NSW Diffuse Source Water Pollution Strategy

Department of **Environment & Climate Change** NSW

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Summary

New South Wales (NSW) has a network of rivers and waterways which provide the mainstay to many local communities, environmentally, socially and economically. The quality of the water in these rivers and waterways is fundamental to their health and to the community's enjoyment of them. Pollution from diffuse sources, which is most often carried by runoff from rainfall and storms, can be a serious problem affecting NSW waters and accounts for the majority of pollutant loads in the State's waterways. Runoff from many urban and rural activities results in pollutants entering water bodies, thereby reducing water quality, and has the potential to negatively affect the environment, the economy and the community. Not surprisingly, because of the diffuse nature of the sources, effective action to control this type of pollution is difficult.

Significant progress has been achieved in controlling point sources of pollution and certain diffuse sources such as stormwater. However, diffuse source water pollution remains one of the biggest challenges in improving water quality for government, industry and the community.

The NSW Government has acknowledged the importance of tackling diffuse source water pollution by calling for the development of a Statewide Diffuse Source Water Pollution Strategy to help deliver on the natural resource and environmental targets in the NSW State Plan. As well as helping to deliver on the natural resource and environment targets, the Strategy aims to reduce diffuse source water pollution in all NSW surface and groundwaters and contribute towards the community-agreed NSW water quality objectives.

This Strategy provides an approach for determining Statewide priority problems and an agreed set of management actions to focus effort and investment. The development of the Strategy has also led to a framework for coordination and fostering of partnerships across all stakeholders in NSW. It aids natural resource managers by providing a guide for investment and a means to report progress and share information on projects and outcomes as the Strategy is implemented across NSW.

A priority action plan has been developed to provide:

- ways of achieving Statewide collaboration by focusing efforts on actions that address priority diffuse source water pollution problems and commitment to those actions
- defined priority management actions to inform investment strategies and support access to Commonwealth and State natural resources and environment funding
- a mechanism for developing partnerships between stakeholders to improve coordination and efficiencies to deliver on the priority management actions
- reporting requirements aligned across government that demonstrate delivery against the Statewide natural resource management targets
- a summary of existing approaches that support the priority actions and a means to share knowledge and experience, in order that the approaches may be adopted across the State where applicable.

This Strategy will be updated periodically to reflect changing priorities, scientific understanding, experience and community values. The NSW Natural Resources and Environment Chief Executive Officers Cluster Group oversees the Strategy's implementation.

Contents

1 Introduction

Diffuse source water pollution is a complex issue. Diffuse source pollutants can lead to poor water quality and negatively impact on ecosystem health (for example loss of flora and fauna), economy (shutting down of aquaculture industries, reducing tourism and affecting water supplies) and community (risk to public health and amenity).

There is often scientific uncertainty on the fate and transport of contaminants and the relative contribution from different sources. Despite this uncertainty there is currently sufficient scientific understanding of the causes and effects of diffuse source water pollution to determine appropriate management responses to address this complex issue.

A number of New South Wales Government natural resources and environment (NR&E) agencies have legitimate roles in water quality management; however, this requires concentrated management to achieve effective integration of actions and responsibilities.

Historically, management of water pollution in NSW has focused first on controlling obvious point sources of pollution, particularly through the regulation of activities that discharge at discrete locations. Diffuse source water pollution has generally been managed through a range of programs, including education and promotion of appropriate land use management. A strategic Statewide approach to coordinate and guide action on diffuse sources of water pollution provides the next stage in controlling this challenging pollution source.

The NSW Diffuse Source Water Pollution Strategy (the Strategy) provides NR&E agencies, including catchment management authorities (CMAs) and local councils, with a policy framework for coordinated action and reporting to better manage non-licensed water pollution. The priority action plan (PAP) in Appendix I is the framework that sets out State-level priority actions and commitments to improving water quality for all surface and groundwater.

There is a need for a wide range of management approaches to address the many causes of diffuse source water pollution. In most cases a combination of management actions will produce the best effect and support landholders in making affordable changes. However, no single management action is enough to improve water quality, nor should these management actions be undertaken in isolation.

Three priority diffuse source water pollutants have been identified across NSW – sediments, nutrients and pathogens – which can arise from a multitude of sources. However, the primary focus of the Strategy will be on sources of these pollutants that are not already regulated. Examples, from both private and public land, include some agricultural practices, unsealed roads, urban stormwater and specific urban activities. Sources that are already formally regulated, including sewerage systems, public forestry operations, waste services, intensive farming and some agricultural practices (for example pesticide use) are not intended to be covered by this Strategy.

The Strategy and PAP aim to influence and focus investment by agencies to achieve synergies from their existing resources, and to support proposals for investment from other natural resource management (NRM) programs, such as the Commonwealth Government's Caring for our Country and the NSW Environmental Trust.

Annual reporting on the management actions (MAs) and periodic reviews of the Strategy will provide information on what activities are being undertaken by government agencies and landholders to support the Strategy.

The long-term intent of the Strategy is to demonstrate the management actions that will contribute to achievement of the Statewide NRM targets, agreed by Government and presented in the NSW State Plan.

2 What is diffuse source water pollution?

Diffuse source water pollution is the contamination of water bodies by pollutants arising from a multitude of diverse urban and rural land use activities across a catchment, rather than from a discrete point source (Gunningham and Sinclair 2004; Ferrier et al. 2005).

Some pollutants occur naturally and only become a problem when the rate of input becomes too high and exceeds 'natural' levels. For example, sediment enters waterways as land erodes through natural processes. However, sediment becomes problematic when large volumes enter waterways faster than can be moved through the system. In addition, sediments transport nutrients and pathogens which can adhere to soil particles.

Nutrients, sediments, pathogens, toxicants (heavy metals, pesticides and other chemicals), acidity, salinity and gross pollutants are the most common water quality problems, and they are the major components of diffuse source water pollution (DEC 2003).

An important characteristic of diffuse source water pollution is that it is mainly driven by rainfall runoff, particularly from storms. As water flows over land it picks up pollutants and transports them into surface water or leaches into groundwater. Sealed surfaces and urban drainage accelerate the transport of pollutants through rapid runoff.

The key issues affecting rivers in NSW are land use changes that result in elevated loads of nutrients and suspended sediment, changes to the hydrological regime, and loss of riparian vegetation. In addition, the scale of land use activities is an important factor in how diffuse source water pollution impacts on the environment (Norris et al. 2001).

In rural areas, management actions such as increasing riparian vegetation and groundcover will improve water quality by slowing the overland movement of water, thereby causing sediment and attached nutrients to be deposited on the land before they can reach waterways. Riparian vegetation can also take up some of the nutrients, as well as limit stream bank erosion which has been shown to be the major source of sediments to streams (Price and Lovett 2002). In urban areas, stormwater management, including water sensitive urban design and stormwater treatment measures, will continue to be important.

The best combination of management actions to address diffuse source water pollution will vary between urban and rural environments and between catchment types, depending on factors such as sources of pollution, geological features and climate.

Northern Rivers CMA

Sediment plumes can also transport nutrients.

2.1 Sources

Stormwater runoff from urban environments typically contains litter, bacteria, nutrients, chemicals, pesticides, metals, sediment and vegetation. Sources include road surfaces, industrial and commercial premises, parks, gardens, degraded riparian areas, bushfires, boats and households. Urban stormwater contaminated with sewage overflows and animal faeces is a significant source of bacterial and nutrient contamination of beaches and recreational waterways after rain (EPA 2000, section 5.9).

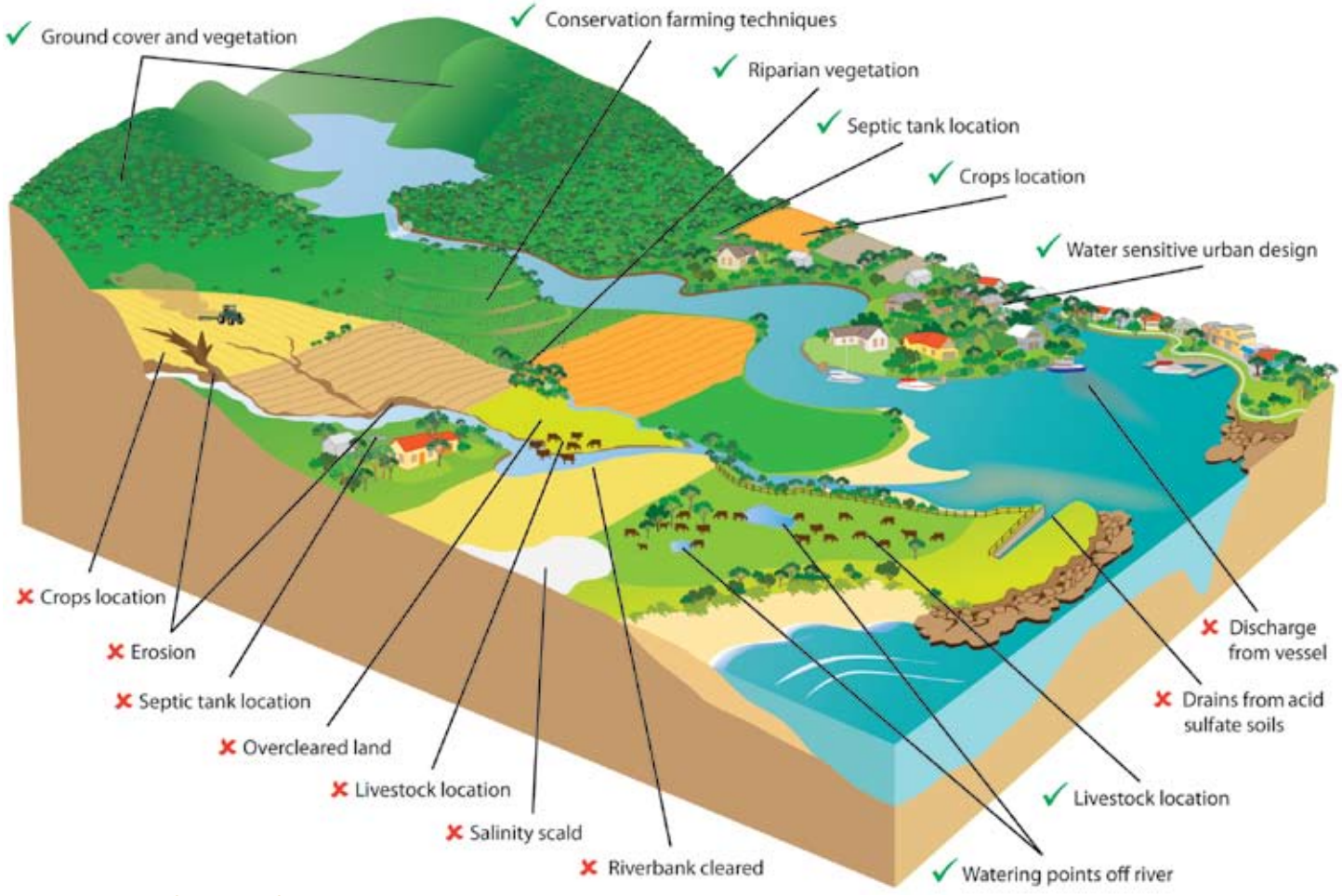
In rural areas, pollutants and their sources are dispersed over areas which are large compared to the urban environment. Some sources are unique to rural settings, such as broadacre cropping, irrigation farming, grazing and intensive livestock industries. Land clearing (particularly historical clearing) and some agricultural techniques have increased the amount of sediment delivered to waterways (Davis et al. 1998).

2.2 Consequences

Examples of diffuse source water pollution that have led to severe environmental, economic and social consequences include the closure of the Richmond River to fishing in 2001 and 2008 due to massive fish kills caused by low dissolved oxygen levels after flooding, closure of Sydney Harbour in 2006 to fishing due to dioxin contamination, restricted access to the Hawkesbury–Nepean River due to excessive aquatic weed growth caused by high nutrient levels, and toxic blue–green algal blooms in the early 1990s extending along 1,000 km of the Darling–Barwon River due to excess phosphorus (Cullen 1995; Donnelly et al. 1998; DPI 2000, 2008; Food Authority 2008).

