to the Murray River corridor. Only a small proportion of farm businesses have access to both surface water and groundwater.

There is limited scope for farm transformation for Murray Irrigation farms in the area west of Deniliquin, due to heavier soils and low rainfall. Most farms are too small to become viable dryland farm businesses.

The irrigation-dependent farms east of Deniliquin have greater enterprise flexibility but still require irrigation for business viability.

Previous agreements have resulted in environmental allocations made to the Moira wetlands (2 GL), the Barmah Millewa Forest (75 GL) and the NSW Murray Wetlands Working Group (30 GL).

The region has been severely impacted by drought since 2002, with General Security allocations falling from an average of 82% prior to the drought to 26% over the period 2002–2009.

The drought has had a major impact on the region’s farming community. Over 50% of farms are accessing Exceptional Circumstances financial support.

A major groundwater adjustment process was implemented in 2008 and involved groundwater entitlements being reduced from 257 GL to 83 GL.

Over the past 15 years, irrigated farm businesses have continued to adjust to changing government water policy, including the MDB Cap on Diversions, the NSW Water Sharing Plan, the recent ACCC Water Charge Rules and NSW IPART Water Price Determinations. This adjustment has resulted in significant restructuring with less than 1,200 farm businesses owning the 2,400 irrigation landholdings previously established within the Murray Irrigation area alone.
There is significant human and financial stress within the region. Many farm businesses have either sold or offered to sell water entitlements to the government as a means of raising funds to meet critical household and business needs.

There is scope for improved farm water use efficiency of around 10% in the short to medium term which will offset climate change impacts, however these improvements may incur greater energy costs. Murray Irrigation modernisation is estimated to achieve a 5% saving on conveyance losses (15 GL at full allocation).

There is scope for water savings by piping stock and domestic water to some of the larger farms in the east, south and far west of the region.

Community sensitivity

The NSW Central Murray region’s population is approximately 35,000. The Murray Irrigation Ltd. area was established as a government irrigation district in the 1940s and 1950s and now provides irrigation water to 1,200 farm businesses.

Value-adding of agricultural production within the region is limited to rice processing, bulk transport of grain and milk, tomato processing and cereal straw processing. There is a small stud stock industry for meat and wool sheep and dairy cattle.

All the rice produced is stored and processed within the region, and the majority is exported as labelled supermarket produce. There are seven major rice storage centres and a milling facility. The storage and processing infrastructure has been placed in a ‘care and maintain’ mode during the drought. The rice and grain transport sectors are currently sourcing most of their work outside of the region due to the low production levels. The rice produced locally has been transported to rice processing facilities located in the Murrumbidgee valley.

In addition to the temporary closure of Deniliquin’s rice mill, the region has sustained a series of losses in employment opportunity and agricultural and community services over the past couple of decades and the drought:

- the abattoir in Deniliquin has closed and is unlikely to reopen;
- the livestock selling centres in both Finley and Deniliquin are not self-sustaining with current throughput and the livestock transport operators have either reduced the size of their businesses or pursued work outside the region;
- in the mid 1990s, a range of government centres were closed in Deniliquin and Finley. These included CSIRO, the regional electricity provider and the Department of Main Roads. The Department of Water Resources was restructured with the privatisation of Murray Irrigation. This change process resulted in the relocation of most senior government staff. Deniliquin and Finley transformed from administrative centres to service centres and as such became far more dependent on the region’s agricultural economy; and
- health services have undergone significant change over the past 15 years. Self-supporting hospitals and associated medical services have been transformed into limited emergency treatment stabilisation centres, and providers of aged care facilities. Deniliquin Hospital is the only hospital in the region that provides surgical and maternity facilities.
9.3.9 Victorian GMID

The Goulburn Murray Irrigation District (GMID) region includes the Goulburn, Murray, Campaspe and Loddon irrigation regions in Victoria.

Farm-level sensitivity

Major enterprises in the GMID include dairy, horticulture and mixed farming operations. There are 12,600 irrigated farms, 5,000 of which are small farms that only use 3% of the irrigation water.

In 2004-05, horticulture and dairy used 61% of the water and produced 83% of the value of agricultural production. Horticulture and dairy have increased their percentage of water used relative to other users in recent years of low water allocations (Figure 17, page 82).

The allocation policy employed by Victoria has provided irrigators with a highly reliable water supply that has resulted in the development of high value industries dependent on that high reliability (horticulture and dairy). Since 2006-07 the region has suffered a series of low allocations (e.g. the average for the last five years has been 64% in Goulburn and 83% in Murray). Low water allocations have led to increased farm debt due to high cost of annual water purchases and/or bought in feed costs.

In dairy, water use efficiency has improved significantly in the last 10 years, due to low water availability:

- in response to low water allocations, dairy farmers have diversified their feed base away from home grown perennial pasture towards more flexible feeding systems (with an increased focus on annual crops, lucerne and annual pastures) and increased use of bought in feed. This system is more adaptable, but more complex to manage. It has achieved significant improvements in feed grown per ML of irrigation water used and is now, in the main, a highly efficient industry; and

- the majority of irrigation infrastructure in the dairy sector is border-check (flood) irrigation with laser-levelled bays. Despite perceptions to the contrary, in many circumstances these systems demonstrate high efficiency levels, although there also are areas where improvements can be made.

Horticulture has rapidly adopted new irrigation technology and introduced new production methods in response to low water allocations.

Low water allocations combined with low prices (especially dairy in the last year) have resulted in sale of dairy cows and dairy farms. Almost all water in drought years has been used by horticulture and dairy, rather than mixed farming, which has declined significantly.

Significant change to irrigation systems and management has been implemented in the past 20 years. Irrigation supply systems and farm water efficiency are currently being modernised through the Northern Victoria Irrigation Renewal Project (NVIRP). There are opportunities to improve on farm water use especially in dairy but current financial stress will limit investment in the short to medium term.

The area has suffered a slump in confidence and high stress caused by poor terms of trade that has been strongly influenced by low water availability.
The current operating environment is highly uncertain due to the substantial reform that has already taken place, and uncertainty around the likely impact of SDLs. This uncertainty is constraining investment and other key decisions.

There is a small amount of irrigation water used in the Goulburn Murray Irrigation District (GMID) that is sourced from the Loddon and Campaspe catchments:

- associated with NVIRP, approximately 70% of landholders representing 90% of the water entitlements in the Campaspe district have decided to exit irrigation. This will result in up to 14 GL of entitlement being offered to the Commonwealth Government as well as 6 GL of savings as a result of decommissioning the irrigation district. This is still work in progress but the most likely outcome is the closure of the CID with a small number of irrigators reconnecting as either direct diverters from the Campaspe River or through to the Rochester Irrigation District serviced from the Goulburn irrigation system; and

- for Loddon, irrigation water is used as part of a large dryland farm. The exception is a small number of intensive irrigated horticulture enterprises, particularly wine grapes. Uses include irrigated lucerne (for hay) and pastures (for finishing livestock). The water is highly valued by the farmers, as it adds value to dryland production. Surface water has been highly unreliable during the drought, with farmers tending to use ground water where available.

Community sensitivity

The region has a population of around 134,455. It includes five municipalities (Swan Hill, Gannawarra, Campaspe, Greater Shepparton, and Moira) and twelve major cities or towns.

The three most important industries in the GMID are agriculture, manufacturing and retail. A large proportion of manufacturing is in food processing. The community depends on irrigated production to a large extent for employment.

Most of the milk and fruit produced in the GMID is processed in the region, with SPC fruit processing in Shepparton and multiple dairy processing operations across the GMID. Low water allocations have a major impact on these industries.

Across the region, towns have varied exposure to the impacts of low water allocations. Towns with other industries such as tourism (around the Murray River and the Kerang Lakes) are much more resilient to low water allocations, however tourism cannot replace agriculture as it is a minor part of the economy. Towns like Cohuna, with an economy that is primarily agriculture-based, are much more exposed to negative impacts.

9.3.10 Nyah to border (including NSW and Victorian Sunraysia)

Farm-level sensitivity

For the purposes of this report the Nyah to border region is defined as the area supplied by the Murray River from Nyah to the South Australian border and the Lower Darling within the Murray Weir pool. The two major regional towns are Mildura in Victoria and Wentworth in New South Wales. The region also is often referred to as Sunraysia.
The region includes 3,500 growers, 65% of whom farm 26% of the irrigation area on small farms in community districts. These districts were established as Government irrigation schemes from 1887 to 1947.

There has been rapid growth in the irrigation area over the last 15 years. This growth has been facilitated by water trade and includes large areas of almonds, wine grapes and vegetables. Managed investment schemes funded much of this new development. There is an expectation locally that growth in irrigation will continue given the region’s competitive advantages in soils, mix of crop types possible, water quality, reliability and ability to buy water. The rate of growth will depend upon commodity prices and cost of production.

The region developed with an expectation of 100% reliable water. Since 2006-07 the region has suffered a series of low allocations (e.g. 35% allocation in 2008-09 for Victoria). Low water allocations have led to high debt from annual water purchases (e.g. 180 GL purchases in Victoria in 2008-09).

Low water allocations combined with low commodity prices (especially for wine grapes) have resulted in 10,000 to 20,000 ha of perennial plantings being dried off (around 20% of irrigation districts). There is very little capacity to fund replanting at $25,000 to $45,000/ha and three to seven years until mature yield production. There has been some land amalgamation and diversification into annual crops such as vegetables.

The area has suffered a slump in confidence and there is high stress caused by current low wine grape prices, variability in other commodity prices over a number of years and low water allocations. This has led to unsaleable developed blocks and low equity. Some irrigators are choosing to sell entitlement and buy water annually to retire debt or gain access to capital.

Nyah to border’s mid to large sized farmers (15 to 100 ha) currently are facing the highest stress, as a group. They lack the opportunities to generate off-farm income that are relatively more feasible for small farmers, and conversely, lack the economies of scale available for large farmers.

Irrigation supply systems and farm water efficiency already is very high with limited scope for water savings. There has been significant investment in pressurised irrigation through private investment that was supported by land and water management plans. A ~4.5 GL/year saving has been estimated with the Stage 1 of the Sunraysia Districts Modernisation Project (for the Mildura, Merbein and Red Cliffs districts in Victoria). A similar volume has been estimated for Stage 2. This Project will enable growers to further invest in drip and other micro-systems, which will lift irrigation to world’s best practice.

**Community sensitivity**

The population of the Nyah to border region is approximately 60,000.

The major service centre is the City of Mildura (30,000 people). Mildura continues to grow at a steady rate. Robinvale has also grown by 8% from 2001 to 2006 due to the large scale managed investment scheme (MIS) development. Some of this has caused housing shortages and over-stretched services. Wentworth has also experienced some growth due to large developments along the River Darling.
Nyah to border’s regional economy of around $3 billion\textsuperscript{96} has a high dependence on irrigation, with wineries, packing sheds and other food processing reliant on a consistent supply of irrigated crops. Around 25% of employment is associated with irrigated horticulture and associated manufacturing.

All commodities are exported and imported for processing and packing. 15% of wine grapes are transported to the Riverland and to the Murrumbidgee for wine making. There is a net import of citrus into the region for packing and marketing.

The Nyah to border region is a major service centre for commercial and government services for North West Victoria and Western NSW.

The region as a whole does not perform well against national socio-economic indicators. It has low socio-economic status, low literacy, high drug and alcohol abuse, high unemployment and significant pockets of disadvantage. The unemployment rate in Mildura in 2006 was 5.7% (the MJA telephone survey found farmers in Sunraysia and in Riverland were more concerned about unemployment than farmers in other regions). This provides challenges to social cohesion and inclusion. The greater proportion and extent of seasonal work tends to create higher unemployment.

9.3.11 SA Riverland

Farm-level sensitivity

The Riverland developed with the expectation of 100% reliable water. Since 2006-07 the region has suffered a series of low allocations, being finishing allocations of 60%, 32% and 18% and starting allocations of only a few percent, which makes planning very difficult. Low water allocations have led to high debt from annual water purchases (e.g. in 2007-08 interstate trade of temporary water (allocations rather than entitlements) into SA was around 150 GL).

Low water allocations combined with low prices has resulted in 6,000 ha\textsuperscript{97} of perennial plantings being dried off (15% of perennial irrigated horticulture and expanding). There is very little capacity to fund replanting at $25,000 to $45,000/ha and several years until payback.

There is no scope for farm transformation to dryland as irrigation property sizes are too small (only 0.5 % to 1% of the area required for dryland operations).

Irrigation supply system and farm water efficiency is already very high with limited scope for water savings. Most of this was privately funded.

Growers believe that they have already achieved very high efficiency and have given up water entitlement in the past, and that this should be recognised in the setting of SDLs.

The area has suffered a slump in confidence and high stress caused by low wine grape prices, unsellable developed blocks and low equity. Some blocks are being poorly maintained, while others are managed by growers who are achieving high returns and see a strong future.

\textsuperscript{96} Mildura Region Economic Profile 2009 with additional agricultural GVAP for Swan Hill Shire.

\textsuperscript{97} PIRSA, 2010, SA River Murray Irrigated Crop Survey, January 2010, February.
Community sensitivity

The South Australian Riverland’s population is around 33,455 and is relatively evenly spread, with 34% in Berri Barmera LGA, 36% in Loxton to Waikerie and 29% in Renmark to Paringa. The Riverland area has above average proportions of children and people aged 45 years and older. There have been below average population increases over recent years, and the population is projected to decline in the future.

Like the neighbouring NSW and Victorian Sunraysia regions, the Riverland’s regional economy of around $2.2 billion has a high dependence on irrigation, with wineries, packing sheds and other food processing reliant on a consistent supply of irrigated crops.

9.3.12 SA River Murray below Lock 1

Farm-level sensitivity

The SA River Murray below Lock 1 (which includes the southernmost extent of the Murray, the Lower Lakes – Lake Alexandrina and Lake Albert – the Coorong, and the Murray Mouth) includes dairy, annual horticulture and perennial horticulture (mainly wine grapes).

The region has been in drought for a shorter period than other parts of the Basin, as drought commenced around 2005. However, irrigation has been impossible for many farmers – regardless of allocations – since 2008 because the water level of the river below Lock 1 and of the Lower Lakes has been below that required for irrigation infrastructure.

Water salinity also has been high; river bank slumping has become a State Hazard that threatens public safety, infrastructure and property; and acid sulphate soils have become a serious problem around parts of the Lakes.

Private diverters below Lock 1 (mainly horticulture) have faced increased costs from having to buy in extra water following low allocations and from the need to extend their pumps and pipelines. Those supplied off back channels have had no access to water. Growers have minimised waterings below optimum. Areas of permanent plantings have been dried off and the area of annual crops planted reduced. Growers have also relocated to areas with more secure water such as areas in the SE of the state serviced with groundwater. These have all involved considerable costs. The sector is sufficiently profitable to survive provided river allocations return. There is little opportunity for any reduction in water use as current practice is below optimal with risk of salt build up in the root zone.

Dairy farmers on the reclaimed Murray Swamps have faced a major program of reform over ten years involving de-regulation of the dairy sector, change to land ownership, the setting up of trusts, introduction of changed practice, laser-levelling, metering and reduced water allocations. This saw a step reduction in the number of dairy properties from 130 down to 58 by 2006. That number has collapsed further to around 25 given the recent drop in the river level that has

99 EconSearch. 2009 for PIRSA, “Economic Profile of the Riverland Region of South Australia 2006/7,” Marryatville Output of Riverland Region Table 4.1.
rendered gravity-fed irrigation inoperable for many. There is a core group of long-standing dairy farming families committed to maintaining operations. Provided the river level returns to levels that allow flood-irrigation they should survive subject to rehabilitation of the land and levee banks. Many have introduced costly new feeding practices as a stop-gap measure - it is unlikely these are viable in the longer-term.

Dairy farms on the Lakes around Meningie and Narrung generally have stopped irrigating. Many have left the industry and most of the remainder have converted to dryland farming. That conversion relies on rain fed pasture and crops and so requires a far larger property for an equivalent yield. Access to buy-back has facilitated adjustment. It is unlikely that this area will re-establish as a significant irrigation sector even if water becomes available. Some farmers have retained their irrigation infrastructure in case lake levels and water quality allow resumption. If this occurs the level of irrigation will be greatly curtailed from past practice with most on high-value fodder crops for the dairy sector, serviced by centre pivots.

Wine-growing in the region has a strong history of adaptability. Growers in Langhorne Creek started with access to groundwater and implemented best practice controls to minimise risks. When access to that resource was reduced the growers constructed a pipeline to gain access to River Murray entitlements out of Lake Alexandrina. Recent seasons have seen that resource become unavailable due to the drop in lake levels. The region was active in promoting construction of an alternative supply via a 110km pipeline to provide a replacement service from the River at Jervois. Other growers have promoted parallel private schemes. If the lake levels return it is likely that the new piped supply will be retained as the primary source of supply. Growers also have access to groundwater resources and balance the two sources of supply depending on availability and cost. Growers also use Aquifer Storage and Recovery to build a reserve and optimise resource access. The area has been at the forefront of best practice irrigation, minimising flows past the root zone to prevent risks of salinity. There is little opportunity for further reductions in water use without compromising production.

Community sensitivity

The region supports a diverse mix of employment. The largest source of employment at a regional level is retail trade. Agriculture is the second biggest direct source of employment, both irrigated (wine grapes, horticulture and dairy) and dryland (dairy, beef, sheep and cropping, closely followed by manufacturing, which includes agricultural processing (for instance, the abattoir in Murray Bridge employs 1,500 people). Tourism is of growing importance supporting a wide range of activities and businesses across the region from boating, accommodation, cellar door sales as well as speciality tours. Tourism adds $10 million to the regional economy. Other industries include machinery and equipment, boat building and maintenance.101

Murray Bridge is a thriving centre with major growth projected in employment and housing due partly to its proximity to Adelaide. The larger towns in the region, which are relatively closer to Adelaide (e.g. Goolwa and Murray Bridge), are growing and tend to have more diverse sources of

100 Such as the Marathon Pipeline, promoted by CMV Farms and Food and Beverage Australia Limited (FABAL) two vineyards at Langhorne Creek. The 42 km, 375mm low pressure pipeline delivers 4.5 GL per annum from the Murray River at Wellington to Langhorne Creek over 350 days to CMV Farms, FABAL and neighbouring customers, Orlando, Fosters and Guild Financial Services. http://www.fabal.com.au/images/stories/Article_FABAL_drought-proofs_critical_Langhorne_Creek_vines1.pdf.

employment than the smaller towns, which tend to be more reliant on agriculture and food processing and therefore more sensitive to water availability.

Apart from the sectors associated with agriculture and its value chain:

- boating and tourism in the region have been damaged by the media reports on the drop in the level of the river and lakes. Adaptive responses have included supporting the construction of a temporary regulator at Clayton to help maintain water levels in the Goolwa Channel to minimise risks from acid sulphate soils. This has restored some of the market for recreational boating around Goolwa. There is a proposal for a similar weir at Wellington to try and restore water levels in the river between Wellington and Lock 1 to protect water supplies.\footnote{Construction of a temporary weir near Pomanda Island (below Wellington) is being considered by the Government of South Australia to protect water supplies. A temporary weir would secure the fresh water between Wellington and Blanchetown and protect the quality and volume of water at the main pump off-takes below Lock 1 by creating a physical barrier between the Lakes and the main river channel. The construction of a weir downstream of Wellington would only result in a partial recovery in water level between Lock 1 and Wellington from the current level of approximately -0.2m AHD to +0.1m AHD (compared with normal pool level of +0.75m AHD). In addition it has been determined that this weir will not be constructed unless there is a further substantial fall in water level to below -1.5m AHD or other critical water quality triggers are reached. \textit{Pers. comm.} Diane Favier, DWLBC, June 2010 to MJA. Further information is available at \url{http://www.environment.sa.gov.au/cllmm/temporary-weir.html}.} This may also help support the houseboat trade. However, this sector’s future prosperity depends on a return to previous levels in the lakes,\footnote{http://www.environment.sa.gov.au/cllmm/pdfs/mhf-document.pdf.}

- commercial fishing on the lakes is a highly adaptive exercise with continuous monitoring and adjustment over time, within seasons and between years to match stocks and opportunities. The sector has been proactive in demonstrating the sustainability of the fishery by seeking accreditation through the \textit{Marine Stewardship Council} (MSC)\footnote{One of the key management mechanisms adopted has been a ‘rotational harvest strategy’. \textit{Pers. comm.} Garry Hera-Singh (2010), President Southern Fishermen’s Association Inc. \url{http://www.environment.sa.gov.au/cllmm/pdfs/mhf-document.pdf}.} and some fishermen have developed specialist markets in major cities across South Eastern Australia to maximise returns for their catch with a premium paid for their MSC certification. Others catch lower value species for supply into the Rock-lobster bait market; and

- the education sector is an important employer in a number of the region’s towns. The provision of education services outside of larger towns is under stress because of demographic change driven to a substantial extent by drought. The community is concerned about the drop in school enrolments and the impact on education services, because there is a strong community view that maintenance of strong education opportunities is an essential service.\footnote{http://www.environment.sa.gov.au/cllmm/pdfs/mhf-document.pdf.}

The entire community is dependent on the health and vitality of the River and the Lower Lakes. All sectors recognise that the region’s economic and social viability is dependent on the environmental condition of these assets. If their ecological health was to be seriously eroded long-term then many of the attributes of the region would be adversely affected, even those that do not directly depend on water use themselves. This is particularly true of tourism and recreation, which are major draw-cards for the region.
The region has been the focus of considerable attention due to the significant challenges raised by the condition of the Lakes and Coorong. This saw the setting up of a major inter-agency and regional stakeholder project under the name the Coorong, Lower Lakes and Murray Mouth to determine and implement an agreed long-term management plan for the region. This exercise has provided an important process to generate and maintain community cohesion and dialogue on these critical issues for the future of the region.

The CLLMM Socio-economic report commented on the social capital of the region as an important factor in determining the regional vulnerability and adaptive capacity of the community to respond in the face of unprecedented challenges.  

The community has had high social capital. Residents have a strong sense of community. This region has been viewed as an area desirable to move to. Despite the low water levels, many people are choosing to stay (particularly older members of the community).

However, the social capital of the region is being eroded by the impacts of low water levels. More young people work away from the home during the week and come back to the town on weekends. This has an impact on family and community life. There is less time available for volunteering and community service which results in a breakdown of supportive networks and services that the communities have become to rely upon. However, all communities are able to identify community leaders who continue to support and bring communities together. Community action groups have formed to deal with the water crisis and provide a platform for dealing with Government. In many instances the hard times have galvanised the community to come together, identify a common cause and advocate for their town and their community.

However, despite this positive analysis, there is also evidence of conflict within and between communities as the impact of the drought, low water levels and low water allocations continues. It is often difficult for local and state government to resolve these conflicts in community objectives.

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106 CLLMM Project (2009), Socio-Economic Report and Scenario Planning for Coorong, Lower Lakes and Murray Mouth (CLLMM) Project.
Section 3: Impacts of reduced water availability

This section describes the results of our analysis of the impacts of reduced water availability on irrigation farms, sectors and regional communities. The results are based on the outcomes of the regional community interviews, and the telephone surveys of Basin households, notably irrigation households.

We outline:

- farm and sector impacts. This chapter describes how reduced water availability is projected to affect the farms in the irrigated cotton, rice, dairy, annual and perennial horticulture, and mixed farming sectors; and

- irrigation region impacts. These results organise the generic farmer results and the irrigation sector on a regional basis to provide a clear understanding of the regional impacts of SDLs on regional farming sectors, and their greater regional communities.

