State of the catchments 2010

Soil condition

Western region

State Plan target

By 2015 there is an improvement in soil condition.

Background

Soil condition is the ability of soil to deliver a range of essential services, including habitat for soil biota, nutrient cycling, water retention and primary production. Soil condition is commonly referred to as 'soil health' by land managers; however the term 'soil condition' is used in this report to ensure consistency with other targets. For this report, current condition is compared to reference or natural condition using program baseline data, existing data and expert knowledge.

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 (SOC) 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.

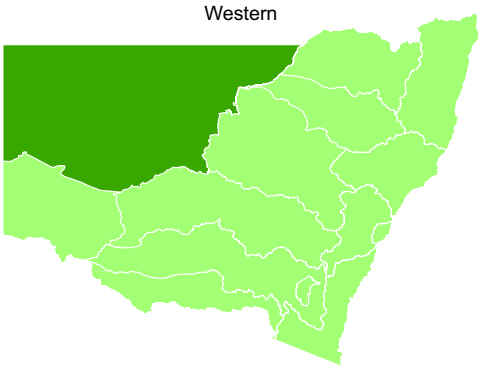
Soil condition monitoring program

The principal current objective of the program is to create a baseline against which future changes in soil condition can be measured.

Soil condition has been assessed for 124 priority soil monitoring units (SMUs) across the state. An SMU is a large tract of land with a predictable pattern of soils, where changes in soil condition and land management can be observed. Up to 10 SMUs were jointly selected within each region by DECCW and catchment management authority (CMA) staff, based upon their area, importance, pressures and vulnerability.

A network of permanent monitoring sites is being established within the SMUs across the state. Fieldwork commenced in June 2007 and, state-wide, 830 sites have been sampled as of this reporting date. This report focuses on current condition and uses soil monitoring data available from 700 of those sites and laboratory data available for 500 sites. Data collection and laboratory testing is continuing. The report is a brief summary of available results. A separate technical report contains more detailed information on methods and references.

Map of the catchment



The distribution of SMUs in the Western region is shown in Figure 1. The SMUs collectively covered 38,000 km^2 or about 17 per cent of the catchment.

Assessment

Within each SMU, up to 10 representative soil monitoring sites were established. Thirty-five sites were established in the Western region. Where possible, sites were paired to reflect differences in land-use on similar soils.