The NSW Farmers Association's Oyster Committee estimated that in 2004–05 diffuse source water pollution cost the NSW oyster industry over $6.6 million per annum in lost sales, which is 22% of the total annual value of the NSW industry in that period. Oysters from harvest areas that do not meet food safety standards for human consumption have to be relocated to cleaner harvest areas and/or depurated to ensure they meet Australian food safety standards.

Further detail on diffuse source water pollutants and their impacts is provided in Appendix II.



Factors affecting diffuse source water pollution

2.3 Climate change impacts

Climate change may alter the current patterns of diffuse source water pollution due to projected changes in the seasonality, frequency, intensity and duration of rainfall (IPCC 2001). For example, more intense storms can lead to enlargement of streams through bed and bank erosion, thus releasing significant volumes of sediment downstream. The total annual load of sediment and contaminants that attach to sediment particles is frequently dominated by one or two large storms (Drewry et al. 2005). Therefore, climate change could further exacerbate an already significant diffuse source water pollution problem, particularly in areas that become subject to more frequent and intense storms.

The cumulative impact of frequent, low volume runoff is also significant and can contribute to long periods in which waterways are unfit for use (Harhcegani and Cornish 2003).

Examples of the possible impacts of climate change may be prolonged periods of drought, increased temperatures and evaporation rates, and increased frequency and intensity of bushfires and storms in NSW. The culmination of these impacts could result in degradation of groundcover and riparian vegetation, leading to increased soil erosion. Farming practices need to adapt to these changes.

DECC

Erosion caused by lack of ground cover

The potential for increased soil erosion requires preventative and adaptive land management and remediation of past degradation. Wider adoption of more sustainable land use will also assist in addressing a number of other land management issues, including land clearing, riparian vegetation management, dryland salinity and soil structure decline. Taken together these measures to reduce soil erosion will help deliver multiple outcomes towards meeting NSW water quality objectives (WQOs) (DEC 2006a) and ecosystem health (DEC 2006b).

Governments, landholders and the community are planning for the greater risks associated with climate change, and 'Australian agriculture is on the verge of a new opportunity for accelerated research and development to adapt farming systems to climate change' (Goss 2008). Diffuse source water pollution and climate change can therefore present opportunities to demonstrate innovation in management and adaptation to address the challenges.

Hawkesbury–Nepean CMA

Riparian vegetation, which can prevent river bank erosion

3 Purpose of the Strategy

This Strategy aims to bring together CMAs, relevant NSW government agencies and local councils to focus their collective efforts on priority problems to address diffuse source water pollution through a coordinated framework that promotes partnerships and improves information sharing.

Its primary purpose is to reduce diffuse source pollutants in all NSW surface and groundwater and to contribute towards the community-agreed WQOs and Statewide NRM targets in the NSW State Plan.

The primary objectives of the Strategy are to:

- identify new and effective ways of achieving Statewide collaboration by focusing on actions that address priority diffuse source water pollution problems
- prioritise management actions to guide investment decisions and focus efforts
- provide an agreed framework to promote and report on the implementation of priority management actions and partnerships.

The Strategy also seeks to provide the following benefits at a State, regional (CMA) and local (councils) level.

Statewide

- improved water quality and health of NSW water bodies
- increased collaboration and efficiencies between NSW government agencies on management efforts
- increased reporting on management actions
- increased information services that build an understanding of diffuse source water pollution and provide a forum to share knowledge and experience in a cost-effective manner.

Regional and local

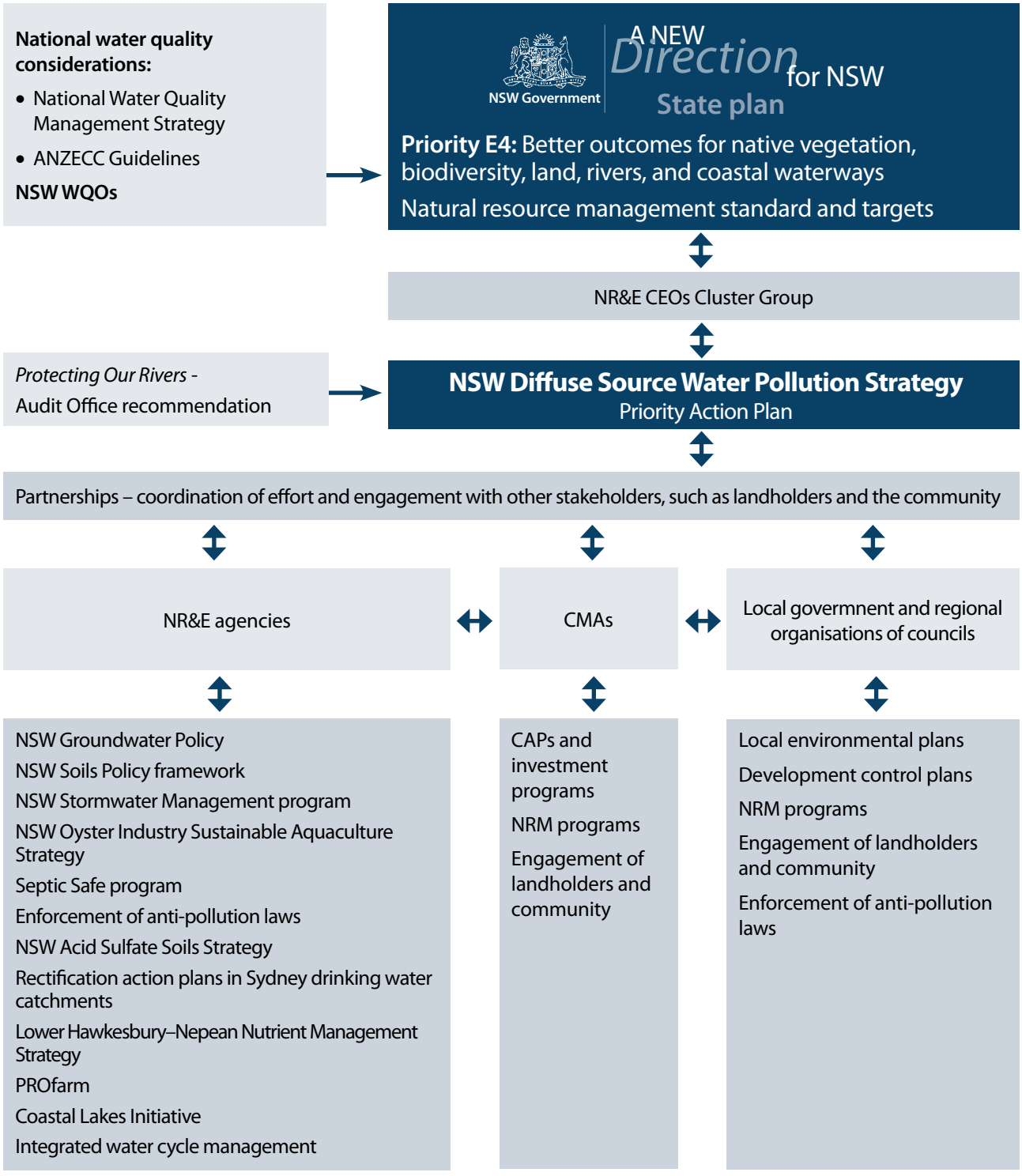
- increased understanding of management priorities to inform investment strategies
- improved support for investment proposals (for example from available Commonwealth and State environment funding)
- increased resource efficiencies and sharing of experience and knowledge
- improved understanding of the causes and effects of diffuse source water pollution in a particular area
- increased knowledge of landscapes, places and activities which are threatened by diffuse source water pollution.

3.1 Context

The NSW State Plan Priority E4 – Better outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways – nominates the Statewide NRM targets as the agreed long-term goals for improved ecosystem outcomes. Given the integrated nature of ecosystem management, the Strategy will contribute to the delivery of all these targets in the same way as many of the actions to improve native vegetation, biodiversity and land will contribute to improved water quality.

Commonwealth, state and territory governments have adopted the National Water Quality Management Strategy and the companion technical reference of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines for fresh and marine water quality (ANZECC 2000).

NSW WQOs, which are consistent with the national framework for assessing water quality in the ANZECC Guidelines, have informed the development of the Statewide NRM targets.


National water quality considerations:
• National Water Quality Management Strategy
• ANZECC Guidelines
NSW WQOs
NSW Government
A NEW Direction for NSW
State plan
Priority E4: Better outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways
Natural resource management standard and targets
NR&E CEOs Cluster Group
Protecting Our Rivers -
Audit Office recommendation
NSW Diffuse Source Water Pollution Strategy
Priority Action Plan
Partnerships – coordination of effort and engagement with other stakeholders, such as landholders and the community
NR&E agencies
CMAs
Local govermnent and regional organisations of councils
NSW Groundwater Policy
NSW Soils Policy framework
NSW Stormwater Management program
NSW Oyster Industry Sustainable Aquaculture Strategy
Septic Safe program
Enforcement of anti-pollution laws
NSW Acid Sulfate Soils Strategy
Rectification action plans in Sydney drinking water catchments
Lower Hawkesbury–Nepean Nutrient Management Strategy
PROfarm
Coastal Lakes Initiative
Integrated water cycle management
CAPs and investment programs
NRM programs
Engagement of landholders and community
Local environmental plans
Development control plans
NRM programs
Engagement of landholders and community
Enforcement of anti-pollution laws

The Strategy will contribute towards meeting the NSW WQOs and the Statewide NRM targets as diffuse water source pollution has a significant impact on water quality. Overseeing the development and implementation of the Strategy is the NR&E CEOs Cluster Group (the Cluster Group), which provides a nexus for NSW NR&E agencies to work together on strategic projects and issues common to their agencies, such as water quality.

Prior to the formation of the Cluster Group, the NSW Audit Office identified that management of diffuse source water pollution requires greater coordination to effectively address improvements in water quality and waterway health (Audit Office 2003).

There have been many strategies and programs implemented that have either directly or indirectly addressed diffuse source water pollution, such as the NSW Stormwater Management Program and Septic Safe Program, NSW Salinity Strategy and NSW Acid Sulfate Soils Strategy.

CMAs have developed catchment action plans (CAPs) that include regional targets consistent with the Statewide NRM targets. The CAPs provide a framework for developing on-ground NRM programs which can also contribute to the management of diffuse source pollution.

Local councils have made significant progress towards improving the management of diffuse sources of water pollution, including septic tanks and stormwater. Councils are also able to enter into partnerships with farmers and businesses to improve water quality, and have opportunities to work with CMAs in many NRM programs.

The context diagram above is provided to visually represent the relationship of the Strategy to existing national and State strategies, targets and programs.

It is recognised that significant efforts to control diffuse source water pollution through education, promotion of appropriate management practices, economic incentives, a wide range of training and extension programs and modification of land use are currently being undertaken (DEC 2006b). The range of programs (see Appendix III) demonstrates the complexity of the issue and the significant commitment of the CMAs, community and all levels of government to tackle the problem.

This Strategy builds on existing programs by providing a more coordinated approach to help maximise the effectiveness of these efforts and maintain the momentum of existing programs. The Strategy provides a Statewide focus on specific diffuse source water pollutants and management actions. It will add value to existing activities and identify any gaps in management approaches. Within the Strategy different approaches and tools can be applied by stakeholders to address priority diffuse source water pollutants at a regional or local scale.

See Appendix IV for an outline of the development of the Strategy.

3.2 Impediments to management

In many cases there are management approaches, regulatory measures or other tools available to address diffuse source water pollution, however there are impediments to their uptake, adoption or implementation. This section discusses the main impediments identified by stakeholders and describes how the Strategy may provide opportunities to overcome them. It is recognised that fully addressing some impediments may be beyond the scope of the Strategy and may require longer timeframes to address.

Resources

Impediment: Funding for activities to address diffuse source water pollution is prioritised against a wide variety of other programs. Many rural landholders are suffering financial hardship associated with prolonged drought, which makes investment in revegetation harder.

Opportunity: The Strategy will raise the profile and significance of diffuse source water pollution and provide a framework for achieving greater 'value for money' through collaboration and consequent synergies.

Skills and expertise

Impediment: Parts of all levels of government and the private sector are experiencing skills shortages.

Opportunity: The Strategy will foster partnerships between, within and beyond government agencies to improve efficiencies through skills sharing and capacity building.