Note that the responses from the interviews and the surveys are premised on the assumptions of no change in commodity prices and no compensation. Unless otherwise indicated, the expected interview responses are predicated on 20%, 40% and 60% reductions in water availability from the current position. Similarly, the survey responses are predicated on 20% and 40% reductions from the current position.
Key Points – Farm and sector impacts

This chapter discusses the responses to reduced water availability scenarios of people across the irrigation regions, by farm sector. It analyses potential impacts and autonomous adaptation. In other words, it analyses the responses that people say they will make to different levels of reduced water availability, if there is no support or compensation from governments to help mitigate impacts or transition to a different future.

The late 30s to early 60s year-old group of farmers is the group that is most likely to respond if water availability reduces significantly. They are more likely to change their farming operations in response to reduced water availability, and are also more likely to seek to exit farming altogether.

Irrigation is the core of the social and economic life of the identified regional communities. Irrigation is essential for the success of key food and fibre sectors in domestic and export markets. Those primary producers in turn support major processing and service sectors in those regional communities. Finally, the combined sectors generate the revenue base for extensive public services from local and state government.

Any reduction in water availability will reduce agricultural production and cause financial loss to farmers and local communities. However, the impacts vary by sector:

- Cotton would be proportionately affected by reduced water availability, with serious socio-economic flow-on impacts to remote cotton-dependent towns that often lack other economic activities, or future economic opportunities. Beyond 40% reductions in water availability, cotton production would contract and regions would lose processing capacity.

- Rice production tends to decline at a greater rate than the respective decline in water availability. That is, a 40% reduction in water availability will lead to a reduction of rice production by 60%. At around 40% water availability reduction rice production in southern to central NSW would be substantially undermined, and at 60% water availability reduction the rice sector largely would fail; and

- Dairy is focused in the Goulburn-Murray Irrigation District (GMID) in northern Victoria (and to a lesser extent in the NSW Central Murray). The GMID region is the focus of major investment by governments and irrigators in irrigation efficiency and renewal, and buy-backs for the environment. The volume of water being saved for the environment under these initiatives is approximately equivalent to a 20% reduction in long-term water availability, potentially helping insulate the region from impacts from SDL-driven reductions in water availability. However, if reductions are close to or greater than this point, the dairy sector will experience a serious decline and loss of confidence;

- Horticulture is focused in the Riverland and Sunraysia regions of South Australia, New South Wales and Victoria, but also occurs in other regions, such as NSW Central Murray and Murrumbidgee. Horticulture tends to have high production value per megalitre of water use, and in the lower water availability scenarios will be able to buy water on the market to make up for water availability shortfalls, or continue to function on very small relative volumes of High Security entitlements (NSW). However, at water availability reductions of 40% or more the viability of some community districts would be threatened and at 60% reduction, horticulture would contract to a smaller industry, mostly located in private diverter areas;

These impacts assume that any reduction in water availability would be implemented by across-the-board cuts to allocations, rather than investment in efficiency and buy-backs beyond those already committed to by governments. They also assume no initiatives by governments to ease structural adjustment.

This chapter summarises the reported responses of farms in each major sector (cotton, rice, dairy, annual horticulture, perennial horticulture) to different levels of permanent reduction in water availability.

Each sector discussion begins by recapping of the sensitivity and adaptive capacity and then it reports the impact responses from the interviews and from MJA’s telephone survey.

Irrigators have three broad responses to reductions in water availability i.e.,
The nature and extent of the adjustments on-farm have critical flow-on effects to impacts on regional communities.

10.1 Cotton

10.1.1 Recap: sensitivity and adaptive capacity

The primary response of the cotton sector to reduced water availability will be to reduce the area planted.

However, continued research and development has led to significant improvements in yield. This means that while the area planted would be smaller, this would be off-set to some extent because of greater productivity.

As discussed in chapter 8, inter-valley trade is almost entirely unavailable in the northern MDB. In addition, the northern Basin is hydrologically much more variable than the southern Basin. Physical and institutional restrictions on water trading in these regions increase sensitivity and will make adaptation more difficult since irrigators are less able to utilise market opportunities to adjust to lower water availability, or higher levels of variability in water availability.

The adaptive capacity of the cotton industry to changes in water availability is highly dependent on several factors including:

- the degree to which commercially feasible water use efficiency initiatives have already been adopted. This will have a direct influence on the ability of the sector to adjust to any new water regime.

  There is still some scope for water use efficiency in the cotton sector, particularly through enhanced soil testing and application timing. However, these gains are unlikely to be sufficient to offset major reductions in SDs. The majority of further water use efficiency options available tend to be very capital intensive (e.g., deepening water storages, or moving to alternative on-farm systems) and commercially viable water use efficiency options are limited; and

- the uncertainty about the availability of water which hinders capital investment in water use efficiency. For example, irrigators in the Macquarie valley have investigated drip tape investments, but are reluctant to make these costly investments in the face of uncertainty regarding water availability. Moreover, because cotton is grown as a rotation crop, a greater area of drip tape is required, further increasing the potential investment costs for cotton irrigators.

Once cotton farmers have exploited water use efficiency to the extent commercially feasible, their next response will be to diversify from permanent cotton crops to mixed cropping and other
crops, including dryland cropping and/or pastoral farming. However, returns to dryland cropping are significantly lower than returns to irrigated cotton, in terms of both yields and employment. This will have negative impacts on cotton farmers that will flow through to regional communities since (for example) the employment intensity in irrigated cotton in Condamine Balonne is approximately 8.4 times as high as for dryland farming.\(^\text{107}\)

The cotton industry has good prospects if water availability returns to the long-term average.

However, if SDLs result in large reductions in water for cotton, the adaptive capacity of the sector will be limited and the structure of primary production in many regions will be fundamentally impacted (i.e., a move out of permanent cotton plantings to opportunistic irrigation in many areas). This will have flow-on impacts throughout regional economies reliant on cotton as the viability of cotton gins is compromised and demand for other inputs (labour, transport, etc.) declines.

Many of the major cotton-producing regions have very narrow economic structures and limited alternative opportunities. Moreover, there are many factors that will limit diversification out of cotton. These include the significant sunk investments already made by irrigators and the existence of large integrated companies that provide risk-free access to market for most small producers.

10.1.2 Reported Impacts

Based on current available information and the MJA face-to-face interview program, the most likely continuum of adaptation pathways to reductions in SDLs would be as follows:

- modest reductions (20%) in SDLs relative to long-term average allocations would trigger further water use efficiencies and trade (where possible);

- moderate reductions (40%) would trigger more trade, consolidation of water entitlements and reduction in permanent cotton plantings, with many irrigators moving to mixed farming and opportunistic cotton production. Even under moderate reductions, some irrigators might opt to sell their water and exit the irrigation sector; and

- larger reductions (60%) would trigger further consolidation in the cotton industry, significant moves out of cotton on a more permanent basis, major reductions in flow-on economic and employment impacts in cotton producing regions, and very limited investment in the sector. In some areas this would place severe economic and social pressures on regions to maintain employment, services and community wellbeing.

Unfortunately, the number of cotton farmers able to be contacted through the MJA telephone survey program was too small to report their responses to the water availability reduction scenarios (only nine respondents).

In short, the cotton industry probably has limited capacity to adapt to major reductions in SDLs and fundamental structural adjustment will be necessary in many cotton producing regions.

Flow-on impacts may include the closure of gins (particularly in the scenarios of higher reductions in water availability) and migration of employment from cotton-based towns. This would result in changed demographics, and reduced viability of other local businesses and government services. Many of the smaller communities in the west of the cotton regions are at risk reflecting their high levels of residual vulnerability.

10.2 Rice

10.2.1 Recap: sensitivity and adaptive capacity

As discussed in chapter 8, rice farmers are highly sensitive to reduced water availability.

Rice farmers report low wellbeing and optimism relative to other sectors. They are highly sensitive to potential reductions in water availability. Rice farmers on average are relatively more highly indebted, with debt : asset ratios over 20%. Furthermore, a large proportion of their assets are water - nearly 60% on average. Anecdotally this has restricted their access to Exceptional Circumstances support during the drought, and increases the potential impact on them if water allocations are reduced through the implementation of SDLs.

While the rice farming system is a mixed farm, its economic engine is rice; it is the rice crop, and winter cereal crops grown in rotation with rice, that underpin farm financial returns. Reduced water availability, even in the relatively smaller 20% reduction scenario, would rapidly marginalise the viability of many irrigated rice system farms. Flow-on effects would occur in the smaller urban service centres in the central Murray region.

10.2.2 Reported impacts: face-to-face interviews

In general terms, a 20% reduction in water availability is expected to lead to a 30-40% reduction in rice production if relative enterprise returns remained similar; this is because rice growers sell their allocation rather than grow rice in an uncertain season (see chapter 8.3.2).

A reduction in water availability of 40% would result in a major reduction in rice production and associated farm viability. This would lead to a substantial reduction in post-farm processing and a major impact at a community level, particularly in the central Murray region and Coleambally in the Murrumbidgee. There is a concern amongst community members and local government that some centres would transform from being service centres to become welfare towns.

A 60% reduction in water availability would be similar to the drought conditions experienced by the Murray and Murrumbidgee regions over the past seven years. Almost all farm businesses have become unviable under these conditions. The impacts on the regions’ towns have been severe resulting in reduced employment, increased debt levels and reduced services. While farms and regional businesses may have coped with drought by taking on debt or running down capital and hoping for the drought to break, this tactic will not work in the face of a permanent reduction in water availability.
These findings are based on the MJA face-to-face interview program. The findings of the MJA telephone survey are consistent (Figure 25):  

- if water availability were to return to the Long Term Cap Equivalent (LTCE), i.e., 0% reduction in long-term availability, very few farmers would seek to exit (less than 1% overall, generally retirees) and rice systems farmers would return to higher value irrigated (summer) crops, notably to rice and lucerne;

- with reductions of 20% in water availability relative to the long-term average, a quarter of rice farmers would exit and a further quarter would change their activity, but half would not change their activities; and

- with reductions of 40% in water availability from the long-term average, more than half would seek to exit. Those rice farmers who remained on farm would effectively exit rice production and shift to less water demanding cereal crops. In addition, at the 20% scenario about 20% of farmers would increase borrowings, and at the 40% scenario about 10% would seek more off-farm income.

![Figure 25. Rice: telephone survey responses to water availability scenarios](image)

Source: Marsden Jacob Associates, 2010. Farm survey technical report. n=16 (-20% scenario). n=25 (-40% scenario). Note, respondent numbers are low so this data should be treated with caution.

**Regional impacts**

The low level of production over the past seven years has resulted in the rice mills at Coleambally and Deniliquin and many of the rice storage depots being placed in care and maintenance mode. This has had significant flow-on effects on employment. At the peak of production in 2000-01,

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108 Note, respondent numbers were low so this data should be treated with caution.
employment in Australian rice storage and processing was approximately 1,300 permanent and casual staff. In 2009-10 the number employed was approximately 400 permanent and casual staff.

Storage facilities and the processing mills are operated on an as-needs basis. A return to long-term average production would likely result in full utilisation of all facilities. The operation of the storage facilities will be influenced by the geographic distribution of the rice grown and the overall level of production.

Even a 20% reduction in water availability would lead to significantly reduced product throughput and hence employment at the Deniliquin and Coleambally processing facilities. A number of the regional aerated storages would be rationalised, and transport requirements would be significantly reduced. The gross domestic return from the industry would be reduced proportionately to the reduction in production.

The impact on the rice farming system may be exacerbated for each water availability scenario in the event that similar or greater reductions in water availability occurred in northern Victoria. It is likely that a reduction in water availability would lead to dairy farmers purchasing water from southern NSW, thus reducing production levels of rice and associated winter cereals in southern NSW. The rice industry is vulnerable to reduced production under this scenario.

10.3 Dairy

Dairy farming is primarily located in the MDB in the Victorian Goulburn-Murray Irrigation District (GMID), and to a lesser extent in NSW Central Murray. In the GMID, where almost all dairy in the MDB is located, the extent of potential exposure to SDLs is likely to be substantially mitigated by the investment in water buy-backs and irrigation efficiency.

10.3.1 Recap: sensitivity and adaptive capacity

As discussed in chapter 8, dairy farming is highly sensitive to water availability, as it generally cannot compete on the market as effectively as horticulture. Dairy farmers are nearly as highly indebted as rice farmers, although less of their assets are held as water. However, dairy farmers irrigate a higher proportion of their farm.

At present, most dairy businesses are in a holding pattern, trying to minimise the impact of continued low water allocations and low milk price but waiting for the drought to break. Farms have converted feeding systems from perennial pastures to annual crops and bought-in feeds with low water availability having reduced margins. The ability to reinvest in their farming operations to achieve the step gains in water use efficiency required in the short-term is limited.

If the water availability and price experienced over the past four years continue, conditions will not be sustainable for a dairy industry that is exposed to the export market.

Declining water availability in future would run counter to the widespread expectation in the industry that rainfall levels will increase and that water allocations will improve in the future, and provide them an opportunity to recover and replenish their financial reserves, which have been depleted by successive years of low water availability. Farms that have taken on additional debt based on this expectation will find it harder than they expected to service that debt (all other things being equal) if water availability actually declines long-term.
If water availability for dairy were to continue to decline into the future, it would be expected to continue to drive adaptation trends that developed during the drought. In particular:

- the change in feeding systems - from perennial pasture to more flexible and complex feeding systems with an increased focus on annual crops, lucerne and annual pastures and greater use of bought-in feed - would be expected to continue, improving risk management but with concomitant negative impacts on farm profitability;

- farm numbers will continue to decline as average farm size increases (for instance, in Victoria during the 1980s and 1990s farm numbers dropped by one third, but production more than doubled);

- a suite of water use efficiency improvements will continue to be implemented on-farm, from improved border check, fast flow, spray irrigation, automation, soil moisture monitoring and sub-surface drip that will all contribute to improvements in water use efficiency. Each farm business will implement the technology that best suits their farm, farming system, skill set and financial position. Where available, farms will link with the Northern Victorian Irrigation Renewal Project (NVIRP) in the GMID; and

- in addition to water use efficiency, farmers will continue to seek to improve productivity and adopt new technology. Farms will need to implement cost-effective farm systems more broadly, to allow them to continue to be world competitive, if the industry is to retain the critical mass required in the GMID region.

A key requirement for farmers contemplating investment in productivity improvements will be an adequate level of confidence to make the required investment. That confidence will be influenced by the:

- level of efficiency they will achieve with the adoption of the new technology;

- total capital cost of installation;

- implications for running costs with future increases in energy costs if the new technology adopted requires pumping; and

- future access to water impacted by climate change and government policy.

Water trading is part of the suite of management tools that farmers use to run their businesses. Some farms are able to manage this component of their business very well while others struggle. It is assumed that the temporary water price will increase as water availability declines. Dairy farmers will make decisions on whether to buy or sell depending on milk price, cost of bought-in feeds and how well they can use the water available. The milk price tends to be volatile with farm gate prices between about $0.3-$0.5/litre over recent years.

All things being equal, the higher the water price, the more likely it is that dairy farmers will be net sellers and substitute water with bought-in feed. However, a future of significantly higher water prices scenario would drive dairy farmers to sell water, rather than use it to grow home-grown feed, will create risks for the dairy sector, as dairy farms will become less cost-competitive because feed-lots have higher unit production costs than irrigated permanent pasture.
10.3.2 Reported impacts: face-to-face interviews

MJA’s face-to-face interview program found that:

- a 20% reduction in water availability compared to the long-term average would represent higher water availability than has been available in the past five years. This scenario will drive some recovery in the industry as dairy still will have access to reasonable volumes of water both from allocations and from temporary water trading to support home-grown feed requirements. Reduced water availability would drive more adoption of improved irrigation technology. Dairy would be in a position to compete effectively for water at the expense of mixed farming operations;

- over the medium to longer term, if water availability improves from the very low levels of the past four years, then dairy farms will be in a position to replenish their financial reserves and reinvest in their farming operations. The ability to access support through government on-farm water use efficiency programs will be critical to assist farms as they invest the required capital in improving their irrigation systems on farm;

- the affordability of water will change from year to year depending on the prices for key inputs/outputs and the margin that farmers can achieve through the use of that water. In recent years, farm decisions around use of water and feed have been driven by the desire to maintain a core herd and minimise losses, so that the farm is in a good position to respond when the operating environment improves;

- a 40% reduction would represent a lower level of water availability than the last ten years. This would see significant change within the dairy industry unless productivity improvements can be made. In the GMID, milk production has declined by 27% in the last four years as farms have reduced production or exited the industry due to the drought conditions and low water availability. Most farms that continue to operate are anticipating that rainfall conditions will improve and that they will see improved water allocations in the future. A reduction of 40% would see many farms question their ability to adjust to the new operating environment;

- a reduction in water availability of around 50% to 60% would see a major reduction in the number of viable dairy farms. This would then have significant flow-on impacts to the regional communities, with reduced processing required; and

- at a 60% water availability reduction, the ability of existing irrigation industries to pay for irrigation infrastructure would also be in doubt. This is because the burden of operations and maintenance costs would increase per unit of water.

These observations are consistent with the findings of the MJA telephone survey.\(^{109}\)

10.3.3 Reported impacts: telephone survey

In the telephone survey, individual farmers were asked about the impact of -20% and -40% LTCE allocations. In fact, at a regional scale, 20% of LTCE has already been secured for the environment through buy-backs and efficiencies in the GMID (see chapter 5), where 95% of dairy occurs. This

\(^{109}\) In the telephone survey, farmers were asked about -20% and -40% reduction; see note 170 for explanation.
means that individual farmer reductions of 20% or 40% would be equivalent, at a regional scale, to reductions of 40% and 60% respectively. Accordingly, the telephone survey scenarios have been re-scaled to ensure internal consistency in reporting of regional and sectoral results.

The telephone survey found that:

- if water availability were to return to the Long Term Cap Equivalent (LTCE), i.e., 0% reduction in long-term availability, very few (<1% of farmers overall, generally retirees) would seek to exit, and dairy producers would stop bringing in fodder and intensive feed systems, with some increasing stock numbers; and

- there is a sharp increase in the proportion of farmers who would seek to exit the sector between the 40% and 60% water availability reduction scenarios.

The detailed changes in farm activities predicted by farmers who indicated they would stay on farm are set out in Figure 27 (from the telephone survey).

For those who would not exit, but would change operations, changing the farm mix and increasing irrigation efficiency would be dominant strategies.

Primarily, dairy farmers indicated they would reduce their irrigated area, irrigate more intensively on more productive areas, and use intensive feed systems. Destocking and drying off would rise

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**Figure 26. Dairy: telephone survey - responses to water availability scenarios**

<table>
<thead>
<tr>
<th>Water availability reduction scenario</th>
<th>Percent of farmer respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40% (regional: equivalent to reduction of 20% for individual farmers)</td>
<td>20% Seek to exit, 38% Change farming activities, 42% No change to farming activities</td>
</tr>
<tr>
<td>-60% (regional: equivalent to reduction of 40% for individual farmers)</td>
<td>30% Seek to exit, 30% Change farming activities, 40% No change to farming activities</td>
</tr>
</tbody>
</table>

Source: Marsden Jacob Associates. 2010. Farm survey technical report. n=50 (-40% scenario). n=47 (-60% scenario). Note that farmers were asked about -20% and -40% reduction; for the GMID, which is over 90% of dairy in the MDB, the extent of buybacks and efficiency savings is around 20% meaning that for most dairy farmers, a 20% reduction in available water for irrigation individually would equate to around a 40% reduction against LTCE allocations regionally, so this graph’s horizontal axis has been re-scaled accordingly.
from 6% to 27% of survey respondents as the magnitude of their individual reduction in water availability increased from 40% to 60%.

Source: Marsden Jacob Associates, 2010. Farm survey technical report. Only significant results are reported. In the telephone survey, farmers were asked about -20% and -40% reduction; see note to Figure 26.

**Regional impacts**

The viability of the $2 billion investment in NVIRP may also be questioned if water availability falls beyond the levels assumed by the NVIRP business case. While detailed analysis of this issue was not within the scope of this assignment, questions about NVIRP’s viability appear to arise at scenarios of 40% or more water availability reduction.

**10.4 Annual horticulture**

**10.4.1 Recap: sensitivity and adaptive capacity**

As discussed in chapter 8, annual horticulture has relatively low sensitivity to water availability, because water is a relatively low input cost, where the largest input cost is labour. Annual horticulture generally will buy water on the market – although as water prices rise, annual horticulture will move to lower-cost regions.

Production of annual crops is highly mobile. Growers will move to areas with higher water security (other factors equal). It would also be expected that different price points will affect
where production is located, although this will also be constrained by other factors such as proximity to markets and the impact of summer temperatures on summer vegetables.

Accordingly, decisions regarding the level of plantings depend more on supply and demand in the fruit and vegetable market than water availability.

If water availability decreased substantially, the industry would not experience significant closure in the first instance. Rather, those businesses with the capacity would relocate to more water-reliable regions and, in the case of higher-value plantings, purchase water from other broadacre agricultural industries.

Producers of higher value plantings are reasonably well placed to respond to a reduction in water availability by purchasing water to offset reductions.

Producers of lower value plantings may respond to reduced water availability by not planting and by selling water (and increasing production again, if water availability returns to long-term average levels). A reduction in the level of lower-value plantings would result in loss of production and employment.

Low water allocations have led to very high levels of irrigation management and as a consequence, no further step change in practice is expected if future water availability continues to decline. Irrigation practices are influenced not only by water availability and water price but also by crop needs. For instance, overhead irrigation of lettuce would be expected to continue due to its cooling ability compared to drip irrigation.

10.4.2 Reported impacts: face-to-face interviews

MJA’s face-to-face interview program found that, depending on what happens to the affordability of water, a significant reduction in the scale of annual horticultural plantings would not be expected to occur unless water availability was reduced significantly, estimated to be below 40% to 60% of the long-term average:

- a 20% reduction in long-term water availability would be less of a restriction than that experienced over the last 5 years. It would be likely, therefore, that there would be some expansion in annual horticulture;
- a 40% reduction in long-term water availability would represent similar water availability conditions to those experienced in last 5 years, noting though that this is highly variable between regions. In these circumstances the status quo of the industry would be likely to be maintained; and
- a 60% reduction in long-term water availability would represent conditions similar to those experienced in the worst year of drought and in these circumstances, only high-value plantings would continue.

Note that MJA’s telephone survey program treated annual and perennial horticulture together (see Figure 28).

Value-adding packing and processing will also be impacted upon by these reductions. For example, much of the packing and processing has been under-capacity during the drought.
10.5 Perennial horticulture

10.5.1 Recap: sensitivity and adaptive capacity

As discussed in chapter 8, perennial horticulture has relatively low sensitivity to water availability, because water is a relatively low input cost; the sector generally will buy water on the market. However, perennial horticulture cannot relocate easily, for climatic reasons, and also because of the long lead-time to maturity, and the long life of plantings.

So long as the enterprise remains profitable, perennial horticulture generally will be a net buyer of water for plantings with a high gross margin per ML and a high expected future gross margin per ML (to keep plantings alive). The capital cost of replacing perennial horticulture is a high motivator to buy water.

Historically, perennial horticulture has purchased water to protect current and future returns. The cost of replanting and waiting for full production represents a high capital cost that can be avoided by purchasing water to keep trees and vines alive. This has been the major driver in water purchase decisions in the recent drought.

However, over the long-term, perennial horticulture will only pay what it is profitable to pay. This is estimated to not exceed 10% of the gross income per ML, which varies between $1,000/ML and $3,000/ML (i.e., $100 to $300/ML). Where the expectation is for low margins, water will be sold, as has recently occurred in the wine grape industry.

