DWLBC REPORT

Land management monitoring in the agricultural areas of South Australia: Report No 1

2008/28

Government of South Australia
Department of Water, Land and Biodiversity Conservation

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Knowledge and Information
Department of Water, Land and Biodiversity Conservation

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FOREWORD

South Australia's unique and precious natural resources are fundamental to the economic and social wellbeing of the State. It is critical that these resources are managed in a sustainable manner to safeguard them both for current users and for future generations.

The Department of Water, Land and Biodiversity Conservation (DWLBC) strives to ensure that our natural resources are managed so that they are available for all users, including the environment.

In order for us to best manage these natural resources it is imperative that we have a sound knowledge of their condition and how they are likely to respond to management changes. DWLBC scientific and technical staff continues to improve this knowledge through undertaking investigations, technical reviews and resource modelling.

Scott Ashby
CHIEF EXECUTIVE
DEPARTMENT OF WATER, LAND AND BIODIVERSITY CONSERVATION

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EXECUTIVE SUMMARY

The Land Condition Monitoring Program (LCMP) was implemented in South Australia in 1995 by the Department of Water, Land and Biodiversity Conservation (DWLBC) and the then Soil Conservation Council, with funding support from the Natural Heritage Trust. A land manager survey was an important part of a suite of tools developed to monitor indicators and provide insights into land managers and their practices. This is crucial for both assessing progress and guiding development of strategies to achieve targets for the State Strategic Plan and natural resource management (NRM) boards. It can contribute for similar purposes to other government-sponsored programs including the Natural Heritage Trust, the National Action Plan for Salinity and Water Quality and the National Carbon Accounting System and to industry groups such as the Grains Research and Development Corporation.

This report describes the rationale and methodology for the land manager survey conducted in South Australia in 2000, 2002 and 2005. It provides a range of example data and the 2005 questionnaire (App. A) to illustrate the type and scope of the data, together with evidence of its complementarity for understanding key management issues associated with land degradation by soil erosion.

1. INTRODUCTION

This report was written as an agreed output under a joint project between DWLBC and the Bureau of Rural Sciences (BRS) for the Australian Collaborative Land Use Mapping Programme (ACLUMP) funded through the Natural Heritage Trust entitled 'Land management practices pilot project 2006-2007: State and regional broadscale cropping management practices information'. This project is one of a set of pilot studies to collate land management practices to aid the development of the national Land Use and Management Information System (LUMIS).

Information and monitoring of land management practice has multiple drivers in South Australia at regional, state and national levels.

The need for land management practice information was originally driven by requirements under the former *Soil Conservation and Land Care Act 1989*. One of the objects of the Act was to undertake '…regular and effective monitoring and evaluation of the condition of the land …'. Under the Act, the Soil Conservation Council (SCC) was required to '…advise the Minister on the extent of land degradation and the economic and environmental implications of that degradation; and '… to advise the Minister on the priorities …' of '… projects or programmes for the conservation or rehabilitation of land …'. To satisfy the monitoring requirement, the SCC and the Department of Water, Land and Biodiversity Conservation (DWLBC) initiated a Land Condition Monitoring Program (LCMP) in 1995 with support from the Natural Heritage Trust. One of the key outcomes from the early work in that program was the recognition of the importance of land management practices in the understanding of the trends in direct indicators of land condition. Furthermore, because the majority of land in the state was in private ownership, land management practices underpinned land condition and the range of factors involved were potentially useful surrogate indicators. For these reasons, the LCMP initiated a survey of the knowledge about, attitudes to, and actual practices used by land managers. The most efficient method was determined to be a telephone survey that could be repeated every few years to establish trends. The land manager survey (LMS) has subsequently been successfully undertaken by DWLBC in 2000, 2002 and 2005.

Currently, the Land Management and Revegetation (LMR) Group within DWLBC is the key end user of information obtained through the LMS and the erosion risk indices program (described in Section 3.2) with responsibilities to report to the Minister, the Natural Resources Management Council, regional NRM boards and groups, other agencies and industry groups.

The LMR Group has the responsibility to report on the land resources section of the next State of the Environment Report due in 2008. The soil condition section will utilise information from the LMS, the LCMP field survey program and other data sources.

The LMR Group regularly provides information to various individuals and organisations to assist with the development of strategies, policies and actions regarding land management. Statewide and regional reports were produced for a range of stakeholders detailing the impacts of the 2006 drought on land condition.

In 2007, South Australia's State Strategic Plan was updated and now contains a soil protection target that is measured using the Erosion Risk Indices (ERIs). The LMS will provide an understanding of land managers' knowledge, attitudes and land management practices they use, thereby helping guide the development of strategies to achieve the new target.

Recently, South Australia has the newly established *State Natural Resources Management Plan 2006* that identifies ten resource condition targets (RCTs) including 'land condition'. Details regarding indicators, specific data requirements, and monitoring programs have not yet been confirmed but it is expected that the LMS will play a crucial role in the state's Monitoring, Evaluation and Reporting Operational Plan (MER-OP), which is currently under development. The regional NRM boards will utilise the LMS and ERI information in the development of their regional targets and strategies to be documented in regional comprehensive NRM Plans.

Regionally, under the Natural Heritage Trust (NHT) and the National Action Plan for Salinity and Water Quality (NAP) funding arrangements, South Australia's regional NRM boards are now required to report on the impacts of NRM programs and activities. This has stimulated a sudden increase in the importance of monitoring, evaluation and reporting processes and hence, increased the need for information on land use and management practice changes.

The National Land and Water Resources Audit (NLWRA) has advised on and developed recommended national indicators and monitoring protocols. The protocols for 'land salinity' have been agreed to and accepted whilst the 'soil condition' protocols have just been released (McKenzie and Dixon 2006) and are currently being trialled across the country. The report recommends the use of land manager surveys to collect crucial land management practice change information on various soil and land condition issues.

The National Carbon Accounting System (NCAS) collects information to determine projected carbon emissions and sinks to meet National Greenhouse Gas Inventory reporting requirements, in order to assess progress towards meeting Australia's emissions target. The NCAS uses multiple layers of data including land use and management change to model changes in carbon stocks.

Additional to these drivers for land management practice data, there are a number of smaller agencies and industry groups with a need or interest in this information such as the Grains Research and Development Corporation (GRDC) and the Grain and Graze program.

2. METHODOLOGY DESCRIPTION

The land manager survey (LMS) is a repeatable telephone survey designed to monitor trends in land management practices, as well as knowledge and attitudes of land managers over time, as indicators of risk of land degradation. To date, the Land Management and Revegetation Program (LMRP) of DWLBC has funded the survey. The survey is the most effective and efficient way to understand trends in land management. It specifically targets crop and livestock farmers, including dairies, as the largest combined group of broad-hectare, agricultural landholders in South Australia. The survey does not include the extensive rangelands grazing or smaller intensive horticultural industries such as vineyards, vegetables and orchards, or hobby farming properties. It was considered that these industries need to be targeted separately, but since they have not been of priority to the LMRP, no funding has so far been made available to undertake such assessments. While the large numbers of small property owners who also contribute to land condition are not included, they represent a relatively small portion of degradable land.

More recently, the NLWRA-appointed Expert Panels for Wind and Water Erosion have recommended monitoring land management practice changes as additional surrogates for erosion trends which will provide background information on why changes in land condition occur.

Status

It was originally planned to carry out the land manager surveys every three years as a component of the Land Condition Monitoring Program (LCMP), although the second survey was in fact undertaken after two years because there was a sense of urgency at the time to confirm some of the baseline data. However, while the LCMP is 'considered to be' ongoing, it is a DWLBC funded project and therefore subject to the continued availability of funding. Institutional arrangements for the continuation and operation of the LCMP require clarification.

To date, surveys have been undertaken in 2000, 2002 and 2005 and the planned intention was to complete four or five surveys to ensure good trend data before reviewing the need and priority for subsequent surveys and their frequency. The next land manager survey is intended to be conducted in February 2008.

Rationale

While information on the physical condition of land is of prime importance, there is actually very little available for state-wide monitoring purposes. Various surrogate measurements are usually easier to capture. Since private landholders manage 80% of South Australia's land resources, their attitude to, knowledge and implementation of sound land management practices are pivotal to progress with regard to land degradation issues. The trends in the proportion of land manager responses in relation to the issues are therefore useful surrogate indicators of current and future land condition.

Some information is available from specific questions occasionally asked as part of the Australian Bureau of Statistics' Agricultural Census. However, there is great value in being able to control the data capture process, particularly with regard the range and type of questions asked, as well as the ability to repeat the survey as often and for as long as desired.

Sample selection

A list of 2000 landholders was purchased in January 2000 from an extensive commercial database of Australian land managers with around 14000 representatives from South Australia. The database is a compilation of landholders who have made a wide variety of agricultural purchases so the samples selected are likely to be as representative as possible of the farming population. Rangelands, horticultural and agricultural irrigators, and hobby farmers were excluded from the sample as far as possible, since the LMRP was only interested in broad-hectare agricultural districts. The commercial database of land managers was chosen because it was updated annually, appeared to cover most land managers in the state, the properties were geo-located via postcode and could be sorted on broad enterprise categories.

Properties were selected on the basis of farming type (broad-hectare cropping and livestock enterprises in agricultural areas), size (greater than 40 ha) and postcode. Although it was not possible to select an equal number of samples from each postcode, representatives were sought from all postcodes to ensure the best possible coverage of the agricultural areas of the state from the samples available. The database sort capabilities were considered a considerable advantage over the random selection of names from a telephone directory where only a limited number of land managers are listed. A new list of 3000 land managers was similarly selected for each of the 2002 and 2005 surveys.

Respondents were identified by postcode and subsequently assigned to:

a). Regions

Eyre Peninsula (EP)
Murraylands (ML)
Mt Lofty Ranges and Kangaroo Island (MLR/KI)
Northern and Yorke (NYR)
South East (SE)

b). Rainfall (annual) zones

<325 mm (Low)
325-600 mm (Medium)
>600 mm (High)

Postcode boundaries were generally a good match for regional boundaries but only an approximate match for rainfall zones. Nevertheless, since the rainfall zones provide a useful insight into conditions and productive potential across the state, they were considered to be a valuable analytical parameter. The low rainfall zone (<325 mm) represents areas where rainfall is normally insufficient to allow the successful use of alternative crops such as grain legumes and oilseeds in farm rotations. The medium rainfall zone (325–600 mm) represents the relatively reliable cropping areas of the state and the higher rainfall areas (>600 mm) the most reliable, but largely intensive stock grazing enterprises, although cropping has increased in parts of these latter areas in recent years. Since the sample selection is primarily based on an even distribution of representatives in postcodes, the low rainfall zone has always had relatively low numbers of samples (around 10% of the total) because properties tend to be much larger and the population much lower than in other zones.

Overall, 618 land managers were surveyed in 2000 and 1003 each in 2002 and 2005. The surveys were conducted by telephone between February and March.

Table 1. Number of respondents interviewed in the land manager survey 2000–2005.

	Number of respondents								
Year	State	EP	ML	MLR/KI	NYR	SE	high	medium	low
2000	618	141	132	84	149	112	117	433	68
2002	1003	203	198	201	202	199	312	598	93
2005	1003	198	201	199	206	199	286	617	100

Target population

The survey currently targets large scale farming (broad-hectare cropping and livestock) since they manage the majority of land identified to be at risk, but there are opportunities to develop separate surveys for specific interest or industry groups with small intensively farmed properties (e.g. hobby farms or horticulture), should funding be made available.

Captured data

The issues of interest and broad questions required were identified by DWLBC, with the final question format devised by Truscott Research, who won the tender to conduct all three surveys to date on behalf of DWLBC. Some survey questions were slightly modified over the first two surveys, where the intent was found to be unclear to respondents.

Data is collected on the following topics: Property, arable and crop areas, crop types grown, general land management issues of concern and more specific details of cropping and cultivation practices, feed-lotting and paddock residue burning, amelioration of acidification, salinity, soil structure decline, and water repellence as well as aspects of soil fertility maintenance and revegetation (see 2005 questionnaire in App. A). There has also been an opportunity for questions to be included on behalf of other DWLBC Programs. In 2000, a series of questions were included to assess acceptance of the Animal and Pest Plant Control (APPC) Program, while in 2002 and 2005 the success of FarmBis™ training and the use of computing and business software tools used to manage properties was assessed.

In 2000, there were 51 questions asked, which took approximately 20 minutes for each telephone interview and around three weeks to complete the survey. Each land manager was first called to seek cooperation and book a time to undertake the interview. Subsequently, 58 and 70 questions were asked in 2002 and 2005 respectively and the interviews took around 30 minutes to complete.

There is some scope for additional questions. The surveys contain a core set of 54 questions but the series of opportunistic questions such as for the APPC or FarmBis™ Programs may not be repeated or only included occasionally. There may be other opportunities for NRM regions to 'piggy-back' the survey by including regionally specific questions. It would make sense to coordinate and carry out land management surveys and store data centrally. While the survey length is as long as it can be at the moment, it would be possible to split the surveys and carry them out alternately if the number of questions became unwieldy.

Data Processing

Truscott Research conducts the telephone surveys in February and March. Prospective respondents are initially contacted to explain the purpose of the survey, seek cooperation and arrange an interview time. Each professional interviewer is responsible for working randomly through a provided list of names in several postcodes to achieve a spread of respondents that is as even as possible.

Data is entered into a professional software package 'Survey System'® developed by Creative Research Systems. This is then used to collate, analyse and summarise the information into graphs and tables. A basic report with some of the graphed results is prepared by the consultant and provided to the LCMP manager as a preliminary summary. In addition, the consultant provides one Microsoft Excel® file with the charts and tables used and one with all the raw data.

The LCMP manager then comprehensively checks the data for accuracy and consistency; amends any anomalies as required and reformats the column layout for some of the multiple answer data for easier analysis. Occasionally respondents have had to be called again to clarify some of their answers. Once the checking process is complete the final data is appended to the main land manager Microsoft Access 2000® database.

Derived information and format

The preliminary report provided by Truscott Research presents an overview of the data captured, including comparisons with previous surveys. It enables an early review of progress in land management and early summary outputs that can be made available, particularly to the LMRP in DWLBC, who have paid for the work to be carried out. However, it is only when the data has been thoroughly checked and corrected that it is suitable for wider distribution.

Final data output calculations are carried out in several Microsoft Excel® spreadsheets. After each survey, queries within the main land manager survey database are used to derive updated data, these are copied to the spreadsheets and then the calculations are in turn all updated to include the new dataset. A series of other linked spreadsheets are maintained to display the final graphical output for all the survey questions. All the data is stored on the LCMP manager's laptop computer.

Since regional samples represent different sized regional populations, in the determination of overall state averages within the output calculation spreadsheets, regional data are weighted in accordance with the distribution of agricultural landholders provided by the Australian Bureau of Statistics.

Key data has been published in the initial land condition report (McCord and Payne 2004), but a wide range of information has been provided to the LMRP in DWLBC, consultants, and a range of Primary Industries and Resources SA (PIRSA) programs and regional staff of Rural Solutions South Australia (RSSA), from time to time. Interest in the data has correspondingly increased with every completed survey as it has begun to illustrate trends. The information should also be useful to a wide variety of other groups such as regional NRM boards, landcare groups and the South Australian No-Till Farmers Association. It is envisaged that a process of providing the land management information to NRM boards, in particular, will be eventually formalised.

