State of the catchments 2010

# Land management within capability

## Murray region

## State Plan target

By 2015 there is an increase in the area of land being managed within its capability.

## Background

Land 'capability' is the inherent physical capacity of the land to sustain long-term land-uses and management practices without degradation to soil, land, air and water resources (Dent & Young 1981). It is a function of various landscape features and processes, including terrain, soil and climatic attributes, as well as their interactions. Failure to manage land in accordance with its capability may result in degradation of resources both on and off site, leading to a decline in natural ecosystem values, agricultural productivity and infrastructure functionality. The management of land within its inherent physical capability is vital for the sustainable use of soil and land resources.

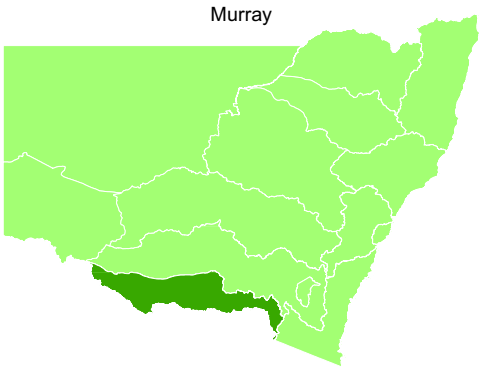
Land management deals with human practices followed during the course of land-use. Management actions, such as the intensity of tillage prior to sowing, length of bare fallow, maintenance of ground cover and the extent of fertiliser application, all impact on the land. Land-uses considered in this report include various forms of cropping, grazing, horticulture, forestry and nature conservation. Current land management practices associated with these land-uses are also considered against land degradation hazards. These hazards include sheet erosion, gully erosion, wind erosion, soil structure decline, organic carbon decline, soil salinity, soil acidification and acid sulfate soils.

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the DECCW website: www.environment.nsw.gov.au/publications/reporting.htm.

**Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.**

This report outlines the level of sustainable land management across the Murray region. It provides information for setting and adjusting natural resource management (NRM) targets and associated resource allocation. Land management within capability closely relates to soil condition, which is also discussed in this report.

## Map of the catchment




The 10 soil monitoring units (SMUs) that were the focus of assessment within the Murray region are shown in Figure 1. An SMU is a large tract of land where changes in soil condition and land management can be periodically observed. SMUs usually have a relatively homogeneous pattern of soils, parent material, geomorphology and climate. The SMUs were jointly selected by DECCW and Murray Catchment Management Authority (CMA) staff on the basis of their area, importance, pressures and vulnerability. They collectively covered 16,900 km$^2$ or 48 per cent of the region.

