15. SOIL DEGRADATION

Erosion was mapped as part of the Land Use and Erosion Survey by the Soil Conservation Service using 1988 air photos. This survey has not been updated, so there is no current information available. Sheet, rill, gully and streambank erosion are found throughout the Little River Catchment. The extent and form of erosion depends on the landuse, soil type, topography, drainage patterns and geology. It is also important to note that sheet and rill erosion were mapped as erosion hazard in relation to landuse and hence may have altered significantly depending on land management since the time of mapping.

15.1 PROCESSES

15.1.1Cause

Soil erosion results from water or wind flowing across the land, where there is insufficient ground cover to protect the soil. It can occur in a variety of forms, defined as:

- **Sheet erosion:** the removal of a fairly uniform layer of soil from the surface by raindrop splash or runoff. No perceptible channels are formed. Sheet erosion commonly occurs on cropping land, but is also present, but less obvious, on grazing country.
- **Rill erosion:** the removal of soil by concentrated runoff, forming channels up to 30 cm deep. Rill erosion typically occurs on cultivated land and can be the precursor to gully erosion.
- **Gully erosion:** concentrated runoff cutting incised channels into the soil profile, which result in an unstable channel more than 30 cm deep. It is usually associated with particular soil types where increased runoff has initiated gullying in flow lines.

The main cause of erosion is lack of ground cover and soil structural decline in cropped areas. Insufficient ground cover, ie less than 70% of the surface covered, can be attributed to: poor grazing management, droughts, farming on long, steep slopes, not retaining crop residues, concentrated runoff, infertile soils, overclearing of trees, shrubs and grass especially on steep slopes, fires and rabbits. Some soil types are far more susceptible than others - eg. dispersible soils are very prone to gully erosion. Once the subsoil is exposed, the soil disperses and collapses on wetting.

Another cause of erosion is inappropriate earthworks that have been constructed to divert water. These can result in severe erosion and may require removal to prevent further land degradation.

Loss of soil fertility and soil structure decline are also problems in the Little River Catchment and often lead to increased erosion rates. Soil fertility loss and soil structure decline is generally the result of landuse practices, usually continuous farming and overgrazing. Features of structure decline include surface crusting or soil compaction. These can lead to accelerated runoff due to the soils' inability to absorb and transmit rainfall. Waterlogging can also result from structure decline.

Soil fertility decline is a result of continuous cropping regimes without pasture or grain legume rotations, or grazing land with low phosphorus levels, chemical imbalances or poor legume content. Constant cropping removes the nutrients with the grain. Stubble retention is also important as the residues add organic matter and nutrients to the soil. (57) However, initially, stubble retention and no till practices may require higher rates of fertiliser to counter the nitrogen tie up that occurs when large amounts of residues are available.

15.1.2 Upstream/Downstream Inter-Relationships

Soil degradation, including erosion, soil structure decline and fertility losses, is the precursor to many other forms of natural resource degradation. Increased sediment load, chemical pollution, eutrophication of waterways, damage to infrastructure, reduced arable land, poor access, changes to patterns of overland flow and loss of production are just some of the impacts of erosion.

In the better rainfall areas, the pressure to crop more intensively has seen a corresponding increase in the occurrence of localised flooding, sedimentation and the clearing of tree and native grass cover. The incidence of erosion is exacerbated by, or is aggravating, other forms of land degradation such as dryland salinity, fertility decline and weed infestation.

15.2 PRESENT CONDITIONS

15.2.1 Extent and Distribution

The distribution of sheet and gully erosion is depicted in Figures 17 and 18 and the extent of the affected area is shown in Tables 17 and 18.

Table 17: Area of the Little River Catchment affected by sheet and rill erosion (1988).