Infrastructure

Impediment: Infrastructure used in the management of diffuse source water pollution (including urban stormwater systems) requires ongoing maintenance (both private and public) to be effective, and in some cases end-of-pipe technologies (methods used to remove a pollutant immediately prior to discharge) are considered to have questionable benefits.

Opportunity: The Strategy promotes information sharing and improved understanding of the effectiveness of different management actions on infrastructure, which should help focus management actions to achieve optimal outcomes.

Monitoring, information, data and decision support tools

Impediment: Monitoring, available quality data, information, compatible models, decision support tools and the ability to access and apply these are needed to identify the best areas for investment.

Opportunity: The Strategy facilitates information sharing through improved communication and collaboration on projects that address priority actions. It also identifies examples of approaches and available tools (see Appendix V). The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy provides a framework that allows agencies, CMAs and local government to access Statewide data on a set of consistent indicators of natural resource condition. Stakeholders can draw on and add to the State-level information (see section 6.2).

Achieving change

Impediment: Fostering attitudinal changes to improve land use is affected by landholder priorities and pressures (for example during drought)), and can take generations.

Opportunity: Actions MA 3, MA 4 and MA 5 have been included in the PAP to promote education, capacity building and incentives that will help raise community and landholder understanding and effect change.

Scale

Impediment: Impacts are spread over large geographic areas and it can take a long time to achieve outcomes.

Opportunity: The PAP action MA 1 to identify 'hotspots'[1] will assist in focusing attention on problem areas. The Strategy encourages the broadscale adoption of improved land use practices to reduce the cumulative impacts associated with diffuse source water pollution.

Regulation and compliance

Impediment: The uptake of incentives and the efforts of good performers may be undermined by inconsistent regulation between different sectors (for example, urban development is subject to tighter controls through development approvals compared with some rural land uses) and a lack of regulatory action against poor performers.

Opportunity: Enforcement is part of a package of measures currently available (including education and incentives) to reduce diffuse source water pollution. Management actions that include targeted compliance audits and investigations may be an effective way of ensuring implementation in the context of limited budgets. The Strategy also identifies a range of priority actions to achieve improved compliance, including ongoing review of legislation and policy.

1 Hotspots include areas where potential sources of pollution may be concentrated or where there are high concentrations of pollutants, particularly adjacent to highly valuable or sensitive water bodies or that may impact on environmental, social and economic assets.

Roles and responsibilities

Impediment: There is confusion over the roles and responsibilities of different stakeholders in the management of diffuse source water pollution.

Opportunity: The Strategy clarifies roles and responsibilities for all agencies and key stakeholders. The MER Strategy also provides a framework that outlines which agencies are responsible for monitoring.

Planning and policies

Impediment: Current NRM policies and the planning framework need to adequately consider and address the impacts of diffuse source water pollution in rural and urban areas.

Opportunity: The Strategy includes the PAP action MA 12 to consider how to include diffuse source water pollution issues more effectively during reviews of legislation and policy.

Coordination

Impediment: Greater coordination between different industry groups and government will improve uptake of industry standards and the adoption of best management practice.

Opportunity: The Strategy provides an opportunity to develop partnerships to improve collaboration amongst all stakeholders, including industry.

Climate change

Impediment: Episodic events are difficult to control and can cause large-scale pollution. Climate change may also exacerbate existing problems such as soil erosion.

Opportunity: It is recognised that some infrequent large events are beyond control; however, improved management of diffuse sources of water pollution should improve long-term outcomes by reducing pollutants – for example improved groundcover reduces erosion caused by rain.

3.3 Statutory framework

Pollution of waters is an offence under the NSW *Protection of the Environment Operations Act 1997* (POEO Act). There is a long history of successful enforcement of this law by the Department of Environment and Climate Change (DECC), its predecessors and by local councils against major point sources of pollution. This is similar to approaches in other Australian states and in other developed nations.

The use of prosecution and enforcement powers in relation to the cumulative impacts of the multitude of small and widely disbursed actions or non-actions that lead to most diffuse source water pollution is, however, difficult and often neither practical nor effective. This Strategy seeks to further develop awareness, pollution reduction management techniques and their application in areas and activities where standards and norms are not yet well established.

The strategic planning and development assessment process under the *Environmental Planning and Assessment Act 1979* (EP&A Act) also has an important role in managing water quality impacts. The Strategy will assist decision-makers to assess and minimise diffuse source water pollution impacts arising from existing and changing land use by providing appropriate support, information and tools.

Appendices III and IV list the elements of the overall NSW policy framework for reducing diffuse water pollution and related agency responsibilities. Appendix VIII further summarises management roles and responsibilities.

4 Priority problems

This Strategy is intended to focus on a set of priority problems that provide a greater focus for coordinated efforts. It therefore does not seek to address every issue which has been identified as contributing to diffuse source water pollution.

To assist in identifying relevant diffuse source water pollution issues, an extensive consultation process was undertaken across the 13 CMA regions in NSW to draw on the broad level of knowledge of CMAs, local government and State government.

Because diffuse source water pollution comes from a range of sources dispersed widely across the landscape, environmental impacts often manifest significant distances from the source and continue for some time after the pollution occurred. The complex temporal and spatial interaction of multiple pollutants from multiple sources makes it extremely difficult to control or mitigate pollution from diffuse sources once it enters waterways. Some remediation solutions seek to capture pollutants before they enter waterways using end of system approaches. Unless these are well maintained, however, they can become ineffective – for example constructed wetlands may become saturated with nutrients and have no net benefit if they are not maintained.

It is clear, therefore, that attention should be directed at minimising pollutant loads at the source by focusing on land uses and related management practices that will reduce water quality problems. The primary mechanism for providing this focus is the PAP.

4.1 Identification of priority problems

The approach used to identify the priority problems was based on consideration of the significant pollutants and their sources. The approach was developed and applied by a reference group consisting of agencies and CMA representatives. It also drew on information from workshops involving CMAs, local councils and other stakeholders, plus literature reviews of the current science and policy settings relevant to diffuse source water pollution both in Australia and overseas.

The full list of priority problems from the workshops was reduced to commonly identified sources across all CMA areas. A matrix analysis was then undertaken to compare the known sources against their associated pollutants. The characteristics of the pollutant–source relationship were also examined to define the scope of the interactions and to describe the extent and relevance of the source contribution.

Pollutants were then analysed using best available information in terms of:

DECC

Acidity at Bottle Bend on the River Murray

- consequence of pollutant impact (environmental, economic, social)
- frequency (all year or seasonal)
- geographical spread.

From this information a single key problem was described for each pollutant. These problems were then prioritised based on the degree to which the pollutant was associated with different sources, the extent of the problem and the consequence of the impacts from that pollutant. For the purposes of the Strategy the top three problems identified were chosen for immediate attention and are listed below. For more information on the approach used refer to Appendix VI.

	Priority problem	Key impacts to address
1	Sediment levels exceeding ANZECC Guidelines	• smothering of aquatic ecosystems • increased water infrastructure maintenance costs
2	Nutrient levels exceeding ANZECC Guidelines	• nuisance weed growth and harmful algal blooms • increased water treatment costs • reduced fishery production (commercial and recreational)
3	Pathogen levels exceeding ANZECC Guidelines	• reduced fishery production (aquaculture, commercial and recreational fishing) • human health impacts from aquatic recreation

The Strategy's primary focus will be on these three priority problems to address the key impacts identified as having the greatest significance now. There are many sources contributing to these impacts, as listed in Appendix VI. The PAP in Appendix I outlines the priority State-level actions to address these problems.

Other types of pollution have significant impacts on economic, social and environmental values and many of these are being addressed by specific programs. For example, acidity (predominantly from acid sulfate soils) is being partially addressed through specific programs, such as the National Strategy for the Management of Coastal Acid Sulfate Soils (National Working Party on Acid Sulfate Soils 2000) and efforts by State government, CMAs and local councils to remediate hotspots.

Salinity is also being addressed through Caring for our Country[2], programs delivered under the NSW Salinity Strategy and a range of salt interception schemes (DLWC 2000). Salinity in NSW has shown improvement at some monitoring sites during 2003–2006 (DEC 2006b).

While these programs have been delivered, there may be a need to review the relevant policy frameworks to determine future directions in relation to the management of these issues. Despite being targeted, acid sulfate soils and salinity continue to have severe impacts and are emerging in new areas. For example, in 2006 the Murray–Darling Freshwater Research Centre undertook an assessment of acid sulfate soils that showed inland wetlands (mainly along the River Murray) are at similar risk from sulfidic sediments as coastal wetlands (Hall et al. 2006).

MA 12 has been included in the PAP to address acid sulfate soils and salinity management when relevant policy is due for review.

It is also recognised that other sources of diffuse source water pollution may have local or regional significance in terms of economic, social and environmental impacts. These may require additional or alternative approaches at the local and regional level and in these cases the Strategy will complement regionally specific work. Any information gathered on additional diffuse source water pollution management actions can also be used to reassess priorities during review of the Strategy and to share information between stakeholders on innovative management approaches.

For more detailed information on the prioritisation approach used, including priority setting and priority action planning, refer to Appendix VI.

2 Caring for our Country is the Commonwealth Government's new NRM program. It commenced on 1 July 2008 and integrates delivery of the Commonwealth's existing NRM programs, the Natural Heritage Trust, the National Action Plan for Salinity and Water Quality, the National Landcare Program, the Environmental Stewardship Program and the Working on Country Indigenous land and environmental program (www.nrm.gov.au).

4.1.1 Sediment

Across NSW, past land use practices (urban development, forestry, agriculture and mining), as well as other disturbances of the soil, have greatly accelerated natural rates of soil erosion by reducing vegetation cover. This has in turn increased runoff and reduced resistance to water and wind erosion causing degraded flow paths and gully erosion (Edwards and Zierholz 2006). Improving groundcover is critical to reducing soil erosion and preventing sediment entering streams.

Erosion is the largest contributor to turbidity and nutrient pollution in water bodies. Agricultural land use changes have been shown to have accelerated soil erosion by 1–2 orders of magnitude, with rates 5–25 times greater than natural levels common in southern Australia and 25–50 times greater in the northern Murray–Darling Basin (Hughes et al. 2001). Unsealed roads, earthworks or cleared areas can also be a significant source of sediment that can directly enter streams through crossings (DEH 2001).

Soil erosion can cause downstream impacts on creeks, rivers, reservoirs, lakes, and estuarine and marine environments. Water-borne erosion increases the supply of sediment to rivers. High concentrations of suspended sediments in rivers can:

Hawkesbury–Nepean CMA

Poor riparian vegetation can cause bank slumping.

- reduce stream clarity
- inhibit respiration and feeding of stream biota
- diminish light needed for photosynthesis
- cause eutrophication of rivers and wetlands
- make water unsuitable for irrigation
- require treatment of water for human use
- smother the stream bed
- increase land flooding.

Suspended sediment can also carry other pollutants such as adsorbed pesticides, nutrients, heavy metals and organic matter. Reducing sediment input should help address the impacts of these pollutants.

See Appendix VII for a more detailed overview of land use in NSW and its impact on water quality.

4.1.2 Nutrients

As discussed previously, the greatest source of nutrient pollution in NSW waterways is from erosion. The dominant source of phosphorus (over 50%) is hill slope erosion. Similarly, hill slope erosion is the source of the majority of total nitrogen loads in coastal NSW. In the Murray–Darling Basin hill slope erosion and dissolved nitrogen produce similar loads (Australian Government 2007).

While erosion and nutrient input from erosion do occur naturally, it is the increased level of these sources that creates problems and is one focus of the Strategy. For example, it is estimated that in river networks, compared to pre-settlement estimates:

- average annual total phosphorus loads are nearly three times higher
- average annual total nitrogen loads are more than double.

High levels of nutrients in waterways can have significant impacts on ecological processes in streams through:

- reduced diversity – a small number of algae and aquatic plant species dominate
- reduced system resilience
- catastrophic system collapses as algae and aquatic plants decay, causing dissolved oxygen levels to crash and the consequent death of aquatic fauna.

Algal blooms can result in human health impacts and the closure of local waterways for swimming, fishing and boating. Some algae can release chemicals that produce a foul taste and toxins in rivers, lakes and estuaries. Stock can be poisoned from drinking water from affected rivers and dams. The presence of these chemicals in drinking water supplies can require expensive water treatment techniques and in some cases can render water supplies undrinkable.