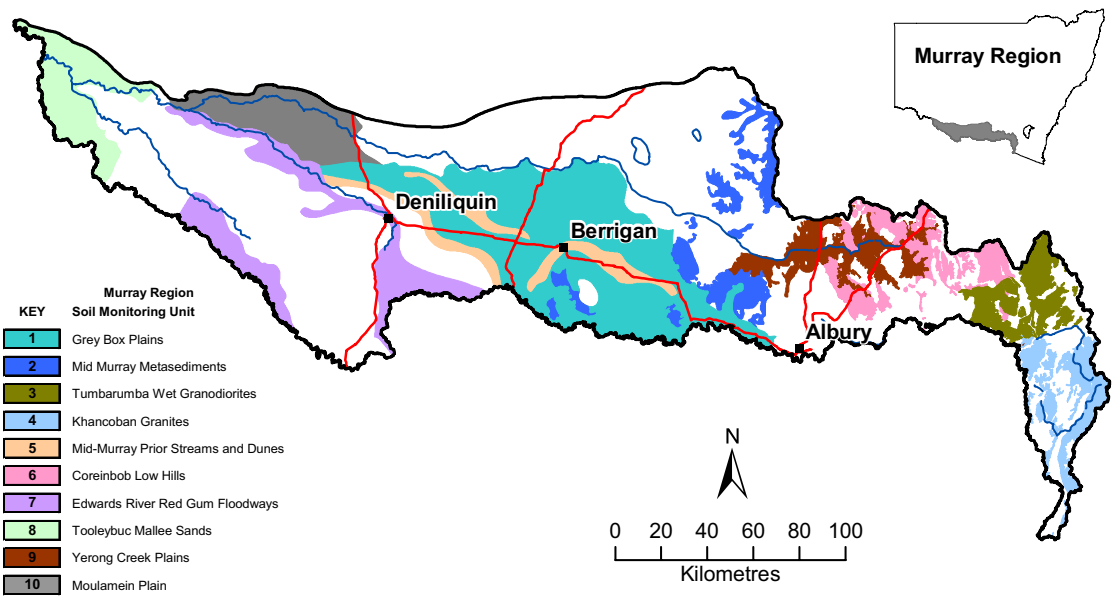



**Figure 1 Location and extent of SMUs within the Murray region**

## Assessment

The project was designed to assess changes in land management, relative to land capability, over time on the most important soils in New South Wales. It involved a comparison of the potential impact of land management actions against soil and land conditions of the sites to derive 'land management within capability' indices. The resulting process is summarised in Figure 2 and briefly described below. It is detailed further in Gray et al. (2008) and the supporting technical report