Sheet and Rill Erosion (ha)	Baldry	Yeoval	Cumnock (Little River)	Cumnock (Bell River)	Suntop/ Arthurville - Little River	Suntop/ Arthurville -Bell River	TOTAL
No appreciable erosion	82460	18593	23790	4539	28750	6699	**164830**
Rill erosion - minor to moderate	471	161	242	62	160	92	**1188**
Rill erosion - severe to very severe	250	49	36	0	14	15	**364**
Sheet erosion - minor - moderate	26586	15052	8278	1045	17301	3879	**72141**
Sheet erosion - severe-very severe	1093	2238	5116	612	6756	2909	**18724**
Erosion caused by salinity	274	173	260	9	306	52	**1074**
TOTAL	**111134**	**36266**	**37722**	**6267**	**53287**	**13646**	**258321**

15.2.1.1 Baldry Subcatchment

Around 75% of the subcatchment was not appreciably eroded at the time of mapping. Goobang National Park is the least affected area in the subcatchment. Areas under cropping mostly experience minor to moderate sheet erosion with some small areas of severe sheet erosion to the north and east of Baldry. Approximately 28000 hectares of the Baldry subcatchment is affected by sheet erosion. Rill erosion occurs on both cropping and grazing land, and covers approximately 800. Gully erosion is a significant problem in the Baldry area as there is nearly 225 kilometres of gullies in the area. Gully erosion is found along drainage lines and waterways, particularly on the light soils to the north of Baldry.

15.2.1.2 Yeoval Subcatchment

The mapped erosion in the Yeoval subcatchment is closely correlated with landuse. Nearly 50% of the land used for cropping is affected by sheet erosion. There are some small areas of severe sheet erosion in the north east of the subcatchment. Mixed pasture areas generally have negligible or minor sheet erosion. The area most severely affected by gully erosion is in the south of the subcatchment particularly along drainage lines into Hanover Creek. There is around 80 kilometres of gully erosion in the Yeoval subcatchment.

15.2.1.3 Cumnock Subcatchment

There is negligible erosion in areas, which are used for mixed pasture or timber, which accounts for approximately 65% of the subcatchment, mostly in the high rainfall area to the south. Scattered areas of very severe sheet erosion occur in the north and south west of the subcatchment and there are areas of severe sheet erosion in the centre and north east of the subcatchment. Moderate sheet erosion occurs across the northern half of the subcatchment. Almost 100 kilometres of gullies are found in the Cumnock district.

15.2.1.4 Suntop/Arthurville Subcatchment

Erosion hazard is again correlated with cropping. Moderate to severe sheet erosion occurs on more than half the subcatchment. The lower lying areas surrounding the river flats are less susceptible to sheet erosion. Some farming areas also have severe rill erosion. Gully erosion is mostly found along tributaries of the creeks and rivers with nearly 90 kilometres of the subcatchment affected. The steep Catombal Range, used for minimal grazing under trees, suffers very little erosion.

Table 18. Length of gully erosion (metres) within the Little River Catchment (1988).

Gully Erosion (metres)	Baldry	Yeoval	Cumnock (Little River)	Cumnock (Bell River)	Suntop/ Arthurville-Little River	Suntop/ Arthurville -Bell River	TOTAL
Minor gully erosion	48265	26708	28568	518	15360	3054	**122473**
Moderate gully erosion	30862	14672	14222	2617	19791	5743	**87907**
Severe gully erosion	66641	23385	28095	8402	15592	14541	**156656**
Very severe gully erosion	78741	17119	13489	1546	3748	11520	**126163**
TOTAL	**224509**	**81884**	**84374**	**13083**	**54491**	**34859**	**493198**

15.2.1.5 Soil Structure and Fertility Decline

Most of the soil types used for cropping in the Little River Catchment are naturally highly to very highly susceptible to soil structure decline and only moderately fertile eg. Red Brown Earths, Non-calcic Brown soils. The only exceptions are the more stable Euchrozems and Terra Rosa soils, which are not widespread. Long term cropping without a perennial grass pasture phase has resulted in extensive and severe soil structure and soil fertility decline.

Grazing land is also subjected to soil structure decline, particularly under continuous grazing systems. Trampling from hard hoofed animals on bare soil and in wet conditions has resulted in compaction and low rates of infiltration. Continuous grazing increases this risk as root development is restricted and there is no opportunity for recovery.