4.1.3 Pathogens

Pathogens associated with diffuse source water pollution are generally restricted to those capable of causing human health problems (mainly bacteria and viruses). There is no information linking these pathogens with impacts on aquatic ecosystems. Three major sources of pathogen pollution pose a significant risk to humans – effluent from leaking on-site sewage treatment, leaking sewer systems and animal faecal matter (from stock and wild populations).

Pathogen pollution can cause human health impacts from recreational contact, consumption of untreated water or consumption of aquatic animals that have been exposed to the pathogens. This can result in the closure of aquaculture harvest areas and recreational and commercial fisheries with economic and social consequences. Additional water treatment may also be necessary and this has a financial impact.

Hawkesbury–Nepean CMA

Nutrient run-off will come from intensive agriculture unless controlled.

DPI

Conservation farming techniques to increase groundcover

5 Priority action plan

Delivery of the Strategy will be achieved through the PAP, which is the agreed framework that aims to provide beneficial outcomes for all levels of government, industry and the community by identifying cost-effective approaches and efficient collaboration to address diffuse source water pollution. The PAP promotes:

- State-level management actions that address priority diffuse source water pollution problems to guide investment decisions and focus efforts to improve water quality and health of NSW water bodies
- collaboration and efficiencies between NSW government agencies and other stakeholders through the establishment of partnerships
- Statewide reporting on management actions to increase available information that builds understanding of diffuse source water pollution
- sharing of knowledge and experience to add value to existing programs that can be expanded to support a Statewide approach
- progress towards achieving the Statewide NRM targets
- improved understanding of the causes and effects of diffuse source water pollution, and which landscapes, places and activities are threatened by it.

The PAP identifies priority management actions and associated Statewide NRM targets, projects that have been committed to that will progress the implementation of those actions, suggested scope for new projects, timeframes, and lead agencies and partners (see Appendix I).

Implementation of the PAP will involve a range of stakeholders with a responsibility for or interest in water quality and catchment management. The roles and responsibilities of the lead agencies in implementing the PAP are discussed below, and a broad overview of management roles and responsibilities, which includes other key stakeholders not mentioned below, is provided in Appendix VIII.

It is up to the discretion of each agency to implement a process in undertaking the responsibilities outlined, with the exception of reporting on management actions which will follow a defined process developed jointly with the relevant agencies.

Hawkesbury–Nepean CMA

Managing stock access to waterways

5.1 Implementation partners

The NSW Government and the Cluster Group set the strategic direction for NRM in NSW. The Cluster Group focuses on improved service delivery to stakeholders and reduced complexity in NRM to increase efficiencies through improved coordination and sharing of information. As such, the Cluster Group is responsible for the endorsement and monitoring of the Strategy.

State Government agencies identified as lead agencies in the PAP will implement the Strategy through the following approaches.

1 Fostering partnerships

Lead agencies will encourage the formation of partnerships between other State government agencies, CMAs, local councils, industry and community groups to engage them in implementing the PAP management actions.

2 Coordination of management actions

Each lead agency is a point of contact for any queries relating to a management action, and provides supporting information and/or expertise to assist with the implementation of the action.

3 Statewide reporting on management actions

Lead agencies are responsible for reporting on progress with partners on the implementation of the Strategy. The PAP also informs CMAs of agreed priorities for action on diffuse source water pollution considered most effective in contributing to the Statewide NRM targets for groundwater, riverine, wetland, estuarine and marine health.

The on-ground projects that CMAs develop in their investment programs and CAPs are likely to be among the most important contributions to regional and local diffuse source water pollution management. As such, CMAs' four-yearly rolling investment programs should be consistent with the Strategy.

5.2 Funding opportunities

In addition to the secure base-level funding provided by the Commonwealth and State governments, CMAs may be able to bid for additional money to support the Strategy available under Caring for our Country. Funding may, for example, be provided for improvement in soil management on farms (Australian Government 2008).

As councils are also able to access Caring for our Country funding to deliver projects that make the Strategy a success, linkages between the PAP and local government investment planning cycles and works programs should be explored and implemented where appropriate. The Strategy builds on and complements a range of existing actions undertaken by many councils, specifically in urban stormwater management. Local councils are also encouraged to make a strong contribution to the Strategy through collaborative projects and consideration of diffuse source water pollution in land use planning.

It is anticipated that the following national priorities, identified through Caring for our Country funding, align with the PAP management actions related to:

- coastal environments and critical aquatic habitats
- sustainable farm practices
- community skills, knowledge and engagement.

The Commonwealth Government has released the first Caring for our Country Business Plan, covering the 2009–10 financial year. This:

- identifies outcomes to June 2013 of Caring for our Country against each of the national priority areas for investment
- outlines the first series of short-term targets to achieve these outcomes
- invites proposals for activities to deliver investment against priorities and targets.

Another potential source of funding is the NSW Environmental Trust, an independent statutory body established by the NSW Government to support exceptional environmental projects that do not receive funds from the usual government sources. The Trust offers competitive grant programs on a yearly basis. The programs under which funding could be obtained are:

- Education
- Research
- Protecting Our Places (Aboriginal)
- Restoration and Rehabilitation
- Urban Sustainability.

NSW Food Authority

Direct stock access can degrade river banks and add to nutrient pollution.

6 Monitoring, reporting and review

While the Strategy is a joint NRM agency initiative, DECC is responsible for coordinating its implementation. As noted in the previous section, implementation of the Strategy will primarily be through the delivery of actions in the PAP.

The implementation of the PAP is intended to reduce diffuse source water pollution and improve natural resource and environmental condition. Establishing an appropriate monitoring, reporting and review framework is important to measure the effectiveness of the Strategy against its objectives and provide for continual improvement.

6.1 Strategy monitoring

Measuring NRM outcomes (to detect localised improvements in environmental condition, water quality and waterway health) is resource intensive and can take many years. In some cases it may also be impractical because improvements may take years to appear and may be difficult to separate from seasonal variation, general landscape changes and natural processes that affect water quality and riverine condition. Note that in some cases specific monitoring of certain projects may be appropriate, for example those trialling new approaches.

Many of the Strategy's benefits will be readily demonstrable through project outcomes, for example the number of projects delivered or riparian areas improved, and extrapolating these outcomes based on the principle of cause and effect that underpins each action, for example, improving groundcover reduces soil erosion.

Monitoring the delivery of actions is valuable to demonstrate increased collaboration, coordination and information sharing, which is one of the primary objectives of the Strategy. It will also provide a measure of how actions contribute to the Strategy's objectives and Statewide NRM targets. For this reason monitoring of the Strategy will be based on the delivery of projects rather than quantitative water quality outcomes. Monitoring natural resource condition is beyond the scope of the Strategy but will be important to inform its review. The link between the Strategy and natural resource condition will be informed by the Statewide MER Strategy discussed below.

6.2 Statewide monitoring, evaluation and reporting strategy

The NSW Government has committed to reporting against all the Statewide NRM targets through the NRM MER Strategy. The MER Strategy establishes a broadscale monitoring framework designed to measure improvements in both landscape condition and river health, including water quality, measured against the Statewide NRM targets. It provides a basis for government and CMAs to establish a coordinated system of monitoring, evaluation and reporting on natural resource condition. Local government and other natural resource managers may apply this framework at a local scale if they wish to align with the Statewide approach. The NSW State of the Environment report will present data and information from the MER Strategy.

The MER Strategy will provide broadscale Statewide monitoring programs that measure certain groups of indicators of natural resource condition (themes) based on the 13 natural resource targets identified under the NSW State Plan. The three themes most relevant to the Strategy are the riverine ecosystems, estuaries and coastal lakes, and wetlands. The indicators for the riverine ecosystems theme include water quality parameters (including temperature and electrical conductivity) as well as measures of ecosystem condition (including fish and aquatic macroinvertebrates). In the future the number of indicators used may be increased and indices may be developed to provide an overall picture of the condition of each theme.

Ultimately the MER Strategy will provide access to resource condition data, and periodic reports on that data will be valuable in informing the policy development, investment and management decisions of government, agencies, CMAs, local government, landholders, community groups and other natural resource managers. Future NSW State of the Environment reports will include the MER indicators as data becomes available.

6.2.1 Catchment scale monitoring

The MER Strategy is flexible enough to use other information such as when CMAs or local councils undertake additional monitoring at the catchment and local scale to fulfil their information needs and augment the Statewide data. Through the MER Strategy, agency and CMA monitoring programs will be coordinated to gain maximum use of data and minimise resource requirements, and it is partnering with several CMAs to formalise these arrangements.

CMAs are also entering into arrangements with local councils to undertake State of the Catchment reporting which will draw on Statewide data from the MER Strategy as well as information from a range of other programs including State of the Environment reports.

6.3 Strategy reporting

In undertaking its reporting role, DECC will be assisted by the lead agencies which have agreed to coordinate, facilitate and report on the implementation of individual actions identified in the PAP. These agencies will liaise with participating partners to consolidate reports on the delivery of actions that have been agreed under the PAP.

To ensure consistency and ease of reporting it is proposed to develop a reporting template that will capture simple information on the implementation of the Strategy, such as stakeholders, projects that support the management actions, and a brief description of the methodology used. Reporting could identify new and effective ways of addressing priority diffuse source water pollution problems (this may include information on an improved understanding of the causes and effects of diffuse source water pollution in a particular area).

In order to minimise the reporting task, reporting on Statewide NRM targets will not be required. This information is already captured through CMA investment program reporting and State agency reporting against the NSW State Plan. However, the PAP does indicate which Statewide NRM targets the PAP management actions are expected to support.

Reporting on the implementation of the PAP will also help to refine critical gaps in management approaches, identify new management approaches that may be applied more broadly, and identify the changing nature of collaboration between partners.

After consolidating reports from lead agencies, DECC will produce an annual report on the Strategy implementation. The annual report will be provided to the Cluster Group and to stakeholders through the diffuse source water pollution web pages on DECC's website.

6.4 Strategy review

While the Strategy initially focuses on three high priority issues to achieve tangible outcomes, it is also intended to reflect emerging issues. For example, increased detection of persistent chemicals in the aquatic environment and the potential for pollution from nanotechnology and its by-products on water quality may become a more prominent diffuse source water pollution issue in the future.

To ensure that the Strategy remains relevant, DECC will lead a periodic review to check it is achieving improved coordination and effective outcomes. Where possible the review period of four years will allow the Strategy to link with CMA investment programs. The review process will provide a framework to allow the Strategy to be updated and reprioritised to meet changing priorities, pressures and threats, stakeholder needs and scientific understanding, including the outcomes of NRM condition monitoring included in State of the Environment reporting.

Appendix I: Priority action plan 2009–2013

The Strategy highlights priority problems at a State scale; the PAP addresses these priority problems, with potential management actions considered to have the greatest impact. They cover education, best management practice, incentive mechanisms, and tools to motivate stakeholders to take action. The PAP provides a framework for integrated approaches to manage diffuse sources of water pollution and recognises that implementation of a management action can have primary and secondary benefits that relate to another management action.

Sharing ideas and information on how management actions could be implemented will be essential to making the Strategy work. To ensure it remains relevant and current, it is proposed that web pages on the DECC website be developed. This is management action MA 9 under the PAP and will be a useful tool to deliver the Strategy and provide up-to-date, readily accessible information that will reach a wide range of stakeholders. The web pages should also enhance knowledge sharing, reduce duplication and help maximise collaboration and coordination in undertaking management actions.

It will include, but will not be limited to:

- general diffuse source water pollution information
- the Strategy and PAP
- case studies of management actions
- progress reports and updates on the implementation of the Strategy
- links to other websites that have information to support management of diffuse source water pollution.

The lead agency will collect basic information on the management actions it has agreed to lead (for example, partners involved in implementing the management action, and the types of projects). This information will be captured in a reporting template (see sections 5 and 6). The reporting will be consistent with reporting on existing CMA investment programs and Statewide NRM targets. That is, there will be no additional requirements placed on agencies that already report on the Statewide NRM targets. Councils and other stakeholders may also want to demonstrate how the management action they have undertaken aligns with the Statewide NRM targets to provide consistency and continuity in reporting.

This section provides a reference and explanation of the PAP below.