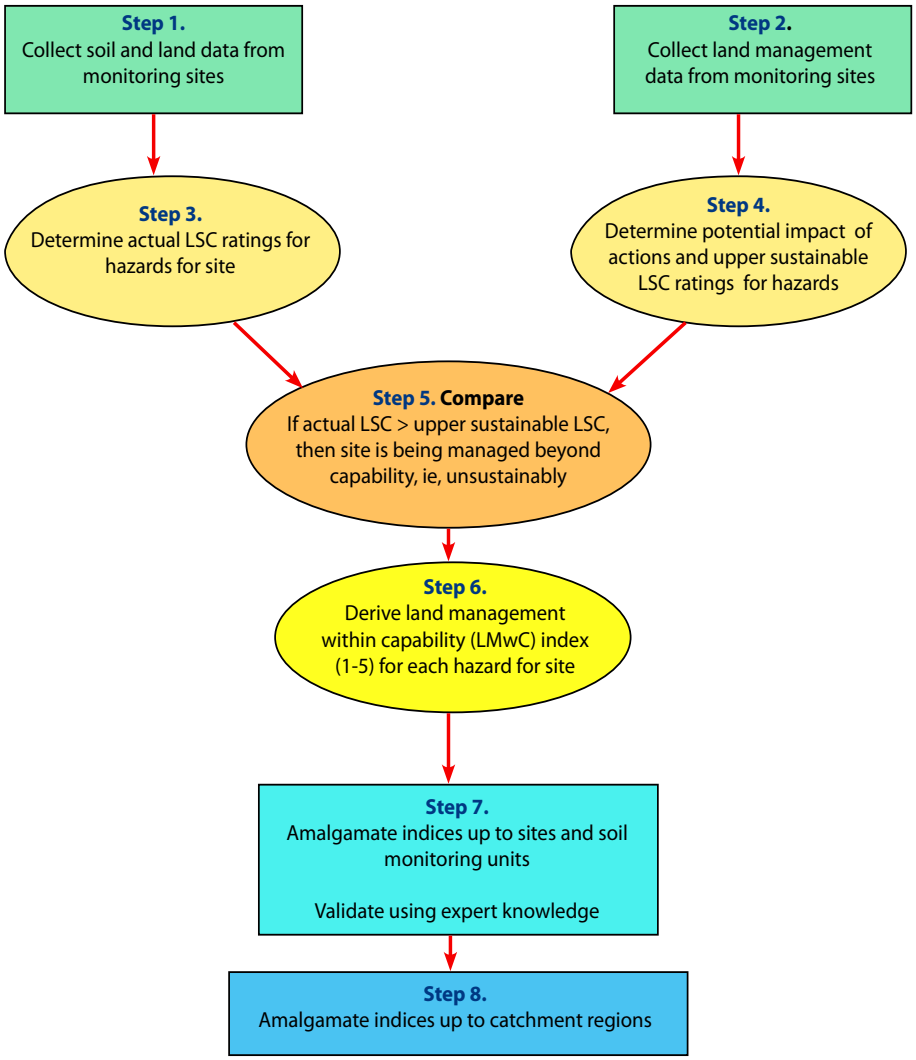



**Figure 2 Assessment of land management within capability**

*Step 1* – the assessment commenced with the collection of soil and land data at each of the permanent soil monitoring sites established within each SMU. This is further described in the protocol document (DECCW 2009).

*Step 2* – a questionnaire was used to collect land management data. This was completed by the landholder and detailed precise management actions for each site (DECC 2008). As of March 2009, 35 monitoring sites had been established in the Murray region, 29 of which have had land management surveys returned.

*Step 3* – land and soil capability (LSC) of each site was determined using a rule-set together with the recorded land and soil attributes (Murphy et al. 2008). Ratings ranged from one (most capable) to eight (least capable) for each land degradation hazard.

*Step 4* – the potential impact from the combined land management actions was determined, corresponding to an upper allowable LSC for each hazard. This was based on a rule-set prepared with the aid of literature values and expert knowledge and approved by DECCW, CMAs and Industry & Investment NSW (I&I) staff.

*Step 5* – the potential impact of the land management actions was evaluated against the actual conditions of the site by comparing the above two derived values (LSC and upper allowable LSC) (see Table 1). Where the potential impact of actions exceeded what could be sustained by the land, the land was rated as being managed beyond its capability.

*Step 6* – results were then converted to the 'land management within capability' index, using the rules given in Table 1. The index indicates the degree to which the land is managed in accordance with its natural ability to sustain long-term uses. An index of five indicates very good, highly sustainable land management where the risk of land degradation is very low. An index of one indicates very poor, unsustainable land management, with a very high risk of land degradation.

*Step 7* – indices for each hazard at each site were combined for the whole site and then combined again to find an average for each SMU. Where significant differences were apparent, expert knowledge gained from DECCW and CMA staff familiar with local land management practices was used to validate the results and modifications made.

*Step 8* – the indices were further combined to give an overall index rating of sustainability for the entire Murray region.

**Table 1 Comparison of upper allowable LSC with actual LSC**

| Impact of Land Management Actions | Upper Allowable LSC | LSC Capability Class: Extremely good 1 | Very good 2 | Good 3 | Mod-good 4 | Mod-poor 5 | Poor 6 | Very poor 7 | Ext. poor 8 |
|---|---|---|---|---|---|---|---|---|---|
| Extremely high (EH) | 1 | | | | | | | | |
| Very high (VH) | 2 | | | | | | | | |
| High (H) | 3 | | | | | | | | |
| Moderate (M) | 4 | | | | | | | | |
| Moderate to low (M-L) | 5 | | | | | | | | |
| Low (L) | 6 | | | | | | | | |
| Very low (VL) | 7 | | | | | | | | |
| Extremely low (EL) | 8 | | | | | | | | |

| | Land management within capability index | Managed at: | Sustainability | Risk of land degradation |
|---|---|---|---|---|
| | 5 | >=2 within cabability | very good | negligible |
| | 4 | 1 within capability | good | very low |
| | 3 | at capability | fair | low |
| | 2 | 1 beyond capability | poor | high |
| | 1 | >=2 beyond capability | very poor | very high |

## Current status of land management within capability

Information products relating to the current status of land management within capability in the Murray region are presented in Table 2 by SMU and Table 3 by indicator. Figure 3 provides an overview of these details on a regional map.