Figure 17: Sheet and Rill Erosion

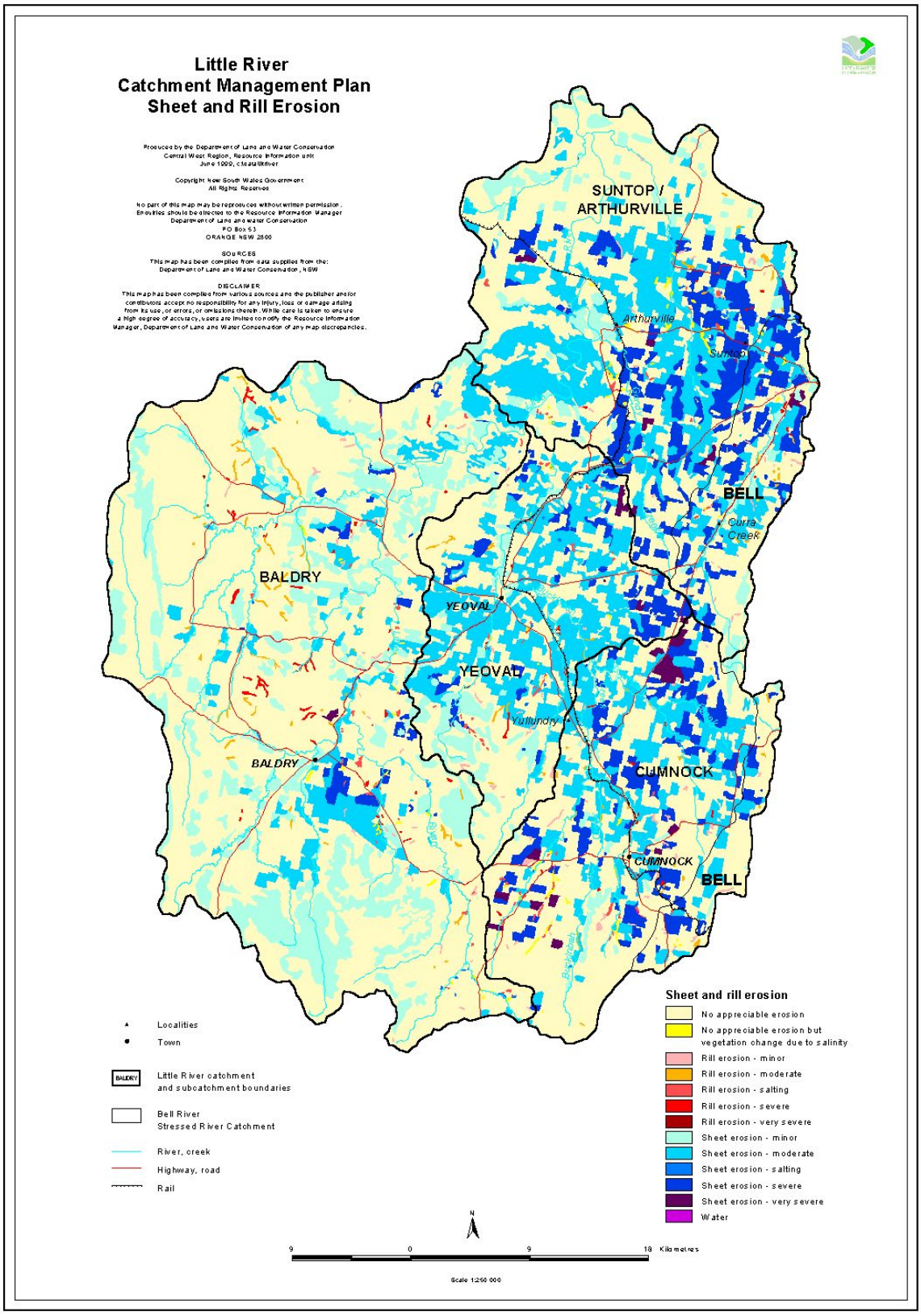
