Sustainability Profile for the Little River Catchment

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The Australian National University
Integrated Catchment Assessment and Management (iCAM) Centre

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Executive summary

The Integrated Catchment Assessment and Management (iCAM) Centre from the Australian National University carried out Sustainability Profile surveys in the Little River catchment during August 2001. The Sustainability Profiles study was part of the TARGET project funded under the NSW State Salinity Strategy and Natural Heritage Trust Murray Darling 2001 program.

The objective of the iCAM study was to provide an improved understanding of the likely long-term biophysical and socio-economic sustainability of the Little River catchment, and an appreciation of the social and economic impediments to uptake a variety of land management options.

Sustainability Profiles are a means of assessing the general health of a farming system. The method is based on an analysis of the stocks and changes in a farm's water, land, and vegetation resources, its social situation, and its business economics. In combination, these elements represent a "quintuple bottom line."

There were a number of key biophysical and socio-economic findings from the surveys:

- The land condition problem of most overall concern to the group was weeds, followed by acidity, salinity/high watertables and foxes. Salinity/high watertables were at least a slight problem for 72 percent of the group and at least a moderate problem for over 40 percent of respondents.

- The majority of respondents had increased their area of perennial pasture and made greater use of conservation farming during the last five years. However, these two measures have not necessarily been in response to a salinity problem. The next most implemented measure was fencing off remnant vegetation areas. Few farms had established farm forestry or saline agroforestry.

- A majority of respondents are planning for an increased area of improved perennial pasture and an increased area of saline pasture However, at least around 50 percent of respondents in the Little River group are not intending to implement any other salinity mitigation measures over the next 5 years.

- Sixty per cent of respondents recorded a farm cash income in 1999-2000 below the estimated sustainability threshold of $50,000, with about one third of respondents recording a negative cash income.

- Most farms had a low or negative business profit and rate of return to capital. There are few if any alternative enterprises that appear to offer a win-win situation with respect to farm profitability and salinity. Off-farm income was important for most of the group and averaged 24 percent of gross cash receipts per property. Off-farm income partially compensated for low farm returns.

By synthesising the survey results with information from the Department of Land and Water Conservation, the iCAM group found that:

- In most areas of the catchment, farming operations are currently sustainable within their current land use with respect to the water resource. There has been a fundamental change in the water balance for the catchment as a result of the introduction of agriculture. The catchment, however, is heterogeneous and there are large variations in the salt and water balance across the region. The supply and quality of water in the catchment's farms would be inadequate for large-scale intensive horticultural irrigation enterprises.

- In some areas of the catchment, there are acidifying soil conditions and without liming these soil resources are being used unsustainably. It is highly likely that the area of land salinisation due to dryland salinity processes will continue to expand. In some areas there is gully and wind erosion but it is unlikely that land degradation alone will make any farm unsustainable.

- Some parts of the Little River catchment are cleared with very little remnant vegetation and in most cases the current remnant vegetation is actively grazed. The shelterbelts probably have only a limited impact on managing groundwater levels or biodiversity. Weeds represent an ongoing farm management problem, but should not affect future sustainability. However, it is believed that the low percentage of remnant vegetation and associated biodiversity in a large proportion of the Little River Catchment is unsustainable.

- The Little River Catchment is composed of a number of semi-independent communities and there are some significant differences between these groups. The social sustainability of the catchment is driven predominantly by the stage of the lifecycle of the managers. There appears to be reasonable levels of replacement amongst the managers from both within the farm family units and from outside of the catchment—this is a healthy social indicator. The land market in the catchment appeared to be working in providing a healthy level of turn over and the possibility of farm build up through aggregation. There appears to be a healthy social system in most of the catchment. However, there are some areas where farm families may be vulnerable to further change. This will need to be taken into account in future integrated catchment management planning.

The findings of the socio-economic work within the Sustainability Profiles project have major implications for uptake of the land management options offered, as the options generally require producers to take on more complexity and risk, not less. In many cases, producers' management skills, decision-making capacity and family situations (especially where producers and their spouses are working several jobs and raising children) are already stretched. These social factors alone are likely to impede uptake of the land management options, even if producers were economically sustainable.

The iCAM group made the following conclusions:

- Salinity was an issue for most properties but was considered less important than weeds or pests;
- A majority of respondents are planning for an increased area of improved perennial pasture and an increased area of saline pasture in the next five years;
- Vegetation and biodiversity decline in the Little River catchment is seen as unsustainable;
- The voluntary basis of involving landholders is considered to be less efficient than a targeted approach in achieving salinity mitigation goals for the catchment as a whole; and
- The broad range of comments collected as part of the profiles project, indicates that there are a significant number of financial and non-financial impediments to the land management options trialled in the first year of the TARGET project. The TARGET project has been an evolutionary process and feedback on the results from this project were used to revise the approach used in the second year. However, there are a range of impediments which remain and unless addressed, these issues will constrain natural resources and environmental management strategies. It is recommended that the key government agencies responsible for the management of issues associated with

the broad range of comments are identified and processes implemented to develop management actions to overcome these impediments.

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1. Introduction

The recent Murray Darling Basin Salinity Audit and the NSW Salinity Management Strategy highlight the problem that the Central West Region of NSW (catchments of the Macquarie, Lachlan & Castlereagh Rivers) faces now and in the future with salinity. For example, it is predicted that the Macquarie River at Narromine will be unfit for human consumption 30 percent of the time by 2020, and 55 percent of the time by 2050.

The *Tools to Achieve Landscape Redesign Giving Environmental /Economic Targets Project* (TARGET) is a cornerstone project of the NSW Salinity Management Strategy. The TARGET project will facilitate large-scale land use change in catchment areas that have been identified as being major contributors to Basin wide salinity. These areas are the Lachlan and Macquarie catchments, and in particular, the Warrangong, Mid-Talbragar, Weddin and Little River sub-catchments.

The degree of land use change required to mitigate the effects of salinity in some catchments and sub-catchments may need to be extensive. Best management land use options to ameliorate the salinity hazard include farm forestry, saline agro-forestry, increased use of perennial pastures, increased use of native pastures, increased use of saline pastures, adoption of conservation and intercropping practices and vegetation establishment/retention for remnant and riparian vegetation.

Departmental agencies have long been involved in capacity (knowledge) building of the physical elements affecting land use. Often, however, this has been without an accompanying knowledge of the social and economic issues. The lack of knowledge of the nature of social or economic factors has contributed to minimal broad scale uptake of best management practices by producers. Social and economic issues are often also important impediments to participation in strategic catchment management actions. In particular, there is little existing information on the biophysical, economic and social sustainability profiles of producers or catchments as a basis for understanding why current problems have occurred or identifying impediments to the implementation of natural resource and environmental management strategies.

The following report is based on surveys that were conducted in the Little River catchment between 19th of July and 16th of August 2001.

Information on the location of the catchment and the procedure for the project is presented in the next section. Details on the Sustainability Profile concept are presented in section 2. In section three a summary of the sustainability assessment of the water, soils, vegetation, financial and social systems of the catchment and the survey results are presented. While in section four details of the catchment Sustainability Profile are presented and discussed. A summary of an assessment of the role of the nine land management options is presented in section five. In section six details on the nature of the impediments to integrated catchment management (ICM) of the Little River catchment are presented and the nature of a possible Strategic approach to ICM are discussed as a basis for discussions of "Where to from here" questions.

1.1 Project objective

The aim of this component of the project is to develop sustainability profiles, as part of the TARGET project, for individual farmers who participate in the surveys and for the Little River catchment.

1.2 Location of properties

The consultants were asked to prepare producer profiles for a sample of 32 properties from the Little River catchment—there are over 350 properties in this catchment. Individual property reports have been prepared for each of the 23 participants. These reports are confidential but form the basis for much of the material in this overall report. No identified individual information is reported here.

In summary, the Little River Creek catchment covers 258,322 hectares of which the total farm area surveyed is 31,976 ha. The survey covers a sample of properties with representatives in all of the main sub-catchments of the defined study area and summary selected summary statistics could be produced for key Land Management Units. Only one business had a property owned by the business outside of the study area, although a number of properties had either leasehold or other arrangements with properties outside the study area.

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2. Development of sustainability profiles

A significant part of this study is aimed at assessing the medium and long-term sustainability of farming in the Little River catchment and the nature of any impediments to the adoption of catchment management strategies or to participation in them.

Sustainability is defined for the purposes of developing Profiles as being:

> *"The ability to indefinitely provide the land managers and the broader catchment community with the lifestyle they aspire to while maintaining or enhancing the natural resource and environmental base"*

Sustainability is inherently a medium to long term concept concerning the whole farm system. Consequently, the fine detail necessary, for example, of a current year financial assessment for farm management or taxation, is not required in assessment of sustainability profiles.

Traditionally, the viability of farming systems has been based only on a financial assessment. However there has been significant change in farming systems over the past few decades, especially in farm size, impact of a range of drivers on farm values, access to off-farm income and impact of a wide range of forms of environmental degradation.

Consequently, the concept of Sustainability Profiles has been developed as the basis of assessing the general the "health" of a farming system, based on an assessment of the stocks and related flows of the following five key sub-systems (a "quintuple" bottom line):

- Water and climate
- Land, Soil and nutrients
- Vegetation, biota and genetic resources
- Social
- Farm business

Individual farm assessments of these sub-systems are aggregated to produce a 'Producer profile'.

This approach provides the basis for an integrated, multi-disciplinary analysis of sustainability. Each sub-system can be thought of as a stock, which is built up or run down by farm management decisions associated with enterprise production. Farmers can make specific decisions to increase or decrease stocks in one of the above five components. Farm viability is reliant on the maintenance of all stocks above key thresholds. In the short run, there may be enough of all of these resources but if the stocks of any or all of the above stocks are run down, then in the long run the farm will not be sustainable. Nor will a farm prosper, in the medium or long run, if there are problems in the quality of the water, the soil, the vegetation, the social or the farm business sub-systems.

Assessment based on an integrated approach to all the farm sub-systems at the same time, is particularly important as it enables the identification of key linkages between the five components of the farm system. For example, land degradation impacts are intimately linked to farm financial performance and alternatively the pressure of a poor financial performance frequently results in pressure on the natural resource and environmental base.

Because of the TARGET project's emphasis on salinity management, the assessments of the biophysical criteria give specific attention to salinity processes and impacts both on-farm and off-farm.

The following example relates to the farm finance sub-system or to the financial viability with which most people are familiar. However, similar examples could have been presented from each of the other components.

Each farm has a stock of financial capital that includes assets, with service lives of greater than one year, and financial deposits. Farmers regularly make decisions that involve on-farm investment in capital assets and the adoption of new technologies and infrastructure replacement that have the potential to build up the financial stocks. They also make decisions with respect to asset sales, the rate at which they depreciate their assets and the degree to which savings are invested off farm which can run down the capital stocks. In a normal situation returns from farm production are required to cover variable costs (which includes the wages for labour) and a return for capital and management. Producers use their share of these returns for family expenses (eg education and food) and to provide capital for new farm investment and asset refurbishment.

In the short run (one or two years) returns may only cover variable costs. However, in the long run this would result in a run down in capital stocks and, beyond a threshold point, the farm would become unviable. For example, many farmers have postponed fertiliser applications, maintenance or replacement of assets in years of low commodity prices; however, in the long run this leads to lower productivity and an unviable farming system.

Barr and Ridges (2000) analysed farming systems in the Murray Darling Basin and concluded that in most of the Statistical Local Areas in the southern part of the Basin, fewer than 20 percent of farms generated a 'sustainable' farm family income. In this context sustainability was based on the FAST benchmark, which is an income of over $50,000. This level of income is judged sufficient to meet all current costs of production and living expenses and to allow for investment in the maintenance and development of the farm business.

Over the past 20 years farm viability has become less reliant on income generated by farm production and to an increasing extent (in regions where this is possible) more reliant on off-farm income. The proximity of the Little River catchment to regional centres, provides significant opportunity for off-farm income compared with many other rural areas in the west of the state.

Data from the Australian Bureau of Agricultural and Resource Economics (ABARE) shows that, throughout Australia, only 20 percent of producers accounted for 80 percent of the production and income. This implies that there is a long tail of the distributions involved and the need for farm data surveys with sufficient sample size to enable distribution analysis.

Structural change involving the continual reallocation of resources in response to environmental and market forces is a sign of a healthy economic system. For example, producers continually revise their management decisions on the nature of crops, pastures and livestock enterprises in response to changes in regulations, commodity prices and climate. In some cases, structural change is not occurring at an optimal rate (either too fast or too slow) or it has stopped, in these cases, structural adjustment policies designed to facilitate change are sometimes justified (eg. the Foundation for Rural and Regional Renewal (FRRR).

Information from an integrated assessment of the sustainability of the water, the soil, the vegetation, the social and the farm business sub-systems of properties is currently unavailable for most rural areas. Producer profiles were developed for each of the farms in the Little River catchment based on this assessment approach and will be presented to the producers concerned as confidential individual farm reports.

Despite all the differences identified between individual farms and summarised in the Producer Profiles, there are often very many similarities (especially for relatively small areas). In addition, strategic management of agriculture, natural resources and the environment to ensure sustainable systems, requires the aggregation of individual farm units into relatively homogeneous Land Management Units wherever possible. Catchment or regional sustainability profiles can be developed based on the aggregation of individual farm profiles. Typically, the basis for aggregation is significant similarity in each of the five key sub-systems.