State-level management actions

The State-level management actions (MAs) are listed in the PAP in rows across the width of the table. There are 12 State-level management actions (MA 1 – MA 12). They describe the desired outcome for the State, and are flexible enough to allow delivery of locally relevant management actions and projects. This allows stakeholders to demonstrate innovation in how they choose to implement management actions within the context of the desired outcome, and reflects differences between urban and rural diffuse source water pollution sources and impacts.

It is understood that some stakeholders may have existing and ongoing programs that support the management actions. It will be beneficial to all parties to list these programs and projects when reporting on the Strategy to share information. Lead agencies will liaise with stakeholders to gain feedback on the implementation of particular management actions to demonstrate how they have been addressed (see section 6.3).

This row in the table also identifies the lead agency, partner organisations, and the relevant Statewide NRM targets.

NRM targets

The Strategy is one of many strategies that will help contribute to the NSW State Plan NRM targets. Those NRM targets which are considered directly relevant to the management action are listed in the PAP; however, other of these NRM targets may have secondary relevance. Including reference to the targets provides alignment and consistency across all levels of government in reporting on NRM and recognition that the environmental outcomes are the core responsibility of all NRM agencies, including local councils.

The Statewide NRM targets of E4 of the NSW State Plan are listed by their numbers:

1. By 2015 there is an increase in native vegetation extent and an improvement in native vegetation condition
2. By 2015 there is an increase in the number of sustainable populations of a range of native fauna species
3. By 2015 there is an increase in the recovery of threatened species, populations and ecological communities
4. By 2015 there is a reduction in the impact of invasive species
5. By 2015 there is an improvement in the condition of riverine ecosystems
6. By 2015 there is an improvement in the ability of groundwater systems to support groundwater-dependent ecosystems and designated beneficial uses
7. By 2015 there is no decline in the condition of marine waters and ecosystems
8. By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained
9. By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems
10. By 2015 there is an improvement in soil condition
11. By 2015 there is an increase in the area of land that is managed within its capability
12. Natural resource decisions contribute to improving or maintaining economic sustainability and social wellbeing
13. There is an increase in the capacity of natural resource managers to contribute to regionally relevant NRM.

Agreed projects

Projects committed to by stakeholders were identified through the consultation process and are either ongoing or new projects. Projects are not included if they were undertaken prior to the development of the Strategy and are not ongoing. As new projects are identified by stakeholders they will be added to a database on the diffuse source water pollution web pages, along with case studies of past projects. Project partners are encouraged to contact the lead agency to discuss ideas on developing new projects or help with establishing further partnerships.

Expected delivery dates

Expected delivery dates for the agreed projects are presented. These dates indicate a general timeframe against which to assess progress. It is understood that organisations need to manage delivery of a range of priorities within existing budgets and therefore delivery dates need to remain flexible.

Considerations for potential projects

Details on the suggested scope of targeted local management actions and projects to support the State-level action are intended as guidance and are not meant to be prescriptive; rather they are ideas that may assist the development of projects in the future. Each region can tailor or design suitable projects to reflect regionally specific considerations.

Also refer to Appendix III for further approaches and Appendix VI for potential sources of pollutants.

Examples of management implementation

The following scenarios are examples of the implementation of management actions in the PAP. However, they are suggestions only and not expectations of how the management actions need to be implemented. Implementation will be at the discretion of stakeholders to allow for innovation and regional flexibility.

Scenario 1: A CMA wants to address soil erosion from cultivated paddocks.

Relevant management action: MA 7 – Develop and implement the adoption of best management practice guidelines or standards for specific land uses and industries that include diffuse source water pollution management principles. The CMA could apply the following steps to implement the action.

Step 1: Contact DPI, the lead agency, to discuss delivery of the management action.

Step 2: Establish best management practice for soil erosion mitigation on cultivated paddocks through liaison with other government agencies, soil conservationists and local cultivators.

Step 3: Notify cultivators of best management practice to address soil erosion and runoff from cultivated paddocks.

Step 4: Use the soil erosion best management practice and the Strategy to support applications for Commonwealth funding under Caring for our Country, Sustainable Farm Practices, to provide incentives to cultivators.

Step 5: Provide incentives to cultivators to implement soil conservation measures that achieve best management practice.

Step 6: Align best management practice with relevant authorities and legislative instruments (for example local government and the POEO Act). That is, cultivators who follow best management practice should be able to meet their responsibilities under the relevant legislation.

Step 7: Establish working relationships between legislative authorities (such as local government) and soil conservationists in State or local government.

Step 8: Work with local government to establish a targeted compliance strategy to ensure best management practice is adopted.

Step 9: Provide feedback to DPI through the reporting template.

Scenario 2: A council wants to improve its roadwork upgrade program to reduce sediment going into local high value waterways.

Relevant management action: MA 11 – Develop and implement an unsealed road prioritisation planning initiative to reduce sediment transportation into high value waterways. The local council could apply the following steps to implement the action.

Step 1: Contact DECC, the lead agency, to discuss delivery of the management action.

Step 2: Design a road prioritisation plan using the methodology in the Northern Rivers CMA's LGA Rural Roads and Roadsides Land Management Strategic Plan to identify dirt roads that are sediment hotspots (drawing on the hotspots criteria – see MA 1).

Alternatively, update an existing road prioritisation program to include consideration of water quality and sediment hotspots (based on the hotspots criteria – see MA 1).

Step 3: Develop partnerships with other agencies or local councils to implement the project.

Step 4: Use the Strategy and road prioritisation plan to seek funding from the Environmental Trust's Urban Sustainability Program (Waterways Program) or Caring for our Country– (coasts and aquatic habitats). Rectification may include improving runoff management, sealing roads, and stabilising roadside environment such as verges, table drains and batters.

Step 5: Provide feedback to DECC through the reporting template.

Diffuse Source Water Pollution Strategy Priority Action Plan

Priority problem 1: Sediment levels exceeding the ANZECC Guidelines
Priority problem 2: Nutrient levels exceeding the ANZECC Guidelines
Priority problem 3: Pathogen levels exceeding the ANZECC Guidelines

Projects can be added at any time by contacting DECC. The most current version of this Priority Action Plan is available on the Diffuse Source Water Pollution web page on the DECC website (www.environment.nsw.gov.au).

This priority action plan presents the details of the State-level management actions (MA 1 – MA 12) aimed at addressing the priority diffuse source water pollution problems.

MA 1: Develop an approach to assist in identifying sediment, nutrient and pathogen hotspots.

Lead agency DECC **NRM targets** 5, 6, 7, 8, 9, 13

Agreed projects	**Expected delivery date**
DECC will prepare information that can be used to help identify hotspots.	December 2009

Considerations for potential projects

- Until such time as this action is complete, any management action referring to a hotspot should use best available information to target known sediment, nutrient and pathogen pollution sources, particularly those adjacent to highly valuable or sensitive water bodies (such as areas with critical fish habitat or aquaculture).
- This action should consider criteria such as source of pollutant, potential impacts from climate change, value of assets (ecological, social and economic).
- Once developed, the approach could be used by NR&E agencies, CMAs or local councils when they are identifying hotspots for targeted investment and compliance. For example, identification of pathogen hotspots may include councils gathering data on the proximity of septic tanks near high-value water bodies.

MA 2: Develop NSW estuary risk profiles to identify hotspots from pathogen pollution to underpin priority setting for strategic investment in pathogen pollution management.

Lead agency DPI **NRM targets** 9
Partners NR&E agencies

Agreed projects	**Expected delivery date**
DPI will liaise with NR&E agencies to develop an estuary risk profile and identify other relevant stakeholders to engage in the implementation of management actions.	December 2009

Considerations for potential projects

- Estuary risk profiles should consider pathogen hotspots that can be identified through approaches outlined in MA 1.
- Estuary risk profiles could inform the development of CMA investment programs and estuary management plans developed by local councils.

MA 3: Deliver targeted programs (education, incentives, on-ground works) that motivate stakeholders to take action.

Lead agency DPI **NRM targets** 1, 5, 8, 9, 12

Partners Border Rivers–Gwydir CMA, Great Lakes Council, Northern Rivers CMA, Hunter Central Rivers CMA, NSW Maritime, SCA

Agreed projects	**Expected delivery date**
• Great Lakes Council has committed to deliver targeted urban stormwater education and a sustainable grazing program for landholders	Ongoing
• Border Rivers–Gwydir CMA has committed to:	
– deliver a groundcover education campaign	Ongoing
– promote their environment issues with documentary DVDs	Ongoing
– assist landholders develop property management plans	Ongoing
– deliver workshops for farmers	Ongoing
– continue their fencing for biodiversity program in identified priority subcatchments	Funded to June 2009
– continue to deliver *How the River Runs – River Management Training*.	Ongoing
• NSW Maritime has committed to strengthen their education program on preventing sewage discharge from vessels (similar to the *Leave only water in your wake* program) and to continue to provide additional pump-out facilities.	Ongoing
• Northern Rivers CMA will continue to implement its *Reach-based and Targeted Rivers* program that aims to reduce erosion from landholdings. This is achieved through a combination of funding for on-ground works, field days and advice.	Ongoing
• Northern Rivers CMA will continue to implement its groundcover management programs with landholders.	Ongoing
• DPI, in partnership with Hunter Central Rivers CMA and Northern Rivers CMA, will continue to implement the *Targets for Change* program. This program encourages farmers to change their land management practices (through training, planning, auditing, on-ground works and demonstration sites) to help achieve environmental targets.	Funded to June 2009.
• SCA, in partnership with DPI, will deliver the *Sustainable Grazing* program. This is a professional development program for graziers, giving them tools, skills and knowledge so that grazing impacts on water quality and catchment health are reduced.	Funded to 2014.

Considerations for potential projects

- Target education and investment programs at landholders in hotspots areas to maximise and rehabilitate riparian vegetation and groundcover.
- Focus on repairing existing degraded flow paths, such as gullies.
- Deliver education material that demonstrates economic benefits of riparian vegetation and groundcover best management practice.
- Target training campaigns to landholders adjacent to streams to encourage the incorporation of techniques to improve the effectiveness of off-stream watering points and shade.
- Identify septic systems in high-risk areas (as identified under the *Septic Safe* program) and undertake yearly site inspections.

MA 4: Deliver incentives to landholders in diffuse source water pollution hotspots to undertake best management practice to reduce sediment, nutrient and pathogen loads.

Lead agency DECC **NRM targets** 5, 6, 7, 8, 9, 12

Partners Central West CMA

Agreed projects	Expected delivery date
• DECC will review the water quality component of the property vegetation plan developer for its effectiveness to manage diffuse source water pollution. • Central West CMA has committed to provide incentive packages to assist farmers implement best land management that minimises erosion.	Review to be initiated by June 2010. Ongoing

Considerations for potential projects

- Encourage property vegetation plan (or other land management planning that incorporates consideration of diffuse source water pollution and includes long-term commitment) uptake by landholders.
- Consider CMAs' incentives-based approach, including linking the provision of incentives funds to compulsory completion of a training course.

MA 5: Promote demonstration sites that provide practical examples to other landholders on how to implement management actions.

Lead agency DPI **NRM targets** 5, 6, 7, 8, 9, 13

Partners Lower Murray–Darling CMA

Agreed projects	Expected delivery date
Lower Murray–Darling CMA will work with landholders, community groups, the indigenous community and relevant agency stakeholders to develop sites (for different land uses) which demonstrate best riparian zone management. This is an action under the *River Frontage Action Strategy*, which aims to improve the management of riparian frontages along the Murray and Darling rivers and the Great Darling Anabranch within the Lower Murray–Darling catchment.	Demonstration sites to be identified in early 2009 with works completed by June 2009.

Considerations for potential projects

- Where possible, this action should include demonstration of the economic benefits to landholders. For example, a fact sheet could be developed that might include a dollar per hectare analysis for specific actions, such as off-stream watering points, and which could be distributed with riparian management incentive packages.
- When identifying possible demonstration sites, consider approaching property owners where best management practices have already been employed.
- Consider including a section in farming incentives or funding package applications allowing farmers to volunteer their property as a demonstration site, or as a case study for field days, or for the diffuse source water pollution web pages.

MA 6: Include management objectives to reduce sediment, nutrient and pathogen loads in new and existing land management plans (such as property management plans, plans of management and council management plans).