Scale of Use

The information covers the agricultural areas of South Australia and can be analysed at regional level. The current regions are based on commonly accepted historical boundaries and are the best option in an agro-ecological sense.

While they pre-date NRM regions the results would largely reflect the situation in these new regions, although there is a significant overlap between the Mount Lofty Ranges (MLR/KI) survey region and the SA Murray-Darling Basin NRM Region in particular. Postcodes could be re-assessed to perhaps achieve a closer match with NRM board regions if necessary.

Additional relevant information

The cost of conducting the LMS using a specialist consultant is currently approximately $35000 and the LMRP of DWLBC has provided these funds to date. The Knowledge and Information Division, DWLBC currently provides funding for the overall LCMP, with time spent by the LCMP manager collating and interpreting the information, as well as maintaining the database, representing an additional $15000 per annum.

FarmBis™ (via PIRSA) has contributed a small amount of funding towards the collection of the data on their behalf by the land manager survey in 2005.

3. SCOPE OF SURVEY

Surveys have been conducted in 2000, 2002 and 2005. The 2000 and 2002 results have been included in the initial land condition report (McCord and Payne 2004). This report has been widely distributed through DWLBC, PIRSA and to all NRM board members across the state. Subsequently, 2005 data has been included in data summaries to regional RSSA staff involved in reporting land condition on behalf of the LMRP of DWLBC to NRM Boards. This is expected to be the main conduit for reporting on the data in the future but the data is available to anyone who can make use of it.

3.1 RANGE OF DATA CAPTURED

The full list of questions from the 2005 survey is included as Appendix A. Almost any variation and combination of these questions can be collated and interpreted. In this section, a series of graphs are presented showing the information that can be revealed by the survey in a variety of temporal and spatial scales. The graphs have been divided between 'knowledge', 'attitude' and 'practice' type survey questions. Some discussion regarding each figure is provided.

3.1.1 'KNOWLEDGE' BASED SURVEY RESPONSES

Figure 1 shows the averaged results from the 2002 and 2005 surveys with regard to the knowledge of land managers about the cause and treatment of soil acidity. The figure identified that around 45% of farmers with acid soils incorrectly cited superphosphate as a direct cause, while 52% knew that nitrogen fertiliser and product removal were major causes. While 41% of farmers wrongly believed that gypsum could be used to treat acidification, 81% correctly indicated that lime application was important before any sign of a production decline occurred.

Figure 2 shows that in 2005 in South Australia, 49% of farmers who considered that they had acidic soils on their property were unable to correctly identify a soil pH level that was within a reasonable range of the real critical pH of 4–5.5, irrespective of the analysis method and pH scale. The trend for this knowledge gap is decreasing, however, as the 2000 survey results showed 65% were unable to correctly identify the critical pH. Importantly, there was a positive trend in the MLR/KI, NYR and SE regions where acidification is a significant issue but there remain a significant proportion of land managers who appear to know little about acidification.

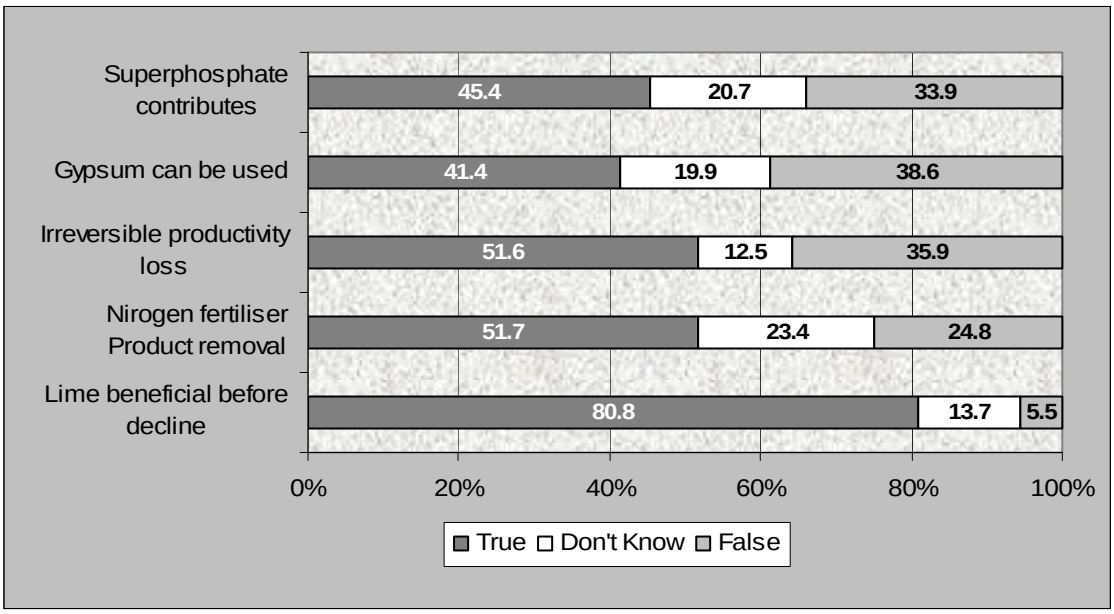


Figure 1. Average perceptions of acidification causes and amelioration practices held by farmers with acidic soils in South Australia; land manager surveys 2002, 2005.

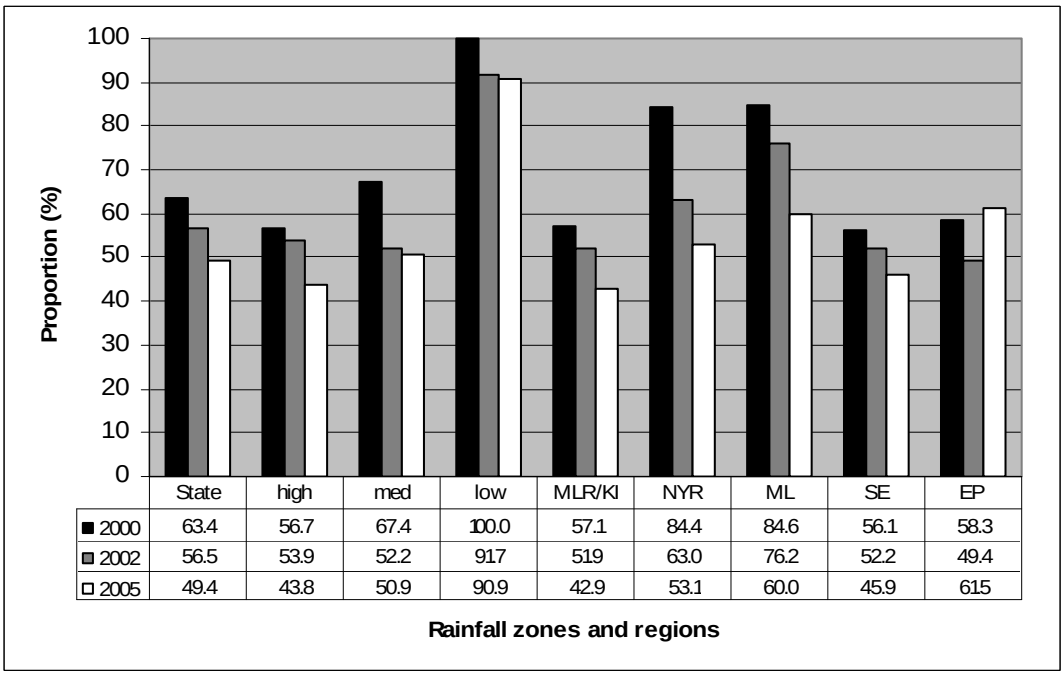
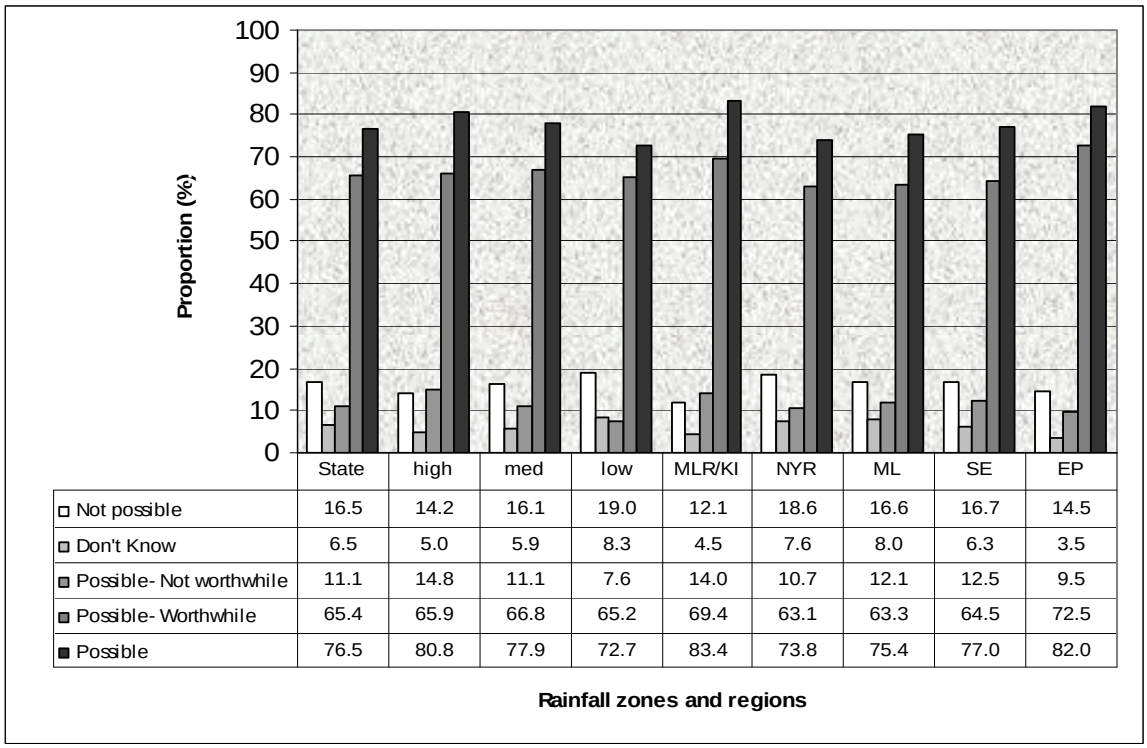


Figure 2. Proportion (%) of land managers with acid soils on their property who don't know the critical soil pH in South Australia; land manager surveys 2000, 2002, 2005.

3.1.2 'ATTITUDE' BASED SURVEY RESPONSES

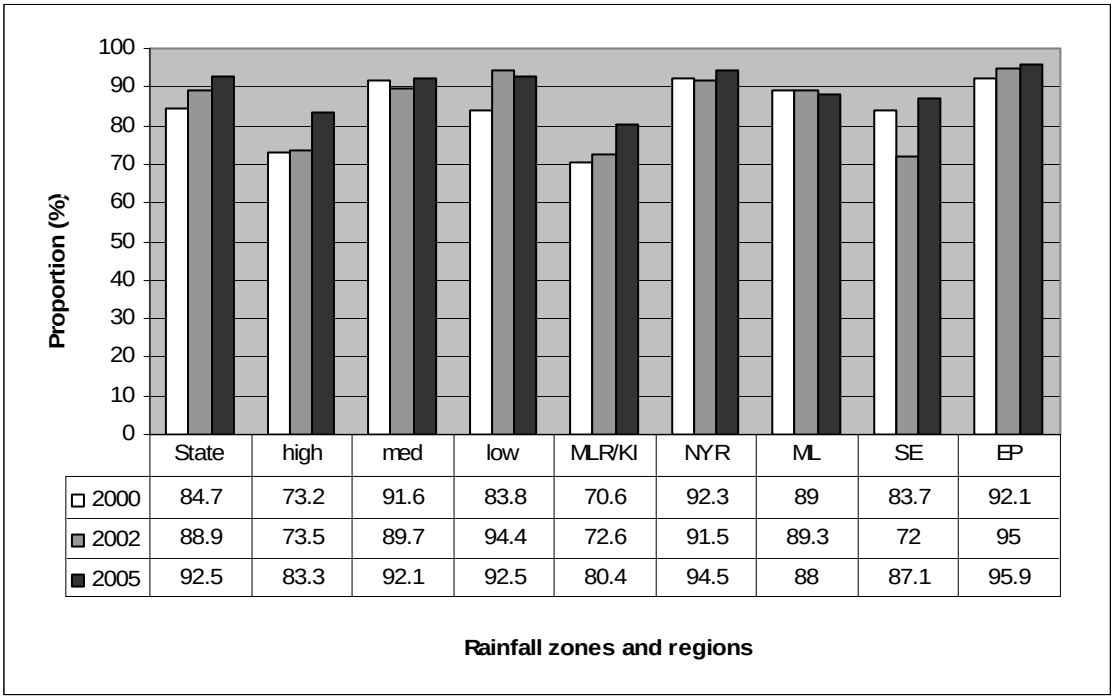
The results in Figure 3 are averages of the combined results from the three surveys conducted, which all show the overwhelming positive attitude of land managers to future potential improvement in productivity. The survey indicates the majority of landholders do consider they can achieve greater productivity and that it would be economically worthwhile, with the result very similar across the regions and rainfall zones. It is interesting to note that as high a proportion of land managers (65%) in low and less reliable rainfall districts were as positive as those in high and medium rainfall zones (66–67% respectively). Improvement is hardly ever possible without change and recognition of the increased potential of their business indicates a positive attitude towards new management practices and skills that they could learn along the way.



	State	high	med	low	MLR/KI	NYR	ML	SE	EP
Not possible	16.5	14.2	16.1	19.0	12.1	18.6	16.6	16.7	14.5
Don't Know	6.5	5.0	5.9	8.3	4.5	7.6	8.0	6.3	3.5
Possible- Not worthwhile	11.1	14.8	11.1	7.6	14.0	10.7	12.1	12.5	9.5
Possible- Worthwhile	65.4	65.9	66.8	65.2	69.4	63.1	63.3	64.5	72.5
Possible	76.5	80.8	77.9	72.7	83.4	73.8	75.4	77.0	82.0

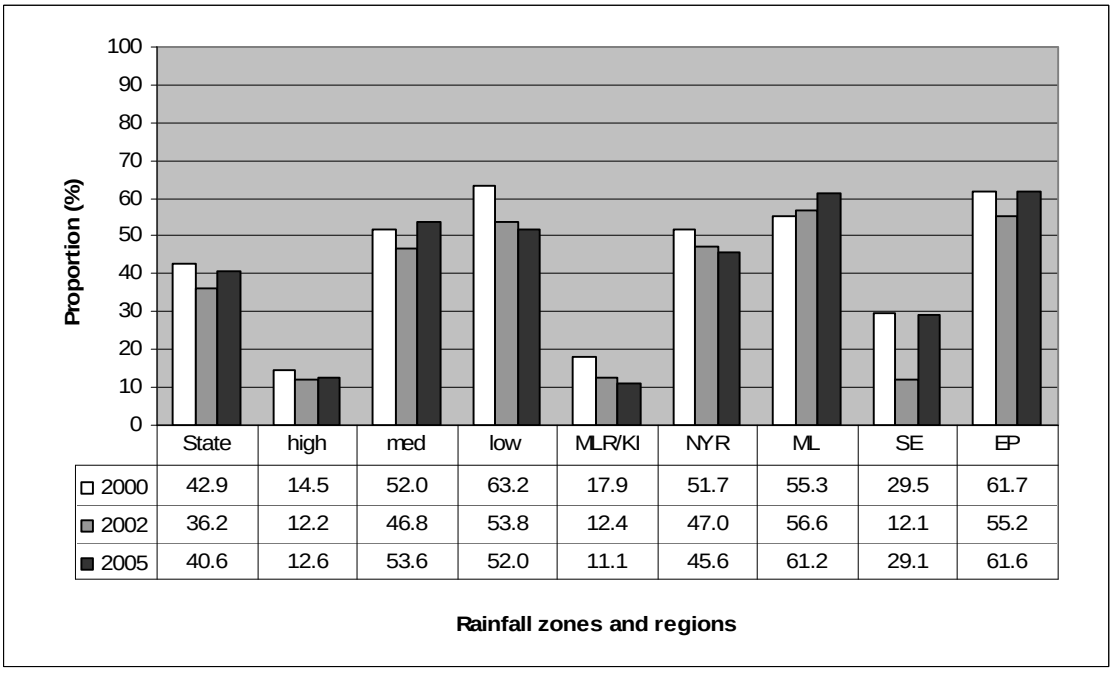
Figure 3. Average proportion (%) of land managers holding beliefs with regard to crop production and economic improvement from rainfall received in South Australia; land manager surveys 2000, 2002, 2005.