A Sustainability Assessment, based on a supplementary biophysical assessment and the survey based biophysical and socioeconomic assessment, are presented in the following sections of this report. A Little River catchment Sustainability Profile, based on this information, is also presented.

The Sustainability profiles approach has allowed an assessment of questions and issues related to sustainability; impediments to the adoption of potential new enterprises; impact of incentives; the need for and nature of cost sharing arrangements; the implications for Strategic Management Plans and the need and capacity for structural adjustment.

2.1 Procedure

This procedure was initially trialled in the Oolong catchment of NSW and has also benefited from its application in the Warrangong catchment as part of the TARGET project. The assessment and development of sustainability profiles for the Little River catchment included the following key stages:

- Meeting with cooperating producers of the Little River catchment and the Catchment Coordinator as a group to discuss the approach in detail;
- Development of a survey schedule to collect the information during farm visits;
- Development of a data analysis system;
- Arrangement for suitable available data, maps and a background brief for the Little River catchment from DLWC and the Little River Landcare Group;
- Assessment of the biophysical nature of the Catchment, including a crude estimation of the catchment salt and water balance;
- Distribution of copies of the survey schedule to participating producers with instructions which requested completion as far as possible before the farm visits;
- Individual meetings with participating producers to:
    - Obtain producer permission to include individual property information in a group report;
    - Conduct a farm tour to identify the key components of the individual farm system;
    - Complete the survey schedule including a discussion of agronomic, socio-economic and natural resource issues; the potential for new enterprises or new farm structures and, the nature of impediments.
- Copies of the Draft Individual Farm Reports were distributed to producers for validation;
- A presentation of details from the Draft Group Report was made to participating producers; and,
- Incorporation of comments from participating producers and key members of the TARGET project for finalisation of Individual Farm and the Catchment Group Report.

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3. Sustainability assessment

3.1 General Catchment description

The Little River is a tributary of the Macquarie River lying west/southwest of Wellington. It joins the Macquarie River between Dubbo and Wellington, and together with the Bell River is the only major tributary between Dubbo and Burrendong Dam. This has important consequences for out-of-catchment salinity impacts and will be discussed further below.

The Little River TARGET area is the same as the Little River catchment plan area. It comprises 258,322 ha, and is the entire Little River catchment, plus a small part to the east in the Bell River catchment (Curra Creek and an area near Eurimbla).

The catchment plan area was divided into 4 main sub-areas – Baldry, Cumnock, Suntop/Arthurville and Yeoval. The analysis below will refer to these planning units, but also describe a different sub-division based on surface water catchments – namely, Barneys Gully, Gundy Creek, lower Little River (on the west bank), Wandawandong Creek, Balrudgery Creek, Buckinbah Creek (including the Eurimbla area) and Curra Creek.

These two sub-divisions will also be the basis for discussion of the various groundwater flow systems as described for the Central West region.

3.2 Biophysical statement

The following analysis draws heavily on the descriptions published in the Stage 1 report of the Little River Catchment Management Plan, May 2000. This background document compiled all the relevant information available to that time. Some additional material describing the groundwater flow systems and the contributions of the Little River to Macquarie Catchment river salinity has been added, primarily from a draft report of the Mid-Macquarie Community Salinity Prioritisation and Strategic Directions Project. The interested reader is referred to the above-mentioned documents for more detail.

Geology

The geology of the Little River catchment is complex. More detailed descriptions are provided elsewhere. The rocks are comprised of a series of north-south trend blocks of sediments and volcanics that have been intruded by granites of the Yoeval complex. These have been weathered, overlain by minor sediments and had more recent volcanics intrude and extrude in some areas. Finally, a long period of weathering has resulted in the river and stream valleys filling with sediments.

Hydrology

The groundwater flow systems described below are based on work done as part of a study of the mid-Macquarie region on behalf of DLWC. The descriptions have been translated directly to the various areas of the TARGET study area. In some cases, there is no data available in the Little River to confirm these as being representative of the region. For instance, there is only one bore in the granite region of the catchment that has more than one water level measurement. This condition is of concern.

Groundwater flow systems

Ordovician sediments

This flow system lies in a narrow belt that runs from Cumnock in the south, northward to the east of Arthurville, towards Geurie.

They are dominated by the low relief, gently undulating country that has developed in response to weathered metasediments, typically Ordovician slates, phyllite, sandstones and schists. Residual and colluvial material overlay these highly fractured sediments. Aquifers in these flow systems are unconfined and typically exist in the fractured rock, which has good porosity, allowing groundwater to move freely. The systems are local in scale with flow lengths usually less than 5km in length. Soil thickness and soil type can vary substantially, with skeletal and thin soils found on the high slopes, while deep weathering can be found elsewhere.

Groundwater flow systems are characterised by a large number of small local flow systems correlating very closely with topographic catchments. Groundwater recharge generally occurs seasonally, with episodic rainfall events contributing additional deep drainage. Higher levels of recharge typically occur in regions where fractured rock outcrops occur in catchment headwaters, however it is likely that all parts of the system are recharging. Groundwater flows down slope and discharges where there is a reduction in the hydraulic gradient consistent with major changes in the slope of the land. Ephemeral and perennial stream networks receive groundwater discharge as base-flow.

Response times to changed groundwater conditions can be rapid (less than 30 years), with equilibrium conditions taking significantly longer to establish.

Cudal Group

This flow system occupies a broad belt either side of the Ordovician sediments, running from Cumnock in the south to Geurie outside the catchment in the north.

These groundwater systems are typically rolling and/or steep hill terrain. The systems are local in scale, with moderately short flow lines, less than 5 kilometres in length. The main aquifer is Palaeozoic fractured bedrock, known as the Cudal Group – a middle Silurian volcanic suite of rocks which can contain thick sequences of sediments, including limestone. Overlying soils and weathered bedrock are variable with thin and limited soils on the higher slopes, and thicker soils on the lower slopes. The fractured bedrock aquifers are usually semi-confined to unconfined and the permeability's are moderate but variable.

The major source of recharge is from rainfall that is seasonal in nature. Recharge to the fractured bedrock occurs generally across the area but tends to be a bit higher on skeletal soils and on the upper slopes. Groundwater discharge typically occurs in localized areas and is linked to breaks in slope, changes in lithology, structural geological controls and valley locations. Ephemeral and perennial stream networks receive discharge as baseflow.

The first appearance of salinity after changed groundwater conditions has been very rapid in this area (less than 30 years) and is still expanding, with equilibrium conditions taking longer to establish. Salt storage in these aquifers is highly variable and is related to the depth of weathering.

This area has a high salinity risk ranking with salinised outbreaks that are currently rapidly expanding.

<u>High relief granite</u>

These groundwater systems are typically found within the steep granitic hilly country found adjacent to the Little River north of Yoeval. The landscape is characterised by tors and other granitic outcrops, boulders and colluvial fans. The flow systems in this area are small in size, with flow lines less than 2km in length.

The main aquifer is the fractured granite. Colluvial deposits on the slopes of the hills and alluvial deposits in the valleys also contain aquifers in the coarser sediment layers. The fractured granite aquifers, and the colluvial and alluvial aquifers, are generally unconfined. Permeabilities and yields tend to be low to moderately low.

The major source of recharge to the granite and colluvium is from rainfall that is seasonal in nature. Recharge to the fractured granite bedrock occurs mainly on the hilltops and slopes where the colluvium/regolith is thin or non-existent. Recharge to the colluvium occurs diffusely across the slopes. Recharge to the valley alluvium can come from river flooding, associated with the higher rainfall events.

Groundwater discharge typically occurs in localized areas and is linked to breaks in slope, lateral changes in lithology of the soil/colluvium and valley locations, where artesian conditions may exist in the bedrock aquifer and the watertable of the alluvium/colluvium is above ground level. Ephemeral and perennial stream networks receive discharge as baseflow.

The first appearance of salinity after changed groundwater conditions can be very rapid (less than 30 years), with equilibrium conditions taking longer to establish.

Groundwater salinity and salt storage is very low in this flow system, so the salinity risk is low, but the risk of waterlogging is high.

Low relief granite

These groundwater systems are typically found within the granite country found in the undulating country to the north, south and west of Yoeval. The landscape is characterised by a gently undulating hills and valleys with minor granite outcrop. The flow systems in this area are small in size, with flow lines between 1 and 5 km in length.

The main aquifer is the saprolite (the weathered granite layer) and colluvial deposits on the lower slopes. The fractured granite bedrock is a minor aquifer. The fractured granite bedrock aquifers can be confined or unconfined and the colluvial and alluvial aquifers tend to be unconfined. Permeability's and yields in both systems tend to be low to moderately low.

The major source of recharge to the granite and saprolite/colluvium is from rainfall that is seasonal in nature. Intense episodic rainfall events also provide some recharge. Recharge to the fractured granite bedrock occurs mainly on the hilltops and slopes where the saprolite/colluvium is thin or non-existent. Recharge to the saprolite/colluvium occurs diffusely across the slopes.

Groundwater discharge typically occurs in localized areas and is linked to breaks in slope, lateral changes in lithology of the soil/colluvium/saprolite, and valley locations, where artesian conditions exist in the bedrock aquifer or high water tables exist in the saprolite/colluvial aquifer. It is uncertain whether the ephemeral and perennial stream networks receive discharge as baseflow or washoff.

The groundwater salinity of both aquifers is low, being lower in the deeper bedrock aquifer. Salt storage is also low with most salts located in the solodic soils of the lower slopes. Waterlogging is a major problem in some soil types of this flow system.

Dulladerry volcanics
These groundwater systems are typically found within the volcanic terrain of the Yahoo Peaks and Saddleback Mt areas. The landscape is characterised by steep hills with sloping colluvial aprons leading to the lower slopes. The flow systems in this area are very small in length, with flow lines less than 1 km. The aquifer for this flow system is situated in the coarser grained sediments of the colluvium—the underlying bedrock is thought to be virtually unfractured. The colluvial aquifers are unconfined. Moderate but variable permeability's reflect vertical and lateral variations in lithology of the colluvium.

The major source of recharge to the colluvium is from rainfall that is seasonal in nature. Recharge occurs diffusely across the slopes directly into the colluvial aquifers. Groundwater discharge typically occurs in localized areas and is linked to breaks in slope and lateral changes in colluvial lithology. Discharge into the ephemeral and perennial stream networks is mainly in the form of washoff but there is a minor component of baseflow from the colluvium.

The groundwater salinity and salt storage in the landscape are both low. Even with these characteristics, saline outbreaks manifest in the landscape. In many cases it is the result of waterlogging and saline residue from evaporation of the waterlogged area.

The main issue for management options is to recognize the localized and very small scale nature of this groundwater flow system. The location of sites for recharge control options is likely to be very close to the sites where discharge control options could be implemented – all within the same colluvial landscape feature. Also, groundwater salinity and salt storage in the landscape are low but the impact of waterlogging and saline residue is still having a deleterious effect on the landscape.

Alluvium
There are a number of areas of alluvium/colluvium that have been mapped within the Little River catchment. The two largest of these are found to the south west of the catchment in a broad band running from the south of Baldry northward towards Wandawandong, and a large flat area running northward from Arthurville towards the Macquarie River. Other occurrences of major alluvial deposits are found associated with the lower gradient parts of the Buckinbah Creek and its upper tributaries.

The systems are local to intermediate in scale, with flow lines up to 10 km in length. The dominant lithologies of the aquifer are sands and gravels in alluvial sequences. The aquifers can be confined, semi-confined or unconfined depending on location and have moderate to high permeability's and relatively high yields.

Recharge is both seasonal and episodic in nature. The amount of recharge into the aquifer depends on the nature and existence of overlying regolith/soil and on the frequency and intensity of flood events, although recharge does tend to occur generally across the terrain. Groundwater discharge typically occurs in localized areas at the break of slope below the terraces. Ephemeral and perennial stream networks receive direct groundwater discharge as baseflow and from discharge areas as surface wash-off.

Salt storage in the landscape is low and groundwater salinity is low to moderate. The first appearance of salinity after changed groundwater conditions can be slow in this environment (up to 50 years), with equilibrium conditions taking longer to establish.

Upper Devonian sediments

These groundwater systems are typically found within sediments and bedrock of the footslopes of the hilly country to the west of the catchment in the Hervey Ranges, and to the east in the Condumbal Range. The systems are local in scale, with short flow lines, in the order of 1 to 5 kilometres length. The main aquifer is fractured Upper Devonian sediments. At the base of the footslopes, there are thick, coarse-grained colluvial deposits with shallow aquifers. The fractured bedrock aquifers are usually confined to unconfined and the colluvial aquifers tend to be unconfined. Permeabilities and yields are variable.

These landscapes are still heavily timbered and composed essentially of national parks or State forests.

The major source of recharge is from rainfall that is seasonal in nature, with the greatest amount occurring during the winter. Recharge to the fractured bedrock occurs mainly on the hilltops and slopes where the colluvium/regolith is thin or non-existent. Recharge to the colluvium occurs diffusely across the slopes. Groundwater discharge typically occurs in localized areas and is linked breaks in slope, lateral changes in lithology of the soil/colluvium and valley locations where artesian conditions exist in the bedrock aquifer. The contribution of discharge from this type of flow system to stream salinity has yet to be assessed.