If, over the long-term, water prices consistently exceed this level, then perennial horticulture would be expected to become a net seller of water. Over the short-term, it may pay more to protect plantings, but only if the expectation is that the purchase is an intermittent event.

At present, the sector has dried-off unprofitable plantings, and in the longer term there will be some re-investment and re-development to newer, higher value varieties. This redevelopment will take place over a long time-frame due to current high debt levels and limited access to capital. High debt levels have arisen due to negative profitability in recent years from funding of water purchases and low commodity prices in some sectors.

In the last 3 years of low allocations, ‘under-irrigation’ (not meeting crop water requirement) has been prevalent and, in general, a costly strategy. This is not sustainable (and is leading to the build-up of salt in the root zone) so is not assumed to continue given water availability reduction scenarios.

Water management practices have changed dramatically as a result of the last five years of low allocations. This has included investment in irrigation technology. Higher reductions will lead to removal of plantings rather than further practice change. No further step change in irrigation practices is expected.

In perennial horticulture, small properties are less than 15 ha, medium 15 – 50 ha, and large more than 50 ha.

Increasing property scale magnifies profits and losses. In unprofitable periods large scale can be a disadvantage (i.e., it multiplies the loss) while small properties – despite their lack of economies of scale - are insulated by access to off-farm income.
Medium sized properties are most at risk and have been disappearing at the greatest rates. This is because they have less access to off-farm income, economies of scale or diversification options.

Over the long-term large properties have the advantage of economies of scale and ability to diversify crops, which is why the long-term trend is for horticultural businesses to expand, usually doubling every twenty years. In the older districts most family businesses now own several blocks, each originally set up to support one family.

10.5.2 Reported impacts: face-to-face interviews

MJA’s face-to-face interview program found that:

- a 20% reduction in long-term water availability would be less of a restriction than experienced over the last 5 years and the industry has contracted and adjusted to a greater reduction than this. Some re-development and expansion would be expected, with the exception of wine grapes;

- at 20% reduction compared to historic availability, perennial horticulture sales of temporary High Security water from Murrumbidgee and NSW Sunraysia would be likely to cease. Other regions probably already have dried off sufficient areas not to need to buy (i.e., 20% already dried off from the drought, assuming that this is not replanted in the intervening period).

- a 40% reduction in long-term water availability would represent similar water availability conditions to those experienced over the last 5 years. The industry therefore would be likely to maintain the status quo in current levels of plantings. The wine-grape sector would continue to remove plantings. Some reduction in Murrumbidgee citrus plantings may occur as the region has not experienced reduced allocations recently. Continuation of this low level of water availability would impact upon the critical mass of some industries. The impacts on older community-supplied irrigation areas would be extreme and they would be likely to be unviable;

In this scenario, horticulture would be a purchaser of entitlement and allocation to protect existing high value plantings in low allocation years. There would be further drying off of lesser profitable plantings depending on commodity price and water price. Critical mass of some industries and community districts would be threatened; and

- a 60% reduction in long-term water availability would be similar to the worst year of drought. In these circumstances, there would be no re-development, with continued drying off and removal of low value plantings from wine grapes and other industries. There would be a significant impact in Murrumbidgee on high security users in the citrus and grapes industry. Critical mass of a number of industries would be lost. The impacts on older community-supplied irrigation areas would be extreme and they would be likely to be unviable:

Purchase of water would continue to increase where economically viable. This would depend primarily on commodity price and water price. The critical mass of most industries and community districts would be threatened.

This was broadly consistent with the findings of MJA’s telephone surveys.
10.5.3 Reported impacts: telephone survey

As noted above, the telephone survey results refer to perennial and annual horticulture combined. The key results are:

- if water availability were to return to the Long Term Cap Equivalent (LTCE), i.e., 0% reduction in long-term availability, very few farmers (<1% overall, generally retirees) would seek to exit and horticulture producers would restock, with some also upgrading irrigation infrastructure; and

- if water availability were to reduce compared to LTCE, then at 20% reduction around 30% of farmers would seek to exit while 32% changed their farming activities. At 40% reduction, the number seeking to exit would rise to 37% (with a further 37% making no change in either scenario; Figure 28).

Figure 28. Horticulture: telephone survey responses to water availability scenarios

Horticulture producers have fewer farm change options available to them, as a result of the inherently lower flexibility of their farm setup, and their smaller area of operations. The dominant strategy of those farmers that indicated they would change operations in response to less water would be to trade in water, seek more off-farm income, and dry-off less productive or lower value plantings. Some scope for increasing irrigation efficiency is evident.

Source: Marsden Jacob Associates, 2010. Farm survey technical report. n=115 (-20% scenario). n=115 (-40% scenario). Includes both annual and perennial horticulture.
Regional Impacts

All horticultural industries have a high regional value adding and processing capacity e.g., wineries, packing sheds, transport companies. This capacity has been built on the basis of long-term average water availability. Any reduction would be expected to impact on the employment and value adding occurring in each region. Many industries may depart as critical mass is lost.

Significant closure of perennial horticulture is estimated to occur if long-term availability of water falls below 60% of long-term cap equivalent. This would likely lead to:

- water purchase from other broad-acre industries (mixed farms, dairy, rice), if affordable over the long-term. This would be for higher value plantings;
- further removal of less profitable/unprofitable plantings, particularly in older community supplied districts, where growers may take up off-farm employment;
- departure of growers from the industry;
- unviable community supplied irrigation districts; and
- closure of much of the regional processing and packing facilities. There has already been some closure of wineries.

Source: Marsden Jacob Associates, 2010. Farm survey technical report. Only significant results are reported. Includes both annual and perennial horticulture.


11 Irrigation region impacts

**Key points – Regional Impacts**

Reducions in irrigation water availability from current levels will impact negatively every irrigation region, even at the 20% water availability reduction scenario. Farmer impacts will reduce the intensity of economic activity as a result of exits, conversion to dryland farming or other reductions in intensity due to on-farm adjustments to reduced water. Trade will mitigate impacts in more profitable regions and exacerbate in less profitable regions. These on-farm impacts will flow on to reduced economic activity and employment in the towns, particularly smaller towns.

Across the cotton regions of northern NSW and the Queensland Lower Balonne:

- at 20% reduction, the Lower Balonne will see investments in water use efficiency and some sale of entitlements where that is allowed. At 40% and 60% reductions, cotton expansion will reduce, farmers will become increasingly likely to exit, some properties will consolidate and cotton gins will start to close, with a decline in employment opportunities and increased migration of people from the region. There are limited alternative employment opportunities in the Lower Balonne, which also has low population and relatively high disadvantage;
- Gwydir, Namoi, Border Rivers, Macquarie and Lachlan are highly dependent on cotton. A 20% reduction in water availability would see significant loss of economic activity in communities such as Goondiwindi. At 40% the economic impact would be major, and at 60%, would significantly undermine smaller cotton-based towns; and
- the Lachlan and Macquarie also are highly dependent on cotton, but the larger urban centres of Dubbo, Forbes and Cowra have more diverse economies and would be relatively less impacted than smaller towns.

The Murray and Murrumbidgee will be particularly negatively impacted, even by relatively smaller reductions in water availability for irrigation, because those regions are dominated by rice. Murrumbidgee may be less affected, because of the higher number of entitlements per hectare for Murrumbidgee farms. Across these two regions:

- at 20% reduction, some rice farms would struggle, and some smaller ones would become unviable. Some larger businesses would attempt to restructure their businesses, and purchase water entitlements or annual allocated water to maintain productivity;
- at 40% reduction, many rice farms would become unviable and the number of dairy farmers would decline, while at 60% reduction, almost all rice farms would become unviable;
- while rice farmers would try to adjust to changed water availability, their options are limited due to farm size, the level of irrigation development, the generally poorly drained soils and low rainfall. Farm consolidation would be very difficult and will not be feasible for many areas; and
- the impact on horticulture, which has been partly protected from drought by its High Security entitlements, would depend to a significant extent on the way the NSW Government chooses to implement reductions in the consumptive pool with respect to High Security entitlements.

For the northern Victorian regions of Goulburn, Murray, Campaspe and Loddon (the GMID):

- a 20% reduction in LTCE would represent an increase relative to drought, and would be met through existing buybacks;
- at 40% reduction in water availability, negligible water would be available for mixed farming, and the horticulture and dairy industries would remain static – or dairying may shrink further due to a loss in confidence. Some would buy water from mixed farming and the NSW rice regions; and
- at 60% reduction in water availability the GMID’s dairy industry would experience a serious decline and loss of confidence with loss of GVAP of around $490 million, or over $1 billion in economic activity. Furthermore, the irrigation system would need to shrink to around half the scale assumed in the NVIRP business case; it is not certain that NVIRP would be economically viable in this scenario, with a greater operations and maintenance burden per unit of water.

For the Nyah to border region (including NSW and Victorian Sunraysia) and the SA Riverland:

- horticulturists would buy in water in response to a 20% LTCE reduction, drying off less viable plantings;
- at 40% LTCE reduction, drying off would expand and some industries would be threatened with negative flow-on impacts into the community, which relies heavily on horticulture and food processing for economic activity; and
- at 60% the industry would contract to private diverter areas, outside the historic irrigation districts, and the regional community would become increasingly welfare-dependent.
This chapter summarises the expected impacts of reductions in water availability in each of the water irrigation regions. These impacts reflect the context, the assessed sensitivity of each region to water reductions and the translation to the region of the impacts to key sectors.\textsuperscript{110}

As noted, the regions tend, with some exceptions, to be dominated by one particular sector.\textsuperscript{111}

Our reporting of the impacts of long-term reductions in water availability on a region-by-region basis discusses first, the flow-on from the farm to the regional towns, and then the flow-on impacts to the agricultural value chain and local communities. Where several regions are dominated by one particular agricultural activity, and where the outcomes of discussions with regional people indicated broadly similar contexts and issues, the regions are discussed collectively.

The following pages represent the emerging views of key regional stakeholders (repeated collectively in Table 14 and Table 15), and the outcomes of the telephone survey conducted as part of this assignment.

It is likely that those regions that are more remote, and more dependent on agriculture rather than other sources of economic activity, will find it relatively harder to adapt constructively to reduced long-term water availability.

\textsuperscript{110} This chapter is a synthesis of impacts discussed in greater detail in the Irrigation Region profiles, provided in Part 2 of this report. The reader is referred to those profiles to gain a better appreciation of the unique features of each Irrigation region.

\textsuperscript{111} Horticulture is predominant in SA, NSW and Victoria in the regions around Mildura. Half of the total annual vegetable crops are grown in the Murrumbidgee. Irrigated dairying in the MDB occurs almost entirely within the GMID regions. Rice farming systems are concentrated in southern NSW. The more northerly regions tend to be dominated by cotton.
Economic and social profiles and impact assessments in the Murray-Darling Basin

### Table 14. Summary of farm level impacts (face-to-face interview program)

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Balonne</td>
<td>Cotton (St George Irrigation Scheme – temp trade possible)</td>
<td>Water availability is marginally lower than long-run average use. Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. More opportunistic cropping.</td>
<td>Water availability is approximately 30% less than long run average use. Capital investment in water use efficiency under co-funding. Some temporary trade. Embedded opportunistic cropping. Severely limited investment in expansion. Potential for some consolidation of properties. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 50% less than long run average use. Significant temporary trade. Region predominantly opportunistic cropping. No capital expansion. Irrigators will sell water. Some irrigators will exit industry.</td>
</tr>
<tr>
<td>Lower Balonne</td>
<td>Cotton (Lower Balonne WMA – no temp trade)</td>
<td>Water availability is approximately 5% lower than pre-drought long-run average use. Some water use efficiency (including capital expenditure under co-funding). More opportunistic cropping. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 30% less than long run average use. Capital investment in water use efficiency under co-funding. Embedded opportunistic cropping. Severely limited investment in expansion. Potential for some consolidation of properties. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 50% less than long run average use. Region exclusively opportunistic cropping. No capital expansion. Irrigators will sell water. Some irrigators will exit industry.</td>
</tr>
<tr>
<td>Lower Balonne</td>
<td>Horticulture (Grapes, other)</td>
<td>Some water use efficiency (including capital expenditure under co-funding).</td>
<td>Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. Depending on commodity prices, changes to areas under production (e.g., disestablishment of crops if prices cannot justify water use efficiency or trading). Largely opportunistic annual horticulture crops.</td>
<td>Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. Depending on commodity prices, changes to areas under production. Disestablishment of crops if prices cannot justify water use efficiency or trading. Largely opportunistic annual horticulture crops.</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>Cotton, horticulture, livestock</td>
<td>Reduced profitability, scaling back of production, efforts to reduce costs, many exiting irrigation, resulting in water market adjustments.</td>
<td>Significant cuts in production and consolidation of water onto fewer farms through water market adjustments.</td>
<td>Further significant cuts in production and consolidation of water onto many fewer farms through water market adjustments.</td>
</tr>
<tr>
<td>Gwydir</td>
<td>Cotton, broadacre, livestock</td>
<td>Reduced profitability, scaling back of production, efforts to reduce costs, many exiting irrigation, resulting in water market adjustments.</td>
<td>Significant cuts in production and consolidation of water onto to fewer farms through water market adjustments.</td>
<td>Further significant cuts in production and consolidation of water onto to many fewer farms through water market adjustments.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Cotton</td>
<td>Contraction from peak planting in 2001 directly proportional to the reduced allocation. Some consolidation of properties but continued viability.</td>
<td>An equivalent reduction in production lost (i.e, ~40%). Many smaller properties would cease to irrigate.</td>
<td>At this level of allocation most of the off-river irrigation schemes could not afford to operate. This would effectively sterilise cotton growing in the valley.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Horticulture: viticulture and citrus</td>
<td>There is a small horticulture sector with access to High Security entitlement and/or groundwater. This sector would be able to buy water to maintain production.</td>
<td>High Security is only 2.6% of total entitlement so it is assumed that horticulture would be able to survive under all 3 three scenarios.</td>
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</tr>
<tr>
<td>Region</td>
<td>Key sectors</td>
<td>-20% LTCE</td>
<td>-40% LTCE</td>
<td>-60% LTCE</td>
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<tr>
<td>-------------</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Horticulture</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by the more efficient and highly developed farm businesses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by a limited number of efficient businesses. Subject to water prices and commodity prices, likely to be a moderate reduction in as less viable growers cease to operate due to increased water expenses.</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Lucerne, cotton and winter crops</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by larger farms or farms producing specialist products. A number of the smaller and mid-size farms become unviable.</td>
<td>Most farms reliant on irrigated agriculture become marginal or unviable.</td>
<td>Significant rationalisation of the number of irrigation farms with most farms being dependent on dryland agriculture.</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Horticulture</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by up to 75% of growers.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by more efficient and highly developed farms. Likely reduction in production as less-viable growers cease to operate due to increased water expenses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by a limited number of efficient businesses. Subject to water prices and commodity prices, likely to be a moderate reduction in production.</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Rice based farm systems</td>
<td>Strategic purchase of allocated water by larger farms or farms producing specialist products. Many farms become marginal or unprofitable. A number of the smaller and mid size farms become unviable</td>
<td>Many farms become unviable.</td>
<td>Almost all farms become unviable.</td>
</tr>
<tr>
<td>Central Murray</td>
<td>Dairy</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans. Likely to be a reduction in production due to less viable growers ceasing to operate due to increased water expenses.</td>
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<td>Central Murray</td>
<td>Horticulture</td>
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<td>Many farms become unviable.</td>
<td>Almost all farms become unviable.</td>
</tr>
<tr>
<td>GMID</td>
<td>Dairy</td>
<td>As this scenario will be met from buy-back and improved irrigation efficiency, the remaining irrigators will be able to expand if there is a return to historical inflows.</td>
<td>No water would be available for mixed farming and horticulture and dairy industries would remain static. Dairying may shrink further due to a loss in confidence.</td>
<td>Milk production would fall by about half (about 1.4 billion litres/year). The dairy industry would experience a serious decline and loss of confidence with loss of GVAP of $490 million at a milk price of 35 c/L.</td>
</tr>
<tr>
<td>GMID</td>
<td>Horticulture</td>
<td>Negligible impact</td>
<td>Orhcrds (i.e., perennial) will access water, probably want to own it and not trade.</td>
<td>Orhcrds (i.e., perennial) will access water, probably want to own it and not trade. Note: cost of water may be prohibitive.</td>
</tr>
<tr>
<td>Nyah to Border (incl NSW and Vic Sunraysia)</td>
<td>Perennial and annual horticulture</td>
<td>Mostly purchase water; some drying off of older and unviable plantings</td>
<td>Drying off of larger areas. Critical mass of many industries threatened. Community District viability threatened</td>
<td>Contraction to smaller industry, mostly located in private diverter areas.</td>
</tr>
<tr>
<td>Riverland</td>
<td>Perennial and annual horticulture</td>
<td>Mostly purchase water some drying off of older and unviable plantings</td>
<td>Drying off of larger areas. Critical mass of many industries threatened. Community District viability threatened</td>
<td>Contraction to smaller industry mostly located in private diverter areas.</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Diverters (mainly horticulture)</td>
<td>No major impact. Permanent plantings face higher costs to buy water to match water needs. Reduction in the area of annual horticulture.</td>
<td>Major reduction in production with drying-off of significant areas of vines and orchards. Annual horticulture would retrench and seek alternative locations.</td>
<td>Abandonment of permanent plantings as price of water trade likely to be prohibitive. Annual plantings would transfer to areas with more secure supplies, e.g., groundwater in the SE of the state.</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Dairy</td>
<td>20% could be managed with improvements in irrigation and selection of better properties.</td>
<td>Major reduction in the area irrigated. Transfer of irrigation to highlands to grow fodder crops. Much water sold to other sectors.</td>
<td>Closure of dairy sector. Could not operate with this level of allocation.</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Dairy</td>
<td>Limited restoration of previous sector with use of existing centre pivots to grow fodder crops.</td>
<td>Very limited opportunistic watering to supplement feed.</td>
<td>Confirmation of closure of irrigated sector</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Viticulture</td>
<td>Probably manage. Greater use of groundwater to off-set + water trade. Many growers have some surplus entitlement.</td>
<td>Mothballing and drying off of area planted plus water trade to back-fill. Increased groundwater usage. Reduction in viability.</td>
<td>Closure of many growers due to increased costs and reduced water availability.</td>
</tr>
</tbody>
</table>
## Table 15. Summary of community-level impacts (face-to-face interview program)

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Balonne</td>
<td>Cotton, grapes and other horticulture</td>
<td>Some positive impacts from implementation of water use efficiency.</td>
<td>One gin in broader Lower Balonne will possibly close. Permanent migration out of the region, changing demographics (reduced people of working age) and impacting on the viability of many businesses and the potential viability of some government services.</td>
<td>One gin in the broader Balonne Region will close permanently. Permanent migration out of the region, changing demographics (reduced people of working age) and impacting on the viability of many businesses and the potential viability of some government services.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Cotton processing</td>
<td>A permanent reduction in production would see consolidation of processing capacity with closure of one gin (5 were operating in 2001; one already has closed due to drought).</td>
<td>Probable halving of the processing capability with closure of two gins. Significant reduction in employment and value adding.</td>
<td>Questionable viability of processing within the valley. High likelihood of consolidation of ginning capacity across valleys with transfer of cotton to Namoi.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Service sectors</td>
<td>Some loss of capacity and employment across sectors including retail, pubs and clubs.</td>
<td>Major impact on service sectors - undermining the quantum needed to support these services.</td>
<td>Not viable with the loss of most of the specialist contracting skills and services required.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Government services</td>
<td>A challenge to the continued availability of services including police, schools and healthcare outside the major centre of Dubbo.</td>
<td>Risk to the viability of smaller communities such as Warren with likely slide into welfare dependency.</td>
<td>High probability of severe retrenchment in local services. Dubbo would then face major challenges from the increased demand for services from the wider region.</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Horticulture</td>
<td>Post-farm processing and direct marketing expected to continue to occur at similar levels subject to commodity prices and water prices.</td>
<td>Post-farm processing and direct marketing expected to continue to occur at lower levels subject to commodity prices and water prices.</td>
<td>Post-farm processing expected to occur at lower levels due to reduced production. There is likely to be reduced farm production.</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Broadacre</td>
<td>Freight of hay and grain and grain handling and storage requirements reduced. Cotton gin at Hillston to reduce capacity.</td>
<td>Freight of hay and grain and grain handling and storage requirements reduced. Cotton gin at Hillston to reduce capacity.</td>
<td>Post farm processing of irrigated production to be significantly reduced.</td>
</tr>
</tbody>
</table>
### Economic and social profiles and impact assessments in the Murray-Darling Basin

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murrumbidgee</td>
<td>Horticulture</td>
<td>Post-farm processing expected to continue to occur at similar levels subject to commodity prices and water prices.</td>
<td>Post-farm processing expected to occur at lower levels and may involve the rationalisation of citrus packing facilities. Any rationalisation of wine industry infrastructure and citrus juicing infrastructure will depend on a broader restructure of these industries across the Riverland, Sunraysia and Murrumbidgee regions.</td>
<td>Post-farm processing expected to occur at lower levels due to reduced production. There is likely to be reduced farm production and rationalisation of post-farm processing infrastructure.</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Rice</td>
<td>Rice aerated storages to be rationalised. Only one mill in the region likely to operate.</td>
<td>Rice mill at Coleambally unlikely to operate.</td>
<td>Most rice storage facilities likely to be closed and milling would only occur at Leeton.</td>
</tr>
<tr>
<td>Central Murray</td>
<td>Horticulture</td>
<td>Post farm processing expected to continue to occur subject to commodity process and water prices.</td>
<td>Post farm processing expected to continue to occur subject to commodity prices and water prices, however at a smaller level due to fewer growers.</td>
<td>Post farm processing expected to continue to occur subject to commodity prices and water prices, however at a smaller level due to fewer growers.</td>
</tr>
<tr>
<td>Central Murray</td>
<td>Dairy</td>
<td>Milk processing expected to continue to occur in northern Victoria.</td>
<td>Milk processing expected to continue to occur in northern Victoria, however at a smaller level due to fewer growers.</td>
<td>Milk processing expected to continue to occur in northern Victoria, however at a smaller level due to fewer growers.</td>
</tr>
<tr>
<td>Central Murray</td>
<td>Rice</td>
<td>Rice aerated storages to be rationalised. One of two mills at Deniliquen unlikely to operate.</td>
<td>Rice Mill at Deniliquen unlikely to operate.</td>
<td>All rice storage and milling facilities likely to be closed.</td>
</tr>
<tr>
<td>GMID</td>
<td>Dairy, horticulture, mixed</td>
<td>Already delivered by buy-backs and NVIRP.</td>
<td>Already delivered by buy-backs and NVIRP, although may affect confidence leading to towns dependent on dairy coming under threat</td>
<td>This would result in loss of $1 billion in economic activity, loss of processing capacity and it is likely only one of seven dairy factories would remain in operation. Towns reliant on dairying (Cohuna, Kyabram, Numurkah, Stanhope), would shrink significantly and become welfare dependent.</td>
</tr>
<tr>
<td>Nyah to Border (including NSW and Vic Sunraysia)</td>
<td>Perennial and annual horticulture</td>
<td>Some loss of plantings resulting in reduced seasonal work and closure of some wineries.</td>
<td>Larger scale losses of plantings and resulting lost direct and indirect employment. Community district viability questionable for some areas. Large scale social impacts would be expected e.g., High unemployment and social costs.</td>
<td>Large scale employment loss and high social impacts. Increase in welfare dependencies. Very large scale social impacts expected.</td>
</tr>
<tr>
<td>Riverland</td>
<td>Perennial and annual horticulture</td>
<td>Some loss of plantings resulting in reduced seasonal work and closure of some wineries.</td>
<td>Larger scale losses of plantings and resulting lost direct and indirect employment. Community district viability questionable for some areas. Large scale social impacts would be expected e.g., High unemployment and social costs.</td>
<td>Large scale employment loss and high social impacts. Increase in welfare dependencies. Very large scale social impacts expected.</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Horticulture (except wine grapes)</td>
<td>Retention of current activity</td>
<td>Closure of local vegetable and fruit packing due to reduction in scale</td>
<td>Closure of sector</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Meat</td>
<td>Retention of current activity as local produce only a small % of total input and most from dryland properties</td>
<td>As for -20%</td>
<td>As for -20%</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>Dairy</td>
<td>Rationalisation of milk processing plants with closure of Jervois factory.</td>
<td>Risk of closure of Murray Bridge plant and transfer of milk to other regional factories</td>
<td>Closure of Murray Bridge plant and transfer of milk produced to other regional factories</td>
</tr>
</tbody>
</table>
## Wine

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA Murray below</td>
<td>Wine</td>
<td>Little impact - some smaller wineries may close faced by higher overall costs.</td>
<td>Transfer of wine-making to larger regional wineries outside the region in line with approach by Orlando Wines, Fosters.</td>
<td>Retention only of smaller boutique wineries with cellar door sales.</td>
</tr>
</tbody>
</table>
11.1 Qld Lower Balonne

11.1.1 Farm level impacts

The main agricultural product in the Lower Balonne is cotton, which is grown in the St George Irrigation Scheme and the Lower Balonne Water Management Area.