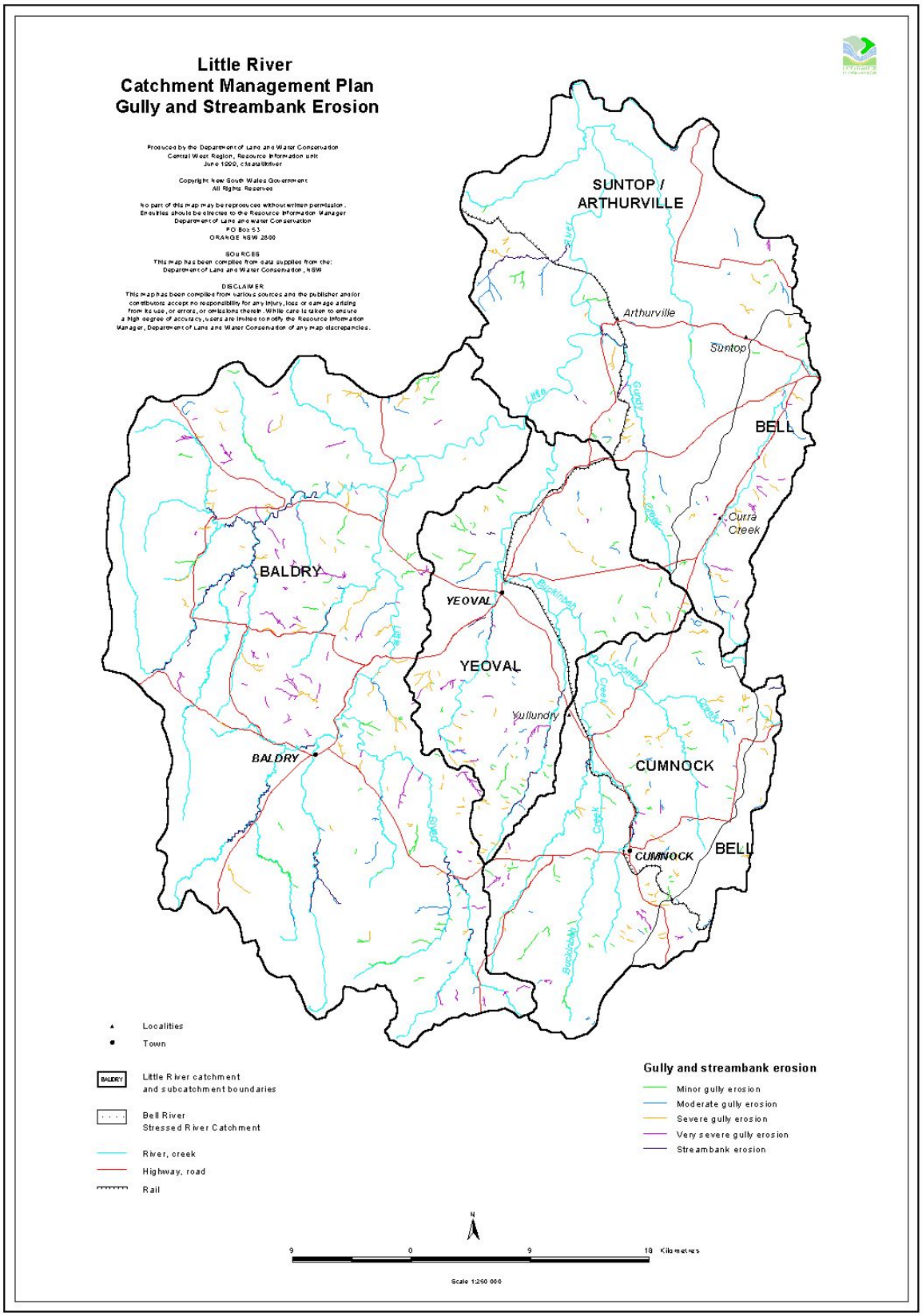