Groundwater salinity is low to moderate and salt storage in this landscape is low to moderate. The bulk of the stored salt is situated in the colluvial and weathered bedrock horizons – not within the fractured bedrock. The salinity risk ranking is low.

Other flow systems

An area of Gregra group rocks occurs in the south east of the Little River catchment to the north east of Cumnock. As well, an area of Devonian sediments belonging to the Toongi Group occurs in the north of the catchment to the north west of Arthurville. Neither of these areas has been described in terms of their groundwater flow system characteristics.

There are some minor areas of other geological material that are too small to be of priority when the groundwater flow systems are being considered. These include areas of Mesozoic sediments, Permo-Triassic sediments and Tertiary basalts and Mesozoic intrusives.

Salinity

Impact

Four main categories of salinity impact have been identified:

1. Areas where producers have leaky land use systems but who have no discharge on their own property but contribute to discharge on neighbours properties or as base flow into creeks;
2. Areas where producers have leaky land use systems and have discharge onto their own properties from impacts of their own land use;
3. Areas where impacts that are occurring off-farm but within the Little River catchment; and,
4. Areas where impacts are occurring outside of the Little River catchment.

Land area

The area has been mapped in 1992 and again in 1998 (though not all of the western part). The area of salinised land increased by a factor of 4 in this time—from 1,074 ha in 1992 to 4,408 ha in 1998. The worst affected areas were south west of Cumnock, east of Baldry, the general area around Yeoval and between Arthurville and Suntop.

The project was unable to access the spatial distribution of land salinisation within the Little River catchment from DLWC.

Stream

The salinity of the stream network of the Little River catchment is poorly documented. Very little data is available that describes the longer term variability of the system, with data only being available for the last few years. However, some general conclusions can be drawn.

Many creeks in the catchment have high salinities – for instance, Gundy Creek, Barneys Gully, Myrangle Creek, un-named creeks in the upper Little River area. However, the downstream parts of Little River were always less than 1.5 dS/m when spot salinity samples were measured.

The draft salinity report (BRS, in prep) documented some data abtained from salinity loggers on important streams in the catchment. This data can be summaries as below:

- Gundy Creek was greater than 3.5 dS/m for 50 percent of its time (6 month period);
- Buckinbah Creek at Yeoval (over a 14 month period) was less than about 1.6 dS/m for 80 percent of the time;
- Little River at Obley (over a 2 year period) was less than 1.2 dS/m for 75 percent of the time and did not exceed 1.8 dS/m. Downstream of Balrudgery Ck was less than 1 dS/m for 90percent of the time (3 month period);
- Balrudgery Creek was less than 0.5 dS/m for 70 percent of the time; and,
- Wandawandong Creek was greater than 3 dS/m for 70 percent of the time (6 month period).

Other analysis shows that the Little River above Obley contributes an insignificant amount of salt to the Macquarie River, both in terms of stream salinity and salt load.

Conversely, the region upstream of Dubbo, but downstream of Obley (Little River – Buckinbah, Gundy, Barneys Gully), Nuerie (Bell River) and Burrendong Dam contributes a large proportion of the salinity and salt load as measured at Dubbo – especially when Burrendong Dam is filling. This suggests a significant issue associated with the Dubbo town water supply.

Soils

<u>Soil landscapes</u>
Previous work has identified nine major soil types/regions within the Little River catchment. The distribution of these soils is complex and reflects the underlying geology to a certain extent.

Alluvial soils – uniform sands or loams; showing moderate fertility, weakly structures surface soils, moderate to high waterholding capacity, salinity, flood hazard and streambank erosion. High erosion hazard when land cover low.

Red Solodic soils – duplex soils showing a sometimes hard setting A horizon with a high level of sodium in the clayey B horizon; low fertility, dispersible subsoils leading to gully erosion, seasonal waterlogging, low available waterholding capacity, acidity and salinity.

Red-brown earths – duplex or texture contrast soils with a light textured surface soil over a clay subsoil; structurally degraded surface soils, high erosion hazards under cultivation and low surface cover, moderate acidification and toxicity, low to moderate fertility, small areas of salinisation, moderate to high waterholding capacity and low to moderate permeability.

Non-calcic Brown soils – consist of a sandy loam A horizon over a sandy clay to light medium clay structured B horizon – well drained; moderate fertility, high to very high erosion hazard under cultivation, moderate waterholding capacity, waterlogging, some acidification, salinity and toxicity.

Shallow Soils – weakly structured topsoils over rudimentary subsoils, usually very thin; steep slopes, very low fertility and waterholding capacity, high permeability, seasonal waterlogging, erosion hazard and acidic surface soils

Siliceous sands – loose to hardsetting sandy surface soils over a sandy loam weakly structured B horizon, usually over a siliceous hard pan; low fertility, salinity, acidification, very high erosion hazard under cultivation, high permeability, seasonal waterlogging, low available waterholding capacity, sodic subsoils.

Red podzolics – texture contrast soils with a sandy loam A horizon over a clay loam to medium clay B horizon; low to moderate fertility, high to very high erosion hazard under cultivation due to slope and surface cover, moderate available waterholding capacity, seasonal waterlogging, soil structure decline, some salinity and acidification.

Euchrozems – a clay loam topsoil over a medium clay B horizon containing carbonates; moderate fertility, moderate to high erosion hazard, high shrink-swell potential, moderate permeability and potential salinity.

Terra Rosa Soils – reddish brown light clays; moderate fertility, shallow soils, moderate to high erosion hazards.

Acidity

There is widespread soil acidification within the catchment. A program of monitoring by Acid Action was reported in the Little River catchment plan. This showed that most soils had a pH less than 6, and that some soils had pHs lower than 4.5. It was found that there was a good correlation between low pH with shallow soils and siliceous sands and most of the red podzolics. The red-brown earths and non-calcic brown soils are moderately acidic – the degree depending on previous land use. The alluvial soils and strongly structured red soils (euchrozems and terra rosa soils) are not generally showing acidity at present and are considered buffered against acidification.

Soil erosion and structure decline

All soil units have a high risk of soil structure decline except for the euchrozems and the terra rosa soils. The red solodic soils, red-brown earths, shallow soils and siliceous sands have a moderate to high erosion hazard.

Land Management Units

The Little River Catchment plan has been based on a number of land management units, generally defined according to soil type. A land use plan for each LMU has been devised and some suggestions for land use change have been made. The project has been unable to access the map of the distribution of the LMUs for the Little River catchment to enable a comparison with the groundwater systems identified below.

Work carried out by DLWC has also identified a number of Groundwater Flow Systems (see above). These units have been devised as an aid to managing the groundwater conditions found in the catchment. It is suggested that land use change can also be considered within the context of the groundwater response likely beneath these units, and will lead to consistent results in terms of dryland salinity management.

There is a need to link the two approaches (LMUs and GFSs).

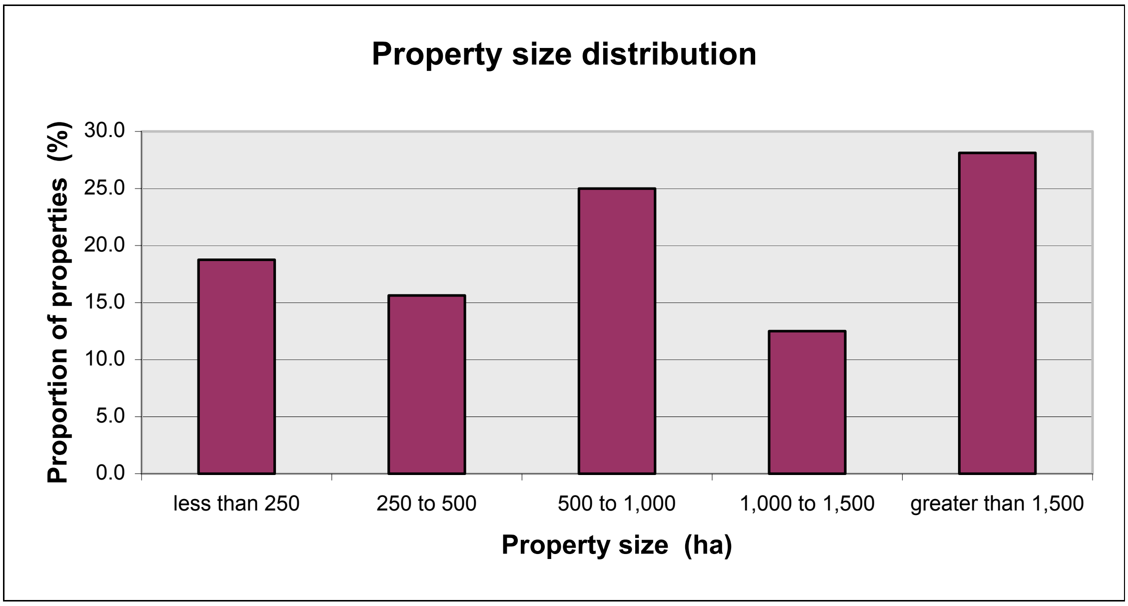
3.3 Little River survey results

This section summarises the results of the property survey questionnaires that were completed as part of the 32 property visits. The complete tables of results are presented in Appendix A. Most financial and production data relate to the 1999-2000 year.

Biophysical and socio-economic data

Land use

The size of properties surveyed in the Little River catchment varied from less than 100 hectares to well over 3,000 hectares. Just under 20 percent of properties were less than 250 hectares in size and about 15 percent of properties were between 250 and 500 hectares in area. Twenty-five percent of properties were between 500 and 1,000 hectares in size. Just 12 percent of properties were between 1,000 and 1,500 hectares while the largest percentage of properties (28 percent) were greater than 1,500 hectares in area. The proportion of property area leased was mostly small.



On average, around 70 percent of total property area was devoted to pasture. The majority of properties (50 percent) had between 60 and 80 percent of total area devoted to pasture. Just under 30 percent of properties had between 80 and 100 percent of their total property area under pasture. Seven properties (22 percent) had a pasture proportion of less than 60 percent. The dominant pasture type was improved perennial pasture, making up 51 percent of total pasture area.

The area devoted to farm forestry, revegetated land and remnant vegetation was relatively small (average of 8 percent of total property area or 78 hectares). The largest area of trees was 32 percent of total property area and the smallest area was less than one percent.

Farm forestry comprised the lowest proportion of total tree area with less than one percent. Remnant vegetation comprised the largest proportion with 94 percent and revegetated area at 6 percent.

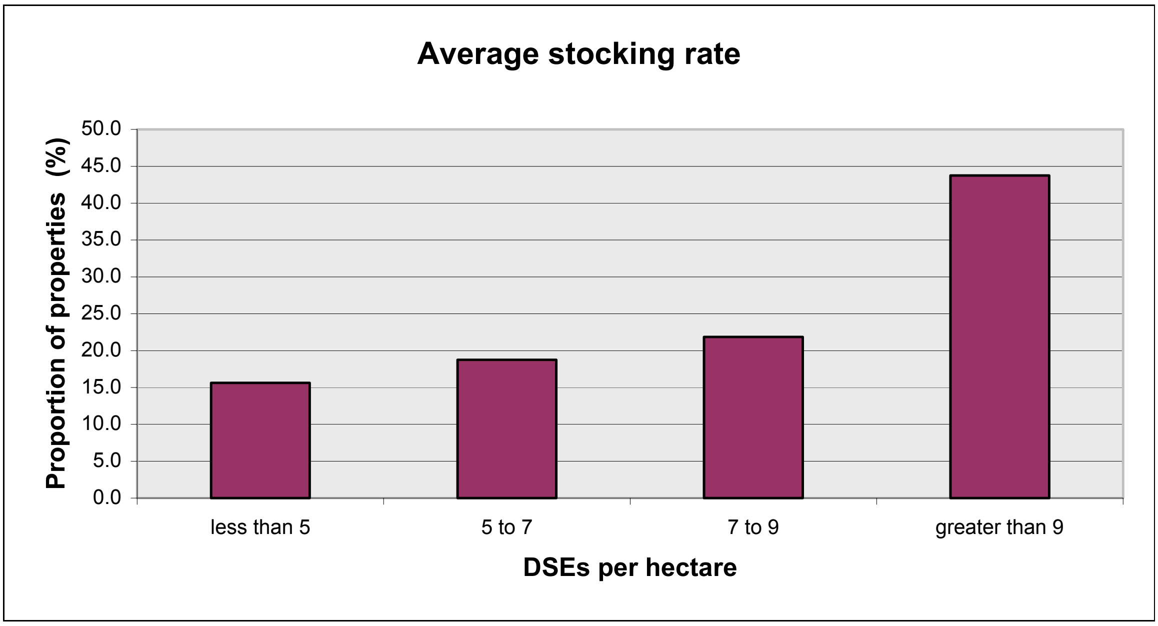
Thirty-one out of 32 properties in the catchment undertook some form of livestock production albeit in some cases the livestock numbers were relatively few. Twenty-seven out of the 32 properties (84 percent) undertook grain cropping with the major crop enterprise being wheat. Twenty-four properties grew wheat during 1999-2000. The next most grown crop was canola (12 properties) followed by barley, triticale, oats and lupins (5 to 7 properties). Fourteen properties produced hay or silage during the year and seven properties grew a dedicated fodder crop.