Permanent water trading between irrigators as a market-driven structural adjustment mechanism is not possible in the Lower Balonne. An important further constraint in the Lower Balonne Water Management Area is that temporary water trade is not possible, which reduces options for water availability risk management for farmers in that area. Temporary trade is possible in SunWater’s St George Irrigation Scheme, largely to finish off crops (typically less than 20,000 ML/annum). In addition, recent changes to the Condamine Balonne Resource Operations Plan enable the sale of water to the Commonwealth.

Enhancements to scheme efficiencies by SunWater (e.g., lining channels) are limited as they generally are not commercially viable within current pricing arrangements.

Horticulture, including grapes, also occurs in the region.

Opportunities for diversification into higher value crops (margins per ML) are agronomically possible. However, these options are commercially limited by a lack of competitive advantage in the Lower Balonne and access to capital. In addition, these markets tend to be very small and wholesale crop changes would likely result in significant reductions in prices received (due to oversupply into key markets).

The most likely response to any permanent and material reduction in SDLs would be a wholesale shift into lower value dryland broadacre crops, with irrigation only being practiced on the rare occasions when water is very plentiful.

A wholesale shift out of cotton would be a major concern to the region as irrigated cotton produces over eight times as much employment per hectare as dryland crop alternatives.

Farm-level impacts in the Condamine Balonne at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 16.
## Table 16. Lower Balonne: summary of farm level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Balonne</td>
<td>Cotton (St George Irrigation Scheme – temp trade possible)</td>
<td>Water availability is marginally lower than long-run average use. Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. More opportunistic cropping.</td>
<td>Water availability is approximately 30% less than long run average use. Capital investment in water use efficiency under co-funding. Some temporary trade. Embedded opportunistic cropping. Severely limited investment in expansion. Potential for some consolidation of properties. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 50% less than long run average use. Significant temporary trade. Region predominantly opportunistic cropping. No capital expansion. Irrigators will sell water. Some irrigators will exit industry.</td>
</tr>
<tr>
<td>Lower Balonne</td>
<td>Cotton (Lower Balonne WMA – no temp trade)</td>
<td>Water availability is approximately 5% lower than pre-drought long-run average use. Some water use efficiency (including capital expenditure under co-funding). More opportunistic cropping. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 30% less than long run average use. Capital investment in water use efficiency under co-funding. Embedded opportunistic cropping. Severely limited investment in expansion. Potential for some consolidation of properties. Some irrigators may consider selling water.</td>
<td>Water availability is approximately 50% less than long run average use. Region exclusively opportunistic cropping. No capital expansion. Irrigators will sell water. Some irrigators will exit industry.</td>
</tr>
<tr>
<td>Lower Balonne</td>
<td>Horticulture (Grapes, other)</td>
<td>Some water use efficiency (including capital expenditure under co-funding).</td>
<td>Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. Depending on commodity prices, changes to areas under production (e.g., disestablishment of crops if prices cannot justify water use efficiency or trading). Largely opportunistic annual horticulture crops.</td>
<td>Some water use efficiency (including capital expenditure under co-funding). Some temporary trade. Depending on commodity prices, changes to areas under production. Disestablishment of crops if prices cannot justify water use efficiency or trading. Largely opportunistic annual horticulture crops.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

### 11.1.2 Community impacts

The lower Balonne is relatively remote, with a small population (3,800 people and declining). The regional economy is probably more reliant on agriculture than any other regional economy in Queensland, with approximately 36% of employment directly in agriculture.

There is a significant concern amongst the community that the permanent introduction of reduced SDLs would trigger further declines and permanent losses of key services (e.g., health clinics and schools). The recent drought has already resulted in population decline, specifically in areas such as Dirranbandi. This has already resulted in a decline in some community services.

In addition to the direct responses by the irrigation industry, the flow-on impacts of reduced water availability also would impact on the broader community, particularly through the loss of jobs and flow-on expenditure. Under the 40% and 60% scenarios there would be likely to be a permanent migration out of the region, impacting on the viability of many businesses (e.g., service stations and retail outlets) and the potential viability of some government services (particularly education services and health services). The demographics of the region would be likely to change and welfare dependency would be likely to increase sharply, particularly in areas with a less mobile labour force (e.g., Indigenous people working in Dirranbandi).
From a structural adjustment perspective, the Lower Balonne provides a difficult challenge as there are few, if any, viable alternative economic activity opportunities in the region.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 17.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Balonne</td>
<td>Cotton, grapes and other horticulture</td>
<td>Some positive impacts from implementation of water use efficiency.</td>
<td>One gin in broader Lower Balonne will possibly close. Permanent migration out of the region, changing demographics (reduced people of working age) and impacting on the viability of many businesses and the potential viability of some government services.</td>
<td>One gin in the broader Lower Balonne Region will close permanently. Permanent migration out of the region, changing demographics (reduced people of working age) and impacting on the viability of many businesses and the potential viability of some government services.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.2 NSW/Qld Border Rivers and NSW Gwydir and Namoi

11.2.1 Farm level impacts

Cotton accounts for more than 80% of the irrigated area in the Gwydir, Namoi, and Border Rivers.

The relationship between water availability and economic activity is more or less a straight line; the more water available for irrigation, the more economic activity. Consequently, in addition to the usual concerns about variable water availability, uncertainty about future water security currently is influencing confidence and investment in irrigation enterprises. In particular, uncertainty about the nature of the move to SDLs is eroding confidence and investment.

Under the 20% scenario irrigators would initially scale back production and try to minimise costs. Irrigators would take what opportunities they could to grow crops opportunistically, but there is very limited potential for business transformation.

Most farms are too small to be viable dryland enterprises, and most farmers want to generate a return from their existing investments in on-farm water infrastructure. Cotton is where they have most potential to make money in the long-run and the future for the cotton industry is bright if they have enough water to produce a viable crop.

The 20% scenario would affect people’s profitability and would see some people leaving farming.

The 40 and 60% scenarios would result in major changes. A series of market adjustments would consolidate the remaining water on to fewer farms.

Irrigators are wary of prorate reductions; they feel it would not give significant recognition to previous reforms that have already reduced the volumes of water that they can expect to receive,
and the reliability with which they can expect to receive those nominal volumes. Irrigators would welcome recognition of what they have already done to improve the sustainability of irrigation.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 18.

Table 18. Border Rivers, Gwydir, Namoi: summary of farm level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border Rivers</td>
<td>Cotton, horticulture, livestock</td>
<td>Reduced profitability, scaling back of production, efforts to reduce costs, many exiting irrigation, resulting in water market adjustments.</td>
<td>Significant cuts in production and consolidation of water onto fewer farms through water market adjustments.</td>
<td>Further significant cuts in production and consolidation of water onto many fewer farms through water market adjustments.</td>
</tr>
<tr>
<td>Gwydir</td>
<td>Cotton, broadacre, livestock</td>
<td>Reduced profitability, scaling back of production, efforts to reduce costs, many exiting irrigation, resulting in water market adjustments.</td>
<td>Significant cuts in production and consolidation of water onto fewer farms through water market adjustments.</td>
<td>Further significant cuts in production and consolidation of water onto many fewer farms through water market adjustments.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.2.2 Community impacts

Recent research commissioned by the Cotton Catchment Communities CRC\textsuperscript{112} examined case study communities (Narrabri, Moree, Narromine, Warren in NSW and a defined region on the Darling Downs in Queensland) and found that:

- where the cotton industry is a significant industry, even the most diversified town economies (which tended to be the least remote) are strongly dependent on cotton; and

- there has been only slow improvement in overall growth and the development of a more diverse economic structure. Limited opportunities to derive additional value for the region’s natural resources, and/or developing new businesses that are primarily based on technology, knowledge and human capital. Businesses based on technology, knowledge and human capital are more likely to establish in ‘lifestyle’ areas closer to the coast.

A 20% reduction in water availability would see a significant loss of economic activity in water dependent communities such as Goondiwindi.

At 40% the economic impact would be major, and at 60%, would significantly undermine the viability of smaller cotton-based towns.

The owners of small businesses in the smaller agricultural towns feel particularly vulnerable to the potential reduction in water diversions. Their livelihoods are affected, but they don’t have any control over the decisions to buy or sell water.

A reduction in irrigated agriculture would have a big impact on small centres, which could be reduced to welfare-dependency and also see a reduction in services. This would make it harder again for farmers in the more remote parts of the catchment to attract and retain skilled workers, especially those workers who have young families and desire ready access to schools and other services.

The owners of small businesses in the smaller agricultural towns would be particularly vulnerable to the potential reduction in diversions. Their livelihoods would be affected, but they don’t have any control over the decisions to buy or sell water.

Cotton processing has been a significant contributor to the local economy both through direct employment opportunities and through the major servicing sector that it has supported. Many of these facilities currently are retained but are running at throughputs below break-even. Reductions in water availability beyond 20% would trigger closure of several of these plants.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 19.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border Rivers</td>
<td>Cotton, horticulture, livestock</td>
<td>Significant loss of economic activity in water dependent communities</td>
<td>Major loss of economic activity in water dependent communities and significant loss of activity in more diverse centres</td>
<td>Catastrophic loss of economic activity in water dependent communities and major loss of activity in more diverse centres</td>
</tr>
<tr>
<td>Gwydir</td>
<td>Cotton, Broadacre, livestock</td>
<td>significant loss of economic activity in water dependent communities</td>
<td>Major loss of economic activity in water dependent communities and significant loss of activity in more diverse centres</td>
<td>Catastrophic loss of economic activity in water dependent communities and major loss of activity in more diverse centres</td>
</tr>
<tr>
<td>Namoi</td>
<td>Cotton, Broadacre, livestock</td>
<td>significant loss of economic activity in water dependent communities</td>
<td>Major loss of economic activity in water dependent communities and significant loss of activity in more diverse centres</td>
<td>Catastrophic loss of economic activity in water dependent communities and major loss of activity in more diverse centres</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.3 NSW Macquarie

11.3.1 Farm level impacts

Cotton is the major irrigation farm product in the region, with some horticulture. The region also is a centre for cereal cropping and is famous for its Merino studs.

There is a direct correlation between water availability and the level of cotton production. This largely is a function of the level of allocation of General Security entitlement. Any reduction in water allocated for diversions would translate into a reduction in the total area under irrigation.
On the other hand, the cotton sector has seen a remarkable and continuing growth in productivity over the last five years, so that the same production now can be generated from 35,000 ha which previously required 55,000 ha - and with a reduction in the total water required.

The cotton sector is used to responding to highly variable levels of water availability, with the ability to adjust the area under cultivation to match available water supplies. The water markets and carry-over also have been important tools in helping maximise the area planted. Note that inter-valley trade is not available for the Macquarie (there is minor trade between the Macquarie irrigation region and Cudgegong).

The cotton sector comprises two scales of operation: a small number of major corporate players with fully vertically-integrated businesses, and a large number of small, family farms that supply cotton product to the gins operated by those major players. There is a mutual dependence between the sectors. The small players rely on the major corporate entities as their route to market access, while the majors rely on the family farms to maximise the throughput of their processing plants.

Because cotton can be so responsive to water availability, any reduction in long-term water availability around the 20% mark would see a correlating reduction in production. However, at a 40% reduction, many smaller properties would cease to irrigate.

A reduction in water availability of more than 40% would challenge the viability of cotton production as it would not be possible to operate the multiple off-river schemes that provide the majority of the irrigation.

At a 60% reduction, most of the off-river irrigation schemes could not afford to operate, which effectively would sterilise cotton growing in the valley.

Any reduction in allowable diversions would be likely to impact differentially on these two categories:

- the major players would be able to buy up additional entitlement to maintain their own production. This would follow recent experience where Auscott has been able to maintain a minimum level of production over the recent seasons, at least to cover its fixed costs of production, as it has access to water out of the upgraded Nevertire scheme and has purchased additional water as required;

- most of the small properties are supplied from the older off-river schemes. These have not been able to operate during the last eight years of low allocations. Several of the schemes are likely to close and those that remain will see major rationalisation to reduce scale and water losses. These pressures will be stronger as the level of reduction increases. There is likely to be a resulting consolidation in the family-farm sector with a growth in medium sized properties at a more competitive scale; however

- too strong a contraction in the level of activity amongst family farms would undermine the viability of the major corporate entities, who rely on the additional product to achieve economies of scale in processing.

The small horticulture sector has access to High Security entitlement and/or groundwater. This sector would be able to buy water to maintain production. As High Security is only 2.6% of total
entitlement, it is assumed that horticulture would be able to survive under all three water availability reduction scenarios.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 20.

Table 20. Macquarie: summary of farm level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macquarie</td>
<td>Cotton</td>
<td>Contraction from peak planting in 2001 directly proportional to the reduced allocation. Some consolidation of properties but continued viability.</td>
<td>An equivalent reduction in production lost (i.e., ~40%). Many smaller properties would cease to irrigate.</td>
<td>At this level of allocation most of the off-river irrigation schemes could not afford to operate. This would effectively sterilise cotton growing in the valley.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Horticulture: viticulture and citrus</td>
<td>There is a small horticulture sector with access to High Security entitlement and/or groundwater. This sector would be able to buy water to maintain production.</td>
<td>High Security is only 2.6% of total entitlement so it is assumed that horticulture would be able to survive under all 3 three scenarios.</td>
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</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.3.2 Community impacts

Outside Dubbo, the region is highly reliant on agriculture for employment and wealth creation, with most employment in the irrigation districts linked to cotton.

Cotton processing is an important component of the regional economy. It has traditionally provided skilled employment in the more remote communities based around the five gins in the region. These have been major sources of investment and employment. One of the five gins has already closed as a response to the drought, with only one of the other four operating consistently through the recent seasons.

Three of the gins are moth-balled but with an expectation that they will re-open when allocations return ‘to normal’. A formal reduction in the long-term access to diversions would provide a signal for reduction in the level of processing across the region. A greater than 40% reduction in diversions would be likely to see all gins close and processing consolidated in neighbouring valleys, i.e., threatening the presence of the significant cotton processing capability.

There is a strong sense across the community that the smaller towns are on a knife-edge. Cotton production and processing have traditionally generated sufficient return to support a vibrant secondary service sector at the local scale. That has sustained the economy and population of the local small towns, which has justified retention of government services. Reduction of employment and revenues beyond 40% would risk the viability of these smaller centres such as Warren, with a potential slide into welfare dependency.

Even if there were a return to historic levels of water allocation it is questionable whether communities would bounce back as:

- there has been a loss of service sectors to support smaller farms;
- technological change has reduced the demand for labour; and
- water buy-backs have reduced the total volume of water available for cotton.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 21.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macquarie</td>
<td>Cotton processing</td>
<td>A permanent reduction in production would see consolidation of processing capacity with closure of one gin (5 were operating in 2001; one already has closed due to drought).</td>
<td>Probable halving of the processing capability with closure of two gins. Significant reduction in employment and value adding.</td>
<td>Questionable viability of processing within the valley. High likelihood of consolidation of ginning capacity across valleys with transfer of cotton to Namoi.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Service sectors</td>
<td>Some loss of capacity and employment across sectors including retail, pubs and clubs.</td>
<td>Major impact on service sectors - undermining the quantum needed to support these services.</td>
<td>Not viable with the loss of most of the specialist contracting skills and services required.</td>
</tr>
<tr>
<td>Macquarie</td>
<td>Government services</td>
<td>A challenge to the continued availability of services including police, schools and healthcare outside the major centre of Dubbo.</td>
<td>Risk to the viability of smaller communities such as Warren with likely slide into welfare dependency.</td>
<td>High probability of severe retrenchment in local services. Dubbo would then face major challenges from the increased demand for services from the wider region.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

### 11.4 NSW Lachlan

#### 11.4.1 Farm level impacts

Irrigated agriculture is a major economic driver in the upper Lachlan upstream of Jemalong Weir, and in the lower Lachlan around Hillston. Vegetables and horticulture enterprises are located in the upper (Cowra) and lower (Hillston) areas, while cotton was a major crop pre-drought in the lower catchment. Lucerne and winter crops are major irrigated enterprises in the mid catchment.

Vegetable, horticultural, cotton and specialist lucerne producers in the upper and lower catchment have a high dependency on irrigation.

Any reduction in long-term water availability will financially impact farmers in the Lachlan.

A material reduction in water availability in the mid and upper catchment will impact on the smaller farms and lead to an increased reliance on groundwater and a long-term reduction in economic production (note that access to groundwater is being heavily reduced through state-based reforms at present, as discussed in chapter 6.2). This will result in reduced lucerne, summer crop (primarily cotton) and livestock production.

All vegetable and horticulture produce currently is generated from groundwater or high security water use. Any reduction in water use or a reduction in seasonal reliability will impact on the...
highly geared farm businesses that have major year round supply contracts with supermarkets, fast food outlets and processors.

Subject to annual water prices and commodity prices, the horticultural industries generally have greater capacity to use the trade market to offset reduced annual water allocations. These industries have historically generated higher returns per unit of water. An adjustment to lower water availability will result in increased operating costs to these businesses. A number of these businesses have recently purchased groundwater entitlements in response to the reduction in groundwater availability introduced as part of the 2008 Groundwater Sharing Plan. The major groundwater adjustment process implemented in 2008 limits the scope for further adjustment.

It is likely that farm transformation will involve the physical expansion of some farm businesses, a reduced reliance on irrigation water each year and a greater capacity to utilise irrigation water efficiently on a more opportunistic basis on the most suitable land and best developed irrigation layouts. This will require significant aggregation of smaller farms in the upper catchment. Some farm businesses have established major long-term supply contracts with food retailers and processors. These farm businesses are reliant on a reliable water supply.

There is limited scope for the smaller and more intensive irrigated farm businesses to adjust to lower long-term water allocations. Dryland farming is not a long-term viable option for these smaller farms in the upper catchment, without significant farm aggregation. Groundwater is not a long-term viable option for many of the farms presently reliant on this water source due to the high cost of extraction and long-term water quality impacts.

There is limited scope for farm transformation below Lake Cargelligo due to low rainfall. A reduction in water availability in this area will lead to contraction, particularly of cotton production.

The medium size farms in the mid catchment, including Jemalong Irrigation, are likely to be more adversely affected by reduced water availability as they have the least capacity to adjust either via scale (larger farms) or via supplementation with off-farm income (smaller farms).

A long-term reduction in available water is expected to result in a relatively greater reduction in irrigated broadacre production, depending on the scale of reduction. It will be uneconomic for individual farm businesses to undertake the necessary investment to maintain and redevelop irrigation enterprises, using small quantities of irrigation water. It is likely that farm rationalisation will occur with fewer larger farm businesses using the water previously used by the smaller farms. Irrigation is likely to contract from the larger broadacre, predominantly dryland farms in the mid catchment region to be used by the more intensive irrigation farm businesses in the upper and lower catchment. This may also lead to a change in crop mix with less irrigated winter crop grown.

A uniform long-term water availability reduction of up to 20% will result in some farm businesses becoming unviable and many other businesses not able to maintain business growth required to accommodate the long-term cost/price squeeze. Some larger businesses will attempt to restructure their businesses and purchase water entitlements or annual allocated water to maintain productivity. Within Jemalong Irrigation it is estimated that most of the smaller businesses (20% of the total businesses) would be expected to cease operation.

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The impacts of the water scenarios evaluated will impact differently on the region’s broadacre farms. It is expected that the smaller farms and a number of the midsized farms will become unviable, if the long-term water availability was reduced by 20% compared to the long-term average diversion limit. Any further increase in the level of reduction will increase the proportion of farms becoming unviable. A 60% reduction in the long-term water availability is expected to lead to significant restructuring of the irrigated agricultural sector.

A reduction in the long-term water availability of greater than 20% will result in medium to larger farm businesses becoming unviable with direct flow-on impacts occurring at a community level.

A reduction in long-term water availability in the order of 60% will not be as severe as the drought conditions experienced since 2002-03, however the impacts are expected to be similar; that is, a continuation of the erosion of working capital, increased borrowings and realisation of assets to meet commitments.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 22.

### Table 22. Lachlan: summary of farm level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lachlan</td>
<td>Horticulture</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by the more efficient and highly developed farm businesses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by a limited number of efficient businesses. Subject to water prices and commodity prices, likely to be a moderate reduction in as less viable growers cease to operate due to increased water expenses.</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Lucerne, cotton and winter crops</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by larger farms or farms producing specialist products. A number of the smaller and mid-size farms become unviable.</td>
<td>Most farms reliant on irrigated agriculture become marginal or unviable.</td>
<td>Significant rationalisation of the number of irrigation farms with most farms being dependent on dryland agriculture.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

### 11.4.2 Community impacts

The NSW Lachlan region is moderately dependent on irrigation. The economies of the major urban communities of Forbes and Cowra are moderately dependent, while Hillston is highly dependent, on irrigated agriculture.

Mining has been important over the last five years providing significant employment and off-farm income for farming families as well as being a continuing source of economic activity during the drought. The economies of Parkes and Forbes have been underpinned by mining over the last five years. The mines are reliant on water and further expansion of mining will be constrained by access to a reliable water supply. The mines currently use around 3 to 3.5 GL water annually.
There is recognition within the broader community that in the long-term, the reliance on agriculture needs to be reduced and that the regional economy needs to become more diverse. Local government is strongly focussed on seeking to attract new businesses based on cheap land, lifestyle advantages and infrastructure (rail, road and air). It is also looking at new models of service delivery to attract professionals such as health workers. Off-farm income has been important for farming families and the mines at Parkes and West Wyalong have been significant employers.

Increasing the diversity of the regional economy and reducing the reliance on agriculture is an important strategy for local government to minimise vulnerability in the long-term. Access to a reliable water supply will be important to attract new businesses. Reliability of water supply and the health of the Lachlan River in the Cowra area are seen to be important components of that local economy.

The lucerne and crop based businesses would suffer the most significant initial impacts from reduced water availability, even at the 20% reduction scenario. The initial impacts will be a reduction in farm inputs, freight from the farm to the grain storage, farm level processing and reduced labour requirements. A significant proportion of the irrigated produce is transported and marketed within the Sydney Basin.