**Table 2 Land management within capability of SMUs in the Murray region**

| Soil monitoring unit | Soil monitoring unit name<br>Soil types and monitored land use | Land management within capability index[a] | Range of indices[b] | Worst indicators and index[c] | | Data source[d] and confidence[e] |
|---|---|---|---|---|---|---|
| 1 | **Grey Box Plains**<br>Grey Epipedic Vertosols and Subplastic Red Chromosols. Unimproved pasture. | 2.9 |  | Wind erosion, Organic carbon decline, Structure decline | 2.7 | B and K Medium |
| 2 | **Mid Murray Metasediments**<br>Red Dermosols. Unimproved pasture. | 3.3 |  | Organic carbon decline | 2.7 | B and K Medium |
| 3 | **Tumbarumba Wet Granodiorites**<br>Yellow Chromosols and Brown Kurosols and shallow Rudosols. National Park and unimproved pasture. | 2.9 |  | Acidification | 2.3 | B and K Medium |
| 4 | **Khancoban Granites**<br>Yellow and Brown Chromosols and Kurosols. National Park and unimproved pasture. | 3.0 |  | Acidification | 2.3 | B and K Medium |
| 5 | **Mid-Murray Prior Streams and Dunes**<br>Arenic Rudosols and Crusty Vertosols. Unimproved pasture and cropping. | 2.5 |  | Gully erosion, Salinity/waterlog | 2.0 | B and K Medium |
| 6 | **Coreinbob Low Hills**<br>Red Kandosols and Red Chromosols and Kurosols. | 2.9 |  | Acidification, Organic carbon decline, Salinity/waterlog | 2.7 | B and K Medium |
| 7 | **Edwards River Red Gum Floodways**<br>Self-mulching Brown and Crusty Grey Vertosols. Forest and unimproved pasture. | 2.3 |  | ASS | 1.5 | B and K Medium |
| 8 | **Tooleybuc Mallee Soils**<br>Calcic Calcarosols and Grey Chromosols. Rangelands. | 2.6 |  | Wind erosion | 2.0 | B and K Medium |
| 9 | **Yerong Creek Plains**<br>Brown and Red Dermosols. Unimproved pasture. | 2.7 |  | Acidification | 2.3 | B and K Medium |
| 10 | **Moulamein Plain**<br>Self-mulching Grey Vertosols and Black Chromosols. Rangelands. | 2.5 |  | Wind erosion, Structure decline | 2.0 | B and K Medium |

**Legend for Table 2:**

a Land Management within Capability (LMwC) Index:

| | | |
|---|---|---|
| **4.6 – 5.0** | Very good | Managed well within capability, negligible risk of degradation and probable improvement of soil and land resources |
| **3.6 – 4.5** | Good | Managed within capability, very low risk of degradation to soil and land resources |
| **2.6 – 3.5** | Fair | Managed at capability, low risk of degradation to soil and land resources |
| **1.6 – 2.5** | Poor | Managed slightly beyond capability, high risk of degradation to soil and land resources |
| **<1.5** | Very poor | Managed well beyond capability, very high risk of degradation to soil and land resources |
| | No data | Not included for change monitoring. Information may be available in support documents |

b Range of indices: pie chart shows variation in LMwC indices for the different hazards in each SMU

c Worst indicators and index: gives the indicators (or hazards) of most concern in the SMU, with the associated LMwC index

d Data source:

| | |
|---|---|
| B | Baseline data for soil condition – from field and laboratory measurements |
| L | Landholder survey on land management |
| K | Expert knowledge – from DECCW and CMA staff |

e Data confidence:

| | |
|---|---|
| High | Derived from numerous landholder surveys and field data from representative sites in the baseline study, and validated using expert knowledge |
| Medium | Derived from limited landholder surveys and field data from sites in the baseline study or roadside surveys, in conjunction with expert knowledge |
| Low | Derived from modelling or expert knowledge only |

**Table 3 Land management within capability indicators in the Murray region**

| Capability hazard | Land management within capability index[a] | Range of indices[b] | Apparent trend[c] | SMUs of concern (index <=2.5)[d] | Data source and confidence[e] |
|---|---|---|---|---|---|
| **Erosion - sheet**<br>Erosion of topsoil by overland flows. Generally a consequence of insufficient ground cover. | 2.9 |  | ↔ | - | B and K Low |
| **Erosion - gully**<br>Erosion of topsoil and subsoils by concentrated overland flows. Generally a consequence of insufficient ground cover and changes to runoff and infiltration patterns. | 3.0 |  | ↔ | 5 | B and K Low |
| **Erosion - wind**<br>Erosion of soils by the action of wind. Generally a consequence of insufficient ground cover and inappropriate tillage practices. | 2.7 |  | ↑ | 5, 7, 8, 9, 10 | B and K Low |
| **Acidification**<br>Trend towards increasingly acid soils, leading to reduced chemical health. A consequence of inappropriate management such as over intense use, allowing excessive leaching, over use of nitrogen fertilisers and insufficient use of lime. | 2.6 |  | ↑ | 3, 4, 7, 9, 10 | B and K Low |
| **Organic carbon decline**<br>The loss of soil organic matter with resulting decline of physical and chemical condition. A consequence of over intense use with insufficient return of biomass to the soil. | 2.7 |  | ↔ | 5, 7, 8, 10 | B and K Low |
| **Structure decline**<br>Degradation of the physical structure of the soil, reducing the potential for water movement and plant growth. A consequence of practices such as over-cultivation, compaction by heavy vehicles and stock, and insufficient plant root growth. | 2.7 |  | ↔ | 7, 8, 10 | B and K Low |
| **Acid sulfate soils**<br>Mismanagement can lead to release of highly acid waters into the ecosystem. This can arise from the exposure of buried potential ASS layers to oxygen such as from lowering of watertable by drainage. | 1.5 |  | ↑ | 7 | B and K Low |
| **Salinity/water logging**<br>Build up of salt or saturated soils on ground surface. A consequence of rising groundwater tables following a reduction of deep rooted perennial plants. | 2.9 |  | ↔ | 5, 7 | B and K Low |
| **Overall index : Catchment** | 2.6 |  | | | |
| **State** | 3.0 |  | | | |

**Legend for Table 3**

a Land Management within Capability (LMwC) Index: see Table 2

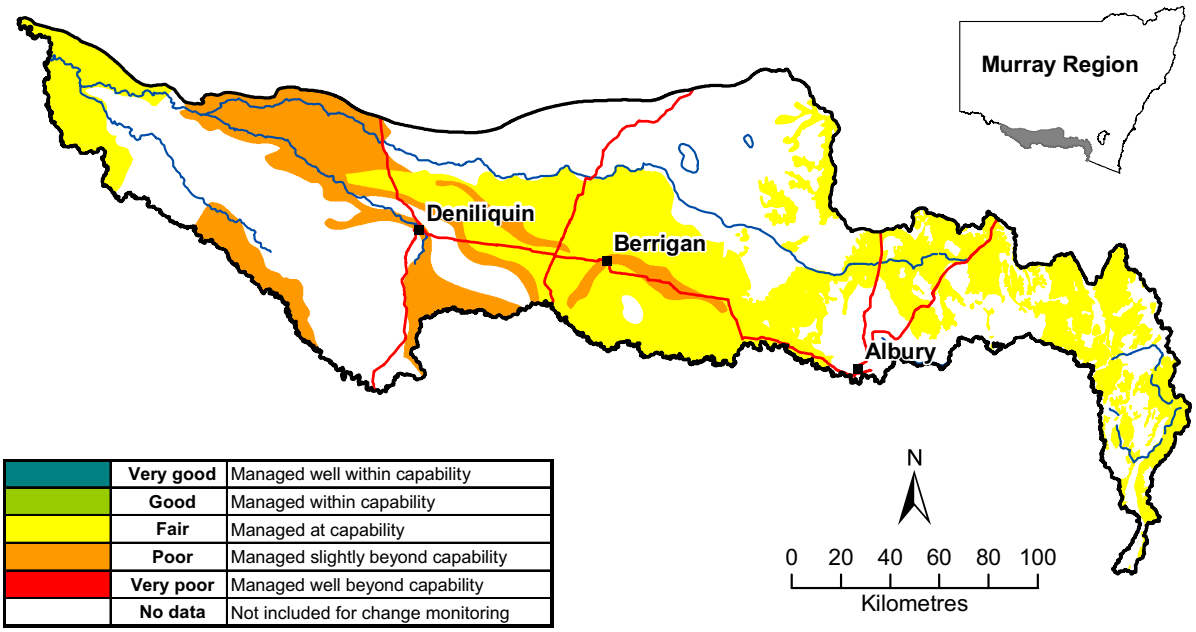
b Range of indices: pie chart shows variation in LMwC indices for the different SMUs for each hazard (indicator)

c Apparent trend in land management relative to capability as gained from the formal expert knowledge surveys:

- ↑ Improving: there appears to be a steady adoption by landholders of more sustainable land management practices, leading to an improvement in soil and land condition
- ↔ Steady, no change: there is no apparent move towards or away from more sustainable practices
- ↓ Declining: there appears to be a general move away from sustainable practices, leading to a decline in soil and land condition

d SMUs of concern: gives the SMU numbers for which the LMwC index is poor (<=2.5)

e Data source and confidence: see Table 2




| | | |
|---|---|---|
| | Very good | Managed well within capability |
| | Good | Managed within capability |
| | Fair | Managed at capability |
| | Poor | Managed slightly beyond capability |
| | Very poor | Managed well beyond capability |
| | No data | Not included for change monitoring |

**Figure 3 Murray region with average index classes for land management within capability for the SMUs**

### Pressures

The broad pressures that control the extent of land management within capability in the Murray region are complex and beyond the scope of this project to assess and monitor. They are partly dealt with in the socio-economic monitoring themes and include issues such as:

- financial, technical and managerial capacities of landholders
- knowledge and perceptions of sustainable land management practices by landholders
- market dynamics of agricultural products and production costs
- tax and government financial and legislative settings to promote sustainable land management
- long-term climatic changes, such as increasing severity of droughts.

## Management activity

The management activity for the soil condition theme and the land management within capability theme are very similar, as both centre on promoting the adoption of sustainable land management practices by landholders.

Increasing the area of land being managed within capability is one of NSW's NRM targets as outlined in the NSW State Plan.

Addressing the target within the Murray region involves initiatives and programs at the state and regional levels that will ultimately bring about the adoption of best land capability-sensitive management practices by landholders.

## State level

The NSW Government guides NRM through various legislation, policies, strategies and programs.

### *Legislation*

The *Catchment Management Authorities Act 2003* established the 13 CMAs and continues to outline their broad responsibility for NRM in their regions. The *Soil Conservation Act 1938* provides for the conservation of soil resources; however its role in effective soil management has diminished over time. Various other Acts provide direct and indirect mechanisms for soil protection and management, including the *Protection of the Environment Operations Act 1997, Environmental Planning and Assessment Act 1979, Native Vegetation Act 2003* and the *Crown Lands Act 1989*.

### *Policies and strategies*

The State Soils Policy (1987) outlines principles for the protection and management of NSW soils. It was recently reviewed and is undergoing public consultation. Other significant state policies and strategies include:

- Total Catchment Management Policy (1987) – aims to ensure the coordinated use and management of land, water, vegetation and other natural resources on a catchment basis
- Sustainable Agriculture Policy (1998) – aims to facilitate a change in agricultural production in NSW towards ecologically and economically sustainable practices and farming systems
- NSW State Salinity Strategy (2000) – aims to slow down the increase in salinity and lay the foundations for future salinity management
- State Environmental Planning Policy (SEPP) Rural Lands (2008) – aims to facilitate the orderly and economic use and development of rural lands for rural and related purposes.

### *Programs*

A number of relevant programs operate at the state level:

- *Monitoring, evaluation and reporting (MER) program* – DECCW is responsible for continuing its MER program and completing a baseline across all CMAs relating to soil condition and land management. The Australian Department of Agriculture, Fisheries and Forestry (DAFF) is funding a pilot program for national monitoring of water and wind erosion, soil acidification and soil carbon. The SoilWatch soil condition performance monitoring kit is being developed to complement and supplement MER surveillance monitoring throughout the state
- *Soil and land-use mapping* – much of eastern and central NSW is covered by soil landscape mapping at 1:100,000 or 1:250,000; this is primarily undertaken by DECCW. Reconnaissance-scale soil or land system mapping covers other areas. A program of detailed land-use mapping across the state is nearing completion
- *Assessment systems* – a number of soil and land assessment systems have recently been developed that will ultimately lead to more sustainable land management. These include:
  - a system to assess the impact of various land management actions on soil condition
  - an LSC assessment system, with draft mapping completed across NSW
  - soil and landscape constraint assessment system
  - the Tools2 (SLICK) modelling system which allows for assessment of the impact on soils from different management options

- *Information exchange and advice* – soil and landscape information and land management advice is provided through various publications, maps and databases (see www.environment.nsw.gov.au/soils/index.htm). The NSW Soil and Land Information System (SALIS) is run by DECCW and is intended as the single soil database for soil information in NSW. The Natural Resource Atlas (www.nratlas.nsw.gov.au) is used to access publicly available soil profile information. The NSW Land Management Database (LMD) is currently being developed and distributed to CMAs throughout the state. Extension services that encourage sustainable land management practices by landholders are undertaken widely by I&I staff throughout the state
- *Research* – programs aimed at improving soil condition, productivity and sustainable land management practices are carried out by various national and state institutions, including the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities, I&I, DECCW and rural industry bodies (eg Grains Research Development Corporation).

## Regional level

The Murray Catchment Action Plan (CAP) is the key document that coordinates and drives the effort to improve natural resources across the region. It describes the whole-of-Government approach to soil condition and sustainable land management targets and sets the direction for investment in NRM over the next 10 years. The Murray CAP can be found at www.murray.cma.nsw.gov.au.

The CAP includes specific targets, with specific areas (hectares), that will address the broader state targets. These targets are achieved through the following:

### *Data collection*

This involves the development of a baseline of soil information and collection of land management data over individual properties. Additional information will be added to the NSW LMD.

### *Planning*

Priority issues are identified, such as:

- refinement of priority salinity provinces for targeted salinity investment
- development of soil priority zones using MCAS-S (multi-criteria analysis shell)
- development of priority water erosion zones using SEDNET modelling and multi-criteria analysis
- development of soil landscape maps based on wind erosion data to determine priorities for wind erosion incentives.

Also identified are locations for improved land management and associated investment.

### *Collaboration*

Partnerships are formed with farming organisations, industry groups, relevant government agencies (particularly DECCW, I&I, the Land and Property Management Authority), tertiary institutions, Landcare and similar community groups and individuals. Examples of specific collaboration include the following:

- community stream sampling project – to date*, 36 priority streams have been monitored for EC, temperature, pH and turbidity
- roadside Wind Erosion Survey and Community Dust Watch project – to date*, two 'dust track' machines and 500 ground cover monitoring points have been established. An additional instrument was purchased and is located in the east of the catchment to provide greater coverage

- irrigation accreditation courses, irrigation whole-farm plans, irrigation area stormwater and wastewater management systems and salinity discharge management (conducted with Murray Irrigation Limited in Land and Water Management Plans).

### *Awareness and skills-raising*

Training days and workshops, such as salinity conferences, are held. SoilWatch kits have been developed for landholders and various guidelines and information sheets have been produced on various topics.

The 2008–09 Conservation Farmer of the Year Awards (Slopes and Plains) was included as part of regional awards, as well as the cross-regional annual awards.

Landholder participation is encouraged in soil improvement activities.

### *Contracts and programs with landholders*

Contracts have been developed with landholders to modify and improve land management practices.

Incentive programs, aimed at improving land management practices, have also been implemented. Outcomes included:

- protection and treatment of severe gully erosion on 1390 hectares (ha), covering over 33 kilometres
- protection and treatment of streambank erosion on more than 4360 ha, covering over 89 kilometres
- establishment of stock containment areas to protect soil from erosion on over 170,000 ha.

### *Continued monitoring and evaluation*

Monitoring programs to assess progress towards the targets will continue under CMA and DECCW programs. These include:

- soil benchmarking project – to date*, 107 sites have been monitored and 22 different soil condition attributes tested, including MIR assessment of labile carbon, as part of a collaborative program with the University of Western Australia and Land and Water Australia
- soil testing, undertaken by 400 landholders, as part of a community-based project called Healthy Soils – Healthy Landscapes
- nationally-funded DAFF Soil Carbon Research Program, a collaborative CSIRO and DAFF Project (spanning two years) that aims to establish 200 sites in the Murray catchment.

Other initiatives include:

- revegetation with strategically targeted woody vegetation – to date* over 240 ha
- establishment of perennial pastures – to date* over 23,100 ha
- establishment of plantation forestry for recharge control
- reduced salt concentration in saline runoff from discharge areas – to date* over 250 ha
- Slopes to Plains Project – to date* 13 programs funded, based on improved soil management practices
- investment in the Soil Health Slopes to Plains Program 2008–09 – 19,921 ha (Plains) and 14,725 (Slopes) exceeding the management target of 10,000 ha (Plains) and 4250 ha (Slopes).

Further details and examples of many of these activities are reported in the CMA's recent annual reports.

Other regional or local based bodies and programs that aid in improved land management include:

- local councils through their compliance with the *Local Government Act 1993* and local or regional planning instruments such as local environmental plans and regional environmental plans
- Landcare groups that facilitate improved landholder knowledge and on-ground works such as:
  - Fowlers Wagra Landcare group's perennial pasture establishment and soil testing project
  - Corowa Landcare's establishment of 80 ha of saltbush on 10 demonstration sites
  - West Hume Landcare's four formal workshops and field days to promote best management relating to cropping and livestock systems
  - Green Gully Landcare's tile drainage and salinity mitigation project
- universities that undertake research programs in the region, such as:
  - Charles Sturt University investigation into quantifying soil processes that contribute to acidification in cropping and grazing systems
  - Evergraze, a collaboration between Charles Sturt University and I&I that researches optimal pasture management
- Murray–Darling Freshwater Research Centre that researches areas such as the impacts of wakeboarding on erosion.

* 'to date' refers to the period July 2006 to June 2008.

## Further reading

DECC 2008, *NSW Monitoring, Evaluation and Reporting Project, Land Management Survey 2008,* Gray J, Chapman G, Murphy B & Jenkins B (eds), Department of Environment and Climate Change, Sydney.

DECCW 2009, *Protocols for Soil Condition and Land Capability Monitoring,* prepared by Greg Bowman, Greg Chapman, Brian Murphy, Brian Wilson, Brian Jenkins, Terry Koen, Jonathan Gray, David Morand, Glenn Atkinson, Casey Murphy, Andrew Murrell and Humphrey Milford, Department of Environment, Climate Change and Water NSW, Sydney.

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