In terms of area grown, wheat was the dominant crop for the Little River group with an average area grown of 162 hectares. Around 40 percent of properties grew less than 50 hectares of wheat, 16 percent of properties grew between 50 and 100 hectares and a further 22 percent of properties grew between 100 and 200 hectares of wheat. The remaining 22 percent of properties grew in excess of 200 hectares of wheat. The average yield for wheat was 2.6 tonnes per hectare.

With respect to crop production methods, around 30 percent of respondents used minimum tillage and crop rotations. Twenty-two percent of respondents used conventional tillage and 14 percent used zero tillage. Full details of land use survey responses can be found in tables 1, 3 and 11 in Appendix A.

<u>Livestock production</u>
Sheep and cattle were the dominant livestock activities for the Little River group. Just over 50 percent of the group ran both sheep and cattle while about 20 percent had sheep only and 20 percent had cattle only. The most common grazing system used for sheep and cattle was rotational grazing.

With respect to stocking rates, the average number of dry sheep equivalents (DSEs) carried was 8.7 per pasture hectare with a range from less than one to 16 DSEs. The majority of properties running sheep and/or cattle had stocking rates in excess of 9 DSEs per hectare (14 properties).



On average just over 1,400 ewes were run with a group maximum of 4,800 ewes. The average lambing percentage was 89 percent. Average wool cut was about 4.5 kilograms per animal shorn. The average sale price per sheep was $24. The average sale price for cattle sold was $461. The average calving percentage was

84 percent and the maximum number of breeders run was 1,000 head. Refer to table 3 in Appendix A for further details on livestock production.

Fertiliser usage

Around 75 percent of respondents topdressed their pastures, however, the frequency with which this was done varied considerably. The three most common frequencies were every 1–2 years, every 3–5 years and during pasture establishment. Just under a quarter of the group topdressed pastures with lime and a similar number topdressed with other soil conditioners.

The majority of respondents (23 properties) applied fertilizer to wheat on a regular basis while 12 respondents applied fertilizer regularly to canola and oat crops. Canola was the crop that most respondents (11 properties) applied lime to on a regular basis.

The most common basis for making both fertilizer and lime application decisions were soil tests and agronomist's advice.

With respect to general soil pH levels, most respondents rated their pH range as being between 4.6 and 5.5. At least half of the respondents indicated this was the range for their pasture paddocks and over 60 percent believed it was the range for their crop paddocks.

Full details of fertiliser use survey responses can be found in tables 7, 8, 9 and 10 in Appendix A.

Water resources

Dams, creeks/rivers and bores were the most common source of on-property water (32, 31 and 28 properties respectively. On average, the estimated maximum quantity of water stored in property dams was just over 20 megalitres. The average number of dams per property was 13 (up to a maximum of 60) while the average number of bores was three (up to a maximum of 20). Refer to table 4 in Appendix A for further details on water resources.

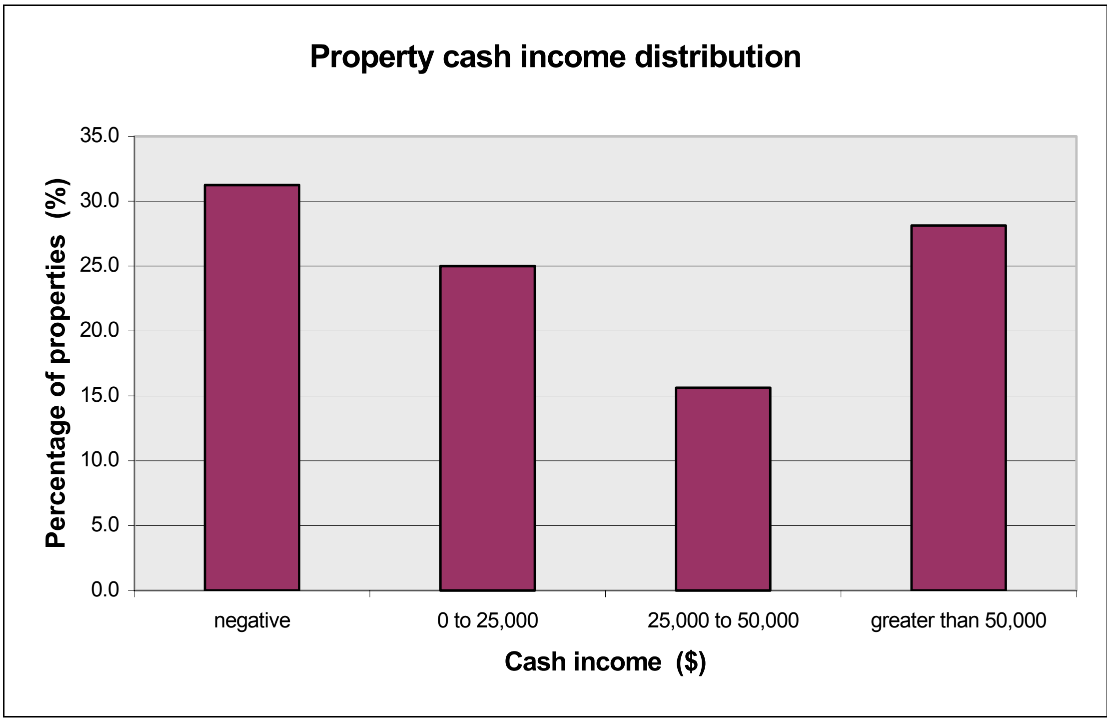
Labour use

Owner-operators provided the majority of labour use on properties (average 23 months per property). An average of three months came from casual labour while permanent labour was rarely used. Off-property labour comprised just under 20 percent of total labour (both on-property and off-property). Refer to table 2 in Appendix A for further details on labour use.

Financial performance

In 1999-2000, the 32 properties generated a total of over $7.1 million in gross cash receipts from primary production activities. The average gross cash receipt per property was just under $224,000.

Total cash costs averaged about $193,000 per property, and on average, properties in the Little River survey had a property cash income of almost $31,000. There was, however, significant variation around this average. Thirty-one percent of respondents recorded a negative property cash income while a similar proportion of respondents recorded a figure of greater than $50,000. Twenty-five percent of respondents had a property cash income of between zero and $25,000 and almost 16 percent of properties recorded a figure of between $25,000 and $50,000.



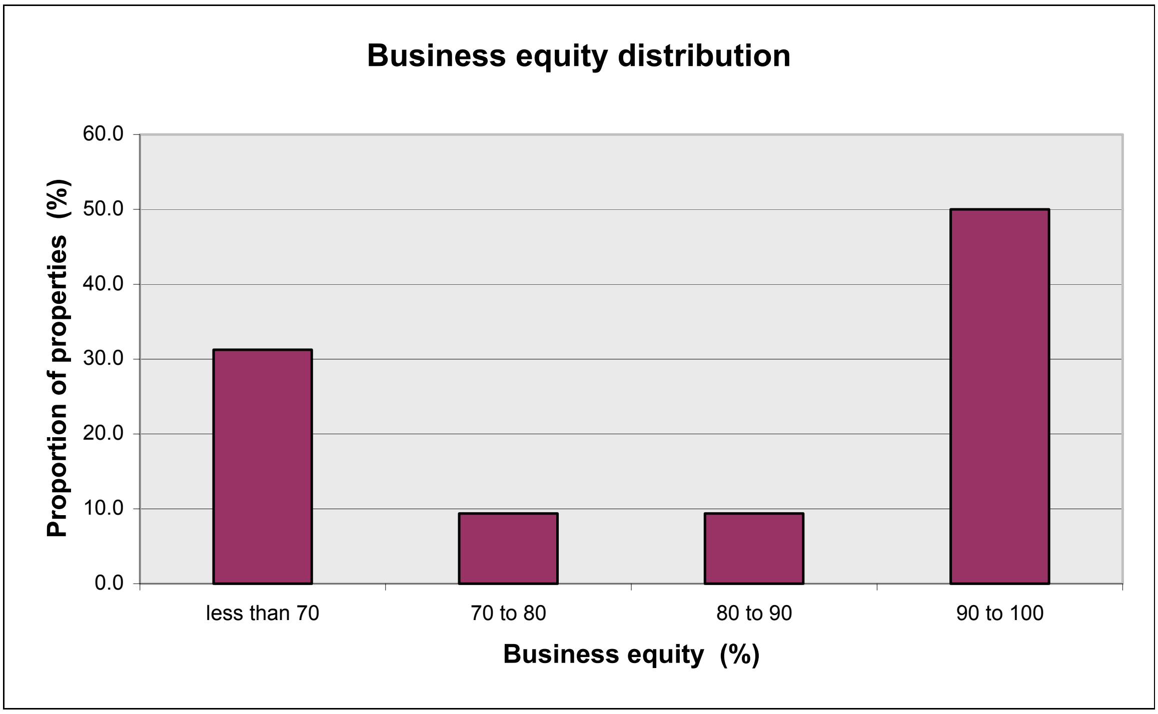
After accounting for trading stock changes and depreciation, the average property business profit for the group fell to about $14,000. Again there was considerable variation around this average with about 44 percent of the group recording a negative business profit and 38 percent and 19 percent having a business profit of between zero and $50,000 and greater than $50,000 respectively.

The highest contributor to total cash receipts was livestock sales (29 percent). Wool sales and grain sales each comprised around 20 percent. Off-property income was a significant contributor at 24 percent of total cash receipts.

On average, surveyed properties had total business assets valued in excess of $1.6 million and an average debt of about $320,000. Over 40 percent of respondents had a business debt in excess of $300,000.

Average business equity for the group was 81 percent. This relatively high average was reflected in the distribution of business equity with 50 percent of the group having an equity ratio of between 90 and 100 percent. Significantly, however, about a third of respondents had an equity ratio of less than 70 percent.

Of respondent's total equity, an average of 87 percent was based on primary production equity (e.g. land, machinery) while 13 percent was based on non-primary production equity (e.g. town property, shares). Refer to table 5 in Appendix A for further details on financial performance.



Social profile

Within the Little River catchment there was a relatively broad distribution of age groups. Thirty-five percent of males and 38 percent of females were 46 years and over. Thirty-two percent of males and 29 percent of females were between 26 and 45 years of age while 17 percent of males and 20 percent of females were dependent children (less than 15 years).

In general, it is an experienced male group with 50 percent of males having more than 21 years of farming experience. However, reflecting the broad age distribution within the group, 28 percent of males and 45 percent of females had less than ten years farming experience and 22 percent of males and 23 percent of females had between 10 and 20 years experience.

Fifty-three percent of male respondents had post secondary school qualifications (32 percent tertiary and 21 percent trade/vocational). For female respondents, the corresponding figure was 61 percent (40 percent tertiary and 21 percent trade/vocational).

Refer to table 6 in Appendix A for further details on social profiles.

Attitudes of landholders to biophysical, production and social issues

Respondents were asked a number of attitudinal and intentions type questions relating to land condition, salinity/high watertable trends and damage, past and intended implementation of salinity mitigation measures, property future and threats, condition of capital equipment, current and prospective enterprises and local services.

<u>Land condition</u>

The land condition problem of most overall concern to the group was weeds, followed by acidity, salinity/high watertables and foxes. Almost 100 percent of respondents rated weeds as at least a *slight* problem and 56 percent of respondents rated it as at least a *moderate* problem.

Acidity was nominated as at least a slight problem by 75 percent of respondents and as at least a moderate problem by 53 percent of the group.

Salinity/high watertables were at least a *slight* problem for 72 percent of the group and at least a *moderate* problem for over 40 percent of respondents. Around 25 percent of respondents, however, rated it as *no problem/non-existent*.

The problems of least overall concern were rabbits, woody weeds, sodicity and scalds/bare earth. At least 50 percent of respondents rated these problems as *no problem/non-existent*).

Across all possible problems the most common rating was *no problem/non existent* (36 percent of total ratings). A *slight* rating was the next most common at 33 percent of total ratings. A *moderate* rating accounted for 18 percent of all ratings while a *serious* and *don't know* rating accounted for just ten and two percent respectively.

For problems rated as either *serious* or *moderate*, respondents were asked to estimate the area affected by the problem. In general, for pests and weeds the areas affected were large because these problems are not generally site specific. Therefore, for example, the average area affected by weeds and foxes was 423 hectares and 266 hectares respectively.

With respect to land condition problems that are more site specific such as salinity and erosion gullies, the areas are usually relatively small. The average area affected by salinity/high watertables was estimated at just 19 hectares. The average area affected by waterlogging was 100 hectares. For acidity, which 53 percent of respondents nominated as either a *serious* or *moderate* problem, the average area affected was relatively large at an average of 580 hectares per property or a total area for the group of 18,551 hectares. This total area of 18,551 hectares represents 58 percent of the total property area for all 32 properties surveyed.

Full details of land condition survey responses can be found in tables 12 and 13 in Appendix A.

Salinity/high watertable trends

Fifty-seven percent of respondents who had rated salinity/high watertables as at least a slight problem believed it had worsened over the past five years. Thirty-five percent believed the problem had stabilized, four percent believed it had improved and four percent were not sure.

The most common category of cost or damage incurred in the past five years as a result of salinity/high watertables was lost production from salted land. A loss of shade and shelter and loss of aesthetic value were the next most nominated costs/damage categories. Of lesser importance were damage to infrastructure and salinisation of on-property water supplies. Refer to tables 14 and 15 in Appendix A for further details on salinity/high watertables.