Cotton processing at the Hillston gin would be expected to decline in all water availability reduction scenarios.

Reduced water availability would impact the horticultural industries in the region; impacts would be relatively small at water availability reductions of around 20%, but much higher at 40-60%.

The impacts of reduced water availability initially would be felt within the Cowra, Forbes and Hillston business communities and to a lesser extent Condobolin. The larger centres have been underpinned by High Security water allocations and groundwater during the drought. They will, however, be directly impacted by flow-on effects from any reduction in General Security water availability as a significant number of the region’s businesses provide services to the broadacre irrigated industries.

Subject to the scale of the reduction in water availability the flow-on effects could have substantial impacts on the level of services local Government can provide and other services including health, education and policing, particularly in Hillston.

There are few if any economic development opportunities from increased environmental flows that would be expected to offset the impacts on irrigated agriculture.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 23.
Table 23. Lachlan: summary of community-level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lachlan</td>
<td>Horticulture</td>
<td>Post-farm processing and direct marketing expected to continue to occur at similar levels subject to commodity prices and water prices.</td>
<td>Post-farm processing and direct marketing expected to continue to occur at lower levels subject to commodity prices and water prices.</td>
<td>Post-farm processing expected to occur at lower levels due to reduced production. There is likely to be reduced farm production.</td>
</tr>
<tr>
<td>Lachlan</td>
<td>Broadacre</td>
<td>Freight of hay and grain handling and storage requirements reduced. Cotton gin at Hillston to reduce capacity.</td>
<td>Freight of hay and grain handling and storage requirements reduced. Cotton gin at Hillston to reduce capacity.</td>
<td>Post farm processing of irrigated production to be significantly reduced.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.5 NSW Murrumbidgee

11.5.1 Farm level impacts

The major commodities produced in the Murrumbidgee are rice, citrus, wine grapes, winter grain crops (wheat, and canola) and livestock (lambs). A range of other commodities are produced in smaller amounts, including other winter and summer crops, fodder crops and vegetables. The rice and horticultural industries across the region dominate in the more intensively irrigated areas because of relatively higher farm-level profitability.

As for NSW Central Murray, any reduction in long-term water availability will financially impact farmers.

Rice and horticulture producers make up around 90% of the farm businesses and have a high (or total) dependency on irrigation. Relatively high historic allocations of 1,300-1,400 ML per broadacre farm (6-7 ML/ha) and 12 ML/ha for horticulture blocks have provided a buffer for lower annual water allocations. Only a small proportion of farm businesses have access to both surface water and groundwater.

While farmers would try to adjust to changed water availability, their options are limited. This is particularly the case for rice farming systems. There is limited scope for farm transformation for Murrumbidgee and Coleambally irrigation districts due to the size of the farms, the level of irrigation development, the generally poorly drained soils and low rainfall. Most farms are too small to become viable dryland farm businesses, and would face similar constraints to conversion to dryland as in NSW Central Murray (discussed in chapter 11.6). A transformation to dryland agriculture is not considered a feasible option for many areas in the Murrumbidgee region.

Also as with NSW Central Murray, medium size farms are likely to be more adversely affected by reduced water availability as they have the least capacity to adjust either via scale (larger farms) or via supplementation with off-farm income (smaller farms). Off-farm income generation is more feasible where the demands of running the farm allow time and/or financial freedom for at least one of the farm business partners (usually a spouse) to be away from the farm.

A uniform long-term water availability reduction of up to 20% would result in some farm businesses becoming unviable and many other businesses not able to maintain the business growth required to address the long-term cost/price squeeze. Some larger businesses would
attempt to restructure their businesses, and purchase water entitlements or annual allocated water to maintain productivity. Many smaller businesses would be expected to cease operation.

A reduction in the long-term water availability of greater than 20% will result in many farm businesses becoming unviable with direct flow-on impacts occurring at a community level. At a 40% water availability reduction, the number of dairy farmers would decline and many rice farm systems would become unviable.

A reduction in long-term water availability in the order of 60% will be equivalent to the drought conditions experienced since 2002-03. Experience over the past 7 years has shown that farm businesses have severely eroded working capital, increased borrowings and realised assets to meet commitments. In this scenario, almost all rice farms would become unviable.

In recent years in the Murrumbidgee, there has been a trend for conversion from rice based farming to horticulture, primarily grapes (although at present the downturn in the wine industry limits further opportunity). Subject to annual water prices and commodity prices, horticultural industries generally have greater capacity to use the water market to offset reduced annual water allocations, because these industries have historically generated higher returns per unit of water – although this is an increased operating cost to these businesses. Young, innovative wine grape growers who have expanded to their full water allocation will be impacted by a reduction in long-term water availability.

Horticulture has partially been shielded from the extreme impacts of the drought as these businesses are based on High Security entitlements; many horticultural businesses have more High Security entitlements than required to meet their annual water requirements in most years, so they sell their surplus on the temporary trade market each year, which also helps underpin their economic viability. The extent to which horticulture would be affected by reduced long-term water availability would depend to a significant extent on the way the NSW government implements any SDL with respect to High Security entitlements.

Subject to commodity process and water prices, horticultural growers may enter the annual water market and purchase water from other industry groups either from within the region (e.g., mixed broadacre farms) or from other regions such as NSW Central or lower Murray, Sunraysia or from the Riverland. Generally there are three broad groups of growers:

- highly geared farm businesses where the annual water requirements are similar to the long-term yield of the entitlements held. Any reduction in water availability would impact directly on these businesses either by reduced production or increased costs to purchase replacement water. It is estimated that around 35% of businesses would be within this group;

- moderately geared farm businesses where the annual water requirements are slightly (10-20%) lower than the long-term yield of the entitlements held. This lower level of dependency is akin to a risk margin to buffer the business from the impacts of short-term reductions in water availability. A long-term reduction in water availability would increase the risk exposure of these businesses and increase the business operating costs in low water availability years, nullifying their deliberate risk management strategy. It is estimated that around 40% of businesses would be within this group; and

- less intensive farm businesses that may not have expanded in previous years, may source off-farm income and trade a proportion of their allocated water each year. In most years around
30-40 GL (10-20%) of High Security allocation is traded. A reduction in long-term water availability initially would reduce the level of income for these businesses from reduced water sales. Any subsequent increase in water prices due to reduced water supply would to some extent offset this impact. It is estimated that around 25% of businesses would be within this group.

It may be noted in face-to-face interviews, a number of farmers expressed a concern that a material reduction in water availability would impact on their ability to manage environmental stewardship of the natural resources on their property.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 24.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murrumbidgee</td>
<td>Horticulture</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by up to 75% of growers.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by more efficient and highly developed farms. Likely reduction in production as less-viable growers cease to operate due to increased water expenses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by a limited number of efficient businesses. Subject to water prices and commodity prices, likely to be a moderate reduction in production.</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Rice based farm systems</td>
<td>Strategic purchase of allocated water by larger farms or farms producing specialist products. Many farms become marginal or unprofitable. A number of the smaller and mid size farms become unviable.</td>
<td>Many farms become unviable.</td>
<td>Almost all farms become unviable.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.5.2 Community impacts

Irrigated agriculture is the major economic driver within the Murrumbidgee region. The major urban communities of Griffith, Leeton, Darlington Point and Coleambally have a high dependency on irrigated agriculture. Post-farm processing of irrigated agricultural produce is a major economic driver and involves rice processing, wineries, citrus processing, and packing sheds for sugar plums, tomatoes and, more recently, almonds.

The impacts of reduced water availability on the rice and non rice-based farm system businesses would be expected to precipitate major flow-on effects. While there is anticipated to be an effect on the horticultural industries in the region this is likely to be relatively small unless the reductions in water availability were 40-60%.

Initial impacts would include a reduction in farm inputs, less freight from the farm to the grain storage and processing facilities, and diminished labour requirements to operate rice milling and storage facilities. Prior to the drought the rice industry operated rice milling facilities at Griffith, Leeton and Coleambally. The Leeton facility is the only rice mill currently operating, and this will
continue to be the case unless rice production returns to levels produced prior to the drought. The Griffith mill has been decommissioned.

At a 20% reduction in long-term water availability, rice aerated storages would be rationalised and only one mill in the region would be likely to operate. At a 40% reduction, the rice mill at Coleambally would be unlikely to operate, while at 60% reduction, most rice storage facilities would be likely to be closed and milling would only occur at Leeton.

If water availability declined, horticultural post-farm processing would be expected to occur at lower levels and may involve the rationalisation of citrus packing facilities. The widespread implementation of reduced water availability throughout the southern basin would likely trigger a broader restructure of these industries across the Riverland, Sunraysia and Murrumbidgee regions.

The impacts of reduced water availability initially would be felt within the Coleambally business community, and to a lesser extent the Darlington Point community. However, the Darlington Point community would be directly impacted by any changes made to groundwater use.

The larger centres of Griffith and Leeton have been underpinned by High Security water allocations during the drought. They would, however, be directly impacted by flow-on effects from any reduction in General Security water availability, as a significant number of the region’s businesses provide service to rice and other broadacre irrigated industries. Subject to the scale of the reduction in water availability the flow-on effects could have substantial impacts on the level of services local Government can provide and other services including health, education and policing.

The region’s wine industry has a vision to be the major wine producing region. There is currently over $2 billion of post-farm gate wine industry infrastructure within the region and approximately 25% of the grapes processed are imported from outside the region. A significant reduction in water availability would reduce the efficiency of this investment and the diverse service businesses it supports.

Regional people perceive that there are few (if any) significant economic development opportunities from increased environmental flows that would offset the impacts of loss of irrigated agriculture.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 25.
Table 25. Murrumbidgee: summary of community-level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murrumbidgee</td>
<td>Horticulture</td>
<td>Post-farm processing expected to continue to occur at similar levels subject to commodity prices and water prices.</td>
<td>Post-farm processing expected to occur at lower levels and may involve the rationalisation of citrus packing facilities. Any rationalisation of wine industry infrastructure and citrus juicing infrastructure will depend on a broader restructure of these industries across the Riverland, Sunraysia and Murrumbidgee regions.</td>
<td>Post-farm processing expected to occur at lower levels due to reduced production. There is likely to be reduced farm production and rationalisation of post-farm processing infrastructure.</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>Rice</td>
<td>Rice aerated storages to be rationalised. Only one mill in the region likely to operate.</td>
<td>Rice mill at Coleambally unlikely to operate.</td>
<td>Most rice storage facilities likely to be closed and milling would only occur at Leeton.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.6 NSW Central Murray

11.6.1 Farm level impacts

Major enterprises in the NSW Central Murray irrigation region include mixed farms growing rice, winter crops and pastures for livestock production and dairying in the mid-Murray region (Finley, Deniliquin and Wakool), citrus in the south west and winter crops and pastures for livestock fattening in the upper and mid-NSW Central Murray areas. Rice farms generally are broadacre mixed irrigation farms producing rice, winter crops, and pastures for stock. The rice and dairy industries dominate water use in the more intensively irrigated areas because of relatively higher farm level profitability.

During the drought, rice based farms have transformed into mixed farms that are not producing rice. Dairy farms have transformed from (permanent) pasture based grazing to feedlot based fodder systems. Most inputs of grain and fodder have been sourced locally by these dairy farms.

Any reduction in long-term water availability will financially impact farmers. While farmers would try to adjust to change water availability, their options are limited. This is particularly the case for rice farming systems.

A key option for adjusting to reduced water availability is to expand farm size, to increase economies of scale and dryland farming. Farm ownership within the Murray Irrigation area has been consolidated over the past 30 years (the original 2,400 landholdings are now owned and operated by approximately 1,200 farm businesses). At present, in response to drought, some farmers are continuing to attempt to reduce their dependence on the supply of irrigation water by increasing farm size.

Conversion to more dryland farming may be an option for some farmers, but in the main is considered impracticable for the region because:

- a substantial degree of consolidation of irrigation farms would be required to develop economic dryland farms (between 2,000 to 4,000 hectares) where by comparison irrigation
farms generally comprise two or three 200 hectare blocks. A transformation to dryland agriculture accordingly would require the aggregation of 5-10 farms into a single farm business. It is logistically challenging to achieve this level of consolidation, and would entail both a loss of property value (for sellers), and sufficient capital in the hands of potential buyers – but the ability for farmers to access capital generally has been seriously eroded by drought;

- in a scenario of long-term reduced water availability farmers will not be able to restore the working capital of their business coming out of drought;
- once soils have been laser-levelled for water-efficient rice farming they may not be suited to other forms of farming, and can be difficult to move machinery across;
- there would be high costs associated with changing irrigation layouts; and
- for dairy farmers, dryland farming will only be an option if the milk price is sufficiently high and a reliable supply of locally based fodder is available. The reliability of sufficient available fodder in the region is questionable, and sourcing fodder from further afield would be uneconomic except when milk prices are high.

Subject to annual water prices and commodity prices, the dairy industry is more able than the rice industry to use the trade market to offset reduced annual water allocations. This adjustment, however, will be an increased operating cost to these businesses.

Farm size in the West Corurgan and Moira Private Irrigation Districts is larger and the number of water entitlements held on a land area basis is lower than for the Murray Irrigation area. These farms are relatively less dependent on irrigation water with the irrigated area of West Corurgan serviced farms being around 10% of the total farm area.

Another option for adjusting to reduced water availability is diversification into high-value enterprises. There is limited scope for high value enterprise diversification, at least in the short-term. There have been numerous attempts to encourage diversification into higher value industries within the Murray Irrigation Limited area over the past 10-15 years, but they have struggled because of factors such as the lack of local processing facilities (a catch-22, as businesses won’t invest in processing until product is being grown).

Medium size farms would be likely to be more adversely affected by reduced water availability as they have the least capacity to adjust either via scale (larger farms) or via supplementation with off-farm income (smaller farms). Off-farm income generation is more feasible where the demands of running the farm allow time and/or financial freedom for at least one of the farm business partners (usually a spouse) to be away from the farm.

A uniform long-term water availability reduction of up to 20% would result in some farm businesses becoming unviable and many other businesses not able to maintain business growth required to address the long-term cost price squeeze. The broadacre mixed irrigation farms producing winter crops, pastures for stock, and rice would be most sensitive to reduced water availability. Some larger businesses will attempt to restructure their businesses and purchase water entitlements or annual allocated water to maintain productivity. Many smaller businesses would be expected to cease operation.
A reduction in the long-term water availability of greater than 20% would result in many farm businesses becoming unviable with direct flow-on impacts occurring at a community level. At a 40% water availability reduction, the number of dairy farmers would decline and many rice farm systems would become unviable.

A reduction in long-term water availability in the order of 60% would be equivalent to the drought conditions experienced since 2002-03. Experience over the past 7 years has shown that farm businesses have severely eroded working capital, increased borrowings and realised assets to meet commitments. In this scenario, almost all rice farms would become unviable.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 26.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Murray Dairy</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans. Likely to be a reduction in production due to less viable growers ceasing to operate due to increased water expenses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans. Likely to be a reduction in production due to less viable growers ceasing to operate due to increased water expenses.</td>
<td></td>
</tr>
<tr>
<td>Central Murray Horticulture</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans. Likely to be a reduction in production as less-viable growers cease to operate due to increased water expenses.</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans. Likely to be a reduction in production due to less-viable growers ceasing to operate due to increased water expenses.</td>
<td></td>
</tr>
<tr>
<td>Central Murray Rice based farm systems</td>
<td>Strategic purchase of temporary water from season to season where appropriate to farm needs, availability and price, and risk management plans by larger farms or farms producing specialist products. Many farms become unprofitable. A number of smaller and mid size farms become unviable.</td>
<td>Many farms become unviable.</td>
<td>Almost all farms become unviable.</td>
<td></td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.6.2 Community impacts

Deniliquin, in the geographic centre of the NSW Central Murray region, is the largest service centre in the region, with a population of 8,000 people. Smaller towns including Finley, Jerilderie, Berrigan, Barooga, Tocumwal and Barham are dotted around the region.

The regional economy is highly dependent on irrigated agriculture, although the Riverine towns of Barooga, Tocumwal and Barham are to a limited extent buffered by tourism. The major economic driver for each urban area is the provision of services to the irrigated agricultural sector. The
major regional industry is service provision to the agricultural sector. These include rice milling, saw milling, transport services, and cereal, milk and tomato processing facilities.

As discussed in chapter 8, reduced water availability over the past five years has impacted significantly on these industries, and they are currently in a much diminished state, mothballed, or closed, with former employees now working elsewhere (often outside the region) or welfare-dependent.

As discussed above, one response to reduced long-term water availability would be farm consolidation and expansion of dryland farming at the expense of irrigation farming. While there would be significant constraints to this occurring, it would occur to some extent. Farm consolidation would mean fewer farmers requiring a lower intensity of servicing from local businesses. In turn, this would have significant flow-on impacts to the service community and the provision of community services such as health, education, police and recreational facilities.

Whether or not farm consolidation became widespread in the region, major flow-on effects of long-term reduced water availability would be expected to result from the impact on the rice and non rice-based farm system businesses. It is anticipated that there will be a lesser effect on the dairy and horticultural industries in the region.

The initial flow-on impacts from reduced rice farming would include a reduction in farm inputs, freight from the farm to the grain storage and processing facilities and reduced labour requirements to operate the milling and storage facilities.

In 2000-01 the rice industry employed 400 staff at the rice mill facility in Deniliquin. By the time the mill had been put into a ‘care and maintenance’ phase in December 2005 the number of employees had reduced to approximately 80 people. The mill workers generally were skilled tradespeople, and in most cases their families are believed to be still in Deniliquin, with the breadwinner now working in other regions such as in mining in Western Australia. Rebuilding the skilled workforce in Deniliquin would entail attracting skilled workers back to the town. However, if rice production diminishes as a result of reduced long-term water availability, this may not be feasible and will have longer-term impacts for Deniliquin.

The flow-on impacts of reduced water availability would be felt throughout the business community. Subject to the scale of the reduction in water availability they could have substantial impacts on the smaller towns and Deniliquin. This would flow through to the level of services local Government can provide and other services including health, education and policing. The local government authorities are concerned that:

- parts of the population of Deniliquin already are spiralling downwards in socio-economic terms, and becoming increasingly welfare-dependent, and that this would become more serious and entrenched if employment opportunities from irrigated agriculture declined long-term; and

- smaller regional towns will struggle to provide a viable environment for small businesses, and support government services, if the economic base of irrigated agriculture diminishes substantially.

Farmers, catchment managers and local government authority representatives in the region uniformly believe that there are few (if any) significant economic development opportunities from increased environmental flows that would offset the impacts of irrigated agriculture.
Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 27.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Murray</td>
<td>Horticulture</td>
<td>Post farm processing expected to continue to occur subject to commodity process and water prices.</td>
<td>Post farm processing expected to continue to occur subject to commodity prices and water prices, however at a smaller level due to fewer growers.</td>
<td>Post farm processing expected to continue to occur subject to commodity prices and water prices, however at a smaller level due to fewer growers.</td>
</tr>
<tr>
<td></td>
<td>Dairy</td>
<td>Milk processing expected to continue to occur in northern Victoria.</td>
<td>Milk processing expected to continue to occur in northern Victoria, however at a smaller level due to fewer growers.</td>
<td>Milk processing expected to continue to occur in northern Victoria, however at a smaller level due to fewer growers.</td>
</tr>
<tr>
<td></td>
<td>Rice</td>
<td>Rice aerated storages to be rationalised. One of two mills at Deniliquin unlikely to operate.</td>
<td>Rice Mill at Deniliquin unlikely to operate.</td>
<td>All rice storage and milling facilities likely to be closed.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.7 Victorian Goulburn Murray Irrigation District (GMID)

11.7.1 Farm level impacts

The Victorian Campaspe, Loddon, Goulburn and Murray irrigation regions were addressed in an integrated manner as the GMID, an integrated irrigation district managed by Goulburn-Murray Water. As noted in chapter 6.2.3, the region currently is the subject of a multi-billion dollar irrigation modernisation project (NVIRP) funded by irrigators, and the Victorian and Commonwealth governments. Expected water savings for the environment from buy-backs and irrigation water efficiency in the GMID is expected to total some 475 GL, which will have a substantial ameliorating impact on any future SDL.

The GMID extends across much of northern Victoria along the Murray, as well as the Campaspe, Loddon and Goulburn rivers, and ends around Swan Hill where it meets Sunraysia. Around Shepparton, perennial and annual horticulture is very important. The GMID overwhelmingly is the main dairy location for the MDB (with other Australian dairying in the Basin states located in dryland regions with higher rainfall). Mixed farming also is important across the regions.

Water trade is very well-established in the GMID, where horticulture is likely to be able to outcompete dairy and mixed farming to purchase water; likewise, dairy is likely to be able to outcompete mixed farming. Any reduction in water availability is therefore expected to impact on productivity from mixed farming first, and then from dairy, all other things being equal.

Confidence in the irrigated dairy sector already is low. A reduction in water availability presents a real risk of further loss of confidence and a collapse in value of farm assets. Conversely, irrigated dairy farmers tend to believe that there are real opportunities in irrigated dairying (subject to water availability), which are poorly understood in the dryland dairy sector.
A 20% reduction in water availability against the LTCE allocations in the GMID would actually represent an increase in water relative to recent years (if there was a return to historical inflows), and would be delivered through buy-backs. Accordingly, those irrigators who have survived the drought would be able to expand in this scenario, helped further by improved irrigation efficiency.

At a 40% reduction in water availability, negligible water would be available for mixed farming, and the horticulture and dairy industries would remain static – or dairying may shrink further due to a loss in confidence.

At a 60% reduction in water availability the GMID’s dairy industry would experience a serious decline and loss of confidence with loss of GVAP of around $490 million, or over $1 billion in economic activity.

A great deal has been learnt in the last five years about transformation. Farmers have adapted and transformed their businesses, often significantly. However, to an important (but unmeasurable) extent those changes have been short-term coping mechanisms that will not be financially sustainable long-term.

Furthermore, the irrigation system would need to shrink to around half the scale assumed in the NVIRP business case; it is not certain that NVIRP would be economically viable in this scenario, with a greater operations and maintenance burden per unit of water.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 28.

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMID</td>
<td>Dairy</td>
<td>As this scenario will be met from buy-back and improved irrigation efficiency, the remaining irrigators will be able to expand if there is a return to historical inflows.</td>
<td>No water would be available for mixed farming and horticulture and dairy industries would remain static. Dairying may shrink further due to a loss in confidence.</td>
<td>Milk production would fall by about half (about 1.4 billion litres/year). The dairy industry would experience a serious decline and loss of confidence with loss of GVAP of $490 million at a milk price of 35 c/L.</td>
</tr>
<tr>
<td>GMID</td>
<td>Horticulture</td>
<td>Negligible impact</td>
<td>Orchards (i.e., perennial) will access water, probably want to own it and not trade.</td>
<td>Orchards (i.e., perennial) will access water, probably want to own it and not trade. Note: cost of water may be prohibitive.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

### 11.7.2 Community impacts

The regional economy of the GMID and all urban centres is highly dependent, and founded on, irrigated agriculture. Reduced water availability will have a direct effect on employment.

At a 40% reduction in water availability, towns dependent on dairy, such as Cohuna, Kyabram, Numurkah and Stanhope, would be under threat in terms of local business viability, and the viability of services as people move away in search of employment.

A 60% reduction in water availability would result in loss of dairy processing capacity and it is likely that only one of the current seven dairy processing factories would remain in operation.
Towns reliant on dairying (e.g., Cohuna, Kyabram, Numurkah, Stanhope) would shrink significantly or become increasingly welfare-dependent.