Figure 18: Gully and Streambank Erosion



The soils in the catchment used for grazing have only low to moderate fertility in their natural state. Continued product removal, inadequate fertiliser applications and soil chemical imbalances, including acidity, mean that many of these soils have depleted soil fertility and significantly reduced production potential.

15.2.2 Severity

The Macquarie Land Degradation Survey (13) delineated Catchment Management Units (CMU) across the valley. These areas were the areas that were considered to be highly degraded in relation to the rest of the catchment. Of the 65 units, 9 were in the Little River area. (The only other area in the Macquarie with more intense land degradation was the Bathurst district.) The CMUs listed in Table 19 describe the subcatchment or locality.

Table 19: Degradation Ranking of Catchment Management Units in the Macquarie Valley

Catchment Management Unit	Overall Degradation (Ranking out of 65)	Sheet, Rill & Gully Erosion (Rank out of 65)	Soil Structural Decline (Rank out of 65)
Wandoo Wandong	2	19	14
Baldry / Little River	17	8	4
Cumnock	28	23	6
Upper Sandy Creek	30	24	30
Gundy Creek	40	45	5
Curra Creek	43	37	9
Yeoval South	46	52	7
Suntop	47	43	1
Yeoval North	50	47	3

15.2.3 Environmental Impacts

Environmental impacts include eutrophication of waterways, increased sediment load, siltation of the river, loss of viable farming land as well as damage to roads, rail and bridges etc. Sediment can carry chemicals from farm land which can affect fish and other aquatic life. Gully and streambank erosion are major contributors of phosphorus into the waterways, from both natural sources and applied fertilisers.

15.2.4 Social and Economic Impacts

Soil erosion is a major factor in declining productivity, and hence low farm returns. This leads to communities with poor socio-economic status, which makes it more difficult to reverse the process, as landholders increasingly don't have the financial resources to make change. Costs include loss of valuable farming and grazing land, reduced yields, loss of nutrients, poor access and reduced farm efficiency, loss of income and the cost of repairing damages caused by erosion.

If the sediment load in the Macquarie is very high, then this can impact on irrigators and Town Water Supplies. Sometimes sediment load and turbidity can be so great that it affects the capacity to pump from the river particularly during high flow off-allocation periods of access to unregulated water. Local Councils also have to bear the cost of repairs to roads and other infrastructure following flooding.

In 1991, an assessment was carried out to compare the relative economic costs of dryland salinity and soil structural decline for cultivated land and pastures on the Wellington 1:100000 map sheet. It was determined that the worst case economic loss due to salinity was $56 000 (100% loss of production on affected areas) or $28 000 (50% loss of production). The estimated loss of farming income due to soil structural decline was $567 000 (5% overall reduction in yield). These costs are on site only. Off site costs of salinity and increased sediment loads in watercourses would be more significant that the on site costs. (13)

15.3 THE FUTURE

Techniques are available to see the potential for erosion significantly reduced. Conservation farming, using reduced tillage, direct drilling and pasture rotations, have a marked impact on ground cover and susceptibility to erosion in crop situations. Similarly, grazing management systems, which maintain high levels of ground cover; at least 70% or more in higher rainfall areas, are quite achievable. If changes to land management practices are not made, the potential for loss of productive agricultural land is significant.

15.4 CURRENT ACTIVITIES

15.4.1 Research and Development

The Central West Farming Systems program is an initiative of Grains Research and Development Corporation (GRDC), which aims to improve production under conservation farming systems and find solutions to impediments.

Meat and Livestock Australia (MLA) has established the Sustainable Grazing Systems Program (SGS) across temperate Australia, including in the Central West region. There is a major research site at Carcoar and a number of paddock scale demonstration sites. Sustainable Grazing Systems programs aim to:

- Determine the principles behind profitable and sustainable grazing systems
- Find practical indicators to help graziers assess their pastures
- Identify 'best bet' grazing management practices
- Develop guidelines to help graziers adopt ‘best bet’ practice

MLA has small amounts of money available for producers to establish a Producer Initiated Research Development (PIRD) group, for farmers to investigate local issues themselves.

15.4.2 Implementation

DLWC has a conservation farming program and has also jointly appointed a conservation grazing officer with the Sustainable Grazing Systems committee. The Catchment Manager is responsible for the soil health and erosion control programs and DLWC still has a Business Unit with expertise and machinery for earthwork construction.