Past implementation of salinity mitigation measures

The majority of respondents had increased their area of perennial pasture and made greater use of conservation farming during the last five years. However, these two measures have not necessarily been in response to a salinity problem. Of the 75 percent (24 respondents) who had implemented conservation farming measures and of the 72 percent (23 respondents) who had increased their perennial pasture area, almost all said it was not because of salinity.

The next most implemented measure was fencing off remnant vegetation areas. Fifty percent of the group had used this measure in the past five years.

The remaining salinity mitigation measures were less frequently implemented. Nine respondents (28 percent) had increased their area of saline pasture and eight respondents (25 percent) had fenced off creeks and waterways.

The least implemented measures were establishment of farm forestry, saline agroforestry, utilization of intercropping and increased area of native pasture.

Past implementation of salinity mitigation measures				
	Had measure been implemented			
Salinity mitigation measure	**Yes** (Mainly due to salinity)	**Yes** (But not due to salinity)	**No**	**Not applicable**
	no.	no.	no.	no.
Increased area of perennial pasture	2	21	9	0
Used conservation farming	1	23	7	1
Fenced off remnant vegetation	5	11	16	0
Increased area of saline pasture	9	0	23	0
Fence off creeks and waterways	3	5	24	0
Used saline agroforestry	2	0	30	0
Utilised intercropping	0	3	28	1
Increased area of native pasture	0	2	29	1
Establish farm forestry	0	1	31	0

Future implementation of salinity mitigation measures

Respondents were then asked if they intended not to implement any of the same set of salinity measures in the next five-year period. Furthermore, respondents were asked to provide their main reason if they were not intending to implement any particular measure.

The two measures that a majority of respondents are contemplating implementing are an increased area of improved perennial pasture (72 percent) and an increased area of saline pasture (59 percent).

However, at least around 50 percent of respondents in the Little River group are not intending to implement the remaining salinity mitigation measures over the next 5 years.

The measure most respondents are not intending to implement is saline agroforestry (78 percent). The major reasons given for not intending to implement this measure were because it was not considered profitable/productive and there was no or an insignificant salinity/high watertable problem.

Future implementation of salinity mitigation measures		
Salinity mitigation measure	*Number NOT intending to implement measure* no.	*Major reasons for not intending to implement measure* Reason and (no.)
Increase area of perennial pasture	9	▪ Already doing as much as intend to (3)
Increase area of saline pasture	13	▪ No/insignificant salinity/watertable problem (9) ▪ Other reason (3)
Increase use of conservation farming	15	▪ Already doing as much as intend to (11)
Fence off creeks and waterways	18	▪ Not profitable or productive (5) ▪ Already doing as much as intend to (5) ▪ Other reason (7)
Fence off remnant vegetation	19	▪ Not profitable or productive (5) ▪ Not applicable (4) ▪ Already doing as much as intend to (4)
Utilise intercropping	20	▪ Wouldn't fit-in with existing set-up (8) ▪ Don't know enough about it (5)
Establish farm forestry	21	▪ Not profitable or productive (11) ▪ Other reason (6)
Increase area of native pasture	21	▪ Not profitable or productive (14)
Utilise saline agroforestry	25	▪ No/insignificant salinity/watertable problem (8) ▪ Not profitable or productive (6)

Fewer than 60 percent were not intending to either fence off creeks and waterways or to fence off remnant vegetation. One of the major reasons in each case was because respondents had already done as much as they intended to. Refer to tables 16 and 17 in Appendix A for further details on past and future implementation of salinity mitigation measures.

Farming intentions and threats

Most (78 percent of respondents) in the Little River survey group intended to still be owning/operating their current property in five years time. Around half the group intended to stay much as is in terms of their current operation and 38 percent intended to increase their property size.

The greatest perceived threats to respondents still being farming in five years time were the cost-price squeeze (25 percent), age/health reasons (18 percent) climate risks, such as drought, (13 percent), and government regulations (11 percent).

Full details of survey responses regarding farming intentions and threats can be found in tables 22, 23 and 24 in Appendix A.

Capital items condition

A majority of the group believed their plant and improvements were in at least a good working condition. The combined ratings for the *good condition*, *above average* and *excellent* categories amounted to 78 percent of total ratings. The most common individual rating was *good condition* (39 percent of all ratings).

Seventeen percent of total ratings were attributed to the *below average* category and just four percent of total ratings were for the *poor condition* category.

Part of the reason for the generally good condition of major items of plant was decisions to invest in these items. At least half of the group had made significant expenditure on both improvements and plant and machinery during the past five years. Over 50 percent had invested in improvements and over 90 percent had invested in plant and machinery.

The average amount spent per farm over this period was $117,700 on plant and machinery and $55,000 on improvements. Refer to tables 18 and 21 in Appendix A for further details on capital items condition.

Enterprise preferences

The two most liked enterprises were cattle and sheep with 87 percent and 77 percent of respondents respectively applying a *highly liked* or *liked* rating. Cropping was the next most liked enterprise with 53 percent of respondents giving it a *highly liked* or *liked* rating.

The enterprises that were least liked were pigs, horticulture (annuals) and to a lesser extent horticulture (trees and vines). Sixty-seven percent of respondents applied either a *highly disliked* or *disliked* rating to pigs and horticulture (annuals) and 53 percent gave the same ratings to horticulture (trees and vines).

Farm forestry had the greatest proportion of *not sure* ratings (40 percent of respondents). A further 37 percent of respondents gave this enterprise a *highly liked* or *liked* rating while 23 percent gave it a *highly disliked* or *disliked* rating. Refer to table 19 in Appendix A for further details on enterprise preferences.

Preferences or liking for enterprises			
Enterprise	*Disliked or highly disliked* no.	*Not sure* no.	*Liked or highly liked* no.
Cattle	1	3	26
Sheep	4	3	23
Cropping	7	7	16
Farm forestry	7	12	11
Horticulture – trees/vines	16	7	7
Pigs	20	7	3
Horticulture - annuals	20	6	4

Local services

In terms of perceptions regarding improvements/deteriorations in local services, 41 percent of total responses indicated that services had *stayed the same*. The proportion of total responses for the *improved* category was 14 percent while the *worsened* category attracted 34 percent of total responses.

The two services given the most nominations in the *worsened* category rating were banking and roads (together accounting for 30 percent of nominations in this category). The two services receiving the most nominations in the *improved* category were hospital and secondary school services. Refer to table 20 in Appendix A for further details on ratings of local services.

4

4. Little River sustainability profile

The following profile is based on the previous biophysical assessment and the surveys.

The Little River catchment is a complex assemblage of biophysical and socioeconomic entities and which cannot be viewed as a homogeneous unit. Previous catchment management plans and studies had aggregated the catchment into a number of management units, for example, the Little River Management Plan (Stage 2) had identified a number of Land Management Units (LMUs) based to a large extent on soil type. Whilst these sub-divisions may have been useful at a simple level it is obvious that any aggregation across the catchment will need to take account of a more complex arrangement of the biophysical, social and economic. From the work reported here, it is still not possible to definitively identify these units.

For example, one unit identified as a LMU in Stage 2 of the Management Plan was seen as an area of major problems. However, when the river salinity data were analysed (Bureau of Resource Sciences, in preparation), this LMU has been implicated as a major source of fresh water diluting more saline water from the upper catchment. Without taking this integrated view of the LMU there is a risk that although significant revegetation of the landscapes will control recharge and discharge, it will also significantly decrease a dilution flow to the River resulting in a possible increase in river salinity.

4.1 Water and climate

In most areas of the catchment, farming operations are currently sustainable within their current land use with respect to the water resource. That is, the current quantity and quality of water will not change (within the natural climatic fluctuations) to the point where current enterprises are no longer sustainable.

There has been a fundamental change in the water balance for the catchment as a result of the introduction of agriculture. The catchment, however, is heterogeneous and there are large variations in the salt and water balance across the region. This change has seen an increased amount of runoff, together with an increase in groundwater discharge (either via the land or directly to streams) in some areas. This will likely lead to increased levels of salt being mobilised in the creeks and streams, and will limit future enterprise options. Conversely, in some other areas the development of soil structure and the increase in organic content (via the adoption of conservation farming practices and establishment of deep rooted perennial pastures) is resulting in a reduction in runoff.

The supply of water in the catchment's farms would be inadequate for large-scale intensive horticultural irrigation enterprises. For example, a large scale horticultural development near Cumnock in the late 19th century failed due to a lack of water at an appropriate salinity.

In addition, there are major structural impediments to intensive horticulture in the catchment, which include the need for irrigation licences and major investment in water storage infrastructure. Even though olives are less demanding for water quality and quantity than viticulture, it is unlikely that there will be sufficient water available to support these enterprises. Although salinity levels would have to increase by a factor of 10 to be a problem for livestock, in the majority of the catchment they are unsuitable for irrigated intensive horticulture or vegetable enterprises.

4.2 Soil and nutrients

In some areas of the catchment, there are acidifying soil conditions and without liming these soil resources are being used unsustainably.

The production of pH sensitive crops in acidifying soils (for example canola) needs the application of lime. Fortunately, the long run profitability of canola and other acid sensitive crops ensures the feasibility of a lime management program.

There are two components to the issue of pasture liming. In the first instance, while pastures on low pH soils produce less, they are also less water efficient that results in increased levels of deep drainage. Secondly, higher water-using deep-rooted perennial pasture species (lucerne and phalaris in particular) don't persist on low pH soils.

Whether liming of pastures is economic (in terms of on-farm investment decisions) depends critically on returns for livestock enterprises. During 1999/2000 livestock returns made liming of pastures only an economically marginal activity, however, livestock enterprise prices for 2000/2001 were more favourable. Lucerne, which is acid sensitive, is seen as a key pasture component for the management of dryland salinity due to its deep rooted perennial nature. Where there are off-site impacts associated with salinity the community may choose to share the cost of liming.

It is highly likely that the area of land salinisation due to dryland salinity processes will continue to expand over the next 5 to 10 years depending on the long term climatic fluctuation. It is unknown how large the area affected will become in this time frame. However, in terms of the sustainability of the agricultural productivity of the Little River catchment, discharge sites have a negative impact on only a small proportion of some of the producers and it is unlikely that land salinisation will become significant enough to force any farms to become unsustainable.

In some areas of the catchment, the nature of the deep drainage and its interaction with the underlying groundwater systems means that most increased recharge will never be expressed as land salinisation, but will, instead, be transferred to streams and creeks as an increased base flow.

In some instances, farms may become unsustainable where there is pressure brought to bear from a perception at the catchment level that land use change is required to meet catchment salinity targets. Especially, if the required land use change is uncompensated.

In some areas there is gully and wind erosion but this is much less than earlier in the last century and much of this has been stabilised with producer or government supported works. As long as this degradation is managed at current levels, erosion and associated turbidity issues will not severely impact on long term sustainability.

There is anecdotal evidence that increased bed-load sediment transport is impacting negatively on the riverine environment, especially in the lower parts of the Little River. It is unknown how this will affect the sustainability of the ecosystems in the Little River now and in the future.

As previously noted (see section on Biophysical Assessment) there are concerns about the fragile nature of a large proportion of the soil resource base. Future management will have to be more intense to ensure sustainable levels of production.

Many of the soils in the catchment suffer from low fertility levels. This will require an increasing level of inputs to maintain sustainable levels of production. For some farmers that are vulnerable to small changes in profitability, this high level of inputs may lead to unsustainable conditions.

4.3 Vegetation and biota and genetic resources

As with other aspects of the resource base, the Little River catchment has a complex distribution of vegetation, biota and genetic resources. In some parts it is cleared with very little remnant vegetation (for example, in the Suntop area there is less than one percent trees) and in most cases the current remnant vegetation is actively grazed. In other parts, for example in a belt north of Yeoval, there are large tracts of contiguous native vegetation. There has been some revegetation on-farm, mainly in the form of shelterbelts and for gully control, as well as plantings on groundwater discharge sites. These latter plantings were observed in a number of cases to be in poor health due to discharge site expansion and were ineffectual. The shelterbelts and other trees currently planted provide shade and shelter but probably have only a limited impact on managing groundwater levels or biodiversity.

In areas of low tree density, there is very little regrowth of young trees and a distinct lack of understorey. There have been some active management of remnant stands via the Grassy White Box Woodlands Project of Community Solutions.

It is believed that the low percentage of remnant vegetation and associated biodiversity in a large proportion of the Little River Catchment is unsustainable and would be a target under the Central West Catchment Plan (the Blueprint). Other work (Sue Briggs, CSIRO Eco-systems Services) associated with the TARGET project is being conducted to deal with these issues.

Some species trials have been instigated (under the auspices of a number of government programs, for instance, MF&F, and some small plantings for commercial agroforestry have been made. There are limited agroforestry plantings as a result of the TARGET project; however, there is no commercially viable forestry in the Little River Catchment to date as few of the plantations have an identified market product.

Weeds represent an ongoing farm management problem, but are being contained. Weeds of concern include broadleaf weeds such as thistles and there is growing concern in the local area about annual grasses in the cropping areas. Weeds are ranked as a moderate to serious farm management issue by the farmers and are being managed with inputs of time and funds. However, they should not impact on future sustainability or pose an impediment to the implementation of strategic management plans.