Tourism is considered an opportunity based around the Murray River and the Kerang Lakes, however the industry requires significant development and will not be able to match the regional economic contribution made through irrigated agriculture if there are significant changes to water availability in the future.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 29.

### Table 29. GMID: summary of community-level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMID</td>
<td>Dairy, horticulture, mixed</td>
<td>Already delivered by buy-backs and NVIRP.</td>
<td>Already delivered by buy-backs and NVIRP, although may affect confidence leading to towns dependent on dairy coming under threat</td>
<td>This would result in loss of $1 billion in economic activity, loss of processing capacity and it is likely only one of seven dairy factories would remain in operation. Towns reliant on dairying (Cohuna, Kyabram, Numurkah, Stanhope), would shrink significantly and become welfare dependent.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

### 11.8 SA Riverland, and Nyah to the border (including NSW and Victorian Sunraysia)

#### 11.8.1 Farm level impacts

The South Australian Riverland irrigation region, and Nyah to the border (including NSW and Victorian Sunraysia), are dominated by perennial and annual horticulture, with some livestock farming.

Water security is essential to industry confidence and investment; perennial horticulture particularly depends on high water reliability to protect plantings.

The response to any permanent and material reduction in water availability is uncertain and would depend upon long-term horticultural profitability. At the moment this is low, especially for wine grapes; reduced water availability in the context of low horticultural profitability could result in a likely reduction in horticultural area, no replanting of dried off areas, and people abandoning properties. This would lead to reduced employment in an area where unemployment is already 2% above State averages.  

\[114\] 2009 Mildura Region Economic Profile.
Any policy-driven reduction in water availability would face widespread opposition in the region. For instance, in South Australia, some farmers believe that they were formerly given statutory guarantees of 100% allocation, and are inclined to anger at the prospect of what is perceived as another government-driven reduction in water availability.

Growers have shown flexibility and have a history of changing crops in response to market signals. For example, adaptations currently being implemented in the region that provide examples of the sorts of options available, include:

- intense crops grown to specification on smaller lots e.g., stone fruit growing and packing;
- expansion into nut crops, although with some caution with respect to the potential for oversupply;
- consolidation and redevelopment of citrus enterprises, transferring from juicing to fresh fruit varieties; and
- a return to dried fruit (with some capital costs) by wine grape growers.

The wine grape industry currently is very sensitive to water reduction due to low profitability, but in the face of reducing water availability, other perennial horticulture may be able to survive by buying water. This will be dependent on commodity price and water prices.

However, if horticulture profitability returns then the regions will be able to purchase water from other areas and expand production, as Riverland has over the last fifteen years.

Any reduction greater than 20% of long-term water availability would affect critical mass and community irrigation district viability.

There is no scope for farm transformation to dryland as irrigation property sizes are extremely small (only 0.5 % to 1% of the area required for dryland operations.)

Some growers see a potential opportunity in being able to buy or being supplied water from the environment water holder in dry years and selling or supplying water to it in wet years.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 30.

### Table 30. Nyah to the border and Riverland: summary of farm level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nyah to Border</td>
<td>Perennial and annual horticulture</td>
<td>Mostly purchase water; some drying off of older and unviable plantings</td>
<td>Drying off of larger areas. Critical mass of many industries threatens. Community District viability threatened</td>
<td>Contraction to smaller industry, mostly located in private diverter areas.</td>
</tr>
<tr>
<td>(incl NSW and Vic Sunraysia)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riverland</td>
<td>Perennial and annual horticulture</td>
<td>Mostly purchase water some drying off of older and unviable plantings</td>
<td>Drying off of larger areas. Critical mass of many industries threatens. Community District viability threatened</td>
<td>Contraction to smaller industry mostly located in private diverter areas.</td>
</tr>
</tbody>
</table>

*Source: MJA face-to-face interviews.*
11.8.2 Community impacts

The regional economy is largely based on the irrigation industry. The economy is largely based on grape growing, citrus, almonds, vegetables and the associated wine making, and almond processing. Most of the industries of the Riverland are highly dependent upon irrigated production for their ongoing viability.

There is also a strong tourism component, partly linked to gourmet food and wine. Potential diversification options being considered are solar industries, and the retirement housing market.

Value adding infrastructure includes wineries, packing sheds, juicing factories, transport and supporting industries. The key determinant of water availability reduction impacts would be the relative profitability of horticulture versus the water price for buying in water to maintain the industry. If the water price is affordable then the impacts will be much less.

If water availability were to reduce, investment in water user efficiency would provide initial economic opportunities. However, seasonal work opportunities would reduce. At a 40% water availability reduction, there would be large-scale unemployment impacts and social costs. At 60% reduction, this would become increasingly serious with regional increases in welfare dependency.

Community-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 31.

Table 31. Nyah to the border and Riverland: summary of community-level impacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nyah to Border (including NSW and Vic Sunraysia)</td>
<td>Perennial and annual horticulture</td>
<td>Some loss of plantings resulting in reduced seasonal work and closure of some wineries.</td>
<td>Larger scale losses of plantings and resulting lost direct and indirect employment. Community district viability questionable for some areas. Large scale social impacts would be expected e.g., High unemployment and social costs.</td>
<td>Large scale employment loss and high social impacts. Increase in welfare dependencies. Very large scale social impacts expected.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverland</td>
<td>Perennial and annual horticulture</td>
<td>Some loss of plantings resulting in reduced seasonal work and closure of some wineries.</td>
<td>Larger scale losses of plantings and resulting lost direct and indirect employment. Community district viability questionable for some areas. Large scale social impacts would be expected e.g., High unemployment and social costs.</td>
<td>Large scale employment loss and high social impacts. Increase in welfare dependencies. Very large scale social impacts expected.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.
11.9 SA River Murray below Lock 1

11.9.1 Farm level impacts

The South Australian River Murray below Lock 1, including the farming regions around the Lower Lakes (Alexandrina and Albert), has four fairly discrete sector groups: private diverter horticulturalists; dairy farmers on the reclaimed swamps; dairy farmers supplied from the Lakes; and horticulturalists (mainly vineyards) at Langhorne and Currency Creek.

As noted in chapter 9.3.12, many farmers have been unable to access their allocations since 2008 because of low water levels (and there have been additional problems of water quality, and lost or damaged soils and irrigation assets due to acid sulphate soils and river bank slumping in some areas). The impacts set out in this section assume that farmers can physically access water. A further benefit of greater flows in the Murray below Lock 1 may be – over the long-term – a reduced incidence of acid sulphate soils and river bank slumping.

For horticulture, the response to any permanent and material reduction in water availability is uncertain and would depend upon long-term horticultural profitability. Irrigation is already highly efficient. Reduced water availability in the context of low horticultural profitability could result in a likely reduction in horticultural area, drying-off of permanent plants, and relocation of plantings elsewhere. Annual horticulture has already partially relocated to the south east of the state on non-MDB groundwater, as a drought response.

As discussed in chapter 9.3.12, dairy by the Lower Lakes is less sensitive than dairy on the reclaimed swamps, because large-scale structural adjustment to dryland dairy farming already has occurred around the Lakes; even if irrigation water returned, the sector probably would not return to large-scale irrigation. Reduced water availability long-term would complete this trend by the Lakes. Dryland dairy herds tend to be smaller than irrigated dairy herds (some farms have more than halved their herds in the drought) so less productive.

Dairy on the reclaimed swamps (the Lower Murray Reclaimed Irrigation Area, LMRIA) would grow if water availability returned to historic levels, and would be able to adjust to a 20% reduction on those levels (assuming that land and assets are able to be rehabilitated following serious cracking during the drought). However, at water availability reductions of 40% or more the structural adjustment that has occurred during the drought would be entrenched and continued, with the sector closing at around 60% reduction. Asset fixity is already a problem in the area, with some farms having been put on the market and abandoned; close to towns, some land is being developed for housing. There is no opportunity to transform these highly productive former swamps into other enterprises, because water needs to be retained to meet environmental watering requirements.

Farm-level impacts at the 20%, 40% and 60% water availability reduction scenario are summarised in Table 32.
Table 32. SA Murray below Lock 1: summary of farm level impacts

<table>
<thead>
<tr>
<th>Key sectors</th>
<th>-20% LTCE</th>
<th>-40% LTCE</th>
<th>-60% LTCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversers (mainly horticulture)</td>
<td>No major impact. Permanent plantings face higher costs to buy water to match water needs. Reduction in the area of annual horticulture.</td>
<td>Major reduction in production with drying-off of significant areas of vines and orchards. Annual horticulture would retrench and seek alternative locations.</td>
<td>Abandonment of permanent plantings as price of water trade likely to be prohibitive. Annual plantings would transfer to areas with more secure supplies, e.g., groundwater in the SE of the state.</td>
</tr>
<tr>
<td>Dairy:</td>
<td>20% could be managed with improvements in irrigation and selection of better properties.</td>
<td>Major reduction in the area irrigated. Transfer of irrigation to highlands to grow fodder crops. Much water sold to other sectors.</td>
<td>Closure of dairy sector. Could not operate with this level of allocation.</td>
</tr>
<tr>
<td>Dairy:</td>
<td>Limited restoration of previous sector with use of existing centre pivots to grow fodder crops.</td>
<td>Very limited opportunistic watering to supplement feed.</td>
<td>Confirmation of closure of irrigated sector</td>
</tr>
<tr>
<td>Viticulture:</td>
<td>Probably manage. Greater use of groundwater to off-set + water trade. Many growers have some surplus entitlement.</td>
<td>Mothballing and drying off of area planted plus water trade to back-fill. Increased groundwater usage. Reduction in viability.</td>
<td>Closure of many growers due to increased costs and reduced water availability.</td>
</tr>
</tbody>
</table>

Source: MJA face-to-face interviews.

11.9.2  Community impacts

As noted above, an outcome of increased environmental watering of the Lower Lakes and Coorong may be raised water levels in the River Murray below Lock 1 and the Lower Lakes (noting water levels are likely to face seasonal and annual variability). Analysis of environmental benefit is beyond the scope of this project.

Raised water levels would have a number of important social and economic benefits to the region in addition to the environmental benefit. Excluding the impact of changes to irrigation, social and economic benefits of a healthier environment and higher water levels would be expected to include, among other things, impacts on non-agricultural sectors:

- tourism-related benefits. Tourism in the region includes experiential and eco-tourism, boating, and recreational fishing. Experiential and eco-tourism rely on a vibrant food and wine sector (including wineries and vineyards) and a healthy, aesthetically attractive environment, which depends to a large extent on water for irrigation and the environment. Fishing depends on the ecological health of the River and Lakes. Boating depends on the waters’ ecological health, but also on accessibility to the water, which has been undermined in recent years by falling water levels. The cost of drought to tourism along the entire SA Murray (including above and below Lock 1) has been estimated (as at 2008) at $133.6 million over 1999-2008 (gross regional product) resulting in an average of 192 fewer

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Tourism activities that tourists perceived to be adversely affected by drought include the availability of fishing opportunities, opportunities for water sports, availability of places to swim, the availability of good quality food and wine experiences, the availability of quality golf courses, opportunities for hiking and other nature based activities, the attractiveness of rivers, lakes and farming landscapes, and availability of paddle steamers and houseboats. Ernst and Young, 2010, Destination Visitor Survey Strategic Regional Research Report – NSW, Vic & SA. Impact of the drought on tourism in the Murray River region. Report to the Commonwealth Department of Resources, Energy and Tourism: Tourism Research Australia.
jobs per annum.\textsuperscript{116} If water levels return to a level that allows a healthy environment and accessible water levels, the key drivers for these costs in the region below Lock 1 will be overcome; and

- commercial fishery-related benefits. Although investigations by the SA Government have found that fisheries have not suffered reduced gross value of output because of reduced water levels, possibly as a result of adaptive management by fishery licensees, it notes that low water levels have affected boat manoeuvrability which may affect catch size.\textsuperscript{117}

The regional agricultural value chain includes milk processing factories at Jervois and Murray Bridge, horticulture packing sheds, a major meatworks in Murray Bridge, and a number of wineries.

If water availability were to reduce, initially impacts on the regional agricultural value chain would be small, except for the possible closure of the Jervois milk factory. At a 40\% water availability reduction, food processing would be seriously curtailed, except for meat processing which is not significantly dependent on irrigation farming. At 60\% reduction, most food processing in the region would close except for meat and some boutique wineries. Irrigation water availability reductions that affect wineries and the aesthetics of the region will also flow through to tourism, as discussed above. Reduced employment will continue concerns about school numbers as discussed in chapter 9.3.12.

Community-level impacts at the 20\%, 40\% and 60\% water availability reduction scenario are summarised in Table 35.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|}
\hline
\textbf{Key sectors} & \textbf{20\% LTCE} & \textbf{40\% LTCE} & \textbf{60\% LTCE} \\
\hline
Horticulture & Retention of current activity & Closure of local vegetable and fruit packing due to reduction in scale & Closure of sector \\
\hline
Meat & Retention of current activity as local produce only a small \% of total input and most from dryland properties & As for -20\% & As for -20\% \\
\hline
Dairy & Rationalisation of milk processing plants with closure of Jervois factory. & Risk of closure of Murray Bridge plant and transfer of milk to other regional factories & Closure of Murray Bridge plant and transfer of milk produced to other regional factories \\
\hline
Wine & Little impact - some smaller wineries may close faced by higher overall costs. & Transfer of wine-making to larger regional wineries outside the region in line with approach by Orlando Wines, Fosters. & Retention only of smaller boutique wineries with cellar door sales. \\
\hline
\end{tabular}
\caption{SA Murray below Lock 1: summary of community-level impacts}
\end{table}

Source: MJA face-to-face interviews.


Section 4: Impact mitigation

This Section comprises a single chapter on impact mitigation.

It sets out the perspectives of interviewees and survey respondents about what governments (whether local, state or Commonwealth) could do to ease the transition to a drier future.
12 Impact mitigation

<table>
<thead>
<tr>
<th>Key Points – Impact Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The net impact of reduced water availability for consumption on irrigators and Basin communities can be reduced by:</td>
</tr>
<tr>
<td>▪ reducing exposure (i.e., the scale and nature of the shock);</td>
</tr>
<tr>
<td>▪ reducing sensitivity;</td>
</tr>
<tr>
<td>▪ strengthening adaptive capacity;</td>
</tr>
<tr>
<td>▪ external programs and actions, particularly those to provide certainty to allow people plan and reducing impediments to structural adjustment; and</td>
</tr>
<tr>
<td>▪ directly addressing residual vulnerability.</td>
</tr>
</tbody>
</table>

Thus, the answer to the question, ‘what will the impacts of reduced water availability be on irrigation regions?’ is – it depends.

This chapter discusses a range of approaches raised by interviewees and recent observations by the Productivity Commission and the National Water Commission that could mitigate the impacts of reduced water availability in irrigation regions.

Pro-rata reductions to allocations are viewed with antipathy in regions, in part because they are likely to bite most aggressively into those farm enterprises that already fully utilise their water resources and may maximise, rather than minimise, the impact on individual farmers and the future sustainability of irrigation communities.

Options to reduce the extent of exposure or shock from reduced water availability include:

▪ securing environmental water from tributaries where the social and economic costs are relatively lower, preferably using the water market;
▪ investing in other (non-water-using) options to improve environmental condition and resilience of key environmental assets, reducing their water requirements;
▪ managing the portfolio of environmental water flexibly and adaptively to minimise the impact on the consumptive pool(s);
▪ purchasing, and compensating for, water for the environment – through programs such as buy-backs and investment in irrigation efficiency
▪ ensuring regional people have an adequate understanding and the information they need to form an accurate perception of the magnitude and nature of the coming change;
▪ ensuring government policies and implementation programs are consistent, and build confidence and trust; and
▪ transitional arrangements such as timing.

Our findings and logic suggest that:

▪ ideally, the transitional assistance mechanisms for regional communities should be outlined in detail at the point when the SDLs are released;
▪ adequate compensation for water surrendered is critical;
▪ as noted by the Productivity Commission, there needs to be substantially more consideration given to the portfolio of water products the government builds to meet environmental watering requirements; and
▪ regional community adjustment – as well as irrigator adjustment - should be targeted.

There is need for a strong active lead agency to coordinate and integrate across the various agencies and tiers of government, and set out a pathway to minimise negative impacts on regional communities.
12.1 Introduction

There is very substantial scope to mitigate the final impacts of the Basin Plan on irrigation farms, supply and marketing chains and communities. Conversely, there is substantial scope to exacerbate these impacts if wrong decisions are taken, or if right decisions are taken but poorly timed or executed.

In other words, the answer to the question, ‘what will the impacts of reduced water availability be on irrigation regions?’ is – it depends.

The purpose of this chapter is to identify and explore the scope for impact mitigation. In doing so, we draw principles from the conceptual framework used throughout this study (chapter 2) and inform these principles from insights, comments and feedback from irrigators, community leaders and others gained through our telephone survey and face-to-face interviews and from the observed experience of past adaptations, including what has or has not helped to ease structural adjustment in the past – including recent observations by the Productivity Commission and the National Water Commission (NWC).

Relationship to preceding chapters

MJA’s analysis of the impact of water availability scenarios on regions, reported in the previous section, assumed an equal percentage cut to allocations across all entitlements, with no compensation.118

This essentially is a worst case scenario for the regions and was built on the views of industry leaders and other informed people.

Governments can mitigate these impacts by addressing potential market and government failures both in the way that SDLs are implemented, and in actions designed to ease structural adjustment, i.e., by providing external support to self-initiated adjustment as discussed in Section 3.

12.2 Insights from first principles

According to the Water Act 2007 (Cth) section 20, the purpose of the Basin Plan is to provide for the integrated management of the Basin water resources in a way that provides for (among other things):

- the establishment and enforcement of environmentally sustainable limits on the quantities of surface water and ground water that may be taken from the Basin water resources... and

- the use and management of the Basin water resources in a way that optimises economic, social and environmental outcomes.

A key policy challenge is to set the SDLs that achieve the required environmental condition in a way that is least cost in total, and especially to irrigators and Basin communities. For irrigators and

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118 See n18
Basin communities, this means minimising the net final impact (i.e., residual vulnerability) of the agreed Basin Plan.

With reference to the conceptual framework underpinning this report (Figure 30), the net impact on irrigators and Basin communities can be reduced by:

- reducing exposure (i.e., the scale and nature of the shock);
- reducing sensitivity;
- strengthening adaptive capacity;
- external programs and actions, that provide certainty to allow people to plan, and reduce impediments to structural adjustment; and
- directly addressing residual vulnerability.

We address these options below.

**Figure 30. The conceptual approach behind this report**

<table>
<thead>
<tr>
<th>EXPOSURE</th>
<th>IMPACT MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>scale of shock</td>
<td>External policies/programs</td>
</tr>
</tbody>
</table>

**SENSITIVITY**
- Human
- Social
- Natural
- Physical
- Financial

**IMPACT**
- Human
- Social
- Natural
- Physical
- Financial

**Residual VULNERABILITY**
- Human
- Social
- Natural
- Physical
- Financial

**ADAPTIVE CAPACITY**
- Internal coping and adaptation

**Note:** Simplified from Figure 1. For a description of the conceptual framework refer chapter 2.

### 12.3 Reducing exposure

Options to reduce the extent of exposure or shock from reduced water availability include:

- securing environmental water from tributaries where the social and economic costs are relatively lower;
investing in other (non-water-using) options to improve environmental condition and resilience of key environmental assets, reducing their water requirements;

- managing the portfolio of environmental water flexibly and adaptively to minimise the impact on the consumptive pool(s);

- purchasing, and compensating for, water for the environment;

- ensuring regional people have an adequate understanding and the information to form an accurate perception of the magnitude and nature of the coming change;

- ensuring government policies and implementation programs are consistent, and build confidence and trust; and

- transitional arrangements such as timing.

We review these options below.

Note that different options to reduce net impacts will themselves have differential effects on and between individual irrigators and whole communities.

Reducing the exposure of any given community may be at the expense of another – for example, through sourcing environmental water from one upstream valley or another – recognising that the sensitivity and adaptive capacity of communities differs.

### 12.3.1 Sources of environmental water

The exposure/shock in question is the increased allocation of water to the environment, which will leave less water than historically was available for irrigation.

The differing sensitivities and adaptive capacities of the different sectors and regions, and the likely differences in SDLs across the MDB, mean that the distributional impacts of the implementation of SDLs are likely to be more pronounced in some regions than others.

Although proposed SDLs are not yet known, it is likely they will differ across the Basin. This will be driven by the location of Key Environmental Assets and the availability of water for those assets.

For instance, some environmental assets (such as the Macquarie Marshes and the Gwydir Wetlands) can only be watered from a single upstream irrigation area.

However, other environmental assets are downstream from multiple irrigation areas. This particularly applies to those along the Murray, especially downstream of the Barmah Choke or Wentworth. There may be a range of valleys from which it is possible to source water for these downstream environmental assets – consistent with the objectives of the *Water Act 2007* (Cth) to optimise economic, social and environmental outcomes.

There are different ways that this can be done:

- at one end of the spectrum, governments may use an information-based approach to try to target those valleys where the social and economic costs of reduced water availability will be lower; and
at the other end of the spectrum, governments may target valleys on a hydrological basis, and rely on the water market to minimise social and economic costs, focusing their efforts on removing artificial barriers to trade and ensuring the market functions efficiently.

The former approach relies on governments being able to access perfect information, and runs a risk of government failure. Particularly in the southern interconnected Basin, the water market is well-established and is becoming increasingly efficient over time. Accordingly, the latter approach is likely to produce a better outcome for the community as a whole, to the extent that it is hydrologically feasible and water markets are effective.\textsuperscript{119}

There is a middle ground – where governments target environmental water acquisition to particular regions through buy-backs and irrigation modernisation. This is discussed below.

### 12.3.2 Environmental water management

Environmental water management practices relevant to minimising the shock include the mechanics of environmental water management and the balance between flexibility and rigidity in the way environmental water can be used. These two issues are closely related.

As an example of flexibility, the face-to-face interview program in northern Victoria tended to strongly endorse the local approach to environmental water management, which includes:

- using consumptive water to achieve environmental outcomes en route; and
- applying a ‘seasonally adaptive’ approach to river and wetland management.

A critical issue is what is done in dry years: \textsuperscript{120}

\textit{In drought years the focus is to avoid catastrophic events, such as major fish kills, and protect drought refugia where plants and animals can survive and begin recolonisation of other areas when conditions improve. At the other end of the spectrum, in wet years the focus is to provide high flows and floods to restore values that were not maintained in drier periods, such as bird breeding events.}

Consideration of a seasonally adaptive approach raises the question of the extent to which environmental water entitlements can be used flexibly depending on rainfall, including for consumptive uses. Flexible use of environmental water could permit some opportunistic uses, whilst also achieving appropriate environmental outcomes.

In addition, environmental water management can be enhanced through non-water-using investment such as weed control, riparian rehabilitation, watering infrastructure, management of weirs to allow efficient flooding of wetlands etc. Such actions potentially reduce the extent of the reduction in consumptive water availability.

\textsuperscript{119} Note that the water market primarily functions in the southern MDB (see chapter 6.1). In addition, it should be noted that the market is also subject to some environmental or hydrological restrictions to trade that generally are considered appropriate (see for example National Water Commission, 2010, \textit{The impacts of water trading in the southern Murray-Darling Basin: an economic, social and environmental assessment}, NWC, Canberra).

\textsuperscript{120} Chapter 7, Victorian Government, 2008, \textit{Northern Region Sustainable Water Strategy}. 
The range of ways that environmental watering needs could be managed to reduce the exposure of irrigators is summarised in Table 34. The environmental consequences of these actions, and the extent of impact on irrigator exposure, would depend on circumstances and are outside the scope of this report.