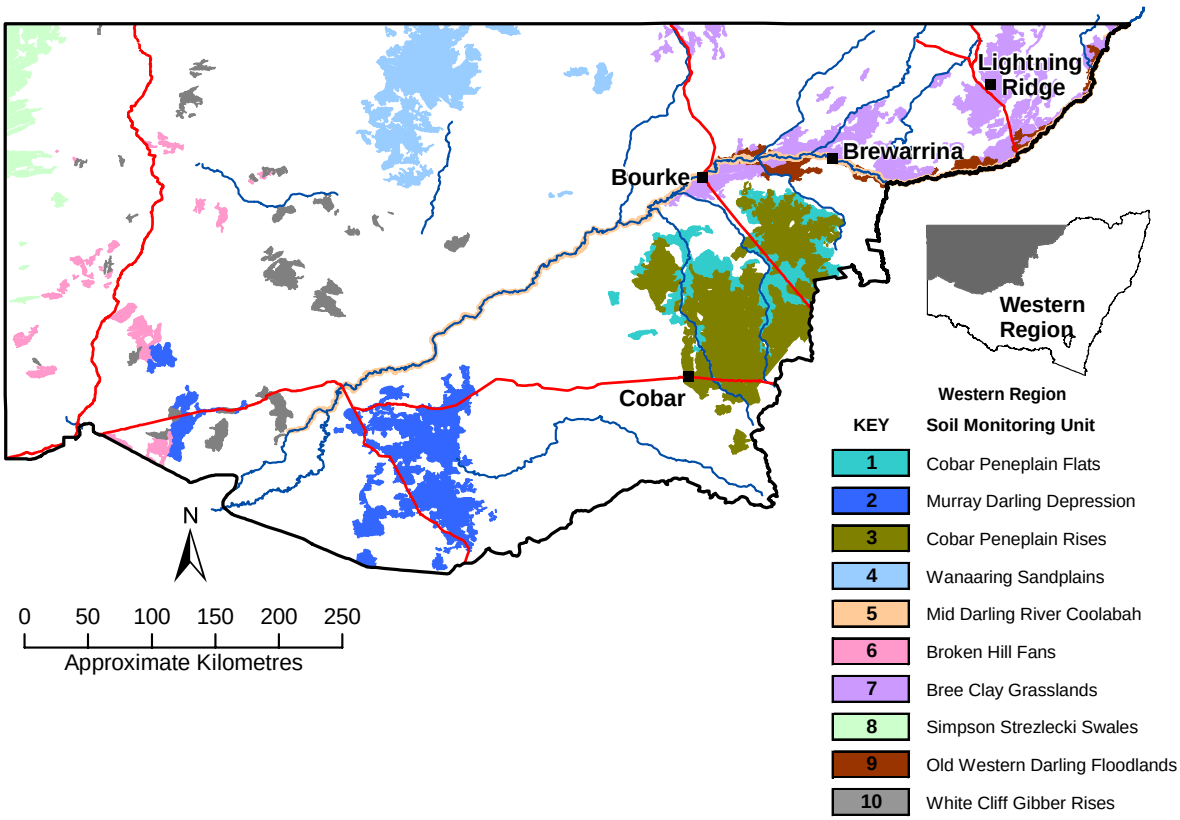


Figure 1 Location and extent of SMUs in the Western region

Condition

Soil condition indicators are measured soil properties that respond to soil pressures. Indicators were assessed using a combination of field observations, field measurements and laboratory analyses. Details concerning the indicators and details of evaluation methods are found in the technical report.

Soil condition indicator classes are based on the degree of deterioration of soil function against a reference or 'natural' condition, determined from measurements in undisturbed sites, published literature and modelling.

The ***soil condition index*** is a measure of the condition of the soil compared to reference conditions. It is the average value of all relevant condition indicator classes within an SMU or region. Results of the assessment of the soil condition index for each SMU in the Western region are given in Table 1 and in Figure 2.

To show the ***range*** of values, a pie chart is provided in Table 1 to indicate the proportion of classes. Trend in condition is not available as only baseline data at one point in time has been collected as of the date of this report. As a surrogate, an ***expected trend*** in soil condition is provided, based on the degree to which land management is within capability (see the land management state of the catchments (SOC) report). ***Data confidence*** is based on how the age, compliance with baseline protocols, replication and representativeness of the data can be used to determine current condition.

Table 1 Soil condition of SMUs in the Western region

Soil monitoring unit	Soil monitoring unit name Soil types and monitored land use	Average soil condition index[a]	Range of indices[b]	Expected trend in soil condition[c]	Lowest scoring soil condition indicators and index[d]		Data sources[e] and confidence[f]
1	**Cobar Peneplain Flats** Red Kandosols. Rangelands and cropping.	3.5		↔	Organic carbon	2.0	K, S and B Low
2	**Murray Darling Depression** Calcic Calcarosols. Rangelands.	3.7		↔	Wind erosion	2.6	K, S and B Medium
3	**Cobar Peneplain Rises** Red Kandosols and Leptic Rudosols. Rangelands.	3.3		↔	Gully erosion, Organic carbon	2.0	K, S and B Low
4	**Wanaaring Sandplains** Red Kandosols and Arenic Rudosols. Rangelands.	3.3		↔	Wind erosion	1.6	K, S and B Low
5	**Mid Darling River Coolabah** Grey Vertosols. Rangelands.	3.7		↔	Wind erosion	2.6	K, S and B Medium
6	**Broken Hill Fans** Brown Vertosols and Brown Chromosols. Rangelands.	3.8		↔	Wind erosion	1.6	K, S and B Medium
7	**Brewarrina Clay Grasslands** Brown Vertosols and Brown Dermosols. Rangelands and cropping.	3.5		↔	Wind erosion	2.2	K, S and B Low
8	**Simpson Strezlecki Swales** Arenic Rudosols and Red Kandosols. Rangelands.	3.7		↔	Wind erosion	1.0	K, S and B Medium
9	**Old Western Darling Floodlands** Grey Vertosols. Grazing.	3.9		↔	Soil structure	2.5	K, S and B Medium
10	**White Cliffs Gibber Rises** Stony Brown Vertosols and Stony Red Chromosols.	3.8		↔	Wind erosion	2.6	K, S and B Low

Legend for Table 1

a Soil condition index:

4.6 – 5.0	Very good	No loss of soil function. Either no deterioration or an improvement on reference condition
3.6 – 4.5	Good	Slight loss of soil function. Noticeable but not significant deterioration against reference condition
2.6 – 3.5	Fair	Noticeable loss of soil function. Noticeable deterioration against reference condition
1.6 – 2.5	Poor	Significant loss of soil function. Considerable deterioration against reference condition
<1.5	Very poor	Profound loss of soil function. Severe deterioration against reference condition
	No data	Not included for change monitoring. Information available in support documents

b Range of indices: pie chart shows variation in soil condition indices for the different indicators in each SMU

c Expected trend in soil condition, based on degree to which land is managed within its capability:

↑	Soil condition is improving
↔	Soil condition shows no change
↓	Soil condition is declining

d Lowest scoring soil condition indicators and index: gives the indicator(s) of most concern in the SMU, with the associated index

e Data source:

B	Baseline data for soil condition – from field and laboratory measurements
S	New South Wales Soil and Land Information System (SALIS)
K	Expert knowledge, publications, maps and reports
M	Modelled data

f Data confidence:

High	Derived from representative sites in the baseline study, compared with data from SALIS and evaluated using expert knowledge
Medium	Derived from incomplete baseline and/or SALIS and has been evaluated using expert knowledge
Low	Derived from modelling or expert knowledge

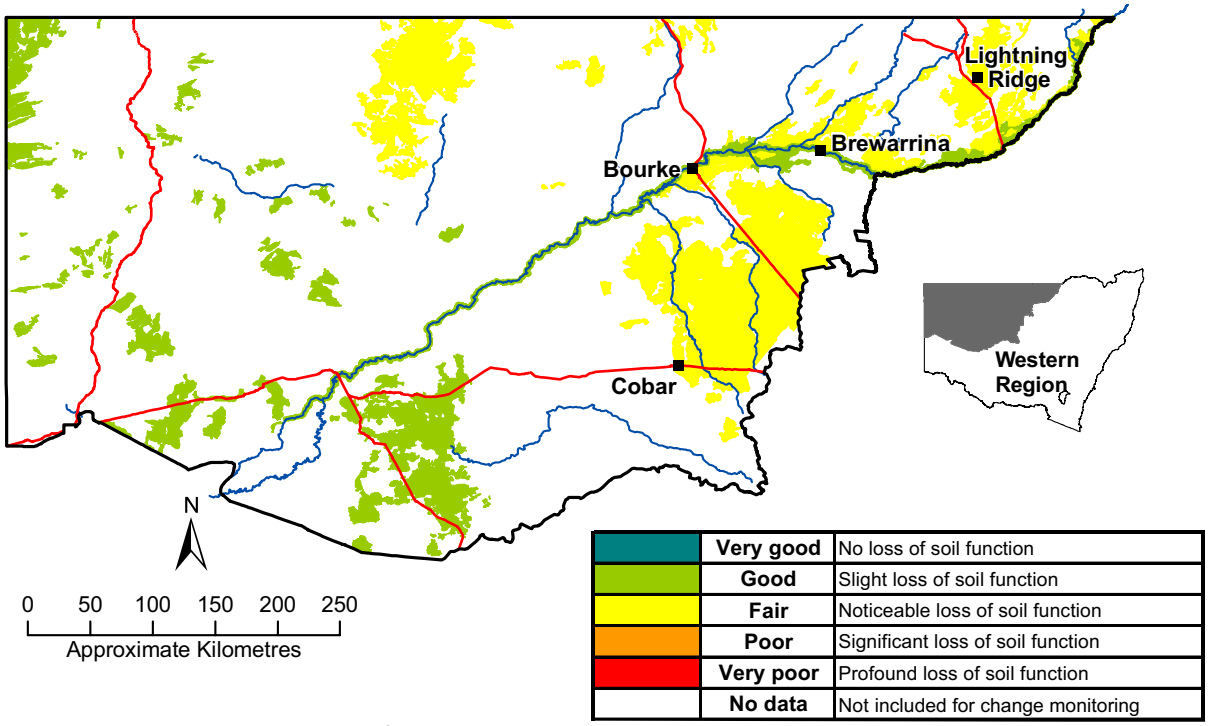


Figure 2 Soil condition index for SMUs within the Western region

Table 2 shows soil condition, by indicator for all SMUs in the Western region. A pie chart is provided to show the proportion and ***range*** of classes. As for Table 1, ***expected trend*** is based on the degree to which land management is within capability (see land management SOC report). ***Data confidence*** is based on how the age, compliance with baseline protocols, replication and representativeness of the data can be used to determine each indicator.

Table 2 Soil condition indicators in the Western region

Soil condition by indicator	Soil condition indicator index[a]	Range of indices[b]	Expected trend in soil condition[c]	SMUs with poor or very poor condition[d]	Data sources and confidence[e]
Erosion - sheet Water erosion, predominantly rain splash and non-concentrated flows. Erodes topsoil and reduces terrestrial and aquatic ecosystem function and productivity.	5.0			-	K, M and B Low
Erosion - gully Water erosion of topsoil and subsoil by concentrated overland flows. Reduces land management options and reduces terrestrial and aquatic ecosystem function and productivity.	3.2			3	K, M and B Low
Erosion - wind Wind erosion of topsoil and subsoil by the actions of wind. Reduces land management options and reduces terrestrial and aquatic ecosystem function and productivity.	2.8			4, 6, 7, 8	K, M and B Medium
Acidity Soil pH is a major indicator of soil chemical health. Declines without adaptive management practices such as addition of sufficient lime. Associated with erosion, structure and carbon decline.	3.7			-	K, S and B Medium
Organic carbon Prime biological determinant of soil health. Sensitive to land management practices including those that sequester carbon by plants from the atmosphere.	2.7			1, 3, 4	K, S and B Medium
Soil structure Architectural arrangement of soil particles and voids. Governs soil water and gas exchange. Prime determinant of soil physical health.	3.3			-	K, S and B Medium
Soil salinity Build up of salt in the soil or on the ground surface. Potential to cause profound terrestrial and aquatic ecosystem damage including massive erosion.	4.4			-	K and B Low
Soil condition index for Western region	3.6				
State soil condition index	3.7				

Legend for Table 2

a Soil condition indexes are scored using the same methods as Table 1

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

c Expected trend in soil condition, based on degree to which land is managed within its capability

↑ Soil condition is improving

↔ Soil condition shows no change

↓ Soil condition is declining

d SMUs with poor or very poor condition: gives the SMU numbers (see Figure 1) for which the indicator in question is rated poor or very poor (<=2.5)

e Data source and confidence: see legend for Table 1

Pressures

Land management practices are the primary pressure on soil condition and are dealt with in the SOC report on land management within capability.

Management activity

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

Increasing the area of land being managed within its capability is one of NSW's natural resource management (NRM) targets as outlined in the NSW State Plan.

Addressing the target within the Western 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 *Western Lands Act 1901*.

Policies and strategies

The State Soils Policy (1987) outlines important 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 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 which will ultimately lead to more sustainable land management. These systems, which have primarily been developed by DECCW, include:

  – a system to assess the impact of various land management actions on soil condition

  – a land and soil capability (LSC) assessment system, with draft mapping completed across NSW

  – a 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 is being developed and distributed to CMAs throughout the state. Extension services that encourage sustainable land management practices by landholders are undertaken widely by Industry & Investment NSW (I&I) staff throughout the state.
- *Research* – research programs aimed at improving soil condition, productivity and sustainable land management practices are carried out by various national and state institutions, including Commonwealth Scientific and Industrial Research Organisation, universities, I&I, DECCW, rural industry bodies (eg Grains Research Development Corporation).

Regional level

The Western 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 and provides direction for investment in NRM over the next 10 years. The Western CAP can be found at www.western.cma.nsw.gov.au/Pages/Tenyearcatchmentplan.html.

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 the collection of land management data over individual properties, for example:

- a database has been implemented to capture changes in land use resulting from Western CMA funding
- the Western CMA supports the Rangelands Assessment Program that monitors rangeland condition and collects information about land management on private property.

Planning

Priority issues are identified, as well as 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 (LC) and similar community groups and individuals. Examples include the following:

- The Western CMA has engaged I&I to benchmark the effects of cropping on red and grey soils in the Western catchment
- The Western CMA is working with I&I and Swift NRM to develop best management practice guidelines for grazing and cropping, with consideration given to improving soil condition
- A collaborative project with Central West CMA is being undertaken to investigate the impact of invasive native species management on soil condition
- The Western CMA is working with the Cotton Catchment Communities Cooperative Research Centre and Cotton Australia on an education and extension program for managing land on cotton properties.

Awareness and skills raising

Training days and workshops are held, for example:

- field days have been held to demonstrate the benefits of undertaking rehabilitation works and the effectiveness of various grazing management strategies
- landholder training courses have been held to assist in improved grazing management on properties and to provide guidance in managing land within its capability.

Guidelines and information sheets have also been produced.

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. For example, an incentive program has been implemented to provide landholders with funding to:

- undertake rehabilitation works on scalds and eroding gullies
- purchase or convert existing machinery to increase landholder capacity for no-till farming
- undertake treatment and prevention works to minimise the extent and spread of invasive native scrub and to remediate native perennial pastures
- improve groundcover in both grazing and cropping properties with the objective to improve soil condition.

To date, 5404 hectares (ha) of land have been treated for or protected from soil erosion by engineering works and a further 339,849 ha of invasive native scrub have been managed.

Continued monitoring and evaluation

The Western CMA:

- supports the annual Carbon Cocky Award that recognises a landholder actively implementing BMP to improve soil condition
- supports landholders in obtaining accreditation under the Cotton BMP
- is about to commence a social benchmarking study to examine the extent of landholder adoption of BMP
- is currently facilitating landholder contact for DECCW to set up a network of permanent monitoring sites.

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

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

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. Landcare also implements an incentive program that provides funding to groups of landholders to improve soil condition
- universities undertaking research programs in the region.

Further reading

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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