Figure 4 demonstrates that there are a high proportion of land managers who consider full stubble and residue retention important in the future sowing of crops and it has increased overall across the state from 84.7% in 2000 to 92.5% in 2005. Less land managers in the more reliable higher rainfall districts were positive about stubble retention than in the main cropping districts, but the proportion still exceeded 80%.



	State	high	med	low	MLR/KI	NYR	ML	SE	EP
2000	84.7	73.2	91.6	83.8	70.6	92.3	89	83.7	92.1
2002	88.9	73.5	89.7	94.4	72.6	91.5	89.3	72	95
2005	92.5	83.3	92.1	92.5	80.4	94.5	88	87.1	95.9

Figure 4. Change in the proportion (%) of cropping land managers who consider stubble retention important for sowing crop in South Australia; land manager surveys 2000, 2002, 2005.



	State	high	med	low	MLR/KI	NYR	ML	SE	EP
2000	42.9	14.5	52.0	63.2	17.9	51.7	55.3	29.5	61.7
2002	36.2	12.2	46.8	53.8	12.4	47.0	56.6	12.1	55.2
2005	40.6	12.6	53.6	52.0	11.1	45.6	61.2	29.1	61.6

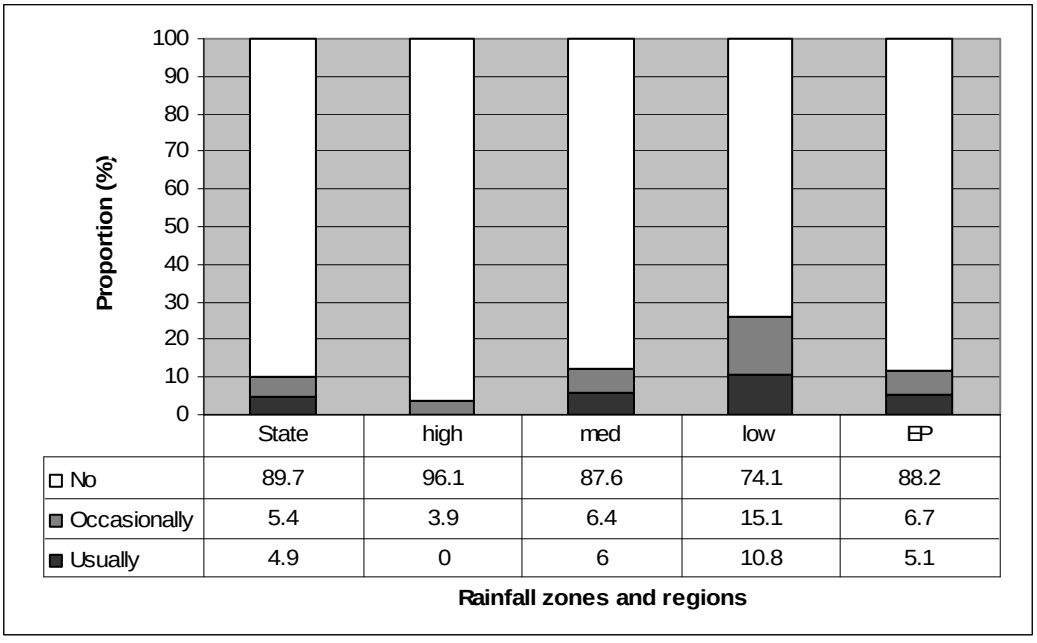
Figure 5. Proportion (%) of land managers considering wind erosion a land management issue in their district in South Australia; land manager surveys 2000, 2002, 2005.

The proportion of land managers that consider wind erosion an issue in their district is shown in Figure 5. The fact that land managers acknowledge this as a management issue suggests they may also be more likely to implement practice changes to minimise the detrimental effects to their land. Although the proportion is lower than expected in the low rainfall areas, particularly Murraylands and Eyre Peninsula regions, the data probably reflects a confidence in the changes to less intense tillage systems that are currently occurring across those districts. As expected, for high rainfall areas where perennial pastures predominate, wind erosion is much less of an issue.

3.1.3 'PRACTICE' BASED SURVEY RESPONSES

The survey questions regarding land management practice change are of most interest and provide very cost effective and simple surrogate indicators of land management trends. There is a wide range of 'practice' questions in the survey because they offer the best chance of obtaining more objective data, in contrast to attitudes or opinions.

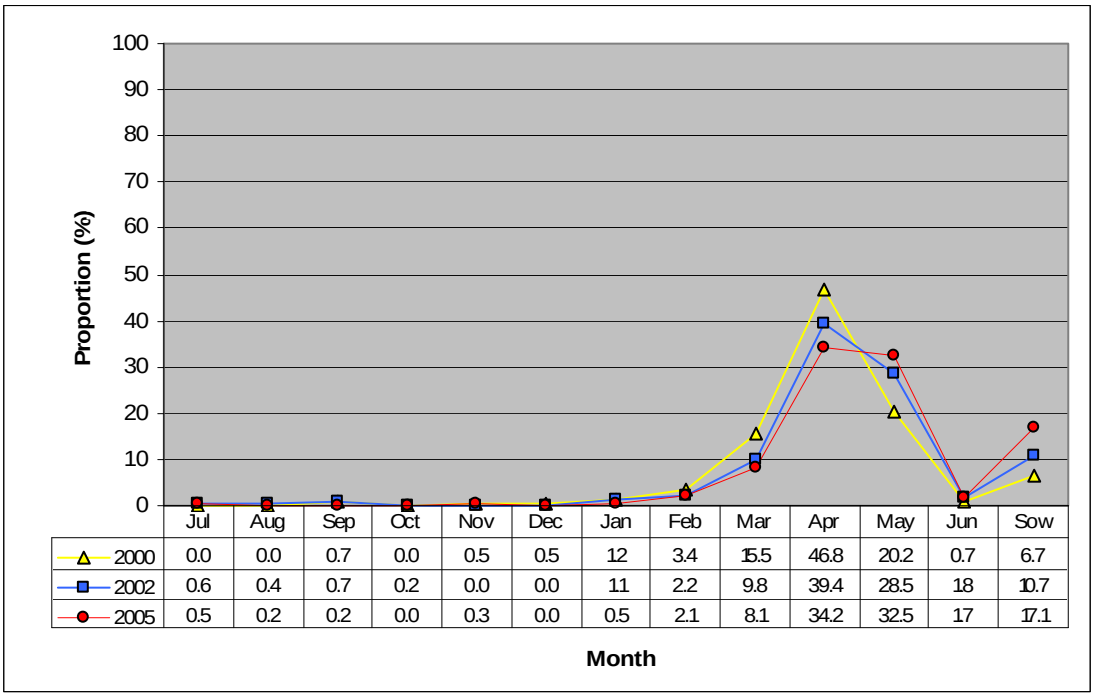
In southern Australia, long fallow is a traditional practice where cultivation of land is commenced in the spring or early summer (before January) prior to sowing a crop. It results in a considerably increased risk of land degradation by erosion because the soil remains in a loosened state for a large proportion of the year.



	State	high	med	low	EP
No	89.7	96.1	87.6	74.1	88.2
Occasionally	5.4	3.9	6.4	15.1	6.7
Usually	4.9	0	6	10.8	5.1

Figure 6. Average proportion (%) of land managers using cultivated long fallow for preparing cropland in the Eyre Peninsula region in South Australia; land manager survey 2005.

The data in Figure 6 show that in 2005, only 5% of farmers across SA still 'usually' make use of long fallows for preparing some of their cropland. This percentage is higher in low rainfall areas where more land managers currently still tend to follow the traditional approach of long fallowing to ensure optimum conditions of soil water, soil nitrogen and weed control for the next crop. However, the data confirm that this practice, which was once the main method of preparing land for cereal crop sowing, today plays only a small role (largely replaced by chemical fallowing) and the risk of erosion is reduced accordingly.

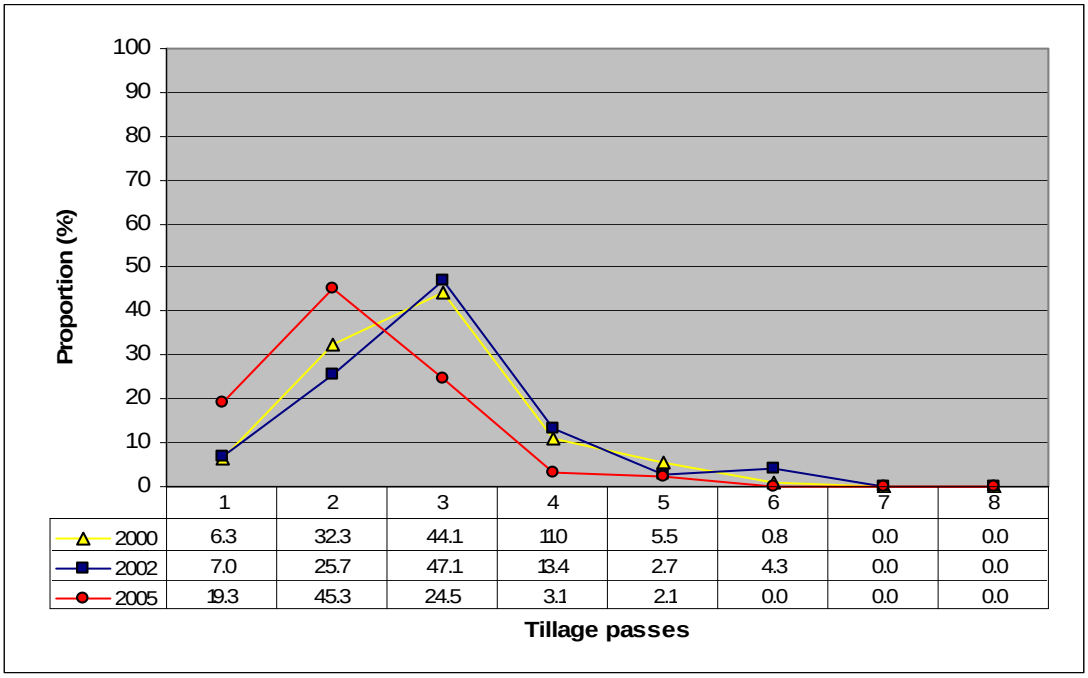


	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Sow
2000	0.0	0.0	0.7	0.0	0.5	0.5	12	3.4	15.5	46.8	20.2	0.7	6.7
2002	0.6	0.4	0.7	0.2	0.0	0.0	11	2.2	9.8	39.4	28.5	18	10.7
2005	0.5	0.2	0.2	0.0	0.3	0.0	0.5	2.1	8.1	34.2	32.5	17	17.1

Figure 7. Change in the preferred month for initial cultivation in preparation for a crop in the medium rainfall zone of South Australia; land manager surveys 2000, 2002, 2005.

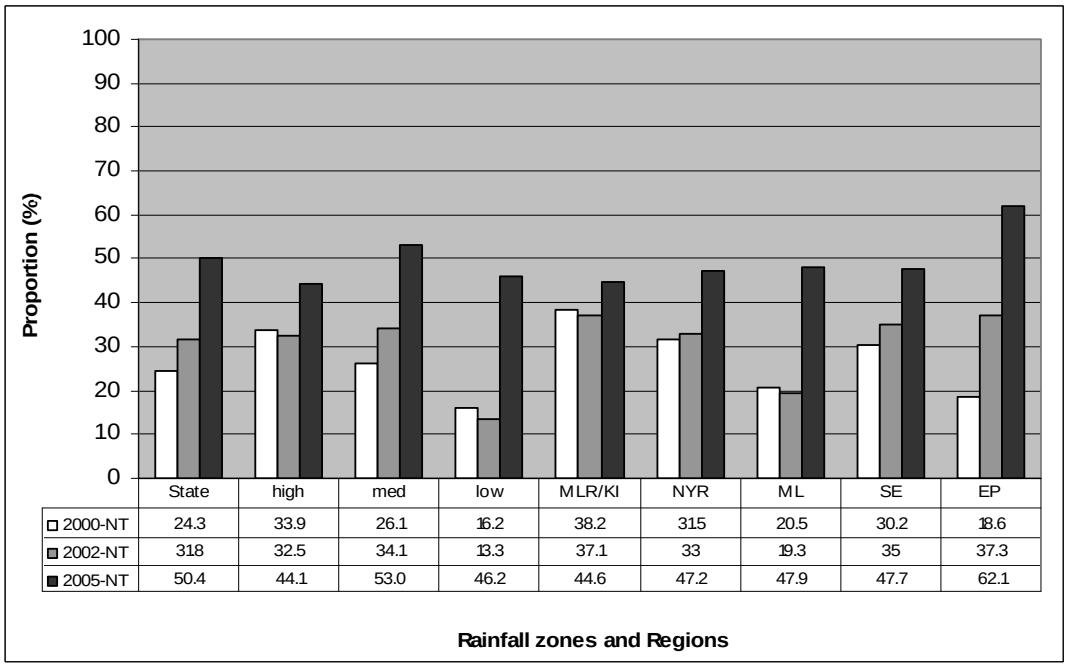
Figure 7 emphasises this change over time by presenting land managers' preferred month for initial cultivation prior to sowing. The desired trend is for the initial cultivation to be as late as possible to limit the period of time that soils are left loose and exposed to erosion. The trend between 2000 and 2005 shows that less landholders are starting cultivations in April or earlier, more are choosing to begin in May, and for an increasingly significant proportion, the initial cultivation is at sowing.

The number of tillage passes on cropping land is another useful indicator contributing to the assessment of erosion risk. The data in Figure 8 show that in the short time since 2000, landholders in the Murraylands region have decreased the number of tillage passes they use to prepare land for crop, thereby reducing the risk of soil erosion.