### Table 34. Environmental water management options: impacts on irrigation

<table>
<thead>
<tr>
<th>Water type purchased</th>
<th>Smaller impact on irrigation</th>
<th>Larger impact on irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Allocations (temporary water, especially in wetter years) (requires care to prevent market distortion)</td>
<td>Entitlements (permanent; high or low reliability)</td>
</tr>
<tr>
<td>Entitlement type purchased</td>
<td>Low reliability entitlements</td>
<td>High reliability entitlements</td>
</tr>
<tr>
<td>Behaviour in dry years</td>
<td>Sell water, e.g., because the available water is insufficient and/or to mimic dryness in natural flow regimes</td>
<td>Carry water over (to increase change of watering in other years) or use it for lower-scale environmental watering</td>
</tr>
<tr>
<td>Payment for use of storage and delivery infrastructure</td>
<td>Pay the same as irrigators</td>
<td>Do not pay (i.e., cost borne by irrigators)</td>
</tr>
<tr>
<td>Multiple sequential uses of water</td>
<td>Encourage multiple sequential uses, with the possibility that environmental entitlements may be traded after environmental outcomes are achieved</td>
<td>Do not encourage multiple sequential uses of water and/or do not include the possibility that environmental entitlements may be traded after environmental outcomes are achieved</td>
</tr>
</tbody>
</table>

Source: MJA summary based on face-to-face interviews.

#### 12.3.3 Procuring water for the environment

There are three broad ways of obtaining water for key environmental assets. These are:

- investing in the efficiency of irrigation systems (whether on-farm or targeting storage and distribution systems) and allocating water savings to the environment;
- buy-backs (such as are occurring under Restoring the Balance, see chapter 5.2); and
- pro-rata reductions to the allocations of consumptive users.

Our survey and interviews indicated a preference for the option of investing in irrigation efficiency, unease about (but familiarity with) the second option, and antipathy towards third option.

**Investment in irrigation efficiency** allows water to be procured for the environment with negligible reduction in water for irrigation – and therefore minimal impacts on both individual farms and on communities.

Refer chapter 5.2.
Buy-back programs allow a degree of choice. Our survey and interviews indicated that voluntary buy-backs are preferred to involuntary acquisition of water for the environment, but that regional people are deeply concerned about the flow-on impacts of buy-back programs, and also the perception that sellers are sometimes ‘desperate’ rather than ‘willing’.

Chapter 4 discussed the extent of existing and committed buy-backs and efficiency programs in the MDB, and noted that the water savings from these programs were substantive on the scale of Long Term Cap Equivalent allocations for the GMID and, to a lesser extent, the NSW Central Murray.

Further purchases of water for the environment could further minimise exposure of regions and therefore reduce the potential socio-economic impact of SDLs. For example, the Australian Government’s $5.8 billion investment in upgrading irrigation systems under the Sustainable Rural Water Use and Infrastructure (SRWUI) Program may invest further in the irrigation regions studied; half of such water savings are expected to be allocated to the environment.

The effectiveness of buy-back programs in minimising exposure depends on their design.

If programs reduce the viability of shared irrigation infrastructure for those farmers who remain, or if programs reduce economic activity in a region without addressing flow-on impacts, then they reduce exposure of the farmer who sells the water.

However, they have a lesser effect on the exposure of others in the region. Farmers who sell their water will not necessarily spend their money in their regional community, and it will not necessarily compensate the community for the lost economic activity or be adequate to support transformation of local economies.

It is also possible that buy-backs of entitlements will attract interest from farmers who previously had sold allocations on the temporary market – thereby reducing the availability of temporary water that other farmers may rely upon.

We found that there appears to be a general consensus in the regions that buy-backs are more effective at reducing exposure at a farm level than at a community level, because while buy-backs pay individual irrigators a price that they are willing to accept, buy-backs still take water out of production and may reduce overall economic activity; they may undermine the agricultural value chain, and also may have flow-on impacts to other local businesses and community services. This strong regional consensus contrasts with recent modelling results from ABARE.  

Pro-rata reductions to allocations, as noted above, are viewed with antipathy in regions. This antipathy is based, in part, on the pertinent observation that pro-rata reductions in LTCE allocations are likely to bite most aggressively into those farm enterprises that already fully utilise their water resources; and the concern that many regional people have that they will not be fully compensated for any reduction. These farms tend to be highly leveraged, and run by more innovative and younger farmers (Figure 31). Conversely, pro-rata reductions in LTCE allocations are likely to have least impact on farms that are less developed and less leveraged – based on the survey results, these farms tend to be owned by farmers over the age of 65 and have lower debt levels, higher rates of farm ownership and higher personal well being.

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It follows that a pro-rata reduction may maximise, rather than minimise, the impact on individual farmers and the future sustainability of irrigation communities.

Water trade will potentially alleviate these issues to a degree, but younger farmers who are already highly geared (and for whom, water assets are an important component of total assets) may not be able to restore their productivity to near its former position.

This raises the importance of the adequacy of compensation (for pro-rata reductions) and prices paid (for buy-backs).

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**Figure 31. Illustration – Impact of pro-rata reductions**

Source: MJA analysis based on interviews.

Notes:

**Top: (Left)** Prior to the introduction of SDLs, some farmers have developed to the limits of the available water, are highly leveraged and ‘best practice’; (Centre) others are highly developed, but have water to trade or do not buy as much water as they could use (a risk buffer); (Right) the third group of farmers is less developed and tend to be less leveraged.

**Bottom: (Left)** SDLs that apply pro-rata reductions, if not fully compensated, will cause the greatest negative impact on the fully developed, highly leveraged farmers, who also often are the youngest and most innovative. (Right) The least impact will be on the less developed farmers, many of whom also tend to be closer to retirement.
12.3.4 Compensation and buy-back prices

There is wide-spread concern in the regions over whether pro-rata cuts to allocations will be compensated (and if so, whether compensation will be adequate) and the level of buy-back prices.

The concern over compensation is despite the well-publicised ‘risk sharing’ arrangements in section 77 of the Water Act 2007 (Cth). There is widespread uncertainty and confusion about what this will mean in practice:

*If the government take back a portion of water licence, are we going to be financially compensated??*

(Irrigator, telephone survey comment)

*[My] biggest concern is reduction in water licenses without giving a fair compensation for the reduction and losses*

(Irrigator, telephone survey comment)

*... particularly the 20% less permanent water is really bad for me being a farmer. We are conscious about the fact of making the river healthy and allow some of our water to run down the river and want to be compensated for the run off.*

(Irrigator, telephone survey comment)

The focus by regional people on the level of compensation and price is appropriate.

As noted recently by the Productivity Commission, the economic models show very different impacts on regional communities according to whether compensation is paid or not.

If compensation is paid, some regional communities may experience increased economic activity due to the increase in disposable income. However, questions of sustainability and distributional impacts across different groups of people may remain, and depend in part on the extent of compensation; who is compensated; and what other, complementary programs exist to ease structural adjustment.

However, if compensation were not paid, all regional communities reliant on irrigation would experience decreased economic activity and income due to the appropriation of a critical asset.

The level of compensation, i.e., the price and values upon which it is based, is critical to regional outcomes. Relevant analytical issues include:

- the divergence between the social value of water for environmental purposes, and the ability to purchase water in the market based on the Marginal Value Product of water. Payment

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(compensation) for water taken for the environment, based on the much lower MVP, means that the economic rent accrues solely to the government, acting as a monopsonist purchaser against competitive sellers:

*We feel the Federal Government are unfairly asset stripping irrigation communities at a time of extreme drought.*

(Irrigator, telephone survey comment)

- this divergence maximises gains to government at the expense of irrigators and does not share the benefit with the local communities. Alternative approaches have been used elsewhere;

- the concern that sellers are sometimes ‘desperate’ rather than ‘willing’, i.e., that the market is essentially unfair:

  *We feel that they are not buying water from willing sellers, they’re buying water from people who’ve been absolutely destitute through drought and government’s attitude on water trading.*

  (Irrigator, telephone survey comment)

- the recognition that the value of the farm assets as a going concern is, in many cases, critically determined by the availability of water. Removing water may not merely reduce that value of water assets; it may substantially reduce the long-term productive capacity of the farm, and therefore the value of all assets – with flow-on effects to the regional community:

  ...*Going on what my bank manager told me there could be up to 50% of farmers would be in trouble if primary production land dropped 20% in value.*

  (Irrigator, telephone survey comment)

- compensation based on prices observed now for relatively small trades in the current market may not be adequate when future prices rise as a result of the reassignment of potentially large volumes of water to the environment.

  *I want to make it very certain to anyone looking into this (the Murray-Darling Basin project) that anyone who takes our water entitlements away from us, compensation has to be paid for the past and in the future. The survey is appropriate because the people around here need to be heard. But it has taken too long to get around to doing it, the survey should have been done years ago before the drought.*

  (Irrigator, telephone survey comment)
This latter point is important because a reduction in water availability for the consumptive pool will increase water prices, other things being equal. Other factors may not be equal and there may be offsets, but an increase in water prices should be presumed.

Price impacts will depend on a range of factors such as the changes in water availability between regions, the degree to which trade can occur between regions, and the rules that constrain that trade (e.g., the way that availability translates to different water entitlement types; limits to trade; etc.).

There is a spectrum of views about what might happen in this scenario.

At one end of the spectrum of views, if markets are perfectly efficient and irrigators are ‘fully’ compensated for water removed, then water should flow to higher value uses. The result will be that:

- regions where water has a relatively low value would see substantial transformation as water is traded out; and

- third party effects in regions that are net buyers of water may be negligible or positive. In these communities, the same amount of water flows in, the same level of agricultural activity occurs, water is a higher valued input and is thus used more efficiently, and the higher water value is passed on through output prices. Thus, the social fabric may not be overly affected. This idealistic view does not recognise that irrigated produce is generally supplied to competitive markets and the ability to pass higher costs through to domestic or overseas customers is limited.

The other end of the spectrum of views emphasises the difficulties in smooth transition, market imperfections and the loss of existing markets to foreign supplies.

There is a range of reasons why markets may not be perfectly efficient, or compensation may not be ‘full’.

For example, as MJA’s survey results demonstrate, farmers are not a homogeneous group of people. Nor do they all have access to perfect information. Furthermore, their responses to exogenous change will vary reflecting their past experiences, their social view of themselves, their access to resources, their age, values that they place on farming apart from profit (e.g., lifestyle), etc.

Indeed, this variability of responses is in some ways a strength of farming communities, where social learning depends in part on seeing what works or does not work for your neighbours, and tailoring those responses to your own unique situation – farms are complex and inherently heterogeneous businesses.

Likewise, the ‘fullness’ of compensation will depend on the extent to which it reflects the total value to farmers and the community of the business that is lost – not just the water’s marginal productive value.

If markets are not efficient, or water lost is not ‘fully’ compensated, then the pattern of externalities and distributional consequences will be more regionally dispersed, and the pattern of transformation will be less clear.
12.3.5 Information, confidence and trust

Faced with substantial change, farmers and regional communities will need to adjust.

To do so positively and effectively requires that they understand the changes about to come – accurately – and have confidence that the situation will not change again unpredictably or suddenly.

_The stress that everyone is under, the stress both physically and financially I believe is totally caused by government and industry departments in "shifting the goal posts" all the time. We make decisions based on government announcements only to find that the rules are changed which leaves all farmers in an absolutely untenable position, which leads to frustration and lack of trust._

(Irrigator, telephone survey comment)

At present, government policy and water management is run by multiple agencies and the interviews suggest a lack of understanding about key issues such as where the roles of the Commonwealth end and States begin; whether and at what level compensation will be paid; the flexibility or otherwise around environmental water management.

Indeed, the interviews suggest that many regional people do not even really know that the implementation of SDLs is being considered.

The Productivity Commission\(^{124}\) recently has commented on the need to clarify and discipline the role of the multiple agencies. The relevance of these observations is that misunderstandings and misperceptions may well cause over-reaction and fear on-farm and in regional communities. Misunderstandings and misconceptions cause a lack of confidence in government processes and uncertainty about how to plan to adapt for the future.

_Water availability is a huge thing. We're a fairly young family and we need to know what the allocations are going to be so that we are able to make long-term plans._

(Irrigator, telephone survey comment)

The interviews also showed a clear expectation that the publication of the draft Basin Plan would (and should) be accompanied by sufficient information to provide regional communities in general (and farmers in particular) with enough information to understand how it will affect them. However, given the multiple agencies and tiers of government involved in matters such as allocation decisions, water resource planning and structural adjustment support, it is not certain to regional people that this will occur.

12.3.6 Timing

SDLs will be implemented through state-based water planning processes, by 2014 for Queensland, New South Wales and South Australia, and 2019 for Victoria.

Our consultation process confirmed that the exposure of irrigation farmers and their communities to reduced water availability depends to some extent on whether:

- clear signals are sent and understood, in advance of the implementation of SDLs, about exactly what they will mean to regional people;
- there is time for people to adapt in advance of the changes, so that they are well-prepared; and
- the changes are implemented rapidly, or phased in over time (and if so how it is phased in; for example, the NSW groundwater reform process discussed earlier and includes Supplementary Water Access Licences that provide a buffer to the step change in licensed diversions - providing an additional volume that decreases by 10% a year for a ten year period before being cancelled).

Once the impact of SDLs is made clear to the industry, the amount of time available for transition will also be an important driver of impacts. A short timescale for adjustment would put pressure on existing business infrastructure, processing facilities and supply chain. Longer timescales would provide greater opportunity to adjust and if necessary change production to higher value commodities. Production and processing of annual crops have high labour inputs and a longer adjustment time scale will also provide opportunity for adjustment in the labour pool.

Investment certainty is a key factor to underpin replanting and recovery from the recent period of low water allocations. The amount of time available for the sector to adjust, after the implications of future SDLs are made clear, will be a significant driver of impacts.

Timing is particularly important for perennial horticulture, because of the long lead-times to crop maturity, and the long lives of perennial plantings.

Some growers in the horticultural industry, especially wine grape growers, currently are suffering from high debt and low profitability and so would be less able to afford water purchases to offset potential SDL water reductions. In such a scenario, these growers may be forced into removing more perennial plantings than they would under conditions of normal profitability. This would result in additional job losses and value adding activity than would be the case in times of normal profitability. Therefore, a longer time frame for the implementation of SDLs may enable growers to return to normal profitability and could mean that less perennial plantings would be removed and as a result the economic and social impacts would be lower.

Table 35 estimates the impacts on perennial horticulture of different timescales for different levels of reduction. The sensitivity to timescale for a 20% reduction is expected to have relatively little impact. This is because perennial horticulture is a long-term investment and a 20% reduction is better than most districts have experienced through the drought.

At the other end of the scale a 60% reduction would have a massive impact, if implemented in a short timescale, with widespread removal of plantings.
Table 35: Impact of transition time-scale on perennial horticulture

<table>
<thead>
<tr>
<th>Time Scale to Respond</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
</tr>
</thead>
<tbody>
<tr>
<td>短时间（&lt;5 years）</td>
<td>信心重新种植</td>
<td>再次种植永久植物</td>
<td>大规模永久植物立即移除</td>
</tr>
<tr>
<td>中时间（5-10 years）</td>
<td>信心重新种植</td>
<td>现状</td>
<td>部分永久植物移除在所有地区，并且某些非替代老植物。</td>
</tr>
<tr>
<td>长时间（&gt;10 years）</td>
<td>信心重新种植</td>
<td>更年长植物未被取代</td>
<td>更年长植物未被取代</td>
</tr>
</tbody>
</table>

Source: MJA analysis based on interview responses.

The implication of not replanting and further removal of permanent plantings is that land values, especially in community supplied districts, will have low or negative values. This is because the cost of paying delivery charges and drainage charges (or termination fees) for land that is no longer irrigated devalues the land for unirrigated properties. This will:

- make land unsaleable, as is currently the case for abandoned wine grape properties without water; and
- lead to large numbers of growers being unable to leave the industry and becoming ‘trapped’ because their properties are unsaleable. This will have significant social and economic consequences. This process is already occurring as a result of low wine grape prices and the drought, any reduction in water availability is therefore likely to increase the pressure on growers and there may be widespread anger.

12.4 Reducing sensitivity

12.4.1 Increasing certainty and confidence

As noted in the previous section, there is a significant risk that the irrigation communities and individual growers may over-react if they do not receive and understand pertinent issues and information and if they lack trust and certainty in governments. The interviews suggest this is a significant issue.

...our greatest fear is government uncertainty. (Irrigator, telephone survey comment)

Moreover, irrigators and their communities feel that governments do not understand the regional situation and certainly do not listen.
...the survey is appropriate because the people around here need to be heard but it has taken too long to get around to doing it, the survey should have been done years ago before the drought.

(Irrigator, telephone survey comment)

These concerns interact with others including the question of compensation, and can influence adjustment decisions and how compensation is spent.

12.4.2 How compensation is spent

In regions that are net sellers of water, what farmers do next is central to the severity and distribution of regional impacts.

For example:

- **reconfiguring of irrigation enterprises**: if they use their compensation and the money from water sold in the market to invest and reconfigure their farm, then adverse impacts (externalities borne by other members of the community) may be small relative to other factors (such as drought or changing terms of trade);

- **shift to dryland**: impacts to other community members will be higher if farm reconfiguration entails conversion to farming with a smaller regional value chain. Wholesale conversion to dryland farming would particularly affect agriculturally-based communities, because dryland farms require greater economies of scale, and therefore generally will entail substantial consolidation of existing irrigation farms (which also entails additional complexity and capital costs). The result of regional expansion of dryland farming will be a smaller number of farmers requiring less servicing from their local town – with fewer opportunities for processing and other employment; and

- **remain in debt trap**: The impact on other community members will be greatest if irrigators are left with high debt (from drought), and farms that are no longer viable for irrigation (because the cost of maintaining and operating shared irrigation infrastructure is now falling on farmers who are too few or too dispersed – the ‘Swiss Cheese’ effect), or for consolidation for dryland farming (for example because they are too small to be viable, or it is logistically too difficult, or capital is unavailable to consolidate them). Such legacies of drought and reform could outweigh compensation in some cases – moving community impacts closer to the ‘worst case’ scenarios examined in Section 3.

12.5 Strengthening adaptive capacity

12.5.1 Adaptive capacity

The relationship between a change event and individual coping and adaption to the event will be mediated by an individual’s cognitive processes. In the current context, this means that the way that irrigators, their supply and marketing chains, and communities respond to reduced water availability will depend upon their understanding and perception of the change, and the options before them.
Moreover, neither adaptive capacity nor adaptation responses are homogeneous – the profiles developed by the MJA team emphasise that sectors differ, communities differ and the farms differ from each other. Heterogeneity is a conclusion repeatedly borne out by our telephone survey and face-to-face interviews. Moreover, adaptive capacity and responses must be seen in the context of the different forms of individual and regional ‘capital’. To strengthen adaptive capacity requires systematic consideration of each relevant dimension and separately for individuals and the region.

However, neither individuals nor regions operate alone; rather, they operate in markets for labour, water and other resources, finance and produce. As noted, none of these markets are perfect markets. There appear to be information issues, particularly at the interface with government and there are other market imperfections. Of particular relevance are the efficiencies of the water, property and financial markets. A key (and minimalist) role for government is to ensure the efficiency of these markets as they operate, particularly in the local areas.

The structure of the Australian economy is changing continuously. People, capital and resources move between sectors and enterprises on a daily basis. Dryland farmers, for example, make constant decisions on the balance between wheat and sheep, or on the choice and composition of their flocks and herds. The minerals boom pulls workers across Australia to the north-west, and has attracted large numbers of workers from many of the regions we analysed.

Structural adjustment is necessary in order to ensure that Australia’s rural sectors remain vibrant and competitive in world markets.

Structural adjustment is an issue of concern where the adjustment choices and where the process does not occur freely due either to fixity or one part of the sector or enterprise, or imperfections in information or in the way markets function. Governments typically assist structural adjustment where market imperfections and externalities can be demonstrated and are substantial. In this case, where government intervention to shift water from the consumptive pool to environmental uses is the stimulus, there also appears to be an equity argument for some level of government support and facilitation of adjustment.

At the farm level, adjustment capacity can be strengthened by attention to:

- human capital, i.e., the skills, health and education of individuals that contribute to the productivity of labour and capacity to manage land. Human capital can be enhanced by helping individual farmers develop the skills and experience to adopt new practices or move into new sectors. Human capital can also be strengthened by generational renewal, and in particular, providing the platforms of confidence and competence for the new generation to come through;

- social capital, i.e., reciprocal claims on others by virtue of social relationships, the close social bonds that facilitate cooperative action and the social bridging, and linking via which ideas and resources are accessed. Social capital can be built by working closely with regional people, including providers of social services, to strengthen social relationships, facilitate cooperative action, help people access ideas and resources;

- natural capital, i.e., the productivity of land, and actions to sustain productivity, as well as the water and biological resources from which rural livelihoods are derived. Natural capital can be enhanced by:
supporting opportunities for improvements in water use efficiency within existing enterprises; and

supporting research and development, or transition into new crops, varieties, sectors.

farming land that is no longer economic does not always transition easily to other constructive uses; it may be abandoned or poorly-managed. Transition to other uses (whether environmental, farming, industrial or residential) can be eased through tools such as land use planning policies, deliberate land consolidation, etc.;

physical capital, i.e., capital items produced by economic activity from other types of capital that can include infrastructure, equipment and improvements in genetic resources (crops, livestock). Physical capital can be strengthened by assisting sectors in transition to new economies of scale or sector structures e.g., consolidation with loss of smaller, less efficient players; and

financial capital, i.e., the level, variability and diversity of income sources, and access to other financial resources (credit and savings) that together contribute to wealth. Financial capital can be built with compensation, buy-backs, and a range of other financial tools that support structural adjustment.

Where compensation (including buy-backs) occurs, irrigators will substitute one form of capital for another (water to financial).

Compensation is a private benefit to farmers. Farmers can use the financial capital in a number of ways, including purchasing in water to continue their agricultural activities;

The amount of compensation that irrigators receive, the ease with which water can be traded between systems and states, and the total amount of water removed in the Basin and by region, are key factors that will determine the extent and distribution of externalities (adverse effects) within agricultural communities (others include terms of trade etc.).

Governments have extensive experience in designing and implementing financial structural adjustment support programs. For example, recently the Commonwealth rolled out a Small Block Irrigators Exit Grant package, a one-off payment up to $150,000 to farmers who wished to leave irrigation. In addition, two complementary grants were included in the package:125

- up to $20,000 for removal of permanent plantings and other above ground production-related infrastructure; and
- up to $10,000 for advice and training, including skills development, direction setting plans, succession planning and business advice.

Such programs need to be carefully designed to avoid unintended consequences. For example, in Sunraysia and the Riverland, there is a perception that the five-year moratorium on irrigating land subject to exit packages will further undermine the productive potential of the region by: lowering land values; raising fixed irrigation delivery costs for non-exiters; stranding irrigation

assets; blocking much needed farm consolidation; and compromising the potential of the whole area. Whether this perception reflects reality or not is outside the scope of this report; however, a negative perception alone can reduce confidence.

12.5.2 Community level adaptive capacity

In terms of primary appraisal of the event, it is likely that the response to SDLs will be affected by the perceptions farmers and their communities have of previous reforms that have constrained irrigation, some of which entailed significant shocks and are still in the process of being implemented (e.g., NSW groundwater reform, discussed in chapter 6.2.2).