4.4 Social

Valuable insights into producers' social circumstances were collected during the surveys. The definition of social sustainability adopted below does not mean that we believe that a family unit is dysfunctional. Rather, it means that the farm system with an unsustainable social character may be at risk of failure in the medium to longer term. The following discussion highlights two possible eventualities regarding social sustainability.

Commercial farmers, for whom farm income is essential for their long term viability, may elect to leave the land as a farm family becomes socially unsustainable. In this case, the farm resources may be reallocated under new socially-healthy ownership and management.

In other cases, for instance where the farm operators are not conducting a farm business but are pursuing lifestyle objectives, other sources of income may allow them to remain on-farm while being socially unsustainable.

The social status of farm families is highly dynamic and can change over time as a result of different conditions and crises. The nature of a crisis is hard to define, and will be different for different people. For example, it may involve a death in a family, or it could relate to a combination of high interest rates and low profitability.

Regular monitoring of social situations is recommended for optimal implementation of natural resource management programs. This is similar in concept to monitoring of social factors as part of implementing health and community welfare programs.

In this report, assessment of social sustainability risk was based on the following criteria:

- Succession planning from the previous generation of farm operators to the current generation, in terms of the transfer of the assets and management responsibilities, has been (or is being) completed satisfactorily;

- The principal operators have appropriate control over farm investment and ability to make management decisions;

- The principal operators have the educational and management skills to access and analyse information, and to undertake essential farm management tasks themselves or to effectively manage staff and contractors;

- The principal operators have the time and resources to be part of both a family unit and a local community grouping, as well as participating in running the farm;

- The principal operators and their families are in good health;

- The principal operators and their families have sound personal and working relationships both within their family and their immediate community;

- Where relevant, succession planning from the current generation of principal operators to the next generation has commenced or been completed to everyone's satisfaction.

Producers who could be considered socially sustainable are those who meet most of the above criteria, while producers who could be considered socially unsustainable meet only some of the criteria.

The Little River Catchment is composed of a number of semi-independent communities and there are some significant differences between these groups. Respondents identified the following as key issues associated with the TARGET project and Landcare generally:

- Landcare was not seen as representative of the whole catchment, even from within Landcare itself;
- The majority of participants identified significant impediments to integrated catchment management;
- A significant number of participants think that Landcare is not a good model for the implementation of integrated catchment management.

The social sustainability of the catchment is driven predominantly by the stage of the lifecycle of the managers. The motivation of farm managers changes, as they pass through each stage of their life cycle. Younger operators need to provide for education and investment in long term management plans. Older farmers are less likely to be investing in new enterprises, especially those that would require establishing new medium and long term debt commitments. The age profile of farm managers is healthy, spread broadly with more than 35percent aged over 46 years. There appears to be reasonable levels of replacement amongst the managers from both within the farm family units and from outside of the catchment – this is seen as another healthy social indicator.

In any farming region, there has to be some turn over in land tenure in order to maintain a healthy age profile amongst the producers. This turn over can be achieved via a number of avenues, but is primarily through intergenerational transfer (inheritance) or via land sales. Of the producers interviewed in the Little River, generational transfer issues have affected a significant proportion. Land degradation can result from a poor outcome of the process due to economic hardship and unsuccessful transfer can be a major impediment to participation in integrated catchment management. The reasons for this impediment are complex and different for each family, but lies in the old adage that "farmers live poor and die rich". For example, some producers, while waiting for the transfer process to proceed, are less likely to make capital investments in property production systems or land degradation rehabilitation. The catchment wide impact of this process is unknown, but appears to represent a significant risk to TARGET and related programs.

Based on information gained from interviews related to the value of land in the catchment and the healthiness of the land market, it is unclear whether property build-up, fragmentation or churning is occurring. However, in most cases there appeared to be a healthy turn over of land driven by a desire to invest in primary production. The land market in the catchment appeared to be working in providing a healthy level of turn over and the possibility of farm build up through aggregation. Unlike other areas, the land values are primarily determined, for the majority of the catchment, by primary production-driven market forces.

As indicated above in the survey results section, there is also a significant group of people that may be classed as dependent children. This could be interpreted as another positive social indicator, but has implications for the levels of farm income necessary to sustain these family units.

For most producers, farm education and access to information associated with most “Best Management Practices” and with forms of land degradation do not appear to be an impediment to farm or catchment sustainability. The managers interviewed are open to new ideas and aware of the changes taking place both in grazing and in rural society generally. Management systems on most of the farms include implementation of best management practices and information systems (for example, state of the art computer hardware and software and farm record keeping systems). This situation is another healthy indicator and may promote movement to a longer term sustainable base. However, many producers with secondary education were frequently challenged in two areas – the first was in understanding the nature of integrated catchment management concepts and land degradation processes, and the second, the more technical aspects of best management practices. For example, although most producers involved in cropping were using soil testing services many lacked the technical knowledge required for interpretation of results.

Although turnover of properties and managers is generally considered to be a healthy aspect of the Little River community, there is a need for a more rapid assimilation of BMP information amongst the new farm managers. Landcare is an important source of information on the nature and management of land degradation for all properties.

There are relatively high levels of experience amongst the farm managers as mentioned above. Long term experience across a range of farming conditions is necessary for natural resource management. It was noted that the skill sharing amongst the husband/wife partnerships on the farms in the catchment was a significant feature that impacts positively on farm sustainability.

Although most local services were perceived to have improved or to have remained the same over the past few years, banking related services were generally believed to have deteriorated. As with other regions, as services deteriorate, people tend to compensate by travelling larger distances to access required services at acceptable levels. For example, key service centres identified by the catchment community included Dubbo, Orange, Wellington and Parkes.

Accordingly respondents are more sensitive to the condition of the local roads as most respondents rated local roads as a major concern. Access to community services is unlikely to be a major impediment to future sustainability. In addition, the condition of some major trunk roads and the inability for these roads to cater for modern road transport is constraining the marketing of crops. This has directly affected the pattern of crop production in some parts of the catchment.

Alternatively, others commented that there was a lack of opportunity to sell land for lifestyle farmers because of the low standard of road infrastructure.

The regionalisation trend identified above has been partially reversed by the up-grading of school and hospital facilities in Yeoval. These facilities would have increased the level of service for local families and may have been a contributing factor for families to stay in the district.

The owners and managers supplied the majority of property labour. A shortage of skilled labour was identified as a major impediment to current land management and would be a significant impediment to the adoption of any ICM Strategic Management activities by producers with limited time availability.

The Little River catchment is surrounded by regional centres that offer opportunities for employment and off-farm income. Two different groups from the farm are accessing these employment opportunities – spouses and rural youth. However, these opportunities are generally limited and are decreasing in the smaller centres (such as Molong and Wellington). Local youth employment opportunities have traditionally been an important outlet for farm youth whilst retaining them in the region. With the need to now move further a field to gain employment, a key family labour resource as well as future farm managers is being lost from the system – with an associated link to a reliance on an extremely limited skilled, farm labour pool. As well, with the reduction in local service industries (such as banks, schools and hospitals) a source of employment for spouses (who may have strong training in these service areas) is also being lost.

A combination of financial constraints, the need for off-farm income and access to education has resulted in an increase in the instance of split families (that is, a family where a spouse is living on the property during the week and a spouse living in a regional centre looking after children's schooling and/or earning an off-farm income) and a disintegration of local communities.

The nature of communication is a major impediment to participation in TARGET related activities. For example, in some farm families, at least one spouse is working full time off-farm, and when this is coupled with a lack of skilled labour, there is little time to attend meetings. Feedback from the community included comments that it was not desirable to hold meetings during the day and the need for a range of approaches to communication (for example, many producers simply missed the notices for meetings when volunteers were called for TARGET projects and as a consequence missed out on participating).

Survey results indicate a wide distribution of managerial expertise and that for a significant proportion of the catchment community this would be an impediment in their participation in integrated catchment management. For instance, high levels of managerial expertise are essential to deal with the more technical aspects of natural resources and environmental issues; issues that are usually not visible, move beyond the farm boundary and occur over long times.

In summary, the question of whether the Little River will be socially sustainable into the future is very complex. Based on the surveys undertaken there appears to be a healthy social system in most of the catchment. However, there are some areas where farm families may be vulnerable to further change. These areas will require further monitoring to assess their social health, and may require specific programs to address any impediments that arise. This approach will need to be carefully integrated into integrated catchment management.

4.5 Farm business

The financial results for the group showed some wide variations in most summary statistics. Most farms had a low or negative business profit and rate of return to capital. Farming 500 studies recommend a business profit of $50 000 for medium term sustainability. As mentioned above, about 70 percent of those interviewed had a property profit of less than $50,000 and this is seen as unsustainable in the medium term. Commodity prices in 1999/2000 were viewed as being close to long term averages.

There are few if any alternative enterprises that appear to offer a win-win situation with respect to farm profitability and salinity. For example, a preliminary assessment, within the TARGET project, of farm forestry enterprises indicated a decrease in farm profits compared with the profitability of existing enterprises. As well, carbon, salinity and biodiversity credits and other strategic incentive schemes would have to be substantial to have any impact, based on the above farm forestry economic analysis.

An important characteristic of the group was the very high equity of all properties (the lowest being over 81 percent). About 20 percent of the respondents had equity of less than 60 percent. This is the equity lower limit for some financial institutions' lending requirements. Producers in this category are facing a major impediment in their ability to borrow, especially for natural resource management.

Producers at the higher levels of equity will have a future opportunity to financially adjust against falling profits by refinancing or selling. However, given the high opportunity cost of capital, most farmers in this situation would be financially better off investing their asset outside agriculture.

Off-farm income was important for most of the group and averaged 24 percent of gross cash receipts per property. Off-farm income partially compensated for low farm returns. The effort involved in earning off-farm income means that there is less opportunity to provide labour into the farm enterprise as well as participation in natural resource management. This, coupled with the scarcity of quality labour, provides a major impediment to participation in integrated catchment activities for this group.

In summary, there is an observable decline in the sustainability of the water, soil and nutrient systems. This is being compensated for by the purchase of off-farm inputs (for example, fertilisers, lime, chemicals, etc). The issue of whether this degradation will impact on sustainability is complex. At one level, as long as producers are left within the current set of costs associated with on-farm production, the main impediment to maintaining sustainable production will be the costs of increasing the off-farm inputs. This will be conditional upon there being no future thresholds within the biophysical system that will impact on farm production levels in a catastrophic sense (that is, that farmers can continue to compensate for ever increasing levels of degradation by off-farm inputs and the system does not reach a point where it is irreversibly impacted). As indicated above, soil structural decline, fertility and possible weed/herbicide resistance are the key issues for management in the immediate future.

At another level, the future sustainability of the production systems will be impacted upon if catchment management imposes a new set of costs to producers so as to meet external catchment targets. This may take the form of salinity management activities similar as those associated with the TARGET project.

5

5. Producer comments on TARGET

Producers provided comments on the TARGET process and the recommended management options during the interview process. This was an unstructured process that does not support rigorous statistical analysis. Although the questions were neutral and designed to elicit any feedback, the majority of comments were negative (ie complaints) or neutral (ie suggestions for improvements of perceived inadequacies), very few were positive. However, there were a number of generic themes identified. The following is a listing of the generic themes with a summary of the nature of the comments and related key issues.

Communication

Nature of comments

(4) Four comments related to inadequacies in the communication approach and possible improvements.

Key issues

Complicated and new programs like TARGET require a strategic communication approach in parallel with the implementation process – before, during and after. In particular, communication strategies associated with more targeted programs (ie non voluntary projects which need to have full community participation) will need to include a range of approaches and scheduled times to ensure effective communication. There were a significant number in the community who indicated that they would not attend a public meeting convened by a government agency to address the management of natural resources and environmental management issues. This is a major problem with a project like TARGET where there was an expectation that the project would be implemented from the first day with a very short time for overall implementation (2 years).

Technical support

Nature of comments

(3) Three comments related to inadequacies in the technical support.

Key issues

Producer investment decisions require appropriate technical information about the biophysical, social and financial nature of the problem associated with a 'business as usual' approach and how that outcome would change following the implementation of management actions. The broad range of management actions associated with the TARGET project required a broad range of technical expertise, much of which was not available as part of the TARGET project process or from within DLWC (for example, forestry expertise).

Extension

Nature of comments

(3) Three comments related to inadequacies in the extension services.

Key issues

A significant number of producers lacked the information for assessment of their salinity problems and the development of an appropriate management plan, even when they had a general awareness of the issue. Appropriately qualified and respected extension officers are required to facilitate information flows needed for producer investment decisions related to the adoption of program management actions. Many producers indicated that they would prefer to deal with non-government agents who did not have the same 'conflicts of interest' as occurs with many government extension officers.

Funding/implementation process

Nature of comments

(26) Twenty six comments (the largest number of comments for all themes), related to inadequacies in the funding/implementation process.

Key issues

Complicated and new programs like TARGET require an accountable, transparent (for example, publicly available information on the eligibility criteria) and consistent approach, with appropriate funding over a suitable time schedule. This research identified a broad range of financial and non-financial impediments to the adoption of the management actions associated with the TARGET project, some of which where taken into account in the second year of the project. Funding/implementation processes varied between focus catchments in year one and evolved with many improvements between year one and year two based on information from the profiles project.

DLWC relationships

Nature of comments

(2) Two comments related to inadequacies in producer-DLWC relationships.

Key issues

Management of natural resource and environmental issues, frequently involves winners and losers and will always be subject to criticism. The success of complicated and new programs like TARGET will rest on key government agencies working hard to maintain community respect (the dual 'game keeper-poacher' roles held by the DLWC is a significant impediment for many producers). Some of the comments related to mistakes made by DLWC many years ago associated with the soil conservation program.

TARGET project

Nature of comments

(6) Six comments (the second largest number of comments for all themes), related to inadequacies in the nature of the TARGET project (excluding funding and the implementation process), of which one producer had a positive comment of support.

Key issues

Complicated and new programs like TARGET require a comprehensive community consultation phase, well in advance of the implementation phase, during which key components are thoroughly discussed and negotiated. At a minimum there is a need for a general awareness of the nature of the perceived problem and the details of the proposed management plan and for those who will be expected to participate, 'relative consensus' will be required regarding the nature of management actions and the funding /implementation process.

Government Policy and programs

Nature of comments

(9) Nine comments (the third largest number of comments for all themes), related to inadequacies in the nature of Government policies and programs designed for the management of natural resources and environmental issues.

Key issues

In addition to comments of disapproval of a range of government policies and programs (for example, Landcare), there was considerable confusion as to the exact role and nature of the TARGET project and its relationship with the broad range of other natural resource and environmental management strategies and programs (for example, CMB Blueprints and the Mid Macquarie Landcare Plan).

The broad range of comments above indicates that there are a significant number of financial and non-financial impediments to the TARGET project. Unless addressed, these issues will remain as constraints to achieving the objectives associated with TARGET and other related natural resources and environmental management projects. It is recommended that the key government agencies responsible for the management of issues associated with the broad range of comments are identified and processes implemented to develop management actions to overcome these impediments. The following section also lists a number of other impediments identified during the study.

6

6. Impediments to ICM land management options

There are a range of impediments that can be identified as a result of the analysis of the information in the Little River catchment.

- Salinity is not impacting negatively on all of the catchment equally. No individual producer is likely to be unsustainable because of salinity in the medium term. There is a lack of information on the nature of off-farm impacts associated with salinity within the Little River catchment. There are some areas that will be contributing substantially to the internal salt and water budget, whilst there are some areas that have been assumed to be doing so, but are probably not;

- There was no linkage between the TARGET management options and the goals of the broader Catchment Management Plan. This lead to an inability to assess the merits of TARGET management options in delivering against these goals. This reinforced a focus on an inputs-based Landcare model rather than a strategic approach based on outputs;

- Most producers lack an appreciation of the ICM salinity management problem and the ICM implications are not specific to their catchment, in particular there were no clear goals or performance criteria for salinity management of off-farm impacts for the Little River catchment against which success could be measured. For example, some producers believed that the Little River catchment salinity problem was a result of regional groundwater flows from the Canowindra area;

- The degree of awareness of the TARGET program varies markedly between individuals;

- There is a great range of circumstances amongst the farmers in the catchment, and DLWC needs to tailor its programs to take account of this diversity;

- Most producers lack the understanding of the salinity processes and the way it impacts on their production processes;

- Most producers lack appropriate information for farm scale investment decisions;

- Most alternative enterprises are risky, capital intensive or long-term crops with a common feature of uncertain long-term market outlook;

- Most producers lack specialist skills, nor are they interested, in alternative enterprises;

- There is a lack of time to spend on implementing and learning about options;

- There is a lack of skilled labour to backfill for farm operator participation when undertaking environmental projects;

- Some producers have implemented all of the "Landcare" they intend to (consistent with farm plan), as part of a previous Landcare funded project;

- Succession planning issues impact on family relationships, farm management decisions and farm finances and are a significant impediment to natural resource management in the Little River catchment;

- The lack of a properly quantified problem statement associated with the current land management practices, against which the various salinity management options can be assessed in terms of a net future improvement in conditions. For example, whilst the nine land management options have been proposed as a *no regrets* approach for natural resource management, some of the options may have little impact on the salinity problem in the future. This emphasises the role of monitoring and evaluation in reducing the level of uncertainty associated with the *no regrets* approach, which was the central objective of the TARGET project;

- Key data sets were not available (that is, had not been collected) that would have better informed the development of a problem statement for the catchment. These data sets need to be spatially and temporally defined so that the impacts of management options can be accurately predicted; and

- The approach adopted for TARGET in the first year relied heavily on the implementation model used under Landcare, which was predominantly a voluntary, grants-based, input subsidised program, rather than a program that focussed on achieving defined ICM goals. It is acknowledged that the mix of options was a *no-regrets* approach put forward as a means of progressing the development of an implementation model for a broad range of natural resource management issues. Further, the options are not being strategically located to produce a salinity benefit, and therefore the impact on salinity by the investment of public monies under TARGET is likely to be limited The management options are also being offered via a voluntary process which mitigates against achieving strategic salinity reductions –

there are no compliance criteria to assess whether the management options are best sited on the areas as volunteered by the producers. Finally, the selection criteria did not include the requirement for demonstrated salinity outcomes at the catchment scale (as opposed to the farm scale). Consequently, it is likely that attempts to determine the effectiveness of TARGET in terms of a change in the salinity condition within the catchment will be inconclusive.

7

7. Strategic ICM in the Little River

ICM in the Little River catchment has two dimensions. Firstly, there are ICM issues that relate to the Little River catchment itself, and secondly, issues that relate to how the Little River catchment fits within the broader Macquarie catchment.

Issues with a high priority at the catchment scale reflect those with the highest community costs, those for which off site impacts are involved and those for which the failure to manage the situation may result in irreversible consequences (for example, loss of biodiversity). The different forms of degradation, as identified in the Central West Catchment Blueprint 2002/2012 are:

- Dryland salinity;
- Declining surface water quality;
- Declining health and abundance of native vegetation;
- Degradation of riparian and wetland eco-systems; and
- Deterioration of the soil resource.

Issues identified during producer interviews were (in order of priority):

- Weeds;
- Soil acidity;
- Dryland salinity; and
- Foxes

Problems of least overall concern were rabbits, woody weeds, soil sodicity and vegetation decline.

The current operating environment for regional and catchment planning of agriculture, natural resources and environmental management issues is undergoing some significant changes. In the past, planning has been achieved through a range of Landcare activities that have developed procedures and a culture focussed on inputs related to management activities (mainly at the farm scale). For instance, this focus results in funds allocated to the cost of fences, or the cost of trees, and a cost sharing debate solely based on how these input costs are valued and shared. The assumption in all this planning is that the implementation of appropriate inputs will result in the desired outputs.

Recently, however, there has been a concerted effort to implement an approach based on integrated catchment management (ICM). For example, an ICM strategy has been developed by the Murray-Darling Basin Commission as a blue print for future catchment planning and, in turn, it has been adopted as a primary objective of the Little River Landcare Plan, the Mid-Macquarie Landcare Regional Plan and the Central West Catchment Management Board Plan. This approach will produce two significant changes. Firstly, ICM will require a systems approach to planning—recognising that catchments are composed of natural systems where changes to one part have ramifications in another part. Secondly, ICM will also focus on the purchasing of outputs or benefits that contribute to achieving catchment targets. For example, managers will be inclined to fund a change for the better in the natural system – a reduction in river salinity at a certain point over a certain timeframe, or a maintaining of a number of species. The primary funder will be less concerned with inputs, but rather will leave the work program required to deliver the benefits up to local concerns.

As well, there will be issues of scale related to the way in which targets are managed and works implemented. By purchasing targets at the catchment level, implementation will be driven by a *down-scaling* process. That is, priority will be given to those areas where the most significant outcome at the whole of catchment scale will be achieved. This change from a focus on input costs to a focus on purchasing system benefits will produce a fundamental shift in both the distribution of responsibilities and the accountabilities. In particular, it has implications for the way in which work plans prioritise different parts of the catchment system to be managed so that a change can be guaranteed (that is, no more “vegemite” policies and programs). It will also have fundamental impacts on the way in which catchment plans are implemented.

For instance, in the previous funding model where money was expended on the basis of voluntary subscription, it would be difficult to ensure that catchment outcomes could be guaranteed. Under the new model, funds will need to be targeted to areas where the highest priority result can be found. The targeted recipient of funding may not, in fact, be a volunteer for the actions.

However, there will be issues within a catchment that will require action at the sub-regional scale but have little bearing on the whole of catchment output. In particular, areas of land significantly affected by dryland salinity may not be contributing to stream salinisation, but in themselves, will be of a high enough priority at the local scale to warrant action. Thus, management and implementation will be different at different scales within a catchment – ranging from the Catchment Management Board, through groups such as the Mid-Macquarie Landcare down to groups such as the Little River Landcare. In effect, each layer of catchment planning will require encapsulating the main issues from the plan immediately above them, and adding in those elements that are key to the desired objectives. That is, a plan such as for Mid-Macquarie Landcare will need to re-inforce those elements in place from the Macquarie CMB plan as well as introducing actions that would satisfy local objectives.

This new model will require a range of new information needs for it to work effectively. It will be critical to understand what processes need to change that will result in the desired benefit (for example, where will actions be required to reduce salinity to the required level in the given time frame). It will be critical also, to understand the capacity of landscapes to produce the desired change – can this landscape be altered significantly enough to achieve the result and in what period of time.

Catchment plans are also changing in a different sense. In the past planning has been driven by the need for actions related to natural resource issues. However, the identification and prioritisation of the key natural resource and environmental issues does not provide the basis for strategic management. A professional assessment of the biophysical nature of the issues is required in terms of the likely nature of impacts and extent under a "business as usual " approach. In addition, information on the biophysical linkages or relationships associated with landscape change and the impacts on the natural resource base and the environment is required.

Strategic management of agriculture, natural resources and environmental issues requires the development of plans for all stakeholders. In particular, as indicated above, management plans are required for farm level and for catchment level managers. Farm level managers operate at scales up to 1:10 000 while catchment managers operate at scales from 1:50-100 000. Whereas farmers may also be required to manage issues of concern to catchment managers, catchment managers are only required to manage issues, which flow beyond the farm gate.

There is a need for a strategic management plan that deals with the issues of concern for the Little River catchment, as a complement to the broader Central West Catchment Blueprint. It is recommended that a Little River Catchment Plan be developed based on an ICM process and should include the following:

- Development of a professional problem statement associated with a *business as usual scenario*;
- Identification of the stakeholder's vision for the catchment;
- Identification of the technical, economic and social feasibility of management options;
- Implementation; and
- Monitoring and evaluation.

Landcare programs have frequently failed to differentiate between the two scales and the issues identified in Stage 2 of the Little River Landcare Plan include a mixture of both sets of issues. Many issues identified in Parts one and two of the Little River Landcare Plan (for example, management of biodiversity and most weeds), are not catchment management issues requiring catchment scale analysis. Most issues requiring catchment analysis and management are related to water quantity and quality.

The Little River catchment of the Sustainability Profiles project was strategically selected as a medium scale catchment which would provide information on the most appropriate approach for scaling up to develop profiles for the whole of Macquarie catchment. Experience associated with the collection of the above information indicated the nature of heterogeneity likely to occur in catchments similar to those with the Little River scale. This information will be used in the development of the approach and the sample selection process required for the development of profiles for relatively homogeneous sub-catchments of the Macquarie catchment.

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A

Appendix

A. Property survey results tables

Results for some of the survey information are presented in table format under the following four column headings; "Total for group", "Average for group", "Highest value" and "Lowest value".

As the heading suggests, "Total for group" is simply the summation of relevant results for the group. The "Average for group" figure is in most cases the calculated mean for all properties. However, for certain variables such as crop yield and stock sale price, the average is based on the subset of respondents who had a particular crop or sold livestock and is therefore not necessarily the average for all properties. "Highest" and "Lowest" value refers to the respective highest and lowest value recorded by any member of the group. Where there were fewer than three responses to a question, then the average and highest/lowest figure is not necessarily provided in order to retain respondent confidentiality.

Financial performance terms

Property business cash receipts
Includes all property business cash receipts.

Property business cash costs
Includes all property business cash costs (excludes capital costs and household/private/other business costs)

Property cash income
Equals property business cash receipts less business cash costs.

Build-up in trading stocks
The value (using standard numbers) of any changes in the inventories of livestock numbers and produce, hay, silage and grains.

Property business profit
Equals property cash income plus build-up in trading stocks and less depreciation.

Business capital
The value of all property business assets at 30 June 2000. Values are at market rates as estimated by the respondent.

Business debt
The value of all property business debts at 30 June 2000.

Business equity ratio
Equals business capital less business debt, divided by business capital. It represents the amount of business capital owned by the property owners.

Business/non-business equity ratio
Equals business equity capital divided by business equity capital plus net non-business capital. It represents the proportion of property business equity relative to total equity.

1 Land use

		Catchment group		LR	
		Total	Average	Maximum	Minimum
Total property area	ha	31,976	999	nc	nc
Proportion of area - owned	%	nc	95	100	59
- leased	%	nc	5	41	0
Area used for trees/vegetation:					
Revegetated area	ha	144	5	23	0
Remnant vegetation	ha	2,343	73	300	0
Farm forestry	ha	2	0	2	0
Total tree area	%	nc	8	32	0
Area used for pasture:					
Native	ha	5,719	179	2,248	0
Improved perennial	ha	11,755	367	2,455	0
Improved annual	ha	5,550	173	1,328	0
Other	ha	30	1	18	0
Total pasture area	%	nc	71	93	29
Area used for cropping:					
Wheat	ha	5,194	162	1,700	0
Canola	ha	1,217	38	324	0
Barley	ha	310	10	113	0
Oats	ha	216	7	70	0
Lupins	ha	130	4	40	0
Other grain	ha	620	19	280	0
Fodder	ha	296	9	90	0

nc = Not Calculated.

2 Labour

		Catchment group			
		Total	Average	Maximum	Minimum
Owner-operator labour	mnth	740	23	52	2
Permanent labour	mnth	44	1	12	0
Casual/contract labour	mnth	106	3	18	0
Total property labour	mnth	890	28	59	2
Off-property labour	mnth	202	6	24	0

3 Crop and animal production

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Crops					
Wheat yield	t/ha	nc	2.6	4.9	0.0
Canola yield	t/ha	nc	1.9	2.4	0.0
Barley yield	t/ha	nc	3.1	3.6	0.0
Oats yield	t/ha	nc	1.8	3.8	0.0
Lupins yield	t/ha	nc	2.5	3.7	0.0
Hay/silage produced	t	nc	80	800	0
Livestock					
Av. DSEs per area pasture	dse/ha	nc	8.7	16.1	0.0
Have livestock enterprise	no.	31	nc	nc	nc
Sheep					
Av. number ewes	no.	nc	1,443	4,800	0
Lambing percentage	%	nc	89	120	38
Wool cut per animal shorn	kg	nc	4.5	6.5	2.6
Average wool price/kg	$	nc	3.4	5.6	1.8
Average value sheep sold	$	nc	24	72	11
Cattle					
Number of breeders	no.	nc	89	1,000	0
Calving percentage	%	nc	84	100	51
Average value animal sold	$	nc	461	822	210

nc = Not Calculated.

4 Water

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Annual rainfall	mm	nc	609	700	0
Dams - no.		427	13	60	0
- maximum quantity	ML	nc	22	75	0
Bores - no.		91	3	20	0
- maximum quantity	L/h	nc	6,877	90,920	0
Springs - no.		15	0	3	0
- maximum quantity	L/h	nc	113	3,600	0
Wells - no.		16	1	4	0
- maximum quantity	L/h	nc	585	5,400	0
Creeks - no.		55	2	6	0
- maximum quantity		nc	nc	nc	nc

5 Financial

		Catchment group	
		Total	*Average*
Property business cash receipts	$	7,162,443	223,826
less property cash costs	$	6,179,141	193,098
Property cash income	$	nc	30,728
plus build-up in trading stocks	$	326,946	10,217
less depreciation	$	860,164	26,880
Property business profit	$	nc	14,065
Total cash receipts from:			
Livestock sales	%	nc	29
Wool sales	%	nc	20
Grain sales	%	nc	22
Misc. business receipts	%	nc	5
Off-farm income	%	nc	24
Off-farm income	$	1,619,634	50,614
Business capital at 30 June '00	$	52,996,215	1,656,132
Business debt at 30 June '00	$	10,260,858	320,652
Business equity ratio	%	nc	81
Business/non-business equity	%	nc	87

nc = Not Calculated.

6 Social profile

	Male no.	Male %	Female no.	Female %
Age group				
< 15 years old	12	17	11	20
16 - 25	11	15	7	13
26 - 35	12	17	5	9
36 - 45	11	15	11	20
46 - 55	8	11	9	16
56 - 65	13	18	7	13
> 65 years	4	6	5	9
Farming experience (since age 15)				
< 10 years	17	28	20	45
10 - 20	13	22	10	23
21 - 30	12	20	6	14
31 - 40	7	12	4	9
41 - 50	9	15	3	7
> 50 years	2	3	1	2
Highest qualification				
Secondary	27	47	16	38
Trade/vocational	12	21	9	21
Tertiary	18	32	17	40

7 Soil pH in pasture/crop paddocks

	Catchment group				
	<4.5 (1)	*4.6 - 5.5* (2)	*5.6 - 6.5* (3)	*> 6.5* (4)	*Don't know* (5)
	no.	no.	no.	no.	no.
Crop paddocks	4	19	3	1	3
Pasture paddocks	6	15	4	2	3

8 Usual application frequency for pasture topdressing with fertilisers/soil conditioners

	Every 1 - 2 yrs (2)	Every 3 - 5 yrs (3)	Every 6 - 10 yrs (4)	No pattern (5)	During estab'ment (6)
	no.	no.	no.	no.	no.
Fertiliser applications	8	7	1	1	7
Lime applications	0	2	0	1	4
Other applications	4	0	0	1	1

9 Crops usually applied with fertilisers/soil conditioners

	Wheat	Canola	Barley	Oats	Other
	no.	no.	no.	no.	no.
Fertiliser applications	23	12	5	12	9
Lime applications	3	11	1	3	5
Other applications	1	4	1	1	1

10 Usual basis for fertiliser/soil conditioner application decisions

	Soil tests	Agron-omist's advice	Visual assess-ment	District averages	Historical routine
	no.	no.	no.	no.	no.
Fertiliser applications	20	20	13	3	14
Lime applications	19	14	4	2	4
Other applications	4	3	1	1	2

11 Use of various methods and approaches to cropping

	Catchment group	
Method/approach	no.	%
Zero tillage	9	14
Minimum tillage	19	29
Intercropping	1	2
Opportunity cropping	2	3
Crop rotations	20	31
Phase farming	0	0
Conventional tillage	14	22

12 Rating of possible land condition problems on properties

	Group's rating of problems				
	Serious (1)	*Moderate* (2)	*Slight* (3)	*No problem/ non-existent* (4)	*Don't know* (5)
Problem	no.	no.	no.	no.	no.
Weeds	5	13	13	1	0
Woody weeds	0	4	7	21	0
Rabbits	0	0	8	24	0
Foxes	3	9	15	5	0
Kangaroos	3	4	13	12	0
Waterlogging	6	3	13	10	0
Salinity/high watertables	7	6	10	8	1
Acidity	8	9	7	5	3
Sodicity	0	4	7	18	3
Erosion gullies	1	5	16	10	0
Scalds bare earth	1	4	9	18	0
Other	3	5	3	0	0

13 Area affected if problem rated as either Serious or Moderate

Problem	Catchment group			
	Total	*Average*	*Maximum*	*Minimum*
	ha	ha	ha	ha
Weeds	13,520	423	3,260	0
Woody weeds	145	5	80	0
Rabbits	0	0	0	0
Foxes	8,524	266	1,571	0
Kangaroos	5,305	166	3,260	0
Waterlogging	3,202	100	1,547	0
Salinity/high watertables	607	19	100	0
Acidity	18,551	580	3,260	0
Sodicity	2,077	65	1,547	0
Erosion gullies	181	6	100	0
Scalds bare earth	35	1	20	0
Other	3,527	110	1,571	0

14 Perceptions of salinity/high watertable trend over past 5 years

Trend in salinity	Group's perceptions	
	no.	%
Worsened	13	57
Improved	1	4
Stabilised	8	35
Not sure	1	4

15 Damage and costs incurred due to salinity/high watertables

Category of cost/damage	Group's reporting of damage no.	%
Lost production from salted land	19	28
Damage to infrastructure	8	12
Salinisation of water supplies	8	12
Increased fertiliser requirement	2	3
Loss of shade/shelter	14	21
Loss of aesthetic value	14	21
Other	3	4

16 Respondents implementing salinity mitigation measures over past 5 years

Mitigation measure	Yes (mainly due to salinity) (1) no.	Yes (but not due to salinity) (2) no.	No (3) no.	Not applicable (4) no.
Increased area perennial pasture	2	21	9	0
Increased area native pasture	0	2	29	1
Increased area saline pasture	9	0	23	0
Used saline agroforestry	2	0	30	0
Established farm forestry	0	1	31	0
Used conservation farming	1	23	7	1
Utilised intercropping	0	3	28	1
Fenced remnant vegetation	5	11	16	0
Fenced creeks/waterways	3	5	24	0

17 Intentions to implement salinity mitigation plans in next 5 years

	Salinity mitigation plan				
	Increase area of perennial pasture	*Increase area of native pasture*	*Increase area of saline pasture*	*Utilise inter-cropping*	*Establish farm forestry*
Intention NOT to implement plan	9	21	13	20	21
Main reason for not implementing					
Not profitable or productive	**1**	**14**	0	**2**	**11**
Wouldn't fit-in with existing set-up	**1**	**2**	0	**8**	0
Simply not interested	**1**	0	0	0	**2**
Too much owner labour required	0	0	0	0	0
Already doing as much as intend to	**3**	0	0	0	0
Don't know enough about it	0	**2**	0	**5**	0
Don't have the right equipment	0	0	0	**1**	0
Country/climate not suitable	**1**	0	0	0	**2**
No need for it	0	0	**1**	**1**	0
No/insignificant salinity/w'table problem	0	0	**9**	0	0
Not applicable (eg. don't have a creek)	0	0	0	**2**	0
Other	**2**	**3**	**3**	**1**	**6**

	Salinity mitigation plan cont.			
	Utilise saline agro-forestry	*More use of conser-vation farming*	*Fence off remnant vegetation*	*Fence off creeks & waterways*
Intention NOT to implement plan	25	15	19	18
Main reason for not implementing				
Not profitable or productive	**6**	**1**	**5**	**5**
Wouldn't fit-in with existing set-up	**1**	**2**	**1**	0
Simply not interested	**2**	0	**1**	**1**
Too much owner labour required	0	0	0	0
Already doing as much as intend to	0	**11**	**4**	**5**
Don't know enough about it	**2**	0	0	0
Don't have the right equipment	0	0	0	0
Country/climate not suitable	**1**	0	0	0
No need for it	**2**	0	**2**	0
No/insignificant salinity/w'table problem	**8**	0	0	0
Not applicable (eg. don't have a creek)	0	**1**	**4**	0
Other	**3**	0	**2**	**7**

18 Rating of major plant items and improvements

Item	Group's ratings: Poor (1) no.	Below average (2) no.	Good condition (3) no.	Above average (4) no.	Excellent (5) no.
Main tractor	2	4	9	6	9
Crop seeding implements	2	6	9	5	7
Fences	2	4	19	5	2
Stock yards	0	9	13	7	3
Farm motor bike	1	0	14	6	7
Farm utility	0	2	10	11	5
Harvester	2	5	9	2	3
Wool shed	1	7	14	6	3
Machinery shed	1	5	8	10	8
Other	0	3	1	2	0

19 Preferences or liking for rural enterprises

Enterprise	Group's enterprise ratings: Highly disliked (1) no.	Dislike (2) no.	Not sure (3) no.	Like (4) no.	Highly liked (5) no.
Sheep	2	2	3	11	12
Cattle	1	0	3	17	9
Pigs	13	7	7	2	1
Farm forestry	2	5	12	9	2
Cropping	2	5	7	11	5
Horticulture - trees/vines	5	11	7	5	2
Horticulture - annuals	10	10	6	2	2

20 Rating of local services over the past 5 years

Service	Group's service rating			
	Worsened (1)	*Stayed the same* (2)	*Improved* (3)	*Not sure or not applicable* (4)
	no.	no.	no.	no.
Banking	25	4	3	0
Primary school	4	14	6	8
Secondary school	2	11	8	11
Doctor	11	19	2	0
Hospital	10	11	10	1
Other government agencies	14	11	3	4
Shopping - groceries/small goods	8	17	7	0
Shopping - other household items	6	20	6	0
Shopping - farm/machinery goods	18	11	3	0
Livestock/grain sale centres	4	24	2	2
Public transport	4	5	2	21
Entertainment	9	13	6	4
Mobile phone	18	5	5	4
Roads	24	7	1	0
RLPB	4	27	1	0

21 Significant expenditure on capital items during past 5 years

Capital item	Catchment group		
	Number buying item no.	*Average amount spent* $	*Total amount spent* $
Plant and machinery	29	117,713	3,766,800
Improvements	17	54,924	1,757,559

22 Intention to be owning/operating current property in 5 years time

Intention to remain	Group's intentions no.	%
Yes	25	78
No	3	9
Unsure	4	13

23 Respondent's intentions for their property in the next 5 years

Intention	Group's intentions no.	%
Stay much as is	15	47
Increase property size	12	38
Sell whole property	3	9
Sub-divide & sell small part of property	0	0
Lease out property	0	0
Sub-divide and sell most of property	0	0
Other	2	6

24 Perceived greatest threats to still be farming in 5 years

	Catchment group	
	no.	%
Climate risk (eg. drought)	10	13
Cost-price squeeze	19	25
Government regulations	8	11
Land availability & price	2	3
Lack of off-farm income	6	8
Animal pests	0	0
Weeds	0	0
Salinity/high water tables	3	4
Acidity/sodicity	3	4
Erosion	0	0
Age or health reasons	14	18
Property transfer	3	4
Wish to retire or change of lifestyle	3	4
Differences within family business	1	1
Differences in money distribution	0	0
Other	4	5