Lead agency DECC **NRM targets** 5, 6, 7, 8, 9, 13

Partners Border Rivers–Gwydir CMA, Northern Rivers CMA, DPI

Agreed projects	Expected delivery date
• Northern Rivers CMA and Border Rivers–Gwydir CMA have committed to a cross-regional program to deliver property management plans that span both CMA areas. Capacity-building workshops for landholders are a key component of this work.	Property management planning is ongoing. Three workshops are planned for 2009.
• Northern Rivers CMA has committed to implement the *Waterwise on Farms* program with DPI. This requires farmers to undertake a waterwise planning program, resulting in an accredited *Waterwise Farm Plan*.	July 2009

Considerations for potential projects

- Existing property planning documents (particularly for lands adjoining hotspots) could be updated to ensure they have a component that also considers the impact of climate change on diffuse source water pollution.
- If not already part of their stormwater management, councils could introduce consideration of diffuse source water pollution into plans of management for reserves and parklands.

MA 7: Develop and implement the adoption of best management practice guidelines or standards for specific land uses and industries that include diffuse source water pollution management principles.

Lead agency DPI **NRM targets** 5, 6, 7, 8, 9, 13

Partners Murrumbidgee CMA, NSW Food Authority, Peak Oyster Advisory Group, Lower Murray–Darling CMA, SCA, DECC, Northern Rivers CMA

Agreed projects	Expected delivery date
• DPI, in collaboration with NSW Food Authority and the Peak Oyster Advisory Group, has committed to lead the development of guidelines for oyster harvest area protection.	July 2009
• Murrumbidgee CMA and DPI will promote implementation of their *Best Management Practices for Dryland Cropping Systems* guidance.	Promotion of uptake is ongoing.
• To complement the *Acid Sulfate Soils Remediation Guidelines for Coastal Floodplains*, published in September 2008, DECC will update acid sulfate soils risk maps, where high resolution airborne laser elevation data is available.	Maps for Port Macquarie and Taree local government areas will be prepared during 2009. The remaining maps will be completed on a rolling basis as resources are available.
• Northern Rivers CMA has committed to develop best practice guidelines for sugar cane, blueberry, banana, coffee and macadamia growers.	June 2009
• Lower Murray–Darling CMA will develop riparian zone management guidelines for specific land uses. This is an action under the *River Frontage Action Strategy*, which aims to improve the management of riparian frontages along the Murray and Darling rivers and the Great Darling Anabranch within the Lower Murray–Darling catchment.	Draft guidelines to be developed by June 2009.
• SCA and DPI are updating the *Best Management Practice Guidelines for Graziers*, as part of the *Sustainable Grazing* program.	July 2009

Considerations for potential projects

- Best management practices should ultimately be developed and updated for all land uses. Existing national best management practice guidelines should be adopted and implemented wherever possible (for example Land & Water Australia industry guidelines).
- Projects could foster cross-industry collaboration to promote best management practice (for example, between dairy farmers and oyster growers).
- Examples of industries and land uses requiring standards (as identified by stakeholders) include share farming, rural and peri-urban areas, specific crop types and oyster harvest.
- Best management practice guidelines or standards should include technical information and advice (including for people from non-English speaking backgrounds). For example, appropriate use of chemicals and fertilisers, land use capability, and soil mapping linked to land management practices.
- Guidance could be developed to improve management of stormwater runoff on cultivated lands – for example, provide information on how to identify drainage lines.
- Consider alignment with internationally recognised environmental management standards

MA 8: Scope the application of a legal framework for implementing market-based instruments or incentives that could be used to address diffuse sources of water pollution.

Lead agency	DECC	**NRM targets**	5, 6, 7, 8, 9, 13
Partners	Great Lakes Council		

Agreed projects	**Expected delivery date**
DECC and Great Lakes Council have committed to work together to investigate the potential for applying market-based instruments as a way of reducing diffuse source water pollution caused by nutrients.	December 2009

Considerations for potential projects

Consider investigating if offset schemes could be established under the green offset provisions in the POEO Act for which councils could be the scheme manager.

MA 9: Develop web pages on diffuse source water pollution.

Lead agency	DECC	**NRM targets**	13
Partners	NR&E agencies, CMAs		

Agreed projects	**Expected delivery date**
DECC has committed to develop web pages to be hosted on the DECC website. Input from NR&E agencies and CMAs will be encouraged.	Launch when the Strategy is released. Update on a regular basis (at least annually).

Considerations for potential projects

The web pages could include:

- the current Strategy
- priority actions
- existing information and research on diffuse source water pollution management
- literature review
- links to external websites (for example stakeholders' websites)
- case studies and projects
- decision-support tools
- reports on implementation of the Strategy.

MA 10: Examine opportunities for surveys to gauge community awareness of diffuse source water pollution.

Lead agency DECC **NRM targets** 5, 6, 7, 8, 9, 12

Agreed projects	**Expected delivery date**
DECC will examine opportunities to incorporate questions on diffuse source water pollution in future *Who Cares about the Environment?* surveys.	Examine opportunities by June 2009.

Considerations for potential projects

Questionnaires could be developed to gain an understanding on how much the community knows about diffuse source water pollution, its potential sources and impacts, including linkages between land-use activities and water quality.

MA 11: Develop and implement an unsealed road prioritisation planning initiative to reduce sediment transportation into high value waterways.

Lead agency DECC **NRM targets** 5, 7, 8, 9

Partners Northern Rivers CMA, Coffs Harbour City Council

Agreed projects	**Expected delivery date**
• Coffs Harbour City Council has committed to adopt the *Local Government Area Rural Roads and Roadsides Land Management Strategic Plan 2007* and incentives developed by Northern Rivers CMA. This strategic plan facilitates effective management of land along local government rural roads and roadside environments. The aim is to sustain soil resources and other environmental, economic and social values associated with the road network.	June 2009
• Coffs Harbour City Council will continue to implement the *Dust Seal* program for roads. Council considers allocation of funding for projects in this program as part of each year's management plan process.	Funding for 2009–2010 will be considered in June 2009.
• DECC has committed to develop field guides containing practical guidance on implementing best practice soil and water erosion standards for unsealed roads in national parks.	Draft to be prepared by June 2009.

Considerations for potential projects

Existing road prioritisation programs or asset maintenance programs could be updated to include consideration of management of diffuse source water pollution and water quality.

MA 12: Consider ways to strengthen relevant environmental legislation, regulations and policies to better manage the impacts of diffuse source water pollution.

Lead agency	DECC	**NRM targets**	1, 5, 6, 7, 8, 9, 10, 11, 12, 13
Partners	DoL, DoP, Northern Rivers CMA		

Agreed projects	**Expected delivery date**
• DoL has committed to develop a NSW Soil Policy Framework.	Substantial progress by June 2009.
• DECC has committed to liaise with DoP on ways to include stormwater management targets for new developments in planning instruments.	Ongoing
• Northern Rivers CMA will engage with councils to facilitate the inclusion of soil loss and soil erosion threatening activities in local environmental plans (LEPs) and development control plans (DCPs). The CMA will encourage councils to use documents such as the *Dorrigo Plateau Agricultural Production Policy and Code of Practice – Cultivation Management on the Dorrigo Plateau – Volcanic Soils*.	Ongoing

Considerations for potential projects

This action should be undertaken at the point at which environmental legislation and policy are due for review, for example:

- Acid Sulfate Soils Strategy
- NSW Salinity Strategy
- *Soil Conservation Act 1938*
- LEPs and DCPs.

Note that the Diffuse Sourse Water Pollution Strategy is aimed at addressing unregulated sources and activities. Once activities are addressed through legislation or regulation they would not be considered under the stratergy.

Appendix II: Causes and effects of diffuse source water pollution

Pollutants from diffuse sources generally enter the environment during wet weather with the largest quantity during large storms. While high flows can dilute the pollutant concentrations, they can also carry large quantities of pollutants into waterways. When flow is low, diffuse source water pollution can have a greater impact as pollutants are not quickly flushed downstream in the surface water system, or broken down or assimilated by biological, physical or chemical processes.

Flow regimes are very important in maintaining water quality. Many NSW river systems have been substantially modified to meet agricultural and urban demands and to prevent the flooding of rural and urban settlements. The impacts of modified flows in NSW include (DEC 2003, section 5.2):

- degraded water quality
- reduced riverine habitat
- reduced flooding of riparian zones, floodplains and wetlands
- an increase in algal blooms
- erosion of river channels.

Water sharing plans have been introduced under the *NSW Water Management Act 2000* to return flows to rivers, better manage the flows for improved environmental outcomes, and introduce a range of programs to promote more efficient water use (DEC 2003, section 5.2). While flow regimes are being addressed and will be important in managing diffuse source water pollution, there is also a need to concentrate efforts on managing land uses that contribute to poor water quality.

The largest volume of diffuse source water pollutants comes from sediments, nutrients and salt – simply because they are the most common constituents of the landscape. For example, the Barwon–Darling River has naturally high nutrient loads (Bek and Robinson 1991). While many of these pollutants are present in natural concentrations, the increased concentration of these pollutants from human activity causes significant problems in the environment. For the purposes of this Strategy the term pollutant and pollution refers to these substances being present in unnaturally high levels due to the inability of the natural system to assimilate them, the overloading of which results in environmental, social or economic impacts.

Common examples of diffuse source water pollutants and their effects include the following.

- **Nutrients.** Plants rely on nutrients that naturally occur in the environment (including carbon, nitrogen, phosphorus and potassium) for survival. However, nutrients are also added to the environment by human activities, such as the use of organic or inorganic fertilisers, which typically contain the three primary ingredients phosphorus, nitrogen and potassium.

  The largest contribution of unnaturally high nutrients in water bodies is from erosion of soil carrying phosphorus and nitrogen (DEH 2001, section 5.2). It should be noted that the distribution of these two elements is intrinsically linked to whether they are soluble or sediment-bound and therefore different management actions to address sediment and water flow may be required. The relative proportions of soluble and particulate nitrogen and phosphorus vary between land uses and land practices. For example, research by Hollinger and Cornish (2006) demonstrated that 'soluble phosphorus was dominant from both intensive irrigated and dryland dairy pasture, while particulate phosphorus was dominant for market gardening. Runoff from market gardens contains a greater proportion of soluble nitrogen than other land uses. Therefore, representation of these processes needs to be considered in development of future catchment models'.

In the Murray–Darling Basin diffuse sources of nutrients contribute approximately 60% of the total nutrient load in an average rainfall year, and up to 85% in a wet year. In the Hawkesbury–Nepean River they account for nutrients loads of 70–80% and up to 98% in less populated areas (Cuddy et al. 1994). Phosphorus generation rates vary depending on land use, with cropping typically contributing approximately 20 times more phosphorus than woodland or forested areas (DEH 2001, section 5.2). Unnatural levels of nitrogen and phosphorus can limit the availability of water resources. Eutrophication and toxic algal blooms can make surface water unsuitable for drinking or recreational purposes and can impact on ecosystems. The measure of total nitrogen and total phosphorus gives an estimate of eutrophication potential and high concentrations in surface water are linked to algal blooms (DEH 2006a).

- **Sediments.** Erosion is the largest contributor to turbid water in Australia (DEH 2001, section 5.2) . A study of the Eurobodalla catchments in NSW showed that approximately 905 tonnes of sediment were transported through the river in one four-day storm. This is compared with 13 tonnes for the previous six-month period (Drewry et al. 2005). Activities such as overgrazing and cropping can lead to very large increases in erosion rates (27 and 21 times natural rates respectively) (Scott 2001). Significant sediment loads have also been identified as coming from unsealed roads (Motha et al. 2003). Suspended sediment loads in inland waters caused, for example, by gully erosion and degraded flow paths, can have significant impacts such as siltation of river channels, infilling of wetlands, reduced light penetration inhibiting photosynthesis, and loss of habitat and spawning sites for gravel-bed dependent fish. This can produce flow-on effects through food chain linkages (DEH 2006b).
- **Pathogens.** These organisms (especially bacteria and viruses), which can cause disease, pose threats to human and animal health through contaminated water or food sources. Major sources include stormwater and sewer overflows, stock with direct access to waterways, stormwater runoff, and leakage of poorly functioning onsite septic systems. Viruses can survive in water for between one and three months and bacteria for up to two months (Feacham et al. 1983). Also, 'the cumulative impacts of frequent, smaller runoff events, though having lower bacterial concentrations and discharge, appear to contribute most to the long periods in which a water body may be unfit for use' (Harhcegani and Cornish 2003). This has been particularly evident in the closure of oyster farm operations in NSW.
- **Toxicants.** These poisonous agents include both artificial and naturally occurring chemicals. Some toxicants do not break down in the environment, and can accumulate in the food chain or have chronic impacts, for example persistent organic pollutants. Toxicants enter the environment from a range of sources including industrial discharges, urban runoff (such as heavy metals from roads, household chemicals, leachate from landfill, groundwater contamination and agricultural sprays) (DEC 2003, section 5.3). Over the past 20 years artificial chemicals and substances such as pesticides are suspected of causing about 8% of fish kills in NSW (DPI 2001). Cyanobacteria (blue-green algae) blooms (exacerbated by increased nutrient levels) can be highly toxic to people and animals. Certain species of blue-green algae produce toxins that may cause skin irritations, gastrointestinal disorders, influenza-like symptoms and, in extreme cases, permanent organ damage and death (DEH 2006a).