Some communities may benefit from assistance to identify new economic opportunities. For instance, irrigation communities in Victoria are interested in attracting more annual horticulture or tourism to their regions. Diversification of the economic base of communities can provide an alternative source of employment or wealth creation. There are already examples of government programs that aim to help regional communities do this, such as the Strengthening Basin Communities Program.

For some farmers or communities, the response to change will be a mixture of adaptation and of resisting or fighting the change, with significant energy, time and other resources going into political and legal activities. Individuals may be more likely to resist change if they believe they have limited resources to cope and adjust to the change.

Generally speaking, fighting change will absorb resources for adapting to change (assuming that the change is unavoidable).

The extent to which this occurs will depend in part on how governments engage with communities to explain the changes, build social capital (including the resources, and the awareness of resources, to adapt to change), and ease structural adjustment.

The regional interviews revealed that that regional people would be more likely to support SDLs if they understood the environmental benefits that would be realised, and had confidence that environmental benefits were transparent and achievable. Box 3 illustrates some of the issues that arise when regional people consider water being moved from consumptive to environmental uses.

Economic and social profiles and impact assessments in the Murray-Darling Basin

Box 3. The Gwydir wetlands and community perceptions

The Gwydir Wetlands is located approximately 60km west of Moree in north western NSW. These semi-permanent terminal wetlands provide habitat for large numbers of waterbirds and support rare, endangered and vulnerable species. The wetlands provide breeding and feeding habitat for large numbers of colonial waterbirds, with parts of the Wetlands being internationally important.127

Recently, 600 hectares of the Gwydir Wetlands was sold to the federal government for $10 million.128 It was the largest privately owned wetlands in NSW and will now become a national park. Because of private ownership, regional communities have had limited access to the Wetlands.

The Gwydir Wetlands is one of the 18 environmental indicator assets identified by the MDBA in preparation of the Basin Plan.129

A number of interviewees in the Gwydir commented that if watering the Wetlands means they have less water for irrigation, ‘there might be a lot of economic pain for little or no environmental gain.’

Community members expressed the view that it will be important for the region to understand and see the potential environmental gains, if water is to move from consumptive use to environmental use for the Wetlands. Because it has been owned by farmers (and parts still are), few people in the community appreciate its environmental worth.

There is also local debate about how the Wetlands should be best managed, the relative importance of more water versus less grazing pressure for its future health, and benefits that might accrue to graziers from increased watering of those parts of the Wetlands that are still accessible to them.

12.6 Emerging directions: the need for coordination/outcomes across multiple institutions

A key conclusion emerging from our telephone survey and interviews is that the impacts on regional communities will depend on far more than the narrow scope of the Basin Plan being prepared by the MDBA. Rather, the impacts of the Basin Plan will depend on the imposition of sustainable diversion limits (SDLs), and a wide variety of other policy decisions and administrative actions and the way the whole package is developed and communicated.

This conclusion implies the need for considered and strong coordination across the different tiers and agencies of government which have different roles to play in the implementation of SDLs. For example, the MDBA will recommend SDLs to the Water Minister; the Department of the

Environment, Water, Heritage and the Arts is responsible for buy-back programs and some structural adjustment programs; State governments are responsible for implementing SDLs; and local governments provide a range of regional services that can ease transition. This coordination task is large and we have not attempted in our process or this synthesis report to differentiate between the varying responsibilities of different parts or tiers of governments. In practice, effective structural adjustment support will require cooperation across them all.

Socio-economic consequences of the Basin Plan are inseparable from the way the Basin Plan is implemented. The mechanisms by which the Basin Plan is implemented are as important, in terms of socio-economic impacts, as the actual SDLs themselves. Irrigator and community perceptions and reactions will be in play from the moment and way the SDLs are formally announced.

The scope of the Basin Plan is clearly intended by the Water Act 2007 (Cth) to include the environmental watering requirements of key assets and SDLs.

The scope of the Basin Plan does not necessarily include the exact mechanisms by which water will be recovered, the timeframe for water recovery, and the means by which regional communities will be supported to transition to sustainable futures under the Basin Plan.

These roles are spread across a number of government agencies, and a range of tiers of government (particularly state governments, who are responsible for the implementation of SDLs).

However, regional people will have a very strong need to understand what the Basin Plan will mean for them – and they will not be able to, unless they also know how SDLs will be implemented and how change will be managed. This uncertainty will cause anxiety and, most likely, trigger resistance in regional communities. It will be a very significant constraint to wise investment decision-making and adaptation.

We make several points in relation to the process of transition to the Basin Plan becoming operable in 2014. Ultimately, in transitioning regional communities through the Basin Plan the role of government lies in:

- ensuring the water market operates efficiently;
- redressing negative externalities arising from market operations; and
- ensuring government failures are minimised.

This is easy to state but difficult to do well. We suggest the following four components are essential:

- first, ideally the transitional assistance mechanisms for regional communities should be outlined in detail at the point when the SDLs are released. It would be entirely inadequate for the government (MDBA) to foreshadow, say, a 20 or 40% reduction in water in the consumptive pool of a region and then be void about the specific mechanisms that will be employed to assist regional communities to adapt. There must be absolute clarity about:
  - volume of water required (the gap between environmental water holdings and state holdings and the water requirements of key environmental assets;
– the mechanisms through which the gap will be recovered (i.e., the portfolio of water products the government will acquire to meet its obligations of the Basin Plan; and

– the value of compensation for water recovered from the consumptive pool;

- second, our interviews, surveys and logic indicate that adequate compensation for water surrendered is critical. On the average horticulture, broadacre, dairy, and mixed production farm, water entitlements make up around 30% of the farm asset base. Reducing the allocation on these water assets without adequate compensation will directly impact on these farms’ asset base and gearing ratios.\(^{130}\) For example, 20% reduction would reduce farm assets by 5%. Banks typically loan against farm water assets, and cutting water allocations to entitlements without adequate compensation would increase the risk that farms will breach or default on debt covenant agreements. Moreover, farm assets are water dependent (e.g., irrigation setup). Cutting into water directly also likely erodes the asset value of fixed assets tied to water use;

- third, we are in consensus with the Productivity Commission that there needs to be substantially more consideration given on the portfolio of water products the government builds to meet environmental watering requirements. Submissions from industry and irrigators on the role of government being in the market (which is consistent with more flexible leasing) should be a focus point of consultation; and

- fourth, regional community adjustment should be targeted. The brunt will be felt by the irrigators, but are likely to receive direct compensation. Any reduction in economic activity as a result of the Basin Plan will also be felt by those in the irrigated agriculture value chain. These people are typically outside the tent when it comes to compensation. Compensation therefore needs to be targeted, but not just to irrigators in isolation. We note this view, albeit with a somewhat different rationale, is consistent with that expressed by the Productivity Commission in their 2010 buy-back paper.

Announcing SDLs, then leaving an interregnum of uncertainty about how the SDLs will be managed operationally in water sharing plans, will unnecessarily generate significant uncertainty and stress in regional agricultural communities. The overall impact of such a policy void on the people’s health and wellbeing in regional communities may be significant, and people will be compelled to make significant farm and livelihood decisions grounded on unnecessarily incomplete information.

Given the multitude of agencies and tiers of government involved in effective and efficient transition, there will be a need for a clear leadership role across the various agencies and tiers of government, to set out a pathway to minimise negative impacts on regional communities. This role will also entail ensuring governments effectively support regional transition through implementation of the Basin Plan, and sending clear and constant signals to communities about the implications of the coming changes.

7 July 2010

\(^{130}\) Although this effect may be somewhat mitigated by water prices increasing in line with increasing scarcity.
Bibliography


Australian Bureau of Statistics (ABS), 2006, *Census of Population and Housing*


Baillie Craig; Justine Baillie, David Wigginton, Erik Schmidt, Peter Watts, Rod Davis, Michael Scobie and Ben Muller, 2010, *An appraisal to identify and detail technology for improving water use efficiency in irrigation in the Queensland Murray-Darling Basin*. Presentation delivered by the National Centre for Engineering in Agriculture and the University of Southern Queensland, Goondiwindi, 29 March.

Beckmana, Jayson F.; Hertelb, Thomas W. and Tynerc, Wallace E. 2009, Why previous estimates of the cost of climate mitigation are likely too low, GTAP Working Paper No. 54. West Lafayette: Center for Global Trade Analysis, the Department of Agricultural Economics, Purdue University


Cotton Catchment Communities CRC, 2009, Social and Economic Analysis of the Moree Community


Department of Natural Resources (NSW), 2006, Background to water management in the NSW Murray and Lower Murray-Darling river systems, p16

Department of Primary Industries and Resources (SA), 2010, SA River Murray Irrigated Crop Survey, January 2010. February


EconSearch. 2009 for PIRSA, *Economic Profile of the Riverland Region of South Australia 2006/7*, Marryatville Output of Riverland Region Table 4.1.

Ellis, F., 2000, *Rural livelihoods and diversity in developing countries*. Oxford University Press, USA.


Fenton D.M., 1999b, *TRC-Analysis for the Logan water allocation and management plan (WAMP)*. Department of Natural Resources, Brisbane.

Fenton D.M., 1999c, *TRC-Analysis for the Barron water allocation and management plan (WAMP)*. Department of Natural Resources, Brisbane.

Fenton D.M., 2000, *TRC-Analysis for the Burnett water allocation and management plan (WAMP)*. Department of Natural Resources, Brisbane.


Institute of Rural Futures, 2010, *From conceptual framework to vulnerability indices and indicators*. Institute for Rural Futures.


Murray-Darling Basin Authority, 2009, *Basin Plan Fact Sheet 3: Sustainable diversion limits (SDLs) and the impacts of environmental water purchases*. MDBA, September


Marsden Jacob Associates 2010


PriceWaterhouseCoopers, 2000, Socio-economic *Impact Assessment Condamine-Balonne WAMP: A report prepared for the Balonne Community Advancement Committee*


Victorian Government, 2009, Northern Region Sustainable Water Strategy.

Water Act 2007 (Commonwealth)

Wong, Senator the Hon Penny, Media Release 83/10, Infrastructure rolls outs in Macquarie River catchment, 13 April 2010

Appendix 1: Sector profiles

This Appendix provides profiles of the following sectors:

A. Cotton
B. Rice
C. Dairy
D. Annual horticulture
E. Perennial horticulture
Appendix 2: Conceptual framework
Appendix 3: Methodological issues in estimating LTCEs & current environmental holdings

Long Term Cap Equivalent

The Long Term Cap Equivalent (LTCE) effectively is a weighted long-term average of the allocation of water to any given type of water entitlement.\(^{131}\)

For example, in the New South Wales Murray catchment, water entitlements include High Security and General Security. They have Cap Factors to calculate LTCE of 0.95 and 0.8084 respectively. This means that over the long-term, 95% of every High Security entitlement is actually allocated to the entitlement holder, and 80.84% of every General Security entitlement is allocated.

Different types of entitlement exist in different States, and the reliability of each entitlement differs between catchments.

In order to compare the outcomes of water availability scenarios across the entire MDB, and to take into account water savings from efficiency projects and buy-backs, it was necessary to be able to express volumes on a common basis. This was done by converting the entitlements available in each irrigation region to LTCE allocations.

To expand on the above example, in the NSW Murray Catchment, there are approximately 1,300 GL of General Security entitlements and 48 GL of High Security entitlements. Each is multiplied by the appropriate Cap Factor, and the results then can be summed:

- \(1300 \times 0.8084 = 1051\) GL LTCE General Security entitlements; and
- \(48 \times 0.95 = 46\) GL LTCE High Security entitlements; therefore
- \(1051 + 46 = 1097\) GL LTCE water allocation in the NSW Murray.

Because LTCE provides a weighted long-term average, it does not reflect the important role that low reliability entitlements may play in wetter years (and does not reflect the use of temporary trades at all). SDLs are expected to be set at a level that protects the condition of key environmental assets. They are also expected to vary year by year. The MDBA has noted that annually, SDLs will be:\(^{132}\)

Influenced by storage levels, expected inflows, groundwater levels and estimates of recharge, interception activities and other factors. In determining SDLs, the variability

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\(^{132}\) Murray-Darling Basin Authority, 2009, Basin Plan Fact Sheet 3: Sustainable diversion limits (SDLs) and the impacts of environmental water purchases. MDBA, September.
in water resources across the Basin and the effects of climate change and variability will also be taken into account.

Over the long-term, however, SDLs will reflect an average impact of those environmental watering needs on the consumptive pool – so LTCE allocations are an appropriate starting point for our analysis, and, indeed, are necessary for comparative analysis between valleys.

Estimating missing Cap factors

Cap factors were required for converting entitlement estimates and buy-backs to LTCE. Efficiency program data tends to be already converted to LTCE as a government condition of funding.

Cap Factors have been published by the former Murray-Darling Basin Commission for most catchments in the Basin.\textsuperscript{133} However, they were not available for the catchments in northern NSW or Queensland. For those catchments, LTCE was approximated by reverse-calculating it from the Commonwealth’s reported Restoring the Balance data (i.e., dividing Expected average annual volume of water available for the environment (ML) by Total Purchases (ML) for each type of entitlement for each region).\textsuperscript{134}

For those irrigation regions not published by the Murray-Darling Basin Commission, derived cap factors are set out in Table A3-1. Where specific data were unavailable, all High Security entitlements were assumed to have a Cap Factor of 1.

Table A3-1. Additional cap factors

<table>
<thead>
<tr>
<th>Catchment / Water Source</th>
<th>Entitlement Type</th>
<th>Derived cap factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gwydir</td>
<td>General Security</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>Supplementary</td>
<td>0.19</td>
</tr>
<tr>
<td>Namoi</td>
<td>General Security</td>
<td>0.77</td>
</tr>
<tr>
<td>Macquarie</td>
<td>General Security</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>Supplementary</td>
<td>0.21</td>
</tr>
<tr>
<td>Lachlan</td>
<td>High Security</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>General Security</td>
<td>0.42</td>
</tr>
<tr>
<td>SA Riverland</td>
<td>SA High Security</td>
<td>0.90</td>
</tr>
<tr>
<td>SA River Murray below Lock 1</td>
<td>SA High Security</td>
<td>0.90*</td>
</tr>
</tbody>
</table>

Note: 1. Pers. comm., Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

For Victoria, the Murray-Darling Basin Commission Cap Factors pre-date the implementation of unbundling (the separation of water rights into water shares, delivery shares and water use licences, and the separation of water shares into high and low reliability water shares). In the case of water savings projects, the calculations used by this project had been prepared elsewhere and


already had been converted to LTCE. For the total entitlements for a region, and for buy-backs, MJA relied on advice from RMCG developed for the Northern Victorian Irrigation Renewal Project (NVIRP).

**Net effect of environmental water procurement in the regions**

We calculated the impacts of committed environmental water buy-backs and irrigation water efficiency programs on water availability in the irrigation regions.

The regional impacts of buy-backs and efficiency savings for the environment are expressed as LTCE in Table A3-2. Note that it was necessary to express buy-backs and efficiency savings as LTCE for comparison purposes. This should not be taken as criticism of the use of low-reliability entitlements, or of allocations, for environmental purposes.
Table A3-2. Environmental water procurement by region (LTCE, approximate, rounded)

<table>
<thead>
<tr>
<th>Region</th>
<th>Buy-backs (GL)</th>
<th>Efficiency project savings allocated to the environment (GL, committed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balonne</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>2(^{135})</td>
<td>-</td>
</tr>
<tr>
<td>Gwydir</td>
<td>40(^{136})</td>
<td>-</td>
</tr>
<tr>
<td>Namoi</td>
<td>5(^{136})</td>
<td>-</td>
</tr>
<tr>
<td>Macquarie</td>
<td>45(^{136})</td>
<td>30(^{137})</td>
</tr>
<tr>
<td>Lachlan</td>
<td>45(^{136})</td>
<td>-</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>55(^{136})</td>
<td>-</td>
</tr>
<tr>
<td>Central Murray</td>
<td>170(^{136})</td>
<td>-</td>
</tr>
<tr>
<td>GMID</td>
<td>400(^{138})</td>
<td>75(^{139})</td>
</tr>
<tr>
<td>Nyah to Border (incl. NSW &amp; Vic Sunraysia)</td>
<td>30(^{140})</td>
<td>-</td>
</tr>
<tr>
<td>Riverland</td>
<td>27(^{141})</td>
<td>8(^{142})</td>
</tr>
<tr>
<td>SA Murray below Lock 1</td>
<td>9(^{143})</td>
<td>1(^{142})</td>
</tr>
</tbody>
</table>

Note: The data in this table come from a number of sources. These are cited. All data were tested in regional interviews. Please note that flow variability in the Northern MDB is very high, so LTCE or averages should be used with caution. A key source was [http://www.environment.gov.au/water/policy-programs/entitlement-purchasing/2008-09.html](http://www.environment.gov.au/water/policy-programs/entitlement-purchasing/2008-09.html)

\(^{135}\) Published figures from the Commonwealth Government were used to estimate buy-backs.

\(^{136}\) Published figures from the NSW and Commonwealth Governments were used to estimate buy-backs.

\(^{137}\) Many of the off-river schemes are proposing co-investment with DEWHA under the Private Irrigation Infrastructure Operators Program.

\(^{138}\) Source: RMCG analysis, NVIRP water balance. Please also note that to date, based on MJA analysis of published buy-back data (all governments), around 183GL of buy-back has been completed for the Victorian districts including GMID, and also including Sunraysia. See separate note on Sunraysia.

\(^{139}\) Note that it is not clear to what extent (if at all) historical and other water efficiency savings will contribute towards offsetting the impacts of SDLs on water availability for consumption. Therefore, only the savings from NVIRP stage 1 (which has been committed to, and which is partly funded from the Commonwealth) have been included in this table. A further 325 GL would be included if NVIRP stage 2, on-farm and distribution system savings and other district modernisation savings, and 80:20 Deal sales water were able to be included.

\(^{140}\) Buy-back from Nyah to Border is unknown, but is estimated to be in the order of 30 GL (assuming 50% of Murray downstream of choke buy-back to Dec 2009).

\(^{141}\) The total volume purchased in South Australia by the Commonwealth Environmental Water Holder since 2006-07 is 36.2GL. This is for the River Murray in South Australia and the SA Government was not able to provide a breakdown of above and below Lock 1. For the purposes of this report it is assumed 27 GL of buyback lies within the RiverLand and 9 GL south of Lock 1, using the same proportion as for total LTCE allocations. However please note that this apportionment between the two regions is approximate, so the data used in this report may not be appropriate to be used for other purposes. Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.

\(^{142}\) Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA. Of the 9 GL efficiency savings, 7.2GL went to The Living Murray and 1.8GL has been retained by the Government of South Australia.

\(^{143}\) The total volume purchased in South Australia by the Commonwealth Environmental Water Holder since 2006-07 is 36.2GL. This is for the River Murray in South Australia and the SA Government was not able to provide a breakdown of above and below Lock 1. For the purposes of this report it is assumed 27 GL of buyback lies within the RiverLand and 9 GL south of Lock 1, using the same proportion as for total LTCE allocations. However please note that this apportionment between the two regions is approximate, so the data used in this report may not be appropriate to be used for other purposes. Pers. comm. Diane Favier and Jarrod Eaton, DWLBC, June 2010 to MJA.
Appendix 4: Farm profile summaries

The following two tables present:

- Farm profile summaries: Broadacre; rice; livestock; and
- Farm profile summaries: Cropping and livestock; dairy; horticulture; mixed farms
### Table A4-1. Farm profile summaries: Broadacre; rice; livestock

<table>
<thead>
<tr>
<th>Variable</th>
<th>Broadacre excluding rice</th>
<th>Rice</th>
<th>Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs</td>
<td>Mean</td>
<td>Std. Dev.</td>
</tr>
<tr>
<td>Farm area (ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area</td>
<td>71</td>
<td>1,218</td>
<td>2,035</td>
</tr>
<tr>
<td>Irrigated area</td>
<td>71</td>
<td>384</td>
<td>717</td>
</tr>
<tr>
<td>Water entitlement (no.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High security</td>
<td>71</td>
<td>137</td>
<td>369</td>
</tr>
<tr>
<td>General security</td>
<td>71</td>
<td>737</td>
<td>1,350</td>
</tr>
<tr>
<td>Water trade 2008-09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased water</td>
<td>71</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td>Sold water</td>
<td>71</td>
<td>45%</td>
<td>50%</td>
</tr>
<tr>
<td>Irrigation technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drip</td>
<td>71</td>
<td>14%</td>
<td>35%</td>
</tr>
<tr>
<td>Flood furrow</td>
<td>71</td>
<td>77%</td>
<td>42%</td>
</tr>
<tr>
<td>Microdrip</td>
<td>71</td>
<td>6%</td>
<td>23%</td>
</tr>
<tr>
<td>Other</td>
<td>71</td>
<td>7%</td>
<td>26%</td>
</tr>
<tr>
<td>Travelling</td>
<td>71</td>
<td>6%</td>
<td>23%</td>
</tr>
<tr>
<td>Irrigation scheduling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calendar based</td>
<td>71</td>
<td>13%</td>
<td>34%</td>
</tr>
<tr>
<td>Own observation</td>
<td>71</td>
<td>82%</td>
<td>39%</td>
</tr>
<tr>
<td>Soil moisture testing technology</td>
<td>71</td>
<td>35%</td>
<td>48%</td>
</tr>
<tr>
<td>Weather forecasts</td>
<td>71</td>
<td>30%</td>
<td>46%</td>
</tr>
<tr>
<td>Profit and loss (5 year annual average)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>57</td>
<td>$394,154</td>
<td>$804,598</td>
</tr>
<tr>
<td>Operating cost</td>
<td>57</td>
<td>$403,446</td>
<td>$740,920</td>
</tr>
<tr>
<td>Gross margin</td>
<td>57</td>
<td>$9,292</td>
<td>$309,685</td>
</tr>
<tr>
<td>Regional expenditure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional centre</td>
<td>57</td>
<td>30%</td>
<td>36%</td>
</tr>
<tr>
<td>Regional town</td>
<td>57</td>
<td>58%</td>
<td>38%</td>
</tr>
<tr>
<td>EC payment</td>
<td>56</td>
<td>$34,956</td>
<td>$80,167</td>
</tr>
<tr>
<td>Off farm income</td>
<td>57</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>Balance sheet (as at December 2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total farm assets (including water)</td>
<td>109</td>
<td>$3,864,719</td>
<td>$6,131,561</td>
</tr>
<tr>
<td>Value of water entitlements</td>
<td>109</td>
<td>$636,371</td>
<td>$1,519,136</td>
</tr>
<tr>
<td>Farm debt</td>
<td>109</td>
<td>$563,395</td>
<td>$920,136</td>
</tr>
<tr>
<td>Financial performance ratios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt to asset ratio</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Gross margin return on assets</td>
<td>0%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Water assets/Total farm assets</td>
<td>16%</td>
<td>25%</td>
<td>60%</td>
</tr>
<tr>
<td>Human capital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deakin wellbeing</td>
<td>135</td>
<td>77.6</td>
<td>13.3</td>
</tr>
<tr>
<td>Optimism</td>
<td>135</td>
<td>3.6</td>
<td>1.2</td>
</tr>
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</table>
### Table A4.2. Farm profile summaries: Cropping and livestock; dairy; horticulture; mixed farms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cropping and livestock</th>
<th>Dairy</th>
<th>Horticulture</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Farm area (ha)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area</td>
<td>135</td>
<td>2,169</td>
<td>3,357</td>
<td>96</td>
</tr>
<tr>
<td>Irrigated area</td>
<td>135</td>
<td>640</td>
<td>952</td>
<td>96</td>
</tr>
<tr>
<td><strong>Water entitlement (no.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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### Economic and social profiles and impact assessments in the Murray-Darling Basin

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