	1	2	3	4	5	6	7	8
2000	6.3	32.3	44.1	11.0	5.5	0.8	0.0	0.0
2002	7.0	25.7	47.1	13.4	2.7	4.3	0.0	0.0
2005	19.3	45.3	24.5	3.1	2.1	0.0	0.0	0.0

Figure 8. **Change in the number of tillage passes (including sowing) used by cropping land managers in the Murraylands region of South Australia; land manager surveys 2000, 2002, 2005.**

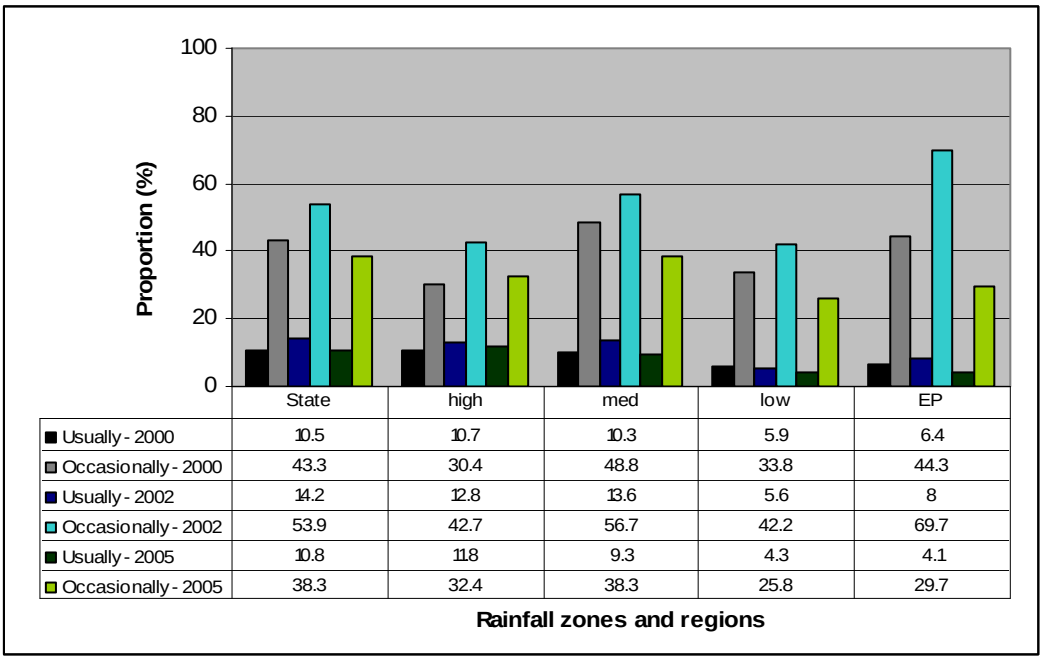


	State	high	med	low	MLR/KI	NYR	ML	SE	EP
2000-NT	24.3	33.9	26.1	16.2	38.2	31.5	20.5	30.2	18.6
2002-NT	31.8	32.5	34.1	13.3	37.1	33	19.3	35	37.3
2005-NT	50.4	44.1	53.0	46.2	44.6	47.2	47.9	47.7	62.1

Figure 9. **On cropped properties, change in the proportion (%) of crop land area where No-Till is used for sowing crop in regions of South Australia; land manager surveys 2000, 2002, 2005.**

'No-Till' is the current best practice method for cropping with the least risk of soil erosion. Figure 9 shows a significant increase in 2005 in the number of landholders across SA using 'No-Till' methods; the area of cropland sown with this method has increased from 16% to 47% over the three surveys. Un-presented data shows a similar increase in the proportion of land managers using 'No-Till' as well, resulting in a substantial increase in the overall area of 'No-Till' sowing in recent years.

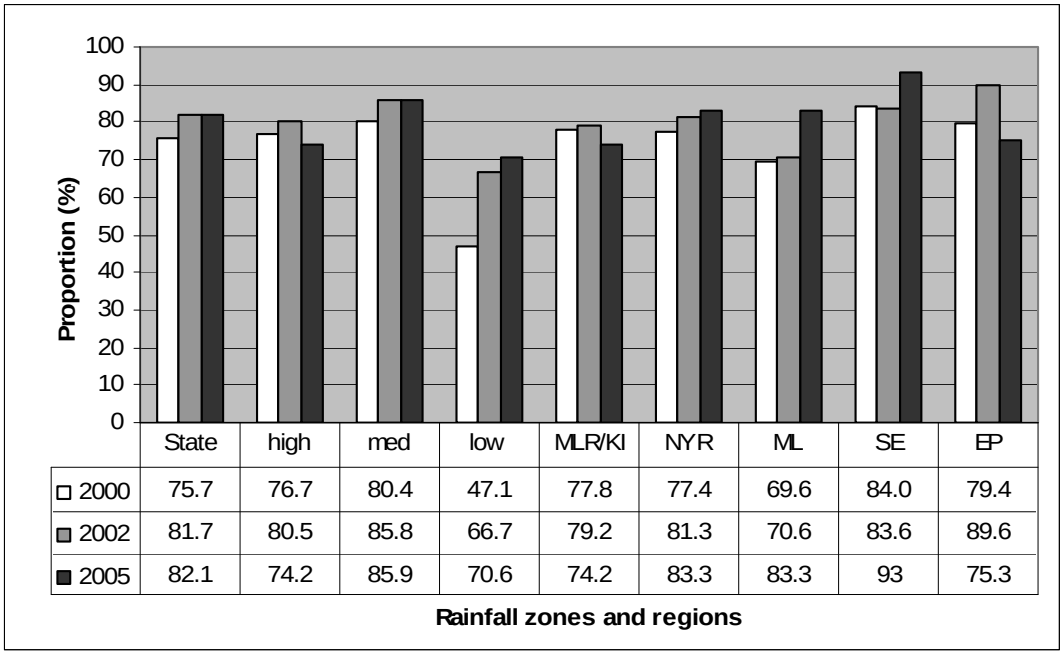
Stubble retention is another practice with multiple benefits for soil condition including reducing erosion as well as improving soil structure and fertility. Most conventional tillage and sowing equipment cannot be used successfully in a stubble retention farming system because the straw rapidly blocks the implements during cultivation. Burning of heavy stubbles has historically therefore had an important role to play in preparing for the next crop. Indeed, even today there may be a strategic need for limited burning, such as for weed seed and snail control. However, with a decline in tillage intensity and an increasing interest in soil conservation–safe stubble retention methods, equipment capable of working through the heaviest of residues is available and becoming more prevalent on farms. There is therefore less need for burning and any consistent reduction in the use of burning is indicative of those changes occurring. Figure 10 shows example data for rainfall zones and the Eyre Peninsula region. In the 2002 survey, more land managers indicated that they burnt paddocks in 2001 compared with the 2000 survey data because of the relatively good stubbles resulting from 2000 crops in most areas of the State. However, the 2005 data shows that burning declined everywhere again despite moderately good crop stubbles resulting from 2004. The 2002 drought and the damage which occurred probably caused a rethink by landholders on the need for burning in their farming system.



	State	high	med	low	EP
Usually - 2000	10.5	10.7	10.3	5.9	6.4
Occasionally - 2000	43.3	30.4	48.8	33.8	44.3
Usually - 2002	14.2	12.8	13.6	5.6	8
Occasionally - 2002	53.9	42.7	56.7	42.2	69.7
Usually - 2005	10.8	11.8	9.3	4.3	4.1
Occasionally - 2005	38.3	32.4	38.3	25.8	29.7

Figure 10. Proportion (%) of cropping land managers who regularly burn residues when preparing land for crop on Eyre Peninsula in South Australia; land manager surveys 2000, 2002, 2005.

The land manager survey also asks a number of key questions about managing soil salinity, which is another important soil degradation issue in some districts. Figure 11 shows that a consistently high proportion (75–82%) of landholders across the state with salinity on their property are undertaking on-site work and that in most areas more landholders are getting involved. The lower activity in low rainfall areas probably reflects the reduced options available for those areas and economic issues. Despite this, the increase in the activity detected in these areas by the surveys (47–71%) is greater than anywhere else.



	State	high	med	low	MLR/KI	NYR	ML	SE	EP
2000	75.7	76.7	80.4	47.1	77.8	77.4	69.6	84.0	79.4
2002	81.7	80.5	85.8	66.7	79.2	81.3	70.6	83.6	89.6
2005	82.1	74.2	85.9	70.6	74.2	83.3	83.3	93	75.3

Figure 11. Proportion (%) of land managers, with salinity on their property, who undertake on-site control practices in South Australia; land manager surveys 2000, 2002, 2005.

The above data are simply examples of the range of information available from the land manager surveys conducted in South Australia since 2000. They highlight the useful nature of the data as background information about issues relating to land condition. They show trends in the knowledge about, attitudes to, and practices used in land management, which fit well with our expected results given the seasons encountered in those survey years, and the differences between regions and rainfall zones. As such they contribute well to assisting the development of strategies to achieve natural resource targets into the future.

3.2 FIELD SURVEY PROGRAM FOR WIND AND WATER EROSION

Soil erosion has been identified as one of the major risks to sustainable land management in the agricultural regions of South Australia. The land manager survey contains a number of questions to establish knowledge of the trends in tillage and residue management practices in cropping systems that are the key contributors to exposing soil to erosion. As such, they are indicators of progress, or otherwise, in land management and they provide valuable supporting information to the main erosion monitoring field program.

Soil loss itself is very difficult to measure directly, and given this, DWLBC has implemented a field survey program to assess the risk of wind and water erosion. Data from this survey program is collated into Erosion Risk Indices (for wind and water erosion), which are estimates of the average cumulative period for which susceptible cropland is exposed to erosion risk during the year (McCord and Payne 2004). The Indices are based on a risk assessment approach, which combines inherent susceptibility (soil and landscape type) and key management practices (disturbance and cover). It is underpinned by the rationale that consistently high exposure of land means high risk and as an inevitable consequence, high erosion when severe wind or water events occur. An assessment of the annual risk of

erosion is considered a more practical and viable approach to soil erosion monitoring than attempting direct measurement of soil loss. The Indices are used to monitor trends and for meeting reporting requirements.

3.2.1 METHODOLOGY

DWLBC has a soil and land description database (Soil and Land Information 2002) that was utilised to identify and map intrinsic erosion susceptibility in land zones in agricultural areas of South Australia. The zones identified include parts of the lower, mid and upper Northern and Yorke region, Eyre Peninsula, Murraylands and the upper and mid South East, representing about eight million ha of a total 10.2 million ha of arable farming land in South Australia.

Approximately 6000 sites are surveyed four times a year to coincide with key cropping phases that have a bearing on soil erosion risk (October, March, May and peak sowing time, which is usually early to mid-June), along fixed transects, through 'at risk' zones (Fig. 12). This time sequence is used to derive a range of risk indicators, with the main measures being the cumulative area and period of land at risk of erosion over the whole year, including land cultivated as long fallow before October.

Data collected at each site includes:

- presence or absence of dunes
- topographic rating for wind erosion (based on soil and land type)
- topographic rating for water erosion (based on slope)
- current rotation phase
- detachment rating (based on stability as influenced by soil surface disturbance (cultivation or grazing))
- cover rating
- wind erosion severity (observance of evidence of wind erosion)
- sheet rill severity (evidence of sheet or rill water erosion)
- degree of residue burning if present, and
- general comments on observations that influence site cover (e.g. seasonal issues, pests, pasture treatments, etc.).

The ratings for each measure ranges; some descriptions and photo standards of the survey elements are contained in Appendix B.

Global Positioning System (GPS) location of sites has recently been introduced to the survey methodology and Personal Data Assistants (PDAs) coupled with a GPS unit are used to navigate to each site and record the data. This has enabled site characterisation (e.g. topographic ratings for inherent wind and water susceptibility) to be stored and displayed with a reduction in the possible variability of the data, where previously, topographic ratings had to be re-assessed at each survey.

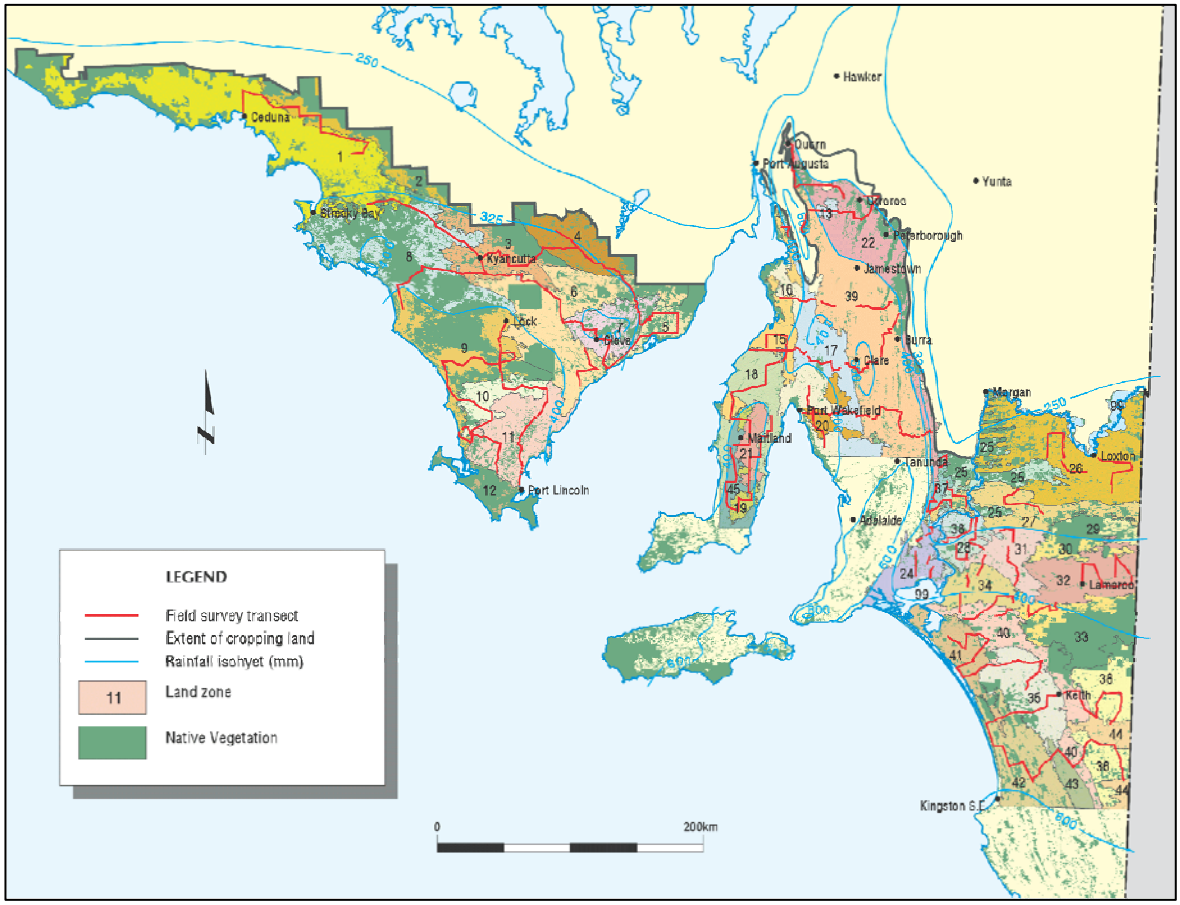


Figure 12. Land zones and field survey transect locations for assessing ground cover and erosion risk in South Australia.

