State of the catchments 2010

Soil condition

Hawkesbury–Nepean 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.

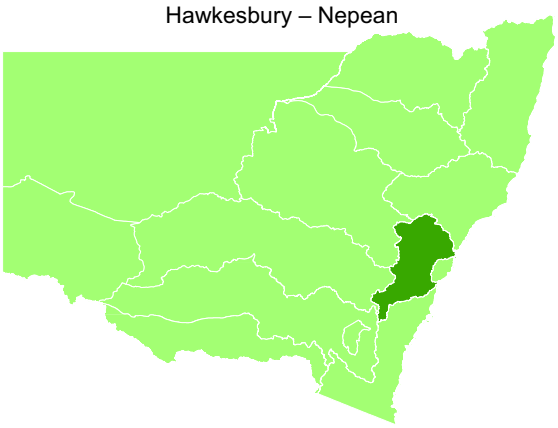
Soil condition monitoring program

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 Hawkesbury–Nepean region is shown in Figure 1. The SMUs collectively covered 1930 km^2 or about nine per cent of the catchment.

Assessment

Within each SMU, up to 10 representative soil monitoring sites were established. Forty-seven sites were established in the Hawkesbury–Nepean region. Where possible, sites were paired to reflect differences in land-use on similar soils.

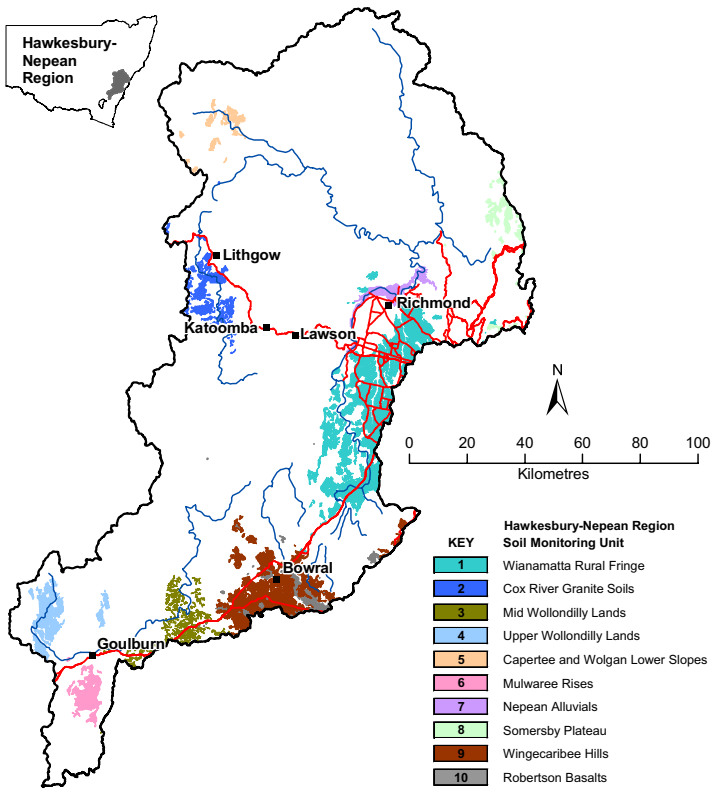


Figure 1 Location and extent of SMUs in the Hawkesbury–Nepean region

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 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 Hawkesbury–Nepean 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 Hawkesbury–Nepean 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	**Wianamatta Rural Fringe** Dystrophic Brown Kurosols and Natric Yellow Kurosols. Improved pasture.	3.8		↔	Soil salinity	1.5	K, S and B Medium
2	**Cox River Granite Soils** Red Kandosols and Rudosols. Improved pasture.	3.5		↔	Sheet erosion	2.0	K, S and B High
3	**Mid Wollondilly Lands** Yellow and Brown Kurosols and Yellow Kandosols. Improved and native pasture.	3.7		↓	Organic carbon	2.5	K, S and B High
4	**Upper Wollondilly Lands** Yellow Kandosols and Yellow Kurosols. Native and improved pasture.	3.7		↔	Organic carbon	2.3	K, S and B Medium
5	**Capertee and Wolgan Lower Slopes** Brown and Red Chromosols, Kurosols and Kandosols. Improved pasture and woodland.	3.8		↔	Soil salinity	1.5	K, S and B High
6	**Mulwaree Rises** Brown and Grey Dermosols and Orthic Tenosols. Cropping and improved pasture.	3.9		↔	Organic carbon	2.2	K, S and B Medium
7	**Nepean Alluvials** Grey Kandosols and Fluvic Rudosols. Vegetable production.	3.6		↔	Organic carbon	2.8	K, S and B Medium
8	**Somersby Plateau** Deep Yellow Kandosols. Vegetable and tree horticulture.	3.7		↔	Organic carbon	2.5	K and S Low
9	**Wingecaribee Hills** Yellow Kandosols and Yellow Kurosols. Native and improved pasture.	3.4		↑	Acidity, Organic carbon	2.0	K and S Low
10	**Robertson Basalts** Red and Brown Ferrosols and Dermosols. Improved pasture.	3.5		↑	Acidity	2.0	K and S 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

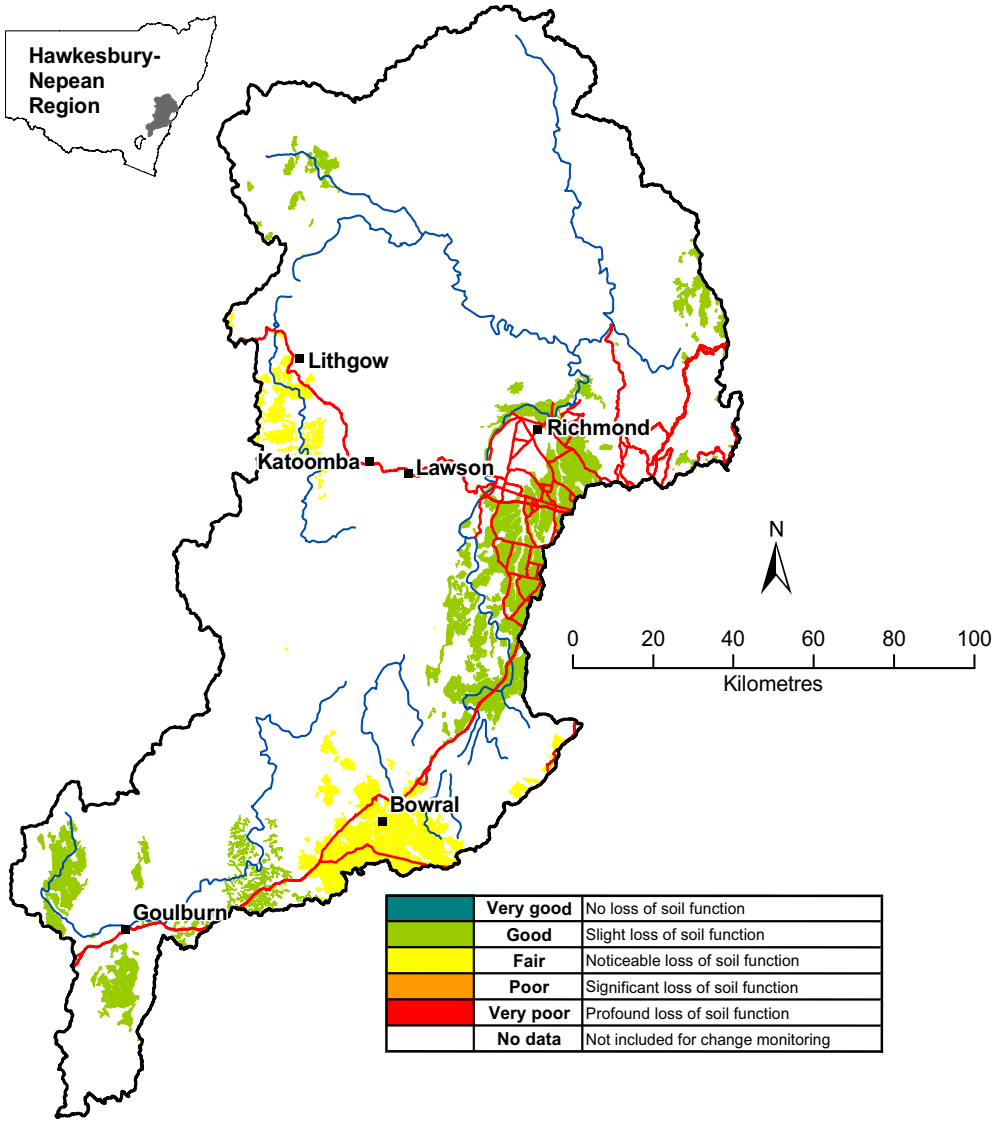


Figure 2 Soil condition index for SMUs within the Hawkesbury–Nepean region

Table 2 shows soil condition, by indicator for all SMUs in the Hawkesbury–Nepean 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 Hawkesbury–Nepean 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.	3.3		↔	2	M and B Medium
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.	4.6		↔	-	K, M and B High
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.	5.0		↑	-	K, M and B High
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.	3.1		↔	9, 10	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.	2.8		↔	2, 3, 4, 6, 8, 9	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.	3.9		↔	-	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.	3.3		↔	1, 5	K and B Low
Soil condition index for Hawkesbury-Nepean Region	3.7				
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 Hawkesbury–Nepean 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 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. 'Soil and Land Resources of the Hawkesbury–Nepean Catchment' is a digital DVD with 21 maps relating to soil landscape information, land capability and hazards for urban and rural land uses across the region; this was developed by DECCW, in discussion with the Hawkesbury–Nepean CMA, and published in September 2008. 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 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 Hawkesbury–Nepean 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 Hawkesbury–Nepean CAP can be found at www.hn.cma.nsw.gov.au/topics/2181.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, eg involvement with the development and promotion of the 'Soil and Land Resources of the Hawkesbury–Nepean Catchment' digital DVD.

Land management data will be collected over individual properties and entered in the NSW Land Management Database.

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 (LPMA)), tertiary institutions, Landcare and similar community groups and individuals. Collaborative activities include:

- targeting severely degraded land to rehabilitate and protect soil resources – this was conducted in partnership with the LPMA, Sydney Catchment Authority and catchment landholders. In 2007–08 these activities stabilised 25 kilometres of streambank/bed, protected 1500 hectares (ha) of land from soil erosion, established 16,000 plants and fenced and rehabilitated 17 ha of saline discharge
- increasing the adoption of current recommended practices regarding the application of composted organics to degraded landscapes, including saline discharge sites to improve soil condition and catchment health – this was conducted with project partners, including DECCW and I&I and included the development of *'Guidelines for Using Compost in Land Rehabilitation and Catchment Management'* published by DECCW
- management of acid soils through adoption of improved land management practices (I&I and catchment landholders).

Awareness and skills raising

A total of 276 landholders were trained in programs such as Prograze and LANDSCAN, and attended courses that focused on the application of current recommended practices.

Farmers and landholder groups were trained in plant/weed recognition, drought management, sustainable grazing and land management practices.

Various guidelines and information sheets were produced, eg Implementing Best Management Practices (BMP) for Sustainable Grazing Management and BMP for Graziers in the Tablelands of NSW (I&I).

Soil and land extension services are also provided to promote the benefits of managing land to its capability.

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.

Property-scale plans that focus on the delivery of on-ground actions, and promote the adoption and implementation of land management activities according to land capability, have been developed.

Continued monitoring and evaluation

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

- treatment of severe gully and in-stream bed and bank erosion in priority subcatchments, as identified by land degradation mapping
- hydro-geological process investigations, including mapping of groundwater flow systems, to better identify recharge/discharge sites and key areas of focus to manage dry land salinity.

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 and Bushcare groups that facilitate improved landholder knowledge and on-ground works
- universities that undertake research programs in the region, especially University of Western Sydney.

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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