The Curra Creek Soil Conservation Project was undertaken in the Suntop/Arthurville subcatchment during the late 1970s and 1980s, and saw the construction of extensive earthworks, supported by government subsidies.

NSW Agriculture has a Sustainable Agriculture policy in place and works actively to provide advice to landholders about best management practice for cropping and grazing, including conservation farming programs and Top Crop monitoring.

15.4.3 Monitoring and Evaluation

The Macquarie River Land Degradation Survey (1988) was undertaken to determine the extent of land degradation in the Macquarie River Catchment. The results were used to develop proposals to treat the problems and to prioritise these problems and proposals. However, this work is out of date and no plans are in place to reassess the condition of the landscape.

Five Top Crop groups are in place in the Wellington district, monitoring crop production.

15.4.4 Best Management Options (BMOs)

The knowledge is available to control erosion and maintain soil health. The lack of adoption is due to social and economic factors, such as financial inability to purchase conservation farming machinery, not gaps in the science. Landholder complacency is also a cause of limited adoption of erosion control techniques and soil health maintenance.

Land management recommendations include:

- conservation farming, controlled traffic, stubble retention
- crop-pasture rotations, green manure crops
- contour farming and soil conservation earthworks
- safe disposal of runoff waters from steeper areas
- pasture improvement and maintaining fertility through lime and fertilisers
- moderate total stocking rates
- remove stock early in drought periods
- controlled stocking and strategic grazing management to maintain 70% ground cover
- maintain a well vegetated riparian zone to filter sediment before it enters the streams
- responsible application of chemicals, fertilisers and biosolids.

15.4.5 Identified or Perceived Barriers

Financial viability may be a problem in investing in best practice technology eg machinery. The costs of erosion may restrict the landholder from repairing the problem properly, or the head of erosion may not be on a particular farm ie. there may be a problem with externalities. Poor grazing management practices are not often seen as a key factor in erosion. There is also concern about on-farm earthworks. Landholders feel there is no technical backup, particularly with diverting creek flow.

The long term impacts on the environment and human health of prolonged chemical use in conservation farming is largely unknown and the possibility of chemical resistance of plants to chemicals is starting to be seen.

15.4.6 Institutional

The Native Vegetation Conservation Act restricts the clearing of vegetation. Applications are required so proper assessment of the area should be undertaken before clearing can commence. There are also regulations about clearing near waterways under the Protected Lands Act. DLWC has the legislation to intervene if erosion is severe, but is very reluctant to use it. The Clean Waters Act administered by EPA provides the power to prosecute if water quality is being impacted. In reality, there has been little use of legislative powers in dryland areas.

15.4.7 Investment

The NHT and its predecessor, the National Landcare Program (NLP) and National Soil Conservation Program (NSCP), were initiated to assist landholders address soil conservation issues. Eurimbla, Hervey Ranges and Obley Landcare Groups have accessed NLP funds to undertake erosion control works. Individual farmers make most investment in conservation works. At times, the Rural Assistance Authority (RAA) has made available incentive packages for the purchase of conservation farming machinery. Loans are also available through RAA - however these are now virtually at commercial rates of interest.

15.4.8 Financial and Benefit Cost Analysis

The Macquarie Land Degradation Survey recommended that DLWC assess the overall economic effects of the various forms of soil physical and chemical degradation in the Macquarie Valley and how producers are affected by these problems.

15.5 ANALYSIS

15.5.1 Identified or Perceived Gaps

The only data set available on erosion is 12 years old, so there is no true picture of the existing condition of the landscape. There are no plans by DLWC to update this information.

15.5.2 Key Stakeholders and Contacts

NSW Agriculture
Mary Kovac - Environment Officer, Dubbo
Dick Gammie - NSW Program Leader, Dubbo
Col Mullins - District Agronomist, Dubbo
Kathi Hurtle - District Agronomist, Wellington

Department of Land & Water Conservation
John Lawrie - Soils and Conservation Farming, Wellington
Richard Chewings - Catchment Manager, Wellington
Mary Goodacre - Conservation Grazing Program, Mudgee

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