  Dioxins are a group of chlorinated chemicals that originate from industrial pollution or are generated in natural processes such as bush fires. They are chemically stable and can stay in the environment for a long time. Dioxins can accumulate in the body fat of animals and humans. Residues of dioxins in seafood caught in Sydney Harbour and Parramatta River are likely to have their sources in contaminated sediments on the bottom of Homebush Bay. Current levels are likely due to many years of industrial activities along those waterways. On land, the main source of dioxin emission in Australia is bushfires and burning of agricultural stubble (Food Authority 2008).

- **Gross pollutants.** Large pieces of debris such as paper, plastics, glass, cigarettes and packaging can smother or entwine aquatic plants and animals, reduce oxygen levels and release toxicants as they deteriorate. Gross pollutants are hazardous to human health and diminish aesthetic values of waterways. Every year thousands of tonnes of gross pollutants are caught in stormwater pollution traps across NSW. However, it will be cheaper for the community and better for the environment if pollution is prevented from entering drains and waterways in the first place (DECC 2008).
- **Acid sulfate soils.** These soils release acidic drainage waters, which degrade water quality through low pH levels and high concentrations of dissolved aluminium and iron, when they come into contact with air. More than 60% of coastal floodplain backswamps in NSW have been drained for agricultural and urban development since 1890. These changes have increased the oxidation and mobility of stored acidity causing adverse impacts on estuarine ecology, infrastructure and agriculture (Slavich et al. 2004). Increased water acidity also causes secondary impacts by reducing resistance of fish to fungal diseases and increasing the concentration of soluble aluminium to toxic levels (DEH 2001, section 3.1).

  Slavich et al. (2004) describe the process of building the capacity of community organisations and individuals to manage acid sulfate soils in NSW and outline the role of soil scientists in this process.
- **Salinity.** Increased salinity levels in waterways affect aquatic life either as a direct toxic impact or indirectly through reducing biodiversity and impacting on food chain structures, and can affect human uses (drinking water and irrigation of salt-sensitive crops) (ANZECC 2000). Salinity can also cause decreased groundcover which increases erosion potential, causing further diffuse source water pollution. Dryland salinity affects the major part of NSW (120,000 ha) and is the primary cause of increased river salinity (DEC 2006b, section 4.3).

Appendix III: Supporting management actions

A number of NRM approaches are currently being used to address diffuse source water pollution in NSW by a range of different stakeholders including all levels of government, community and industry.

The approaches can be summarised in the following categories.

- **Environmental legislation** includes laws to protect the environment and community and empower agencies or third parties to take legal action against polluters.
- **Policies and strategies** include policy, plans, guidelines and strategies that are non-binding tools to guide decisions and provide a framework of objectives, principles and key actions.
- **CAPs**, established by CMAs, set future directions for NRM in NSW catchments by identifying investments in programs that specifically address natural resource targets.
- **Land use planning and consent processes** prevent potentially negative environmental impacts from some classes of development or activity.
- **Guidance** provides technical and other information for stakeholders to minimise environmental impacts.
- **Education** increases stakeholder awareness of the impacts of their activities and provides guidance, tools, and demonstration of good practice.
- **Regulation** includes legislation, planning instruments and agreements that are legally binding and require stakeholders to prevent or minimise discharges, or to clean up after a pollution incident.
- **Research** provides information for assessing environmental impacts and a basis for better management actions.
- **Funding mechanisms** provide financial capacity to undertake actions or opportunities to increase outcomes with available resourcing.
- **Economic instruments** provide incentives to undertake actions or opportunities to increase outcomes with available resources, or disincentives aimed at reducing pollution-causing activities; these may include polluter contributions, taxes or fines.
- **Community partnerships** facilitate ownership and effective management of environmental impacts by involving community in the development and implementation of programs.
- **Monitoring and reporting** provide information for identifying priorities and feedback on effectiveness of management actions.

There are too many regional and national programs to mention here. For example, the Coastal Catchments Initiative is a national program designed to improve and protect water quality in coastal water quality hotspots by promoting competent water quality planning.

The intention is to use the diffuse source water pollution web pages to highlight current national, State and regional actions, and those that have been developed to support the State-level management actions as identified in the PAP.

Stakeholders will be able to draw on information from the database (past and existing projects) when developing new projects or to add value to existing programs.

The following table provides some examples that have primary relevance to the Strategy.

State-wide legislation, planning instruments, agreements		
Name	**Relevance to diffuse source water pollution**	**Lead agency**
Contaminated Land Management Act 1997	This Act controls the management of contaminated sites that pose risk of harm.	DECC
EP&A Act	EP&A Act section 79C provisions, State environmental planning policies (SEPPS), section 117 directions, LEPs, DCPs, and impact assessment of development proposals and associated conditions of consent can all be used to minimise diffuse source water pollution.	NSW Department of Planning (DoP)
POEO Act	Pollution of waters is an offence under section 120. In general, local councils can regulate non-scheduled activities through notice and enforcement powers. However, the Environment Protection Authority (EPA) can issue a licence to regulate water pollution from a non-scheduled activity. If it does, it becomes the regulator for all environmental impacts from the activity under the POEO Act instead of the local council. The Sydney Catchment Authority (SCA) has similar powers to an appropriate regulatory authority under the POEO Act for non-scheduled activities in relation to a catchment area under the Sydney Water Catchment Management (Environment Protection) Regulation 2001. Furthermore, any person may bring proceedings in the Land and Environment Court for an order to remedy or restrain a breach of the POEO Act or the Regulations, regardless of whether there is any environmental harm. DECC also provides manuals to guide authorised officers on water pollution considerations, such as 'Considering environmental values of water when issuing prevention notices', www.environment.nsw.gov.au/resources/mao/envvalueswater06171.pdf	DECC
Native Vegetation Act 2003 Native Vegetation Regulation 2005	The Act controls the illegal clearing of native vegetation. PVPs, which are voluntary but legally binding agreements between a landholder and the local CMA to encourage better land management, are implemented through this Act.	DECC
Soil Conservation Act 1938	This Act controls conservation of the soil resources of the State, mitigation of soil erosion and land degradation, and the conservation of water resources.	DoL

State-wide policies, plans, tools		
Name	**Relevance to diffuse source water pollution**	**Lead agency**
Acid Sulfate Soils Strategy and *Acid Sulfate Soils Manual*	The Acid Sulfate Soils Strategy includes education and awareness, regulatory review and planning controls to address the likely impact of new development on acid sulfate soils, and is supported by the *Acid Sulfate Soils Manual*. The *Acid Sulfate Soils Remediation Guidelines for Coastal Floodplains in NSW* supports the Acid Sulfate Soils Strategy.	DECC
Integrated Water Cycle Management	This is a way for local water utilities (often run by councils) to manage water systems to maximise benefits to the community and environment. It involves the integration of water supply, sewerage and stormwater, so that water is used optimally within a catchment resource, State and national policy context.	Department of Water and Energy (DWE)

Managing Urban Stormwater series	The series provides targeted stormwater management advice for different stakeholders. The series includes *Harvesting and Reuse* and industry specific guidance. Refer to www.environment.nsw.gov.au/stormwater/#managestormwater.	DECC
Managing Urban Stormwater: Soils and Construction (the 'Blue Book')	This publication provides guidance for local councils and practitioners on the design, construction and implementation of measures to improve stormwater management during the construction phase of urban development.	NSW Department of Housing (DoH) and Landcom
State-wide NRM standards and targets	In May 2005, the Natural Resources Commission recommended to the government a Standard for Quality NRM and State-wide targets for NRM. These targets have been adopted in the NSW State Plan. Refer to www.nrc.nsw.gov.au.	NSW Government
NSW Oyster Industry Sustainable Aquaculture Strategy	This identifies the key water quality parameters necessary for sustainable oyster aquaculture and establishes a mechanism to maintain and improve the environmental conditions required for sustainable oyster production. The commercial and recreational fishing industry (driven by the environmental subcommittee of the Seafood Industry Advisory Council) is currently progressing a water quality initiative, based on the strategy.	DPI
NSW Salinity Strategy - *Taking on the Challenge: NSW Salinity Strategy*	This sets out an approach to slow down the increase in salinity and lay the foundations for salinity management in the future. The principles are now reflected in CAPs and are closely linked to Caring for our Country and Water Quality, as well as Murray–Darling Basin Commission programs.	DECC
NSW Water Quality and River Flow Objectives (WQOs)	These are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. They are not intended to be applied directly as regulatory criteria, limits or conditions but are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a waterway. The environmental values expressed as WQOs provide goals that help in the selection of the most appropriate management options. The guiding principles are that: • where the environmental values are being achieved in a waterway, they should be protected • where the environmental values are not being achieved in a waterway, all activities should work towards their achievement. Refer to www.environment.nsw.gov.au/ieo/index.htm.	DECC
Rectification Action Plans for Sydney drinking water catchments	These are being developed under the Regional Plan for the Sydney drinking water catchment and adjacent regional centres. They are implemented by the SCA in collaboration with community, landholders, local council, industry groups, interest groups and other NSW Government agencies. These plans will identify and prioritise actions that improve water quality by addressing impacts from existing and past land uses, developments and activities.	SCA

State-wide campaigns and specific actions		
Name	**Relevance to diffuse source water pollution**	**Lead agency**
Arc Linkage Project	This aims to develop computer modelling that predicts the likelihood that a road drainage structure will deliver sediment to the stream network.	UNSW CRC for Catchment Hydrology
Coastal Lakes Initiative (under the Coastal Lakes Strategy)	Management strategies, which aim to ensure that coastal lakes are managed to sustainable loads, are being developed for eight coastal lakes in NSW: Cudgen, Myall, Wollumboola, Burrill, Narrawallee, Coila, Merimbula and Back lakes.	DECC
Dairying for Tomorrow (includes DairySAT)	This is a program to develop regional-based projects to address environmental issues. DairySAT is an industry self-assessment tool to audit management practices.	Dairy Australia
Don't Be A Tosser	This is a litter prevention advertising campaign and council resource kit of campaign materials.	DECC
EverGraze™, Enrich™, EverCrop™, EverTrain™	EverGraze™ aims to optimise animal production and attain NRM targets by researching new plant-based land use systems that lessen the economic, environmental and social impacts of dryland salinity. It will be adopted on 500 farms in 2009 and on 2,400 farms by 2014. Its companion system, EverCrop™ and the Enrich™ options will be ready for adoption from 2014. EverTrain™ is a training program for agronomists and farmers.	Future Farm Industries Cooperative Research Centre
Fish Friendly Farms Program	The involves educational field days, workshops and publications on fish friendly land management, and includes creating off-stream watering points, building riparian fencing and re-establishing riparian zones.	DPI, NSW Council of Freshwater Anglers, Murray–Darling Basin Commission
NSW Coastal Floodgate Program	This promotes the active management of coastal floodgates in non-flood periods to improve water quality, weed management and fish passage within agricultural drains.	DPI
NSW Shellfish Program (under the Australian Shellfish Quality Assurance Program)	This is a food safety program designed to safeguard the human consumption of shellfish harvested in NSW. It is based on water quality and meat testing and also involves shoreline surveys to identify and record potential pollution sources within the catchment of a shellfish growing area. The adoption of these guidelines will also provide additional benefits to commercial and recreational fisheries.	NSW Food Authority
PROfarm	This training program reflects the public benefits provided by the adoption of more sustainable farming practices and includes courses such as Prograze.	DPI
Septic Safe Program	The program was introduced to provide education, support and supervision to landowners and councils as they implement and undertake their sewage management responsibilities. It provides education, support and supervision to landowners, so that their systems operate in accordance with health and environmental performance standards, and enables monitoring and management of the cumulative impact of sewage pollution in and across LGAs.	NSW Department of Local Government
Waterwatch NSW	This program involves and educates communities in protection and improvement of waterways, particularly water quality.	DECC

Appendix IV:Policy context

The Strategy was developed in response to *Protecting our Rivers* (Audit Office 2003), which recommended the development of a comprehensive plan to limit and reduce pollutant levels, particularly from diffuse sources. To do this effectively it is vital that the Strategy provides an integrated framework that complements existing policy for NRM in NSW. A brief history of the process is provided in the following table.

