Sustainability Profile for the Warrangong Catchment

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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 Warrangong catchment during May 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 Warrangong catchment, and an appreciation of the social and economic impediments to uptake a variety of land management options.

Sustainability Profiles provide a basis for assessing the general health of a farming system, based on an analysis of the stocks and changes in the 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 problems of most overall concern to the group were salinity/high watertables and waterlogging. Acidity, weeds, erosion gullies, scalds/bare earth and to a lesser extent foxes, were also mentioned.

- The majority of respondents had implemented an increased area of perennial pasture and made greater use of conservation farming during the last five years. However, these two measures mostly not been in response to a salinity problem The least implemented measures were increased areas of native pasture, saline agroforestry, farm forestry and fencing-off of creeks and waterways.

- The majority of respondents in Warrangong are not intending to: implement an increase in area of native pasture, establish farm forestry and utilise saline agroforestry.

- Average cash income on the Warrangong catchment was estimated at $18,000. There are too few farms to discuss the distribution of incomes.

- 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 20 percent of gross cash receipts per property.

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

- Farming operations are currently sustainable within their current land use with respect to the water resource. The supply of water in the catchment's farms would be inadequate for large-scale intensive horticultural irrigation enterprises.

- Within the catchment generally, both lime and fertiliser applications are essential for sustainable crop and pasture management, In some areas there is minor gully and wind erosion, salinity is not seen as a serious issue for most farms in this catchment. Hence it is expected that soil condition will not severely impact on long term sustainability.

- Most of the Warrangong catchment is cleared with very little remnant vegetation There has been some revegetation but the shelterbelts and other trees currently planted probably have only a limited impact on managing groundwater levels or biodiversity. It is believed that the low percentage of remnant vegetation and associated biodiversity in a large proportion of the Mid Talbragar area is unsustainable. Weeds represent an ongoing farm management problem, which is being contained.

- The Warrangong is small and there appears to be a healthy social system in most of the catchment.

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 a minor issue for most properties;
- A majority of respondents are planning for an increased area of improved perennial pasture in the next five years;
- Vegetation and biodiversity decline 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 salt concentration in the Lachlan River at Forbes will be above the desirable limit for human consumption by 2050, and the average salt load of the Lachlan at Forbes in 2050 will exceed 300,000 tonnes per year.

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 Warrangong catchment between 17th of April and 3rd of May 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 Warrangong 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 Warrangong social catchment. In particular, it is designed to identify impediments to producers participating in the strategic management of natural resource and environmental issues.

1.2 Location of properties

The consultants were asked to prepare producer profiles for all properties in the Warrangong social catchment—there are seven properties in the catchment. Individual property reports have been prepared for each participant. These reports are confidential but form the basis for much of the material in this overall report. No identified individual information is reported here.

The social catchment is different from the topographic catchment of Warrangong Creek, and conforms to the Warrangong Landcare area. Some of the surveyed properties lie outside the topographic catchment and some portions of farms that lie inside the topographic catchment were not interviewed. The boundary used by the Department of Land and Water Conservation (DLWC) to specify the Warrangong Creek catchment is defined by the catchment from the junction of the Warrendale and Warrangong Creeks.

The study area lies predominantly within the Warrangong Creek catchment in the Mid Lachlan River Catchment, approximately thirty kilometres south west of the town of Cowra. The Warrangong Creek rises just east of the town of Greenethorpe and flows to the east to where it is impeded by a major constriction in the topography. Just before it passes this constriction it is joined by the Warrendale Creek that drains a small sub-catchment to the north of the Warrangong catchment. The Warrangong Creek continues to the east beyond the constriction, joining the Crowther (or Back) Creek near Koorawatha, which in turn flows north joining the Lachlan River downstream of Cowra.

Four of the properties of the study area ring the upper slopes of the catchment. *Pinkerton* lies on the northern slopes and outside the northern catchment boundary (in the Warrendale catchment). The property of *Uppingham* lies on the most westerly slopes of the catchment and spills over the catchment boundary into the Tyagong Creek catchment. *Illourie* lies on the south west slopes of the catchment and also spills over the catchment boundary into the Tyagong Creek catchment (especially, their most recent 162 hectare acquisition). On the south east slopes of the catchment lies the *Kindamindi* property. The *Warrengong* property is located in the lowest position in the catchment where the creek flows through the constriction and eastward to Crowther Creek. *Hillcrest* is the property in the centre of the catchment, with some of its area running up to the catchment's western divide north of *Uppingham* and bordering most of the previously mentioned properties. Finally, *Bonaview* is located on the Warrangong Creek downstream of the constriction and outside the Warrangong Creek topographic catchment. *Bonaview's* eastern boundary is the Crowther Creek.

The Warrangong Creek catchment covers 2,127 hectares. The total farm area surveyed is 4,005 ha of which 2,167 ha occur in other catchments. About 289 ha of the catchment were not covered by a farm survey.

In summary, the survey covers most of the Warrangong Creek topographic catchment area and includes a significant area outside the catchment.

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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 Warrangong 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 Warrangong 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 Warrangong 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 of the Warrangong catchment, are presented in the following sections of this report. A

Warrangong 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 Warrangong catchment included the following key stages:

- Meeting with cooperating producers of the Warrangong 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 Warrangong catchment from DLWC and the Warrangong 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.
- Distribution of copies of the Draft Individual Farm Reports to producers for validation;
- Presentation of details from the Draft Group Report 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 Warrangong Creek catchment is an undulating to hilly catchment lying to the west of the Crowther/Back Creek plain. The catchment lies midway between Koorawatha and Greenethorpe, and almost mid way between Cowra and Young (refer to chapter 1 for more details).

3.2 Biophysical statement

The biophysical assessment of the Warrangong catchment is based mostly on inspections during the survey visits and some discussions with DLWC staff located at Cowra, specifically Rob Muller (groundwater) and Ian Packer (soils). General information was also provided by DLWC staff (Alan Nicholson, Kieran Hawker, Peter Sparkes and Andrew Wooldridge).

The catchment makes up one of a large number of small tributaries lying along the entire length of the western margin of the Crowther/Back Creek floodplain. The Warrangong Creek catchment is shaped in the form of an amphitheatre, with a steep ridge of resistant rocks forming the eastern margin, and a more gently sloping landscape leading up to the western boundary.

Both the Warrangong and Warrendale Creeks will generally be ephemeral in their upper parts, but under present day land use may well be almost perennial at the catchment outlet.

The Crowther Creek valley is an ancient feature that has been identified by Williamson (1968) as being a Tertiary Valley that has infilled with thick alluvial sediments, and was probably a major tributary valley to the Lachlan River at the time.

The bounding hills of the valley are comprised a series of rocks of varying ages that form part of the Lachlan Fold Belt. The dominating features are the Young Granodiorite lying to the west (and just entering the catchment under parts of *Uppingham*) and a series of volcanic/intrusive rocks occupying the majority of the catchment and the country to the north. These rocks, which intrude or overlie the Young Granodiorite, are composed of two sequences (at least) of extrusive volcanic layers, each with an associated intrusion. There are numerous dykes cutting through the catchment running roughly north-south. The resistant eastern ridge is a complex of these intrusives and associated dykes. Warrangong Creek has cut a narrow gorge/valley through the ridge.

A ridge of hard resistant Devonian sandstone, similar to the rocks to the east of Koorawatha, forms the high country along the southern margin of the catchment.

The volcanic/intrusive complex of the main catchment is reasonably deeply weathered, with recent drilling by DLWC encountering weathered conditions at depths generally around 30 metres. The style of weathering is similar to that encountered in the Young Granodiorite elsewhere, and produces a layer of disaggregated rock where the original rock texture is "opened up" by the weathering. This rock feature produces open space within the weathered mass and allows water to flow through. In some areas there are changes in the degree of openness (its permeability) of the rock, in some places enhanced by a change in rock type, or in others reduced by a cross cutting dyke.

Generally, the catchment rocks have produced an aquifer that is on average about 20 to 30 metres thick and which blankets the landscape. It is disrupted in places by rock type change and dykes.

The weathering has produced a range of soils across the catchment.

The soils of the main Warrangong catchment comprise the Crowther Soil landscape unit as described in recent soil mapping undertaken by DLWC. The dominant soils of the unit moderately deep to deep, moderately well drained red and yellow chromosols (podzolics). The higher slopes and ridges are comprised of red dermosols (earths), with yellow sodosols (solodic) in the bottoms of the drainage lines. Rudisols and tenosols (skeletal soils) are found in areas of outcrop. There is an area of black chromosols (prairie soils) immediately adjacent to the *Warrengong* homestead.

The soils association formed on the Crowther Creek plain is described as the Koorawatha-Billimari Soil landscape Unit. The landscape is broken into two main areas—the long slopes of the flanking hills and the flatter alluvial plains. On the slopes, the dominant soils are similar to those found in the Warrangong catchment—red and yellow chromosols and dermosols. Calcic and Hypocalcic chromosols (red-brown calcic earths) are found on the alluvial terraces, with some areas of sodosols and sodic chromosols.

The dominant soils of the study area, the red dermosols, have a high hydraulic conductivity.

Groundwater exists everywhere in the Warrangong catchment. The area of study is comprised of two distinct groundwater flow systems. One, the Warrangong Creek, lies immediately west of the main eastern ridge between *Bonaview* and *Warrengong*. This flow system is a local flow system developed on the intrusive/extrusive rock sequence described above. It is most probably recharged generally across its surface expression, with groundwater flowing towards the

gorge exiting the catchment at *Warrengong*. Recharge will be highest where there are poorly developed soils, which generally coincides with the higher slopes, but will be significant in all other parts of the landscape. Discharge from the system will be via flows to the two creeks with all groundwater discharging to the lower Warrangong Creek where it crosses the rock bar just below the Warrengong homestead.

The salinity of groundwater in the Warrangong Creek groundwater flow system is relatively high given the amount of rainfall received by the catchment. Salinities of 2 to 2.5 dS/m (or 1200 to 1500 mg/L TDS) are common, with some salinities ranging up to 4 dS/m (about 2,400 mg/L TDS). Surface water salinities during the time of the interviews showed the same variation in salinity. This tends to indicate that there is a substantial salt store lying in the weathered rocks of the catchment.

The second groundwater flow system exists on the Crowther Creek floodplain. This flow system is developed in sediments infilling the Crowther Creek Valley. Recharge will occur across the plain, with significant recharge associated where the tributary valley flows out onto the floodplain, such as between *Warrengong* and *Bonaview.*

Groundwater flow will initially be towards the Crowther Creek, but then will generally tend to move in a northerly direction down the floodplain. Discharge will be to Crowther Creek and will appear as baseflow in the creek bed. Anecdotal evidence suggests Crowther Creek is now a perennial stream, whereas at some stage prior to the 1950s it was ephemeral. There was little information regarding groundwater salinity in this flow system, except for one or two readings on *Bonaview* – which showed the same pattern as for the Warrangong Creek flow system.

Degradation

There are a number of forms of degradation evident through out the catchment however the dominant forms are salinity, soil acidity, low soil nutrient status, and significant loss of native vegetation and biodiversity. Weeds and erosion are a constant threat to the sustainability of the catchment and will continue to require management and resources.

There is major degradation associated with groundwater discharge, which can be found on all farms of the catchment. In general, this degradation is seen as areas where salt tolerant grass species have colonised patches of waterlogged ground. In some places these salt tolerant species have given way to bare ground and salt crusts. The largest and most widespread problems occur in the lower reaches of the Warrangong catchment, on *Warrengong* and *Hillcrest*. Here salinity may cover areas of up to 0.25 of a hectare. A detailed electromagnetic study has been taken across the catchment and a map of apparent EC has been produced. This

map has been suggested as a salinity map for the catchment. No ground-truthed data was available to determine how well the mapped distribution of EC matched actual salinity on the ground.

Salinity expression in the higher slopes is more discontinuous, with each outbreak confined to a small area. Some outbreaks conform to linear features across the higher slopes and are probably influenced by the underlying geology.

It is unclear to what degree the salinity outbreaks in the Warrangong Creek catchment are contributing to salinity in the wider Lachlan River Catchment. Anecdotal evidence from local farmers tends to indicate that a substantial proportion of the flow of the Warrangong Creek passes underground immediately east of the topographic constriction at the topographic catchment outlet, thus passing into the subsurface environment of the Crowther Creek groundwater flow system. No data were made available to the profiles work to indicate what impact Crowther Creek was having on the Lachlan River, and whether this impact was attributable to the salt discharge from catchments such as Warrangong Creek.

One possibility is that the output from the catchment is small but when integrated across the large number of such catchments along the length of Crowther Creek amount to a significant proportion of the addition to the Lachlan River. On the other hand, it is possible that the salt export is lost into the Crowther Creek groundwater flow system, and that salt output from this system is due to perturbation of the Crowther Creek floodplain itself. This question is a critical one to be answered in terms of the formulation of plans to invest public monies in the catchment.

The soils of the study area are currently degrading, suffering from soil acidity, soil nutrient loss, soil structure decline and organic matter content problems. In their original state, the soils were reasonably robust, but long periods of cropping and sustained production have rendered the soils fragile to further changes. Anecdotal remarks from the landholders attest to the increasing level of inputs that are required to keep the soil resource base at a production level consistent with previous years. It is believed by regional DLWC staff that the soils have passed a threshold where future management will have to be more intense to ensure sustainable levels of production.

Details associated with the loss of native vegetation and biodiversity are currently the focus of the companion TARGET study by Sue Briggs of CSIRO Sustainable Ecosystems.

3.3 Warrangong survey results

This section summarises the results of the property survey questionnaires that were completed as part of the 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 socioeconomic data

Land use

The size of properties surveyed in the Warrangong catchment varied from around 400 to over 1,000 hectares. The proportion of property area leased was generally small with an average for the Warrangong group of 7 percent.

On average, around 60 percent of total property area was devoted to pasture. The dominant pasture type was improved perennial pasture, making up two thirds of total pasture area. The areas of revegetated or remnant vegetation were uniformly small (average of 4 percent of total property area). The largest area devoted to trees was 11 percent and the smallest less than one percent of total property area.

All properties in the catchment undertook both grain cropping and sheep production with three properties also having other livestock enterprises. The major crop enterprises during 1999-2000 were wheat, canola and triticale. All properties grew wheat and six properties grew canola and triticale. Other crops grown were barley, lupins, oats and mustard. Five properties produced hay or silage during the year, however, only one property grew a dedicated fodder crop.

In terms of area grown, wheat and canola were the two largest crops for the Warrangong group. The average yield for wheat and canola was 4.5 tonnes per hectare and 1.8 tonnes per hectare respectively. With respect to crop production methods, most respondents used minimum tillage, zero tillage and crop rotations. Full details of land use survey responses can be found in tables 1, 3 and 11 in Appendix A.

Livestock production

Prime lamb and wool production were the dominant livestock activities for the Warrangong group. Pig and cattle enterprises were relatively few. 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 about 13 per pasture hectare with a range from 6 to 17.

On average, around 1,300 ewes were run with a group maximum of over 3,000 ewes. The average lambing percentage was 74 percent. Average wool cut was about 4.4 kilograms per animal shorn with an average wool price of about $3 per

kilogram of wool sold. Refer to table 3 in Appendix A for further details on livestock production.

Fertiliser usage

Pasture topdressing was uniform with respect to frequency of lime applications but varied considerably when it came to fertilizer applications. The four respondents who made lime applications all did so every six to ten years. For fertilizer applications, however, each of the five respondents who topdressed did so at different intervals. These intervals ranged from every year through to no fixed pattern.

Most respondents applied fertilizer to all crops on a regular basis while lime applications on crops were largely confined to canola.

The most common basis for making both fertilizer and lime application decisions were soil tests and agronomist's advice. All seven properties used soil test results and six properties used an agronomist's advice to decide on fertilizer/lime applications. Visual assessment was used by two properties while district averages or historical routine were not used at all.

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

Water resources

Dams and bores were the most common sources of on-property water. All respondents had at least one dam and five respondents had at least one bore. The average number of dams per property was eleven (range 3 to 25) and the average number of bores was two (range 0 to 4). A further four properties had rivers/creeks as usable sources while three properties utilized springs.

On average, the maximum quantity of water stored in property dams was ten megalitres. For bores, the estimated average maximum flow rate was just over 780 litres per hour. Refer to table 4 in Appendix A for further details on water resources.

Labour use

The majority of labour use on properties was provided by the owner-operators (average 17 months per property). An average of five months came from casual labour while permanent labour was not used by many properties. Refer to table 2 in Appendix A for further details on labour use.

Financial performance

In 1999-2000, the seven properties surveyed generated in excess of $1.6 million in gross cash receipts from primary production activities. The average gross cash receipt per property was just over $230,000.

Total cash costs averaged about $215,000 per property, and on average, properties in the Warrangong catchment had a property cash income of just under $18,000. After accounting for inventory changes and depreciation, the average property business profit for the group was about $15,500.

On average, Warrangong properties had total business assets valued in excess of $1.6 million and an average debt of about $260,000. Average business equity for the group was 82 percent.

The main contributors to cash receipts were livestock and grain sales (28 percent and 32 percent respectively). Wool sales comprised 18 percent. Off-property income was a significant contributor at 20 percent of total cash receipts.

Refer to table 5 in Appendix A for further details on financial performance.

Social profile (Table 6)

Within the Warrangong catchment there is a distinct distribution of two age groups. For the older group, 54 percent and 70 percent of males and females respectively, were aged 36 and over. For the younger group, 46 percent and 30 percent (males and females respectively) were aged less than 25. There was no member of the group aged between 26 and 35.

In general, it is an experienced male group with 55 percent of males having more than 21 years of farming experience. However, reflecting the age distribution within the group, 46 percent of males and 50 percent of females had less than ten years farming experience.

Sixty-nine percent of male respondents had post school qualifications (31 percent tertiary and 38 percent trade/vocational). For female respondents, the corresponding figure was 57 percent (43 percent tertiary and 14 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.

Land condition

The main issues identified as problems were salinity/high watertables and waterlogging which were viewed as *slight* to *serious* problems – all respondents

nominated these three problems as being at least a *slight* problem. Of the nine *serious* ratings, three were for salinity/high watertables and three for waterlogging.

Acidity, weeds, erosion gullies, scalds/bare earth and to a lesser extent foxes, were mostly rated as a *slight* to *moderate* problem while woody weeds, rabbits, kangaroos and sodicity were mostly rated as either *no problem/non-existent* or a *slight* problem.

Across all possible problems the most common rating by far was *slight* (46 percent of total ratings). *Moderate* and *no problem/non-existent* ratings, by comparison, accounted for 22 percent and 20 percent respectively. A *serious* rating was given just nine times (11 percent of total ratings) and *don't know* only once.

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

Salinity/high watertable trends

Around half of the group believed salinity/high watertables on their property had worsened over the past five years while the other half believed the problem had stabilized.

The main categories of cost or damage incurred in the past five years as a result of salinity/high watertables were lost production from salted land, 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

Almost all respondents had implemented an increased area of perennial pasture and 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 those who had increased their perennial pasture area (6 out of 7 respondents), half had done so mainly because of salinity problems and half had done so but not because to salinity. All the respondents implementing conservation farming measures had done so but not due to salinity.

Conversely, the salinity mitigation measures that were least implemented were an increased area of native pasture, saline agroforestry, farm forestry and fencing-off of creeks and waterways.

Around half the group had implemented the remaining salinity mitigation measures, that is, increased the area of saline pasture, utilization of intercropping and fencing-off of remnant vegetation. The four respondents who said they had increased their area of saline pasture had done so because of salinity.

Implementation of salinity mitigation measures over past 5 years

Salinity mitigation measure	Yes (Mainly due to salinity)	Yes (But not due to salinity)	No
	no.	no.	no.
Increased area of perennial pasture	3	3	1
Used conservation farming	0	6	1
Increased area of native pasture	0	1	6
Used saline agroforestry	0	0	7
Established farm forestry	0	1	6
Fenced off creeks and waterways	1	1	5
Increased area of saline pasture	4	0	3
Utilised intercropping	2	1	4
Fenced off remnant vegetation	1	2	4

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 responses to this question followed some similar patterns to the responses given in the previous question (ie. intentions during the past five years).

The majority of respondents in Warrangong are not intending to: implement an increase in area of native pasture, establish farm forestry and utilise saline agroforestry. For native pasture, the main reason given for not implementing the plan was it was considered not profitable or productive. For farm forestry and saline agroforestry, there was no predominant reason given for not implementing these measures.

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

All respondents in the Warrangong 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 half intended to increase their property size.

The greatest perceived threats to respondents still being farming in five years time were climate risks, such as drought, (28 percent), the cost-price squeeze and age/health reasons (both 17 percent) and government regulations, lack of off-farm income and salinity/high watertables (all 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

The group overwhelmingly believed their plant and improvements were in at least a good working condition. Eighty-four percent of all ratings were in the *good condition*, *above average* and *excellent* categories. The most common rating was *good condition* (33 percent of all ratings).

Of those items considered to be in *poor* or *below average* condition, three respondents believed their wool shed fell into these categories and two respondents rated their crop seeding implements and stockyards similarly. A *poor* or *below average* rating was given once each for a tractor and a farm bike.

Part of the reason for the generally good condition of major items of plant was decisions to invest in these items. Around half of the group had made significant expenditure on plant and machinery items during the past five years. The average amount spent per farm over this period was $76,000. With respect to expenditure on improvements however, the situation was quite different. Only one respondent had made a significant investment in property improvements. Refer to tables 18 and 21 in Appendix A for further details on capital items condition.

Enterprise preferences

The two most popular enterprises were sheep and cropping with seven and five respondents respectively applying a *highly liked* or *liked* rating.

Farm forestry had a fairly even distribution of ratings. Almost equal numbers of respondents gave it a *liked* rating, a *not sure* rating and a *disliked* rating. It was a similar situation for cattle except that respondents polarized into either liking this enterprise or not liking it.

The enterprises that were least liked were horticulture and to a lesser extent, pig production. Horticulture relating to production of annuals was the only enterprise not to get a *highly liked* or *liked* rating. Refer to table 19 in Appendix A for further details on enterprise preferences.

Preferences or liking for enterprises			
Enterprise	**Liked or highly liked** no.	**Not sure** no.	**Disliked or highly disliked** no.
Sheep	7	0	0
Cropping	5	1	1
Farm forestry	3	2	2
Cattle	3	0	4
Pigs	2	1	4
Horticulture – trees/vines	1	1	5
Horticulture - annuals	0	1	6

Local services

In terms of perceptions to changes in local services, 51 percent of total responses indicated that services had *stayed the same*. A perception that services had *improved* was not widely held (11 percent of total responses). Of these most related to shopping services (mainly grocery or farm/machinery shopping).

Of the services given a *worsened* rating (19 percent of total responses), banking and hospital services accounted for almost half. (Five respondents applied a *worsened* rating in each case.) Around half the group (three respondents) gave entertainment a *worsened* rating. Refer to table 20 in Appendix A for further details on ratings of local services.

4

4. Warrangong sustainability profile

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

4.1 Water and climate

Assessment of the bio-physical sustainability of Warrangong catchment indicates that for the next ten years at least, under current land management practice, it will decline further in some aspects (land and water resources and vegetation and biodiversity) and improve in others (soil acidity).

The supply of water on the catchment's farms would be inadequate for large-scale intensive horticulture irrigation enterprises. In addition, there are major 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, they are of marginal quality for irrigated intensive horticulture or vegetable enterprises.

4.2 Soil and nutrients

Within the catchment generally, both lime and fertiliser applications are essential for sustainable crop and pasture management, as well as, long term organic matter management. The production of pH sensitive crops (for example canola and lucerne) would need the application of lime. Fortunately, the long run profitability of canola and other acid sensitive crops ensures the feasibility of a lime management program. Whether liming of pastures is economic 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.

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

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

4.3 Vegetation and biota and genetic resources

Most of the Warrangong catchment is cleared with very little remnant vegetation (less than one percent trees). There has been some revegetation, mainly in the form of shelterbelts and for gully control. The shelterbelts and other trees currently planted provide shade and shelter but probably have only a limited impact on managing groundwater levels or biodiversity. There is very little regrowth of young trees and a distinct lack of understorey. It is believed that this low percentage of remnant vegetation and associated biodiversity. Other work (Sue Briggs, CSIRO Eco-systems Services) associated with the TARGET project is being conducted to deal with this issue.

Weeds represent an ongoing farm management problem, which 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. Although weeds are ranked as a slight to moderate farm management issue by the farmers, they are being managed and 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; and,
- 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 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 50 percent aged over 36 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. 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.

The owners and managers supplied the majority of property labour. Most managers currently enjoy good health and should be able to continue to farm for some years to come. 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.

Managerial expertise is supported by good education at the secondary and tertiary levels. 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.

Although turnover of properties and managers is generally considered to be a healthy aspect of the Warrangong 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.

Although most local services were perceived to be adequate or to have remained the same over the past few years, both medical and banking related services, were generally believed to have deteriorated. Access to community services is unlikely to be a major impediment to future sustainability. As with other regions, as services deteriorate, people tend to compensate by travel larger distances to access required services at acceptable levels. Currently, the people of the Warrangong catchment access services in the Young-Cowra-Grenfell triangle.

The group interviewed appeared to be people that had been drawn together by the need to manage the natural resources of the catchment, and were not necessarily a close-knit social group in relation to other issues. At the end of the interview and report back process, however, there appeared to be a higher level of identification with the Warrangong catchment as an integral unit at a social level. It is unknown how significant this observation will be in the over-all assessment of sustainability.

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.

Information from the Sustainability Profile surveys suggests that the majority of producers surveyed could be considered socially sustainable.

4.5 Farm business

The majority of income for most properties came from livestock and grain sales. Cropping has become a major activity in the Warrangong catchment, particularly in the last decade.

The financial results for the group showed some wide variations in most summary statistics. Most farms had a low or negative business profit. Farming 500 studies recommend a business profit of $50,000 for medium term sustainability. The average business profit for the catchment is $15,000 and this is considered unsustainable in the long run.

Most farms also have a low or negative rate of return to capital. This is partly related to the high land values in the Warrangong catchment that are beginning to reflect outside demand for land rather than the capacity to generate farm incomes. This indicates an increasing opportunity cost of capital invested in agriculture and a pressure for structural adjustment.

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 82 percent). This will allow farm owners 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 better off investing their asset outside agriculture.

Off-farm income was important for most of the group and averaged 20 percent of gross cash receipts per property. Off-farm incomes 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.

4.6 Summary

In summary, as indicated above, there is an apparent decline in the biophysical systems, especially salinisation of water and soils, reduced soil health and structure and to a lesser extent possible weed/herbicide resistance.

Soil health issues are being addressed 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. As long as producers are left within the current set of costs and returns associated with on-farm production, the main impediment to maintaining sustainable production will be the costs of increasing the off-farm inputs compared with the additional income generated by those inputs. If the extra income justifies the costs, then sustainability 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).

At the farm scale within the Warrangong catchment, management of salinity impacts may prove to be an intractable problem under current institutional arrangements. Management feasibility also depends on the nature and cost of salinity management options, and the timeframe for them to have the desired effect. It is unlikely that any of the properties in the Warrangong catchment will become unsustainable due to salinisation.

At the Lachlan River Catchment scale, the future sustainability of the production systems will be negatively 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 to those associated with the TARGET project. However, this should be unlikely as the downstream effects of salinity from Warrangong are almost negligible. Hence, Warrangong should fall outside the Lachlan blueprint's focus on "key upland catchments".

In addition, as indicated above, some of the producers in the catchment are neither socially or economically sustainable. These issues help to explain the lack of participation in current or previous natural resource management programs and will need to be allowed for in the design of future catchment scale management strategies.

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

(2) Two 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. 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

(1) One comment related to inadequacies in 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). Additional information was made available to the Warrangong community by DLWC to assist investment decisions for year two, in response to comments made as part of the Profile project.

Extension

Nature of comments

(1) One comment related to inadequacies of 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

(9) Nine 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

(1) One comment 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).

TARGET project

Nature of comments

(3) Three 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

(1) One comment 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).

The broad range of comments made by producers 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 Warrangong area.

- Salinity is an off-site problem – there are salinity impacts within the Warrangong catchment between farms, but there are limited impacts outside the catchment (within the broader Lachlan catchment);

- 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 agreed goals for the Warrangong catchment against which the success of salinity management could be measured. For example, some producers believed that the Warrangong catchment salinity problem was a result of regional groundwater flows from the Koorawatha area;

- The degree of awareness 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;

- Lack of time to spend on implementing and learning about options;

- Lack of skilled labour to backfill for farm operator participation when undertaking environmental projects ;

- 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 for some properties they are a significant impediment to natural resource management in the Warrangong 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.

7

7. Strategic ICM in the Warrangong

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

Within the Warrangong catchment, priority issues identified by producers, ranked from most significant to least significant are:

- Salinisation of land
- Native vegetation and biodiversity decline
- Soil health – including structure, nutrition and acidity
- Weeds/herbicide resistance

Within the broader Lachlan catchment, the Lachlan Catchment Blueprint 2002 - 2012 identifies the following priority issues:

- River salinity
- River water quantity and quality
- Soil health (as measured by organic carbon and vegetation cover percent)
- Vegetation and biodiversity
- Cultural heritage.

A comparison of priority issues in the Warrangong catchment with those at the whole of Lachlan scale suggests that the only common issues of importance are soil health, native vegetation and biodiversity. A distinction has been made between the issues of river and land salinisation. Whilst the Catchment Blueprint may have focussed on river salinity in a more generic sense, this study highlights the importance of distinguishing areas of local land salinisation that are unlikely to impact on end of catchment river salinity targets.

The difference in priority of issues reinforces the need for a strategic management plan that deals with the issues of concern for the Warrangong catchment, as a complement to the broader Lachlan Catchment Blueprint. Ideally, a Warrangong Catchment Plan should be 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 stakeholders' vision for the catchment;
- Identification of the technical, economic and social feasibility of management options;
- Identification of appropriate cost sharing arrangements;

- Implementation; and,
- Monitoring and evaluation.

Integrated catchment management deals with the management of catchments. The surveys within the Warrangong catchment related to a social grouping that did not equate directly with the topographic catchment. For instance, some of those surveyed were outside the groundwater flow system boundary, whilst some who farm inside the Warrangong topographic catchment were not included in the survey. This issue needs to be addressed. For pragmatic reasons it may be appropriate to deal with the combined Warrandale and Warrangong catchments.

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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			WG
		Total	*Average*	*Maximum*	*Minimum*
Total property area	ha	4,447	635	1,000	396
Proportion of area - owned	%	nc	93	100	53
- leased	%	nc	7	47	0
Area used for trees/vegetation:					
Revegetated area	ha	37	5	10	1
Remnant vegetation	ha	113	16	60	0
Farm forestry	ha	0	0	0	0
Total tree area	%	nc	4	11	0
Area used for pasture:					
Native	ha	344	49	218	0
Improved perennial	ha	1,651	236	500	0
Improved annual	ha	566	81	166	0
Other	ha	20	3	20	0
Total pasture area	%	nc	58	94	35
Area used for cropping:					
Wheat	ha	1,023	146	480	14
Canola	ha	767	110	378	0
Barley	ha	115	16	115	0
Oats	ha	15	2	15	0
Lupins	ha	38	5	22	0
Other grain	ha	312	45	91	0
Fodder	ha	24	3	24	0

nc = Not Calculated

2 Labour

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Owner-operator labour	mnth	120	17	33	12
Permanent labour	mnth	20	3	11	0
Casual/contract labour	mnth	38	5	20	1
Total property labour	mnth	177	25	53	13
Off-property labour	mnth	39	6	13	0

3 Crop and animal production

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Crops					
Wheat yield	t/ha	nc	4.5	5.0	2.5
Canola yield	t/ha	nc	1.8	2.5	0.0
Barley yield	t/ha	nc	0.6	4.1	0.0
Oats yield	t/ha	nc	0.4	2.6	0.0
Lupins yield	t/ha	nc	0.5	2.5	0.0
Hay/silage produced	t	nc	105	300	0
Livestock					
Av. DSEs per area pasture	dse/ha	nc	12.9	17.4	5.9
Have livestock enterprise	no	7	nc	nc	nc
Sheep					
Av. number ewes	no	nc	1,343	3,200	0
Lambing percentage	%	nc	74	118	41
Wool cut per animal shorn	kg	nc	4.4	6.3	3.2
Average wool price/kg	$	nc	2.9	4.7	2.3
Average value sheep sold	$	nc	40	98	20
Cattle					
Number of breeders	no	nc	nc	nc	nc
Calving percentage	%	nc	nc	nc	nc
Average value animal sold	$	nc	nc	nc	nc

nc = Not Calculated

4 Water

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Annual rainfall	mm	nc	0	0	0
Dams - no.		76	11	25	3
- maximum quantity	ML	nc	10	20	5
Bores - no.		12	2	4	0
- maximum quantity	L/h	nc	784	2,730	0
Springs - no.		4	1	4	0
- maximum quantity	L/h	nc	0	0	0
Wells - no.		7	1	5	0
- maximum quantity	L/h	nc	0	0	0
Creeks - no.		7	1	3	0
- maximum quantity		nc	nc	nc	nc

5 Financial

		Catchment group			
		Total	*Average*	*Maximum*	*Minimum*
Property business cash receipts	$	1,627,417	232,488	nc	nc
less property cash costs	$	1,503,288	214,755	nc	nc
Property cash income	$	124,129	17,733	nc	nc
plus build-up in trading stocks	$	95,035	13,576	nc	nc
less depreciation	$	110,562	15,795	nc	nc
Property business profit	$	108,602	15,515	nc	nc
Total cash receipts from:					
Livestock sales	%	nc	28	nc	nc
Wool sales	%	nc	18	nc	nc
Grain sales	%	nc	32	nc	nc
Misc. business receipts	%	nc	2	nc	nc
Off-farm income	%	nc	20	nc	nc
Off-farm income	$	290,027	41,432	nc	nc
Business capital at 30 June '00	$	11,362,182	1,623,169	nc	nc
Business debt at 30 June '00	$	1,824,227	260,604	nc	nc
Business equity ratio	%	nc	82	nc	nc
Business/non-business equity	%	nc	nc	nc	nc

nc = Not Calculated

6 Social profile

	Male		Female	
	no.	%	no.	%
Age group				
< 15 years old	2	13	3	30
16 - 25	5	33	0	0
26 - 35	0	0	0	0
36 - 45	4	27	3	30
46 - 55	2	13	3	30
56 - 65	1	7	1	10
> 65 years	1	7	0	0
Farming experience (since age 15)				
< 10 years	6	46	4	50
10 - 20	0	0	2	25
21 - 30	4	31	1	13
31 - 40	1	8	1	13
41 - 50	1	8	0	0
> 50 years	1	8	0	0
Highest qualification				
Secondary	4	31	3	43
Trade/vocational	5	38	1	14
Tertiary	4	31	3	43

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	nc	nc	nc	nc	nc
Pasture paddocks	nc	nc	nc	nc	nc

nc = Not Calculated

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	2	1	1	1	0
Lime applications	0	0	4	0	0
Other applications	0	0	0	0	0

9 Crops usually applied with fertilisers/soil conditioners

	Wheat	**Canola**	**Barley**	**Oats**	**Other**
	no.	no.	no.	no.	no.
Fertiliser applications	6	5	0	0	5
Lime applications	1	4	0	0	2
Other applications	0	0	0	0	0

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	7	6	2	0	0
Lime applications	7	6	2	0	0
Other applications	0	0	0	0	0

11 Use of various methods and approaches to cropping

	Catchment group	
Method/approach	no.	%
Zero tillage	4	20
Minimum tillage	6	30
Intercropping	2	10
Opportunity cropping	1	5
Crop rotations	5	25
Phase farming	0	0
Conventional tillage	2	10

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	0	3	4	0	0
Woody weeds	0	0	1	6	0
Rabbits	0	0	5	2	0
Foxes	0	2	3	2	0
Kangaroos	0	1	2	3	0
Waterlogging	3	1	3	0	0
Salinity/high watertables	3	2	2	0	0
Acidity	1	3	3	0	0
Sodicity	1	0	3	2	1
Erosion gullies	1	1	4	1	0
Scalds bare earth	0	2	5	0	0
Other	0	2	1	0	0

13 Area affected if problem rated as either Serious or Moderate

	Catchment group			
	Total	*Average*	*Maximum*	*Minimum*
Problem	ha	ha	ha	ha
Weeds	481	69	396	0
Woody weeds	0	0	0	0
Rabbits	0	0	0	0
Foxes	764	109	405	0
Kangaroos	405	58	405	0
Waterlogging	145	21	65	0
Salinity/high watertables	127	18	65	0
Acidity	2,201	314	1,000	0
Sodicity	44	6	44	0
Erosion gullies	3	0	3	0
Scalds bare earth	8	1	8	0
Other	9	1	9	0

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

	Group's perceptions	
Trend in salinity	no.	%
Worsened	4	57
Improved	0	0
Stabilised	3	43
Not sure	0	0

15 Damage and costs incurred due to salinity/high watertables

	Group's reporting of damage	
Category of cost/damage	no.	%
Lost production from salted land	5	31
Damage to infrastructure	5	31
Salinisation of water supplies	3	19
Increased fertiliser requirement	0	0
Loss of shade/shelter	1	6
Loss of aesthetic value	1	6
Other	1	6

16 Respondents implementing salinity mitigation measures over past 5 years

	Yes (mainly due to salinity) (1)	**Yes** (but not due to salinity) (2)	**No** (3)	**Not applicable** (4)
Mitigation measure	no.	no.	no.	no.
Increased area perennial pasture	3	3	1	0
Increased area native pasture	0	1	6	0
Increased area saline pasture	4	0	3	0
Used saline agroforestry	0	0	7	0
Established farm forestry	0	1	6	0
Used conservation farming	0	6	1	0
Utilised intercropping	2	1	4	0
Fenced remnant vegetation	1	2	4	0
Fenced creeks/waterways	1	1	5	0

17 Intentions to implement salinity mitigation plans in next 5 years

	Salinity mitigation plan				
	Increase area of perennial pasture no.	*Increase area of native pasture* no.	*Increase area of saline pasture* no.	*Utilise inter-cropping* no.	*Establish farm forestry* no.
Intention NOT to implement plan	2	6	2	3	6
Main reason for not implementing					
Not profitable or productive	0	**4**	0	0	**2**
Wouldn't fit-in with existing set-up	0	**1**	0	**1**	0
Simply not interested	0	0	0	0	**1**
Too much owner labour required	0	0	0	0	0
Already doing as much as intend to	**1**	0	0	0	0
Don't know enough about it	0	**1**	0	**1**	**1**
Don't have the right equipment	0	0	0	0	0
Country/climate not suitable	0	0	0	0	0
No need for it	**1**	0	**1**	**1**	0
No/insignificant salinity/w'table problem	0	0	**1**	0	0
Not applicable (eg. don't have a creek)	0	0	0	0	0
Other	0	0	0	0	**2**

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

18 Rating of major plant items and improvements

18

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

19 Preferences or liking for rural enterprises

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

20 Rating of local services over the past 5 years

Service	Group's service rating: *Worsened* (1) no.	*Stayed the same* (2) no.	*Improved* (3) no.	*Not sure or not applicable* (4) no.
Banking	5	2	0	0
Primary school	0	4	1	2
Secondary school	0	5	0	2
Doctor	2	3	0	2
Hospital	5	0	0	2
Other government agencies	2	5	0	0
Shopping - groceries/small goods	0	4	3	0
Shopping - other household items	1	5	1	0
Shopping - farm/machinery goods	0	4	3	0
Livestock/grain sale centres	0	6	1	0
Public transport	1	2	0	4
Entertainment	3	3	0	1
Mobile phone	0	0	0	0
Roads	0	0	0	0
RLPB	0	0	0	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	4	76,000	532,000
Improvements	1	nc	nc

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

	Group's intentions	
Intention to remain	no.	%
Yes	7	100
No	0	0
Unsure	0	0

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

	Group's intentions	
	no.	%
Intention		
Stay much as is	4	57
Increase property size	3	43
Sell whole property	0	0
Sub-divide & sell small part of property	0	0
Lease out property	0	0
Sub-divide and sell most of property	0	0
Other	0	0

24 Perceived greatest threats to still be farming in 5 years

	Catchment group	
	no.	%
Climate risk (eg. drought)	5	28
Cost-price squeeze	3	17
Government regulations	2	11
Land availability & price	1	6
Lack of off-farm income	2	11
Animal pests	0	0
Weeds	0	0
Salinity/high water tables	2	11
Acidity/sodicity	0	0
Erosion	0	0
Age or health reasons	3	17
Property transfer	0	0
Wish to retire or change of lifestyle	0	0
Differences within family business	0	0
Differences in money distribution	0	0
Other	0	0