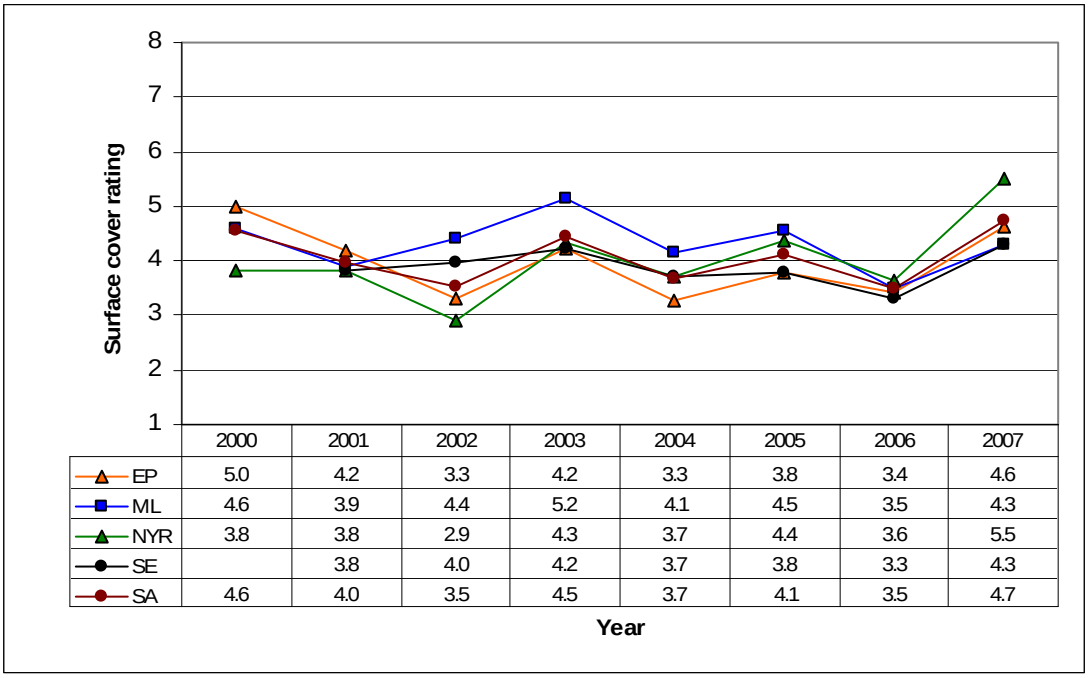
3.2.2 EXAMPLES OF 'WINDSCREEN SURVEY' DATA PRODUCTS

3.2.2.1 Mean Cover Rating

The mean cover rating (CR) provides a very broad picture of the condition of land. The CR is designed to record a value of the protective vegetation surface layer on soil rather than the total volume or mass of vegetative product.

Cover Ratings are reviewed in October to detect prospects for adequate protection over the following summer, particularly in droughts, and in March to assess how the deterioration of cover over summer has progressed.

Cover Ratings are essentially 'demerit points' with a low mean cover value meaning high cover (App. B). The impacts of the 2002 drought are apparent in Figure 13 with poor cover levels in March 2003. Until the drought in 2006, the mean cover ratings in March were beginning to trend down (improve). However, the combined effects of poor growth across the State in 2006 and the economic pressure on producers influencing them to try to keep livestock through summer and autumn led to cover levels generally deteriorating, in places, to the poorest recorded in the eight survey years to date.



	2000	2001	2002	2003	2004	2005	2006	2007
EP	5.0	4.2	3.3	4.2	3.3	3.8	3.4	4.6
ML	4.6	3.9	4.4	5.2	4.1	4.5	3.5	4.3
NYR	3.8	3.8	2.9	4.3	3.7	4.4	3.6	5.5
SE		3.8	4.0	4.2	3.7	3.8	3.3	4.3
SA	4.6	4.0	3.5	4.5	3.7	4.1	3.5	4.7

Figure 13. March mean surface cover rating of land in regions of South Australia for the period 2000–2007.

While such mean data can provide a general overview of cover levels they don't convey any realistic appraisal of the actual land at risk. For that reason, they contribute in only a small strategic way to the land condition assessment program.

3.2.2.2 Proportion of land at risk of wind erosion

To more specifically target an estimate of wind erosion risk, rather than simply the general risk posed by exposure of land, the cover, detachment and topographic ratings are combined in a matrix. After each survey, every site is assessed against the matrix to determine which are at risk and from that the proportion of land at risk is estimated. The topographic rating is especially important since any site can be exposed but only those with an inherent susceptibility are actually at risk of erosion. For example, sandy soils are considered more likely to be impacted by wind erosion than clay soils in South Australia. While it is certainly possible to create an erosion problem on heavier textured and well-structured soils in extreme circumstances, this rarely occurs.

Figure 14 is an example of the data collected at zone scale. While this scale data may be useful at district level it is best reserved for discussion of key indicator zones with adequate site numbers and relatively consistent and simple landform. Regional and state scale data is statistically more robust.

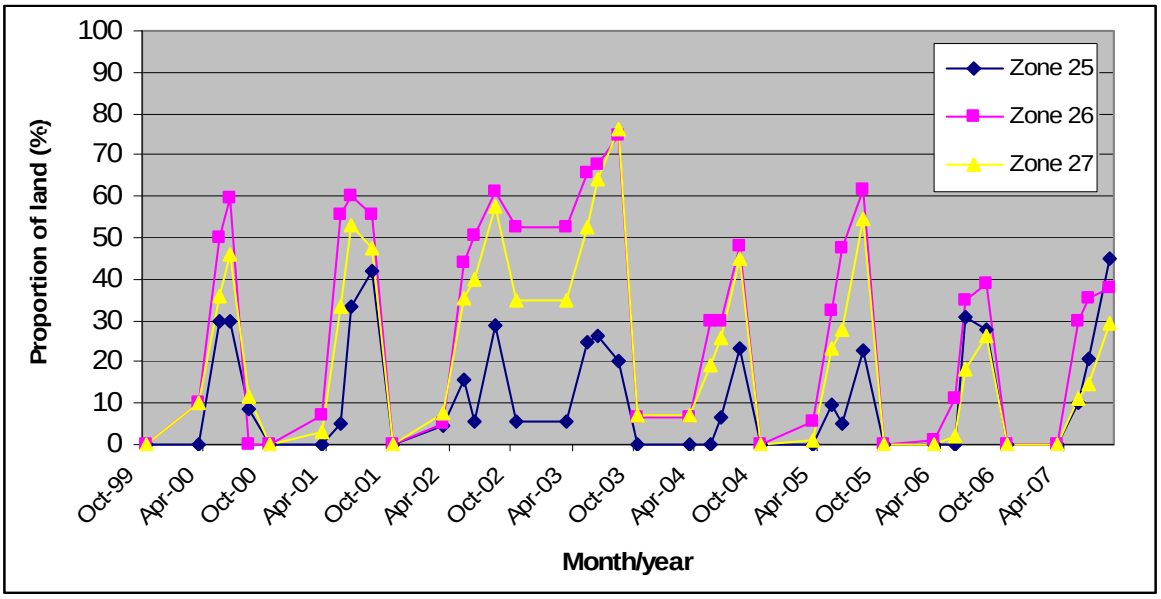


Figure 14. Proportion (%) of land at risk of wind erosion in zones 25, 26 and 27 in the northern Mallee district of the Murraylands region in South Australia for the period 1999–2007.

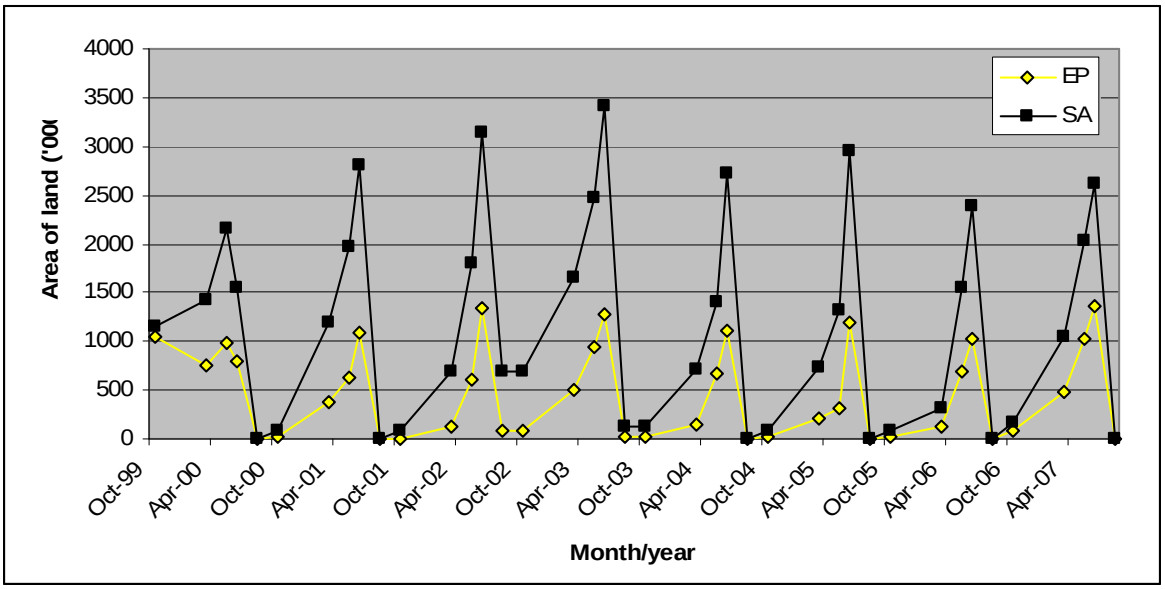
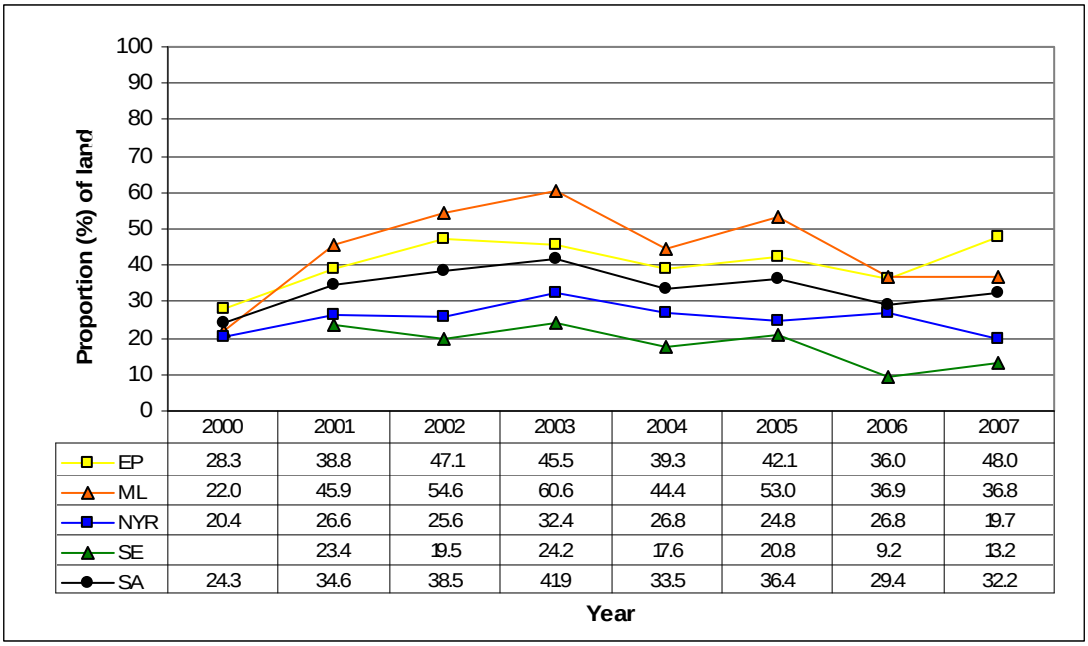


Figure 15. Estimated area of land ('000 ha) at risk of wind erosion in the Eyre Peninsula region of South Australia for the period 1999–2007.

In this case the data provide a profile of the cyclic nature of erosion risk typical of a cropping farming system in three zones in the northern Murray Mallee. The downward trend in risk since the severe problems caused by the 2002 drought is clear. Even given the poor rainfall in 2006, the proportion of land at risk in May 2007 continued that trend. Another way of looking at the same data is to calculate the estimated area of land at risk from wind erosion, as displayed in Figure 15 for Eyre Peninsula region and South Australia.

Figure 16 shows another indicator, namely, the trend in the proportion of land at risk of wind erosion in June (normal sowing time) over the years since the field surveys commenced in regions of South Australia. The low figure recorded in the Murraylands and Eyre Peninsula

regions in 2000 was largely due to significant areas being sown early in May. The proportion of land at risk then grew steadily, along with the area of crop sown, until after the 2002 drought and since then has generally declined. A small increase occurred in 2007 due to the poor residue cover following the 2006 drought.



	2000	2001	2002	2003	2004	2005	2006	2007
EP	28.3	38.8	47.1	45.5	39.3	42.1	36.0	48.0
ML	22.0	45.9	54.6	60.6	44.4	53.0	36.9	36.8
NYR	20.4	26.6	25.6	32.4	26.8	24.8	26.8	19.7
SE		23.4	19.5	24.2	17.6	20.8	9.2	13.2
SA	24.3	34.6	38.5	41.9	33.5	36.4	29.4	32.2

Figure 16. Proportion (%) of land at risk of wind erosion in regions of South Australia in June for the period 2000–2007.

3.2.2.3 Proportion of land at risk of water erosion

The indicators for water erosion risk are calculated as for wind erosion. However, as per the description in Appendix B, the topographic rating for water is based on slope, rather than land and soil type as used for wind erosion risk. The 'proportion of land at risk' data is also similarly based on the proportion of sites within the zone, region and state framework.

Water erosion in cropping districts of South Australia is only a significant problem in the Northern and Yorke region and parts of Eyre Peninsula, and data is presented only for these regions in Figure 17. In contrast to wind erosion, water erosion risk has not changed much in the state overall since field surveys began, with a steady increase in the Northern and Yorke region and a decline on Eyre Peninsula.

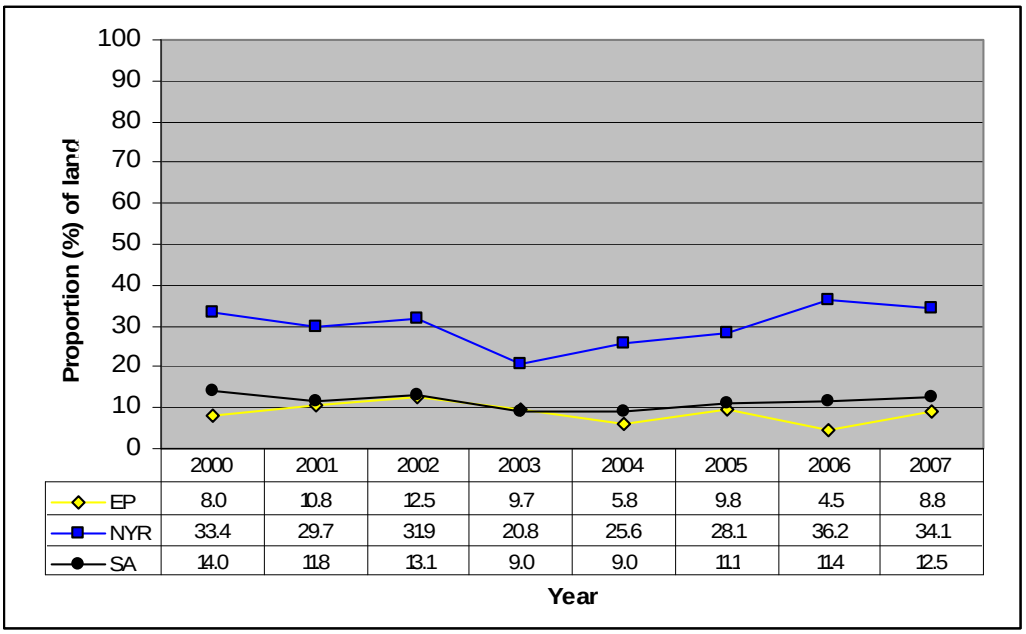


Figure 17. Proportion (%) of land at risk of water erosion in regions of South Australia in June for the period 2000–2007.

3.2.2.4 Erosion Risk Index

The Erosion Risk Index (ERI) (shown in Fig. 18) is based on the estimated area of land exposed (cover rating >5) during the periods A, B, C and D shown in Figure 18 from each of the four surveys (labelled 1, 2, 3 and 4). This is converted into a cumulative risk period as it applies to the crop area as estimated in June. The ERI incorporates the extent of exposure of the land surface and the length of time of its exposure, both important contributors to the risk of erosion.

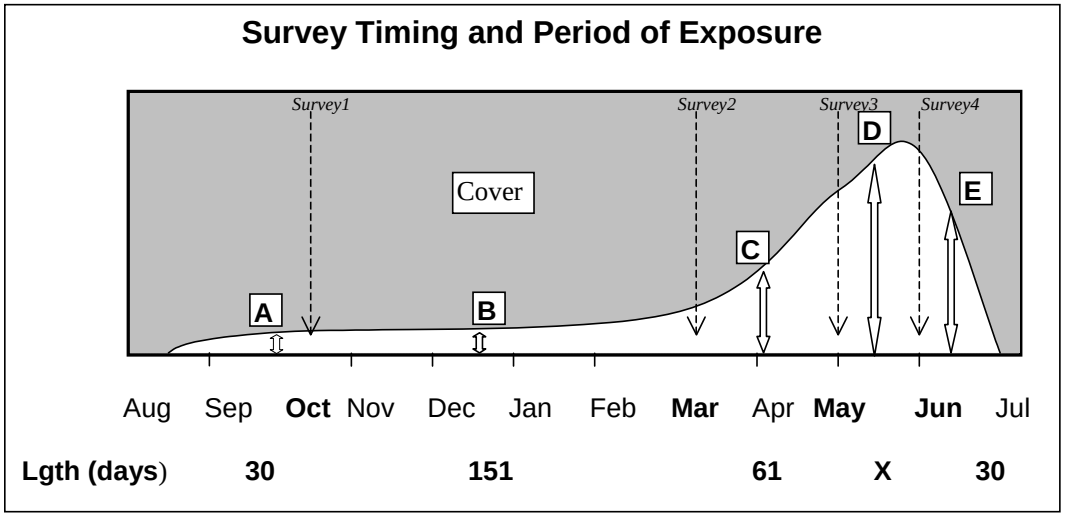


Figure 18. Erosion Risk Index survey timing and period of exposure.

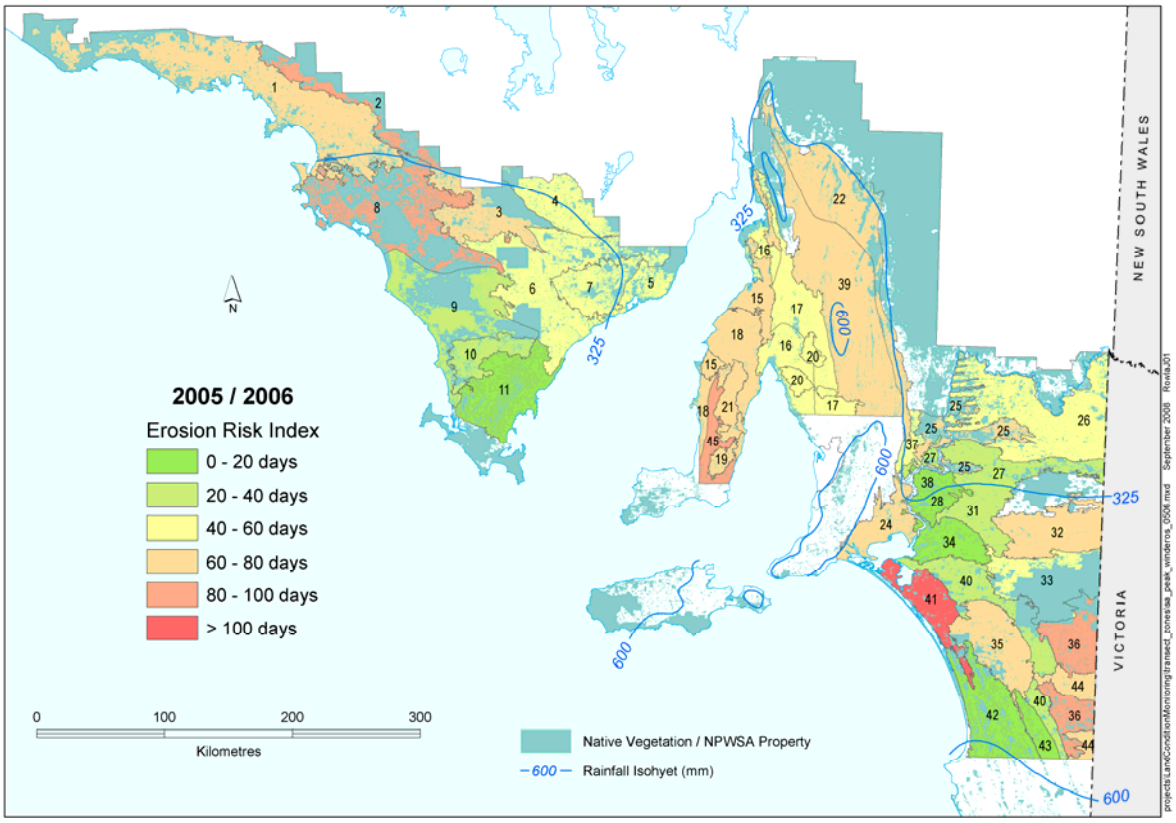


Figure 19. The distribution of the erosion risk index in South Australia for 2005-2006.

As is shown in Figure 19, the Erosion Risk Index data can be mapped for zones to show the distribution of erosion risk on an annual basis or to show change.

Figure 20 highlights that in the Murraylands Region, the highest ERI recorded to date was 196 days as a result of the severe drought of 2002 with bare land after sowing carried over into 2003 over summer. In most other years the index has been around 100 days, with the exception being the large decline in 2005–2006 to 46 days.

Observations during recent surveys indicates widespread trials with 'No-Till' sowing implements has occurred since the severe erosion experience in the 2002 drought in areas of the Murraylands. This has contributed to the decline in risk, and further decline is expected, provided production is not jeopardised by change to No-Till. As a result of the lower than normal cover levels caused by the 2006 drought, the Erosion Risk Index rose marginally in this region but not to the degree that would have been expected in the past.

3.2.2.5 Wind Erosion Risk Index

The Wind Erosion Risk Index is based on identifying those sites with a topographic rating indicating an inherent wind erosion susceptibility and applies the calculated cumulative wind erosion risk (using the Matrix in App. C) to only the inherently susceptible crop area.

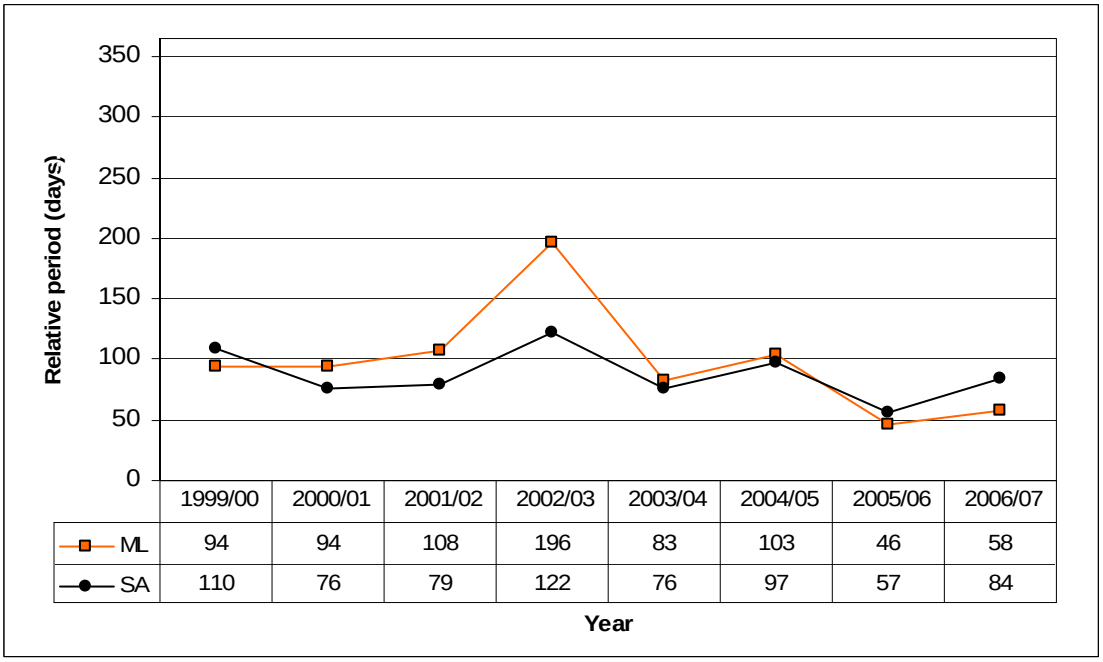


Figure 20. The Erosion Risk Index (cf. crop area) in the Murraylands region of South Australia for the period 2000–2007.

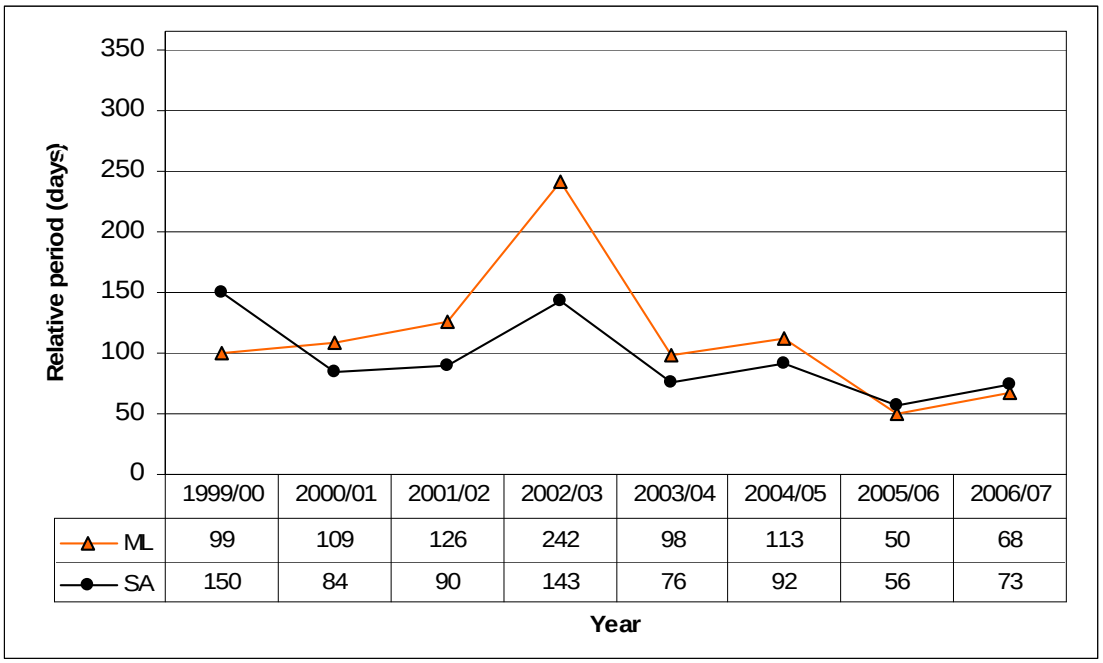


Figure 21. The Wind Erosion Risk Index (cf. susceptible crop area) in the Murraylands region of South Australia for the period 2000–2007.

Figures 20 and 21 are very similar since most of the sites in the Murraylands region are at least moderately susceptible to wind erosion. Since monitoring began in 1999–2000 the Wind Erosion Risk Index has consistently been around 100 days. The Murraylands was the most severely drought affected region in South Australia in 2002 and the carry over of bare land resulted in the Index reaching 242 days in 2002–2003. Since then it has declined to 50 days in 2005/2006 and observations suggest that an increase in stubble retention combined with 'No-Till' sowing methodology has made an important contribution to the lowered risk.

While the Index rose to 68 days in 2006–2007, it could have deteriorated much more without the advances in safer tillage practices that have recently been achieved by land managers in the region.

3.2.2.6 Proportion of land cultivated vs rainfall

Data in Figure 22 is another example of data collected during the 'windscreen survey' that can contribute to an understanding of changes in land management practices. During the March survey, the proportion of sites cultivated is recorded and can be compared to rainfall data to assess whether there is a shift in the practice of traditional cultivation techniques. Traditionally, cultivations would commence as soon as there was a reasonable rain event between January and March. 'No-Till' and 'Direct Drill' methods do not require this early cultivation, so this data can make some prediction to the progress toward these best practice methods early in the season.

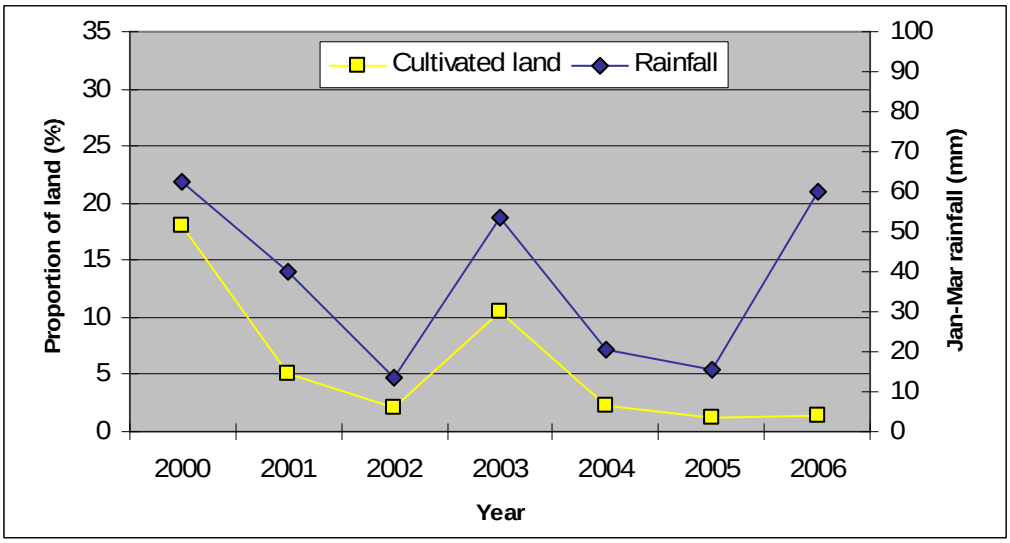


Figure 22. Proportion (%) of land cultivated by March in relation to January–March rainfall in the Eyre Peninsula region in South Australia for the period 2000–2006.

Figure 22 shows in Eyre Peninsula, between 2000 and 2005, early cultivation parallelled the cumulative rainfall received during the January–March period. When significant rainfall occurred, cultivation followed, but if it was dry, this did not occur. However, in 2006, when good rainfall was received, little cultivation occurred, suggesting land managers are being more cautious about early cultivation and the increased soil exposure and erosion risk which result. This is another indication of the way that more soil conservation safe tillage practices are contributing to improving land condition.

4. SUMMARY

Land management practice information and monitoring have multiple drivers in South Australia at regional, state and national levels. The information is used for policy decisions, development of strategies and regional and local programs.

To satisfy the monitoring, reporting and information requirements, the SCC and DWLBC initiated Land Condition Monitoring Program in 1995 with support from the Natural Heritage Trust. The LCMP collates various sources of information on land condition including the LMS and the ERI.

Early work in the LCMP recognised the importance of land management practice in the understanding of the trends in direct indicators of land condition. Given that the majority of land in the state was in private ownership, an assessment of land management practice, which underpinned land condition, was considered essential. The most efficient method of gathering data was determined to be a telephone survey, which could be repeated every few years to establish trends. The land manager survey has subsequently been successfully undertaken by DWLBC in 2000, 2002 and 2005.

The LMS is a repeatable telephone survey designed to monitor trends in land management practices, as well as knowledge and attitudes of land managers over time, as indicators of risk of land degradation. It specifically targets broad-hectare crop and livestock farmers, including dairies, the group that manages the vast majority of land cleared and developed for agriculture in South Australia.

Respondents are identified by postcode and subsequently assigned to regions of the state and low, medium or high rainfall zones. The information covers the agricultural areas of South Australia and can be analysed at regional level. The current regions are based on commonly accepted historical boundaries and are the best option in an agro-ecological sense.

Data is collected on the following topics: Property, arable and crop areas, crop types grown, general land management issues of concern and more specific details of cropping and cultivation practices, feed-lotting, paddock residue burning, amelioration of acidification, salinity, soil structure decline, and water repellence as well as aspects of soil fertility maintenance and revegetation.

Soil erosion has been identified as one of the major risks to sustainable land management in SA's agricultural regions. Soil loss to erosion is very difficult to measure directly and, given this, DWLBC (initially PIRSA) developed a field survey program for monitoring wind and water erosion risk as surrogate indicators of soil loss. Data from the survey is collated into a number of risk indicators, including a range of Erosion Risk Indices, which are estimates of the average cumulative period for which cropped land is exposed to erosion risk during the year (McCord and Payne 2004).

Section 3 contains a wide range of examples of information generated from the LMS and ERI. There is an almost infinite range of combinations of information that could be generated to evaluate the data. While only a small set of example data is discussed in this report, the questionnaire in Appendix A shows how broad the range of other information is that is captured and can be used.

It is envisaged that the ERI data may be combined with land management practice data from the LMS to obtain spatial trends in land management practice that will ultimately contribute to a national Land Use Management Information System. Opportunities also exist to develop improved reporting products to assist stakeholders in decision-making processes to achieve improved land management practice, and sustainable resource use. In the first instance, the land manager survey data provides the essential ingredients to understand and confirm the changes that are being seen in the erosion risk field surveys.

5. CONCLUSIONS

Land management practice change has been well recognised in South Australia as the key to broad scale improvement in the sustainability of agriculture and natural resource protection. DWLBC's land manager survey captures changes in land management practice through surrogate indicators and is supported by other soil indicators including the Erosion Risk Indices in monitoring land condition.

Ultimately, a national Land Use Management Information System is desired to improve reporting products to assist decision makers and achieve the desired improvement in natural resources across Australia. South Australia hopes to contribute to the development of LUMIS using the land manager survey and Erosion Risk Indices.

APPENDICES

A. LAND MANAGER SURVEY 2005

Good .... My name is .... from Truscott Research. We are conducting a survey on behalf of the Department of Water, Land and Biodiversity Conservation.

We are speaking to commercial land managers about a range of land management issues.

SCREEN:

Before we continue, could I check that agriculture is your main source of income [TERMINATE IF NO]

… and that you are farming

Hills/KI: **at least 50 hectares?** [TERMINATE IF NO]**?**

other regions: **at least 200 hectares?** [TERMINATE IF NO]

I also need to check that you are involved in crop, stock or dairy farming [TERMINATE IF NO] **rather than horticulture or rangeland grazing** [TERMINATE IF YES].

ALL AREAS TO BE RECORDED AS HECTARES [= 2.5 X ACRES] NB 1 KM SINGLE ROW OF TREES = 0.5 HECTARES

1. **Could I start by confirming that the postcode for this property is…?** [FROM LIST]
2. **ALSO RECORD REGION CODE 1-5**
3. **What is the total size of your property?** [IN HECTARES – SPECIFY]
4. **What is the total area of cleared land – including any that is saline or unsuitable for commercial purposes?** [IN HECTARES – SPECIFY]
5. **And what was the total area under cropping last season?** **[**HECTARES; [IF 0 – GO TO Q. 8]
6. **In the next few years, do you expect the area of cropping to …**

   1---- increase 2----decrease 3----- stay the same? 4 --- don't know
7. **Do you grow …**

   1---- cereals 2----grain legume 3----- oilseeds 4.....none of these

8. ASK ALL: As I said, the survey is about land management issues. Are any of the following issues of concern in your district? [READ OUT 01 to 12 – MAX 10]

01-- animal pests (rabbits, foxes)
02-- plant pests – weeds
03-- soil acidity
04-- soil compaction
05-- soil fertility/nutrition
06-- soil salinity
07-- soil structure decline
08-- native vegetation decline
09-- water erosion
10-- water repellent soils
11-- waterlogging
12-- wind erosion
13-- none of these

9. Do you have a physical property plan that you use as a basis for management of your farm? IF SO: Does it cover any of these issues?

01-- animal pests
02-- plant pests – weeds
03-- soil acidity
04-- soil compaction
05-- soil fertility/nutrition
06-- soil salinity
07-- soil structure decline
08-- native vegetation decline
09-- water erosion
10-- water repellent soils
11-- waterlogging
12-- wind erosion
13-- plan does not address any of these issues
14-- no plan/informal plan only.

10. With the rainfall you get, do you believe it is possible to improve your production levels? IF POSSIBLE: Would you expect this to be economically worthwhile?

1---- not possible
2---- don't know if possible
3---- possible – but not worthwhile
4---- possible and potentially worthwhile

---

11. **Changing the subject to SOIL SALINITY, please tell me the approximate area of saline soil on your property?** [HECTARES – SPECIFY]

12. Would you expect to have more or less than this in ten years' time?

1---- increase – estimate given [SPECIFY – HECTARES = Q13]
2 -- increase - don't know how much
3 -- same as now
4 -- decrease
5 -- don't know

13.

14. IF HAVE SALINE LAND NOW [Q10]: **What practices are you using <u>on the saline land</u> to manage the problem?** [UNPROMPTED]

01-- install drains
02-- plant lucerne
03-- plant perennial grass pasture
04-- plant barley
05-- plant *salt tolerant pasture*
06-- plant saltbush/shrubs
07-- plant trees
08-- mounding
09-- mulch/manure
10-- fencing/minimise use
11-- other action ~ SPECIFY= Q15
12-- don't do anything

15.

1. ASK ALL: **What, if anything, are you doing <u>elsewhere on your property</u> to control salinity?** [UNPROMPTED]

01-- install drains
02-- plant lucerne
03-- plant perennial grass pasture
04-- manage native pasture
05-- plant trees/reveg. surrounding land
06-- clay spreading
07-- improving water efficiency
08-- fencing
09-- low tillage techniques
10-- plant trees
11-- other action ~ SPECIFY= Q17
12-- don't do anything
13-- not a problem

2.

3. The next group of questions is about SOIL AND RESIDUE MANAGEMENT. Do you feedlot stock when necessary as a means of managing erosion risk in paddocks?

1---- yes 2 --- no 3 --- not applicable (no stock)

4. Do you have contour banks to combat water erosion?

1---- yes 2 --- no 3 --- N/A (not erosion prone)

| |

GO TO Q. 21/31

5. IF YES: **What area of land have you protected with contour banks in the last three years?** [HECTARES]

---

6. [CROPPING PROPERTIES ONLY [SEE Q.5] - OTHERS GO TO Q.26]

Do you use cultivated long fallows [worked before November in the previous year] in your cropping rotation?

1---- **usually** **2 --- occasionally** 3 - no

7. When preparing for cropping, do you burn crop stubbles or pasture residues?

1 ---- usually **2 --- occasionally** 3 - no - GO TO Q.24

8. IF BURN: **What area did you burn last year?** [HECTARES - CAN BE ZERO]

9. Thinking about soil protection and health, how important is full stubble and residue retention in cropping rotations?

1	2	3	4
very	**quite**	**not very**	**not at all**

10. Given suitable conditions, in which month do you prefer to do your first cultivation when preparing land for crop?

01 -- Jan
02 -- Feb
03 -- Mar
04 -- Apr
05 -- May
06 -- Jun
07 -- Jul
08 -- Aug
09 -- Sep
10 -- Oct
11 -- Nov
12 -- Dec
13 -- at sowing
14 -- don't know

11. **On average, how many full cultivations – <u>including sowing</u> - do you normally carry out when <u>preparing for and sowing</u> a cereal crop?** [RECORD # 1 TO 8; DK = 9]
PROBE: **Does this include cultivation at sowing? Do I add another one?**

12. **[EXTRA BOX: 1 IF ADDING 1 CULTIVATION TO TOTAL , 0 IF NONE ETC]**

13. **On average, how much of your crop area do you sow using direct drilling?**
[IN HECTARES – SPECIFY**]**

14. **Do you think that you will do (more of) this in future?**
1---- yes 2--- no 3 - don't know
4 ---already DD all/most 5--- don't DD (likely no)

15. **Direct drilling can be carried out using either full cultivation methods or no – till methods [direct drill with narrow low disturbance points].**
On average, how much of your crop area do you sow using no – till methods?
[IN HECTARES – SPECIFY]

---

16. ASK ALL: **Changing the subject to SOIL ACIDITY, please tell me whether you have acid soil on your property? And could you also tell me if there is any more of your land that is potentially acidic?**
1 -- Actual - estimate given [SPECIFY - HECTARES = Q 32]
2 -- Potential - estimate given [SPECIFY - HECTARES = Q 32]
3 -- no acid soil – GO TO Q. 48
4 -- don't know/depends on definition – GO TO Q. 47

17.

18. **Have you applied lime or dolomite to any of this acidic land?– IF YES: have yo applied it to all of your acid soils or only part of the area?**
1 yes - all 2 --- part 3 --- not applied any

19. IF APPLIED LIME OR DOLOMITE TO ONLY PART OF THE AREA: **to what area?**

20. IF <u>NOT</u> APPLIED LIME/DOLOMITE OR NOT APPLIED TO <u>ALL</u> ACTUAL ACID SOILS*:*
Can you tell me why you haven't treated [all of] your acid soils with lime or dolomite?
1 -- Land too steep UNPROMPTED
2 -- Can't afford/too expensive
3 -- Not financially worthwhile
4 -- Worried about nutritional problems
5 -- Don't have right equipment
6 -- Other ~ SPECIFY = Q 36

21.

22. IF APPLIED LIME/DOLOMITE:
What is the total tonnage of lime or dolomite applied in the last 3 years?

38-42 ASK ALL WITH ACID SOILS/POTENTIAL ACID SOILS:

Please give a true or false response to each of the following:

- **a. It is beneficial to apply lime to acidic soils before any sign of production decline.**
- **b. Gypsum can be used to treat acid soils.**
- **c. High levels of acidity cause irreversible loss of soil productivity.**
- **d. Super phosphate is a direct contributor to soil acidity.**
- **e. The major causes of soil acidity are nitrogen fertilisers and produce removal.**

1---- true 2--- false 3--- don't know/depends

43. **What do you consider to be the critical pH level at which production is likely to be reduced?** [RECORD # 01.1 to 14.0; DK = 99.9]

44. IF GIVEN LEVEL: **Which test does this refer to? - distilled water or calcium chloride?**

1----distilled water 2 -- calcium chloride 3 - don't know

45. **Have you sought information on treating soil acidity? IF SO, where did you look for that information?** UNPROMPTED

1 -- farming journals
2 -- internet – SPECIFY SITE= Q 46
3 -- DWLBC/PIRSA newsletters
4 -- DWLBC/PIRSA staff
5 -- agronomists
6 -- stock agents/fertiliser companies etc.
7 -- landcare groups
8 -- other - SPECIFY= Q 46
9 -- did not seek info on acidity

46.

---

47. ASK ALL:

Do you undertake regular SOIL TESTING to determine the nutrient status of your soils?

1---- yes 2--- no – GO TO Q. 49

48. On average, how many years would there be between tests in any given paddock?

[RECORD # OF YEARS: ONCE ONLY = 98, DK= 99]

49. ASK ALL: **In deciding your fertiliser use strategies, do you mainly …?** [READ OUT]

- **1 -- use advice from fertiliser companies and agents**
- **2 -- use advice from agronomic specialists and consultants**
- 3 -- **rely on your existing knowledge**

---

50. **The next group of questions is about WATER REPELLENCE. Could you tell me the approximate area of water repellent soils on your property?** [IF ZERO, GO TO Q 55]

51. To what extent, if at all, do you believe this limits your production?

1	2	3	4	5
great extent	**moderate extent**	**small extent**	**not at all**	don't know

52. **Do you use any of the following techniques to improve production on your water repellent soils:** [READ OUT 1 TO 4]
    - **1 -- soil wetting agents**
    - **2 -- modified tillage technology [press wheels, furrow sowing etc.]**
    - **3 -- clay delving [mixing layers]**
    - 4 -- **clay spreading** [clay excavated from a pit and spread over soil surface] - GO TO Q 54
    - 5 -- none of these

53. IF CLAY SPREADING: **What area have you treated by clay spreading?** [HECTARES]

54. ASK ALL WITH WATER REPELLENT SOILS: **Over the next three years, what area do you think you will treat by clay spreading?** [HECTARES]

---

55. ASK ALL: **Finally, I would like to talk about REVEGETATION. What is the total area of <u>perennial pasture or vegetation</u> currently existing on your property?**
– I will ask you about 5 types:

- **Irrigated lucerne**
- **Dryland lucerne**
- **Other sown <u>perennial</u> pasture** (eg. perennial veldt grass, cocksfoot, phalaris)
- **Moderate/dense native vegetation**
- **Planted tree/shrub species revegetation - for general conservation, windbreaks, fodder, flowers, timber etc** – PROBE IF ZERO
  NB. 1 KM single row of trees = 0.5 HECTARES [HECTARES]

56. **In 2004, have you fenced any area of <u>remnant native vegetation</u>?**
IF SO: **what area or strip length was involved?**

57. Next I want to ask you about vegetation <u>you planted</u> on your land last year. There are four types - local native vegetation with the seed collected at or near the site, vegetation that is native but not local, fodder trees and shrubs and trees and shrubs planted for specific product. First can you tell me what area of <u>local native vegetation</u> [local native - seed collected at/near site] was <u>planted</u> in 2004?

And the area of any <u>native but not local vegetation</u> that was <u>planted</u> in 2004?

And what area of <u>fodder trees and shrubs</u> [eg tagasaste, saltbush] was <u>planted</u> in 2004?

What area of <u>trees and shrubs planted for specific product</u> [timber, brush fencing, flowers, foliage, oil, bush tucker etc. – not necessarily natives] was <u>planted</u> in 2004?

Before we go on, I just want to check that last year you planted
XX hectares of local native vegetation,
XX hectares of other native vegetation,
XX hectares of fodder trees and shrubs and
XX hectares of trees and shrubs planted for specific product.
This comes to a total of YY hectares planted last year – is this correct?

58. In the next 5 years, do you think your average annual planted native vegetation activities will increase, decrease or stay the same?

1 -- increase
2 -- decrease
3 -- stay the same
4 -- don't know

59. What are the main <u>barriers</u> to increasing perennial vegetation on your property? [UNPROMPTED]

01-- no benefit
02-- cost - labour
03-- cost – seed/lings etc
04-- cost - fencing
05-- cost – overall
06-- lack of time
07-- lack of technical info
08-- lack of tech support/contractors
09-- lack of machines/materials
10-- lack of markets for product
11-- loss of productive land/no more land
12-- have sufficient already
13-- risk of planting failure
14-- low rainfall/lack of water
15-- animal pests
16-- weed problems
17-- other ~ SPECIFY= Q 60
18-- none/don't know

60.

61. What benefits, if any, do you believe you gain from establishing perennial vegetation?

[UNPROMPTED]

01-- production/income
02-- increase in land value
03-- shelter breaks for crop/pasture
04-- shelter breaks for stock
05-- fodder for stock
06-- increased biodiversity
07-- attracting native birds/animals
08-- landscaping/amenity
09-- preventing erosion
10-- reduced recharge for soil
11-- salinity control
12-- lowering water table
13-- control of spray drift
14-- other ~ SPECIFY= Q 62
15-- none/don't know

62.

---

63. **To finish the interview, I have a few general questions.**
Is there a computer in your household?
IF YES: **Do you use email for business purposes?**

1---use email for business 2 --- don't use 3 ----- no computer – GO TO Q65

64. Do you use a business software package – such as MYOB/Best Books, Quicken, Phoenix?

1---- yes 2--- no

65. ASK ALL: **Which if any of the following business tools do you use:** [READ OUT 01 – 11]

01-- physical and natural resources planning
02-- risk and drought strategies
03-- quality assurance processes (Cattle Care, Flock Care, SQF1000, etc)
04-- sales and marketing planning
05-- financial benchmarking
06-- enterprise benchmarking
07-- other business and financial planning
08-- succession planning
09-- people management planning
10-- training plans
11-- other human resources planning
12-- none of these

66. FarmBis is a scheme that over the last 5 years has subsidised activities that assist farmers to learn about running their farm more effectively and efficiently.
Are you aware of the FarmBis program?

1---- yes 2--- no – GO TO Q 72

67. In recent years how many FarmBis subsidised training activities have you attended?

[RECORD # 01 TO 30; DK = 19 ; NONE = 20]

68. IF NOT ATTENDED FARMBIS TRAINING: **Is there any particular reason why you haven't attended any FarmBis funded training?** UNPROMPTED

01-- too busy
02-- no need - I learn all I need from my farm, friends and neighbours
03-- topics not of interest
04-- inconvenient location
05-- inconvenient times
06-- insufficient information/informed too late
07-- cost
08-- doubt the usefulness
09-- plan to retire
10-- nothing on offer
11-- other family members etc. attend
12-- too technical/hard to understand
13-- problems with invitations/bookings/cancellations
14-- other - SPECIFY= Q 69
15-- no particular reason [NOW GO TO 72]

69.

70. F ATTENDED: **Did you go to any kind of farm management training sessions before FarmBis?**
IF YES: **Do you now attend more, less or the same amount of training as you did before FarmBis – say 6 years ago?**

1 -- more
2 -- less
3 -- same
4 -- not attended previously

71. IF ATTENDED: **To what extent, if at all, do you believe FarmBis training has influenced how you run your farm?**

1	2	3	4	5
great extent	**moderate extent**	**small extent**	**not at all**	don't know

72. ASK ALL: **In recent years have you attended any Property Management Planning workshops?**
IF YES: **To what extent, if at all, do you believe this has influenced how you run your farm?**

1	2	3	4	5	6
great extent	moderate extent	small extent	not at all	not attended	don't know

---

Thank you

B. 'WINDSCREEN SURVEY' STANDARDS

Topographic Rating - Wind (soil x land type)

Land type	Wind Erosion Topography Rating
Loam/Clay Flat/slope/rise	**1 (Essentially no risk)**
Sandy or Calcareous Loam Flat/slope/rise	**2 (Low/moderate risk)**
Sandy Flat/Slope	**3 (Moderate high risk)**
Low Sandhills (<5m)	**4 (High risk)**
Mod/Large Sandhills (>5m)	**5 (Very high risk)**

Topographic Rating - Water (Slope)

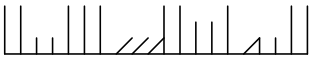
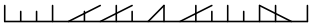
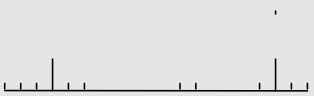
Water Erosion Topography Rating	Slope
1	0-3%
2	3-6%
3	6-12%
4	12-24%
5	> 24%

Detachment Rating (Cultivation/Grazing)

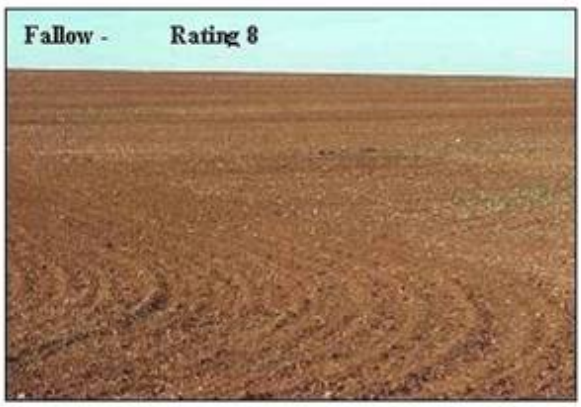
Detachment Rating	Stability	Description
1	**Stable**	No significant disturbance
2	**Slightly to moderately Unstable**	Partial soil surface disturbance by: - No-Till (narrow point) sowing - first working with blade plough, prickle chain or harrow - or grazing livestock. Includes any land which has been cultivated at least once: - which has consolidated due to rain (on **loamy** NOT sandy soils) and/or new growth - which is very cloddy and has some residue present - which may have full disturbance but has moderate to heavy residue protection (eg. Cover Rating 4, 3, 2 and some is likely to be anchored) Also includes land with new crop, up until late tillering: - which has partially consolidated due to rain and/or new crop growth. Also includes crops beyond tillering stage - where cover is too poor for complete stability and consolidation is only partial or patchy (eg. drought or erosion affected crop).
3	**Very Unstable**	Complete soil disturbance by cultivation or heavy grazing (or both). - Includes sowing by full disturbance direct drilling Such disturbance by grazing alone would normally occur only on sand.

Cover Rating

(Surface cover rating - combined dry and green material protecting the soil surface)

Rating	Amount	
1	Residues **knee height or greater**. **Stable.** A bulk of feed. A definite fire hazard in the right circumstances	
2	Residues **> Ankle height and < knee height**. Relatively even coverage. **Stable.** A bulk of feed probably remains. Moderate to high fire hazard.	
3	Cover variable from **< ankle height to knee height**. Residues may be a mixture of upright and flattened. Maybe flattened by grazing, cultivation or sowing with No-Till **Stable.** Feed reserves moderate to high. Moderate a fire hazard.	
4	Residues **2cm-ankle height**, but sufficiently dense for stability. Residues may be a mixture of upright and flattened. Maybe flattened by grazing, cultivation or sowing with No-Till **Stable.** Feed reserves may be low to moderate. Low fire hazard	
5 *	Grazed moderately heavily, harrowed, cultivated stubble or pasture, partially burnt* or saline land. Cover light but minimal for immediate soil stability. *Only **2 cms of relatively even but thin residue** cover remain. *or, **cover variable from sparse knee height to <2cm** cover. **Residue colour dominates what you see in the paddock** **Usually Stable if undisturbed**. Feed low. Fire hazard low.	
6 *	Grazed moderately heavily, harrowed, cultivated stubble or pasture, partially burnt* or saline land. **Cover is patchy** and may vary from **<ankle height to bare.** **Soil colour dominates where Soil is exposed in patches** **Soil stability at risk in patches**. Feed low. Fire hazard low**.**	
7	Mostly bare although **some residues may be seen**. **Soil colour dominates what you see in the paddock** Grazed or cultivated virtually **bare.** **Insufficient residues to protect surface soil from erosion**.	
8	Nil cover **(bare**)	

Cover/Fallow Photo-Standards



Wind Severity (Wind Erosion Severity)

Rating	Severity	Description	
1	**Nil, or Insignificant**	Nil	
2	**Minor**	Only minor evidence of erosion. Small areas in crop or rangeland. No crop damage or extremely rare. Slight but observable levelling of ridges or soil surface and some associated dusting may occur.	
3	**Moderate**	Evidence of significant sweeping on sandy soils particularly rises. Dusting occurs associated with levelling of ridges/smoothing of soil surface, minor fenceline deposition. Obvious soil surface movement and dusting in rangelands. Occasional small areas of crop damage.	
4	**High**	Evidence of severe erosion of sandhills and significant sweeping on flats in cropland or rangeland. Levelling of ridges/smoothing and gouging of soil surface in places in crop or rangeland, and associated frequent/severe dusting. Erosion is usually extended over months of bare soil. Significant fenceline deposition. Significant crop damage.	
5	**Severe**	Extreme stage of 4. Extended period of bare soil or strong wind has meant massive soil sweeping and deep gouging of surface in places.	

Sheet Rill Severity…….(Sheet/Rill Water Erosion)

[Rills < 30cm deep]

Rating	Severity	Description	
1	Nil, or, Insignificant	Nil. < 1 t/ha	
2	Minor	Very little erosion. Some sporadic evidence of soil movement but not obvious. (1 - < 5 t/ha soil loss). In rangelands-shallow soil deposits in sediment traps.	
3	Moderate	Significant erosion and obvious soil movement/washing. 5-6 cm deep rills 4-5m apart or equivalent. (5 - < 10 t/ha soil loss). In rangelands-partial exposure of roots and evidence of soil deposits in sediment traps.	
4	High	Severe erosion. Significant soil movement/washing and obvious deposition in flats, swales, fencelines or creeks/gullies. 5-6cm deep rills 2m apart or equivalent. (10 - <25 t/ha soil loss). In rangelands-exposure of roots and subsoil, pedestalling. Substantial soil deposits in sediment traps	
5	Severe	More extreme than 4. Severe erosion. 5-6cm deep rills <2m apart or equivalent. (> 25 t/ha soil loss).	

Residue Burning

Nil	**n**	
Minor Burn (<25%) Typically the header or harrow rows	**mb**	
Partial Burn (25-50%) Usually more widespread patches	**pb**	
Complete Burn (> 50%) Complete burn over the majority of paddock	**cb**	

C. WIND EROSION RISK SELECTION MATRIX

Topographic Rating	Cover Rating	Detachment Rating	Erosion Risk Category
All TR	CR = 1-3	All DR	Safe
TR = 1-2	CR = 4-5	DR = 1	Safe
TR = 1	CR = 6-8	DR = 1	Safe
TR = 2	CR = 6-8	DR = 1	Safe/Slight
TR = 3-5	CR = 4	DR = 1	Safe
TR = 3-5	CR = 5	DR = 1	Slight
TR = 3-5	**CR = 6-8**	**DR = 1**	**Moderate/High**
TR = 1	CR = 4-5	DR = 2	Safe
TR = 1	CR = 6-8	DR = 2	Safe
TR = 2	CR = 4-5	DR = 2	Slight
TR = 3-5	CR = 4	DR = 2	Slight
TR = 3-5	**CR = 5**	**DR = 2**	**Moderate**
TR = 2-5	**CR = 6-8**	**DR = 2**	**Moderate/High**
TR = 1-2	CR = 4	DR = 3	Safe
TR = 1	CR = 5	DR = 3	Safe
TR = 1	CR = 6-8	DR = 3	Safe
TR = 3-5	**CR = 4**	**DR = 3**	**Moderate**
TR = 2-5	**CR = 5**	**DR = 3**	**Moderate/High**
TR = 2-5	**CR = 6-8**	**DR = 3**	**High/Very High**

UNITS OF MEASUREMENT

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	µg	10^{-6} g	mass
microlitre	µL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	356 or 366 days	time interval

EC	electrical conductivity (µS/cm)
pH	acidity/alkalinity
ppm	parts per million

GLOSSARY

ABS. Australian Bureau of Statistics.

ACLUMP. Australian Collaborative Land Use Mapping Programme

APPC. Animal and Plant Pest Control.

BRS. Bureau of Rural Sciences. Government of Australia.

Direct Drill. Method of sowing a crop in a one-pass operation (without prior cultivation).

DWLBC. Department of Water, Land and Biodiversity Conservation. Government of South Australia.

ERI. Erosion Risk Indices.

EP. Eyre Peninsula Region.

Erosion. Natural breakdown and movement of soil and rock by water, wind or ice. The process may be accelerated by human activities.

GIS (geographic information system). Computer software allows for the linking of geographic data (for example land parcels) to textual data (soil type, land value, ownership). It allows for a range of features, from simple map production to complex data analysis.

GPS. (global positioning system

GRDC. Grains Research and Development Corporation.

KI. Kangaroo Island Region.

Intensive farming. A method of keeping animals in the course of carrying on the business of primary production in which the animals are confined to a small space or area and are usually fed by hand or by mechanical means.

Land. Whether under water or not and includes an interest in land and any building or structure fixed to the land.

LCMP. Land Condition Monitoring Program.

LM. Land Manager.

LMS. Land Manager Survey.

LMR Group. Land Management & Revegetation Group.

LMRP. Land Management and Revegetation Program within DWLBC.

LUMIS. Land Use and Management Information System.

MER-OP. Monitoring, Evaluation and Reporting Operational Plan.

ML. Murraylands Region.

MLR. Mount Lofty Ranges.

Model. A conceptual or mathematical means of understanding elements of the real world which allows for predictions of outcomes given certain conditions. Examples include estimating storm runoff, assessing the impacts of dams or predicting ecological response to environmental change.

NAP. National Action Plan for Salinity and Water Quality.

NCAS. National Carbon Accounting System.

NHT. Natural Heritage Trust.

NLWRA. National Land and Water Resources Audit.

Natural Resources. Soil; water resources; geological features and landscapes; native vegetation, native animals and other native organisms; ecosystems.

Natural Resources Management (NRM). All activities that involve the use or development of natural resources and/or that impact on the state and condition of natural resources, whether positively or negatively.

No-Till. Method of sowing crop in a one-pass operation using narrow seeder points or disc openers.

NRM Plan. State Natural Resources Management Plan.

NYR. Northern and Yorke Region.

Pasture. Grassland used for the production of grazing animals such as sheep and cattle.

PDA. Personal Data Assistant.

PIRSA. (Department of) Primary Industries and Resources South Australia.

RCT. Resource Condition Target.

RSSA. Rural Solutions South Australia

SA. South Australia.

SCC. Soil Conservation Council.

SE. South East Region.

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