1999	**NSW Water Quality Objectives** (DEC 2006a) were endorsed by Government. They express the community-agreed environmental values and long-term goals for waterways and coastal waters.
2003	***Protecting our Rivers*** (Audit Office 2003) was released. The report recommends a comprehensive plan to limit and reduce pollutant levels, particularly diffuse source, in accordance with the WQOs. The ***Catchment Management Authorities Act 2003*** requires each CMA to prepare a CAP that provides a strategic framework for NRM in the catchment and direction for future investments.
2005	**Audit of the Sydney Drinking Water Catchment** (DEC 2005) found there were significant pressures on water quality in the catchment due to diffuse source water pollution; integration of nutrient control programs with riparian management and erosion control programs were recommended. **A Standard and 13 State-wide targets for NRM** (NRC 2005) were developed by the Natural Resources Commission of NSW, and endorsed by the Government. The NRM targets include water ecosystem targets and the standard outlines how they should be attained. **CMAs** develop **CAPs** consistent with the 13 NRM targets that focus on regional priorities. CAPs spell out the priority NRM issues identified by CMAs, with investment programs defining on-ground works and management responses to target both regional NRM priorities and the State-wide NRM targets.
2006	**The NSW State Plan** (NSW Government 2006) was launched. Priority E4 – Better outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways – nominates the 13 State-wide NRM targets as key deliverables. **Water CEOs** agree for the need for a consolidated and well coordinated program to tackle the management of diffuse source water pollution.
2009	**The Strategy released.**

Appendix V: Examples of decision support tools

There are many models that can support decision makers with predictions of sediment, nutrient and pathogen exports. The following list of tools provides examples of models that may assist in managing diffuse source water pollution. The list is not exhaustive and further information on each model's purpose, data requirements and limitations should be obtained before applying them to make management decisions. In some cases the tools are still under development.

Research papers are useful for gaining a greater understanding of the data and types of models available, for example Drewry et al. (2006) and Merritt et al. (2003).

Tool	Description	Further information
2CSalt	2CSalt was designed for the CRC for Catchment Hydrology Industry Partners in the Murray–Darling Basin. It integrates concepts from a range of models operating at different spatial and temporal scales across eastern Australia. 2CSalt predicts, within catchment surface and groundwater, contributions of water and salt export at a catchment scale. It can also be applied to predict the impacts of land use change on salt and water export at a subcatchment scale. Murrumbidgee CMA has used 2Csalt to assess the impacts of land use change (planting lucerne in alluvial areas) on flow and salt export for all subcatchments in the mid and upper Murrumbidgee.	http://www.toolkit.net.au/mailman/listinfo/2csalt
Catchment Management Support System (CMSS)	CMSS is designed to provide long-term, broad area prediction of the impacts of different nutrient management strategies on water quality in Australian catchments. It is an appropriate tool for any group or agency involved in setting land use policies and developing land management strategies at a catchment scale, with the primary goal of maintaining and improving water quality. CMSS is straightforward. It has been designed specifically so that it can be applied to any catchment by people without a high level of computer expertise. Inputs are minimal and are: • the distribution of land uses • the typical average annual generation rates for nutrients • some basic data on the proposed management practices.	http://www.toolkit.net.au At national level, it is an accredited estimation tool for the National Pollutant Inventory (http://www.npi.gov.au).
Coastal Eutrophication Risk Assessment Tool (CERAT)	CERAT is currently under development by DECC. The aim of the tool is to permit comparative assessments of the risk of NSW estuaries to eutrophication and to assist in decisions on broad scale management actions. CERAT is founded by a series of coupled catchment and estuary models that are being developed using data from the State-wide MER Strategy.	CERAT will be available in 2009 from DECC.
Catchment Scale Multiple-Landuse Atmosphere Soil Water and Solute Transport Model (CLASS)	CLASS is a physically based distributed eco-hydrological modelling framework that can be used to predict land use effects at paddock, hill slope and catchment scales. Effects of climate scenarios predicted by stochastic climate models as well as the effects of spatio-temporal climate variations within a catchment can also be analysed. CLASS includes seven tools that can be used for water balance, solute balance and vegetation growth modelling, terrain modelling, recharge, discharge and lateral flow modelling and streamflow routing.	http://www.toolkit.net.au

Tool	Description	Further information
Coastal Lake Assessment and Management (CLAM)	CLAM supports the Coastal Lakes Initiative and Coastal Lakes Strategy. It is intended for use by local councils and State government to assist in a holistic approach to planning and decision making in the management of a coastal lake catchment. However, it also provides an educational tool to view the interactions that occur within a catchment, and to assist in identifying important knowledge gaps of how the catchment system operates.	http://icam.anu.edu.au/products/clam.html www.clam.net.au
Diffuse source water pollution estimator	This prototype green offset tool estimates the change in pollution loads likely from a specified development type and size. It focuses on land-use change and is recommended for developments up to five hectares in size and as a first-cut estimator for larger developments. Users (including potential developers and consent authorities) input data on: • existing land use and site characteristics • future land use and site characteristics • proposed measures to minimise diffuse water pollution. The estimator provides: • estimates of pre-development pollution loads • estimates of post-development pollution loads incorporating benefits of the proposed pollution reduction methods • any increase in net pollution loads (the amount of pollution that would require an offset if the development were located in an area where an offset scheme was operating). Users can enter alternate pollution reduction measures to evaluate strategies to reduce net pollution loads. Pollution load estimates for the following pollutants are currently provided: • total nitrogen • total phosphorus.	http://www.environment.nsw.gov.au/dwpe/index.htm
E2	E2 is designed for researchers, modellers and consultants who are constructing tailored models for particular catchment management problems. Users of E2 should have considerable knowledge and experience with integrated catchment modelling. E2 is designed for application in a range of catchment sizes, from backyards to many hundreds of thousands of square kilometres. It provides output at various temporal and spatial scales. Examples of application of E2 include: ▪ policy analysis and sediment and nutrient load assessment ▪ urban development and sewage treatment plant impacts in Hornsby Shire ▪ prediction of nutrient loads from dairying catchments in north-east Tasmania.	Available online at: http://www.toolkit.net.au
EGPE	EGPE is a computer decision-support tool for the eco-management of animal manure as agricultural fertiliser. It is an object-oriented model, which estimates the environmental distribution of contaminants within different environmental compartments and the specific risk associated with these distributions and final concentrations. This model evaluates environmental impacts related to the use of sludge or manure as fertiliser, and direct discharges of slurry or effluents from treatment plants to water streams.	http://www.iemss.org/iemss2002/proceedings/pdf/volume%20uno/244_vega.pdf

Tool	Description	Further information
Great Lakes Decision Support Tool	This tool is specifically designed for Great Lakes Council area and allows the prediction of ecological impact from diffuse pollution, as opposed to estimation of the magnitude of pollution that is likely by integration of a catchment load export model with an estuary response model. The tool enables the user to assess the consequences for indicators of estuary condition, such as chlorophyll-a, seagrass (macrophyte) extent and water clarity, and of changes in land use or land management practices, allowing the user to determine how much reduction in load is necessary to achieve desired ecological condition in the estuary. It also includes simple economic indicators to estimate the cost of various combinations of land management actions to achieve estuary condition targets. Put simply, this tool shows how much work is necessary to get an estuary back to a desired condition (or to keep it there).	Available from Great Lakes Council.
Identification of unit Hydrographs And Component flows from Rainfall, Evaporation and Stream-flow data (IHACRES)	IHACRES is a catchment-scale rainfall–streamflow modelling methodology whose purpose is to characterise the dynamic relationship between rainfall and stream-flow, using rainfall and temperature (or potential evaporation) data, and to predict stream-flow. The model can be applied over a range of spatial and temporal scales, from small experimental catchments to basins using times steps of minutes, days or months. It can be used to fill gaps in data, extend stream-flow records, explore the impact of climate change and identify effects of land use changes.	http://www.toolkit.net.au
Integrated Quantity–Quality Model (IQQM)	IQQM was developed as a daily time-step integrated quantity–quality river basin simulation to model various NSW rivers. It is designed to examine long-term river behaviour under various management regimes, which include environmental flow requirements. Currently the model is used for water quantity modelling rather than water quality (with the exception of salinity).	Contact the Department of Water and Energy. DLWC (1995)
Irrigation Recording and Evaluation System (IRES)	IRES allows irrigators to keep comprehensive irrigation records, analyse the records and evaluate water use efficiency.	http://www.pir.sa.gov.au/pirsa/nrm/water_management/ires/
MUSIC	MUSIC is designed to simulate urban stormwater systems operating at a range of temporal and spatial scales, catchments from 0.01 km^2 to 100 km^2 and modelling time steps ranging from six minutes to 24 hours to match the catchment scale. MUSIC provides a user-friendly interface to allow complex stormwater management scenarios to be quickly and efficiently created, and the results to be viewed using a range of graphical and tabular formats. This reduces the uncertainty surrounding the planning of stormwater management strategies, and may generate substantial cost savings.	http://www.toolkit.net.au

Tool	Description	Further information
Pesticide Impact Rating Index (PIRI)	A risk assessment tool designed to assist pesticide users and regulators to make informed decisions about the best product to use given their circumstances, taking into account the likely impact of pesticides in the local environment. PIRI is a simple risk indicator for different pesticides and cropping systems. It is based on the integration of the various factors that determine the impact of pesticides in the environment: • the value of the asset (e.g. an adjacent water resource that may be threatened) • the sources of threat to the asset (e.g. a certain pesticide load) • the transport pathways by which the threat is released (e.g. spray drift). Information about pesticide properties, soil and environmental conditions, and site specific factors is built into the process.	http://www.clw.csiro.au/research/biogeochemistry/assessment/projects/piri.html
PRISM	PRISM provides information on over 90 tools, models and frameworks that can assist NRM planning.	http://prism.ndsp.gov.au/default.asp
SedNet	SedNet constructs sediment and nutrient (phosphorus and nitrogen) budgets for regional scale (3,000–1,000,000 km^2) river networks to identify patterns in the material fluxes. This can assist effective targeting of catchment and river management actions at the regional scale to improve water quality and riverine habitat. SedNet has been designed for a range of users with different backgrounds. However, modelling sediment and nutrient budgets is a complex activity; GIS and data analysis experience is required for initial construction of a catchment SedNet model. Experience and knowledge of landscape processes are valuable aids in interpreting model operation and results.	http://www.toolkit.net.au
TOOLS2	This is currently under development by DECC. The aim of the project is to provide CMAs with a structured framework of decision support tools to support NRM programs. The DST, proposed to be called SCARPA – Site and Catchment Resource Planning tool – provides an integrated framework for:· • customising the site-scale environmental assessment process that will be undertaken for incentives funding programs • undertaking catchment level planning via the generation and/or use of priority maps to inform a targeted investment strategy.	To be involved in pre-release trialling of any of the tools please contact: Alastair Grieve, Project Coordinator, (02) 9872 0582, alastairg@sf.nsw.gov.au
Wetland DST	Murrumbidgee CMA, in partnership with Murrumbidgee Irrigation and funded by the National Water Commission, is developing a wetland decision support tool. The system will be a digital terrain model and will cover the Murrumbidgee floodplains.	Contact Murrumbidgee CMA

Appendix VI: Prioritisation approach

An assessment approach was developed to identify an initial set of problems for immediate focus that will progress the implementation of the Strategy. It is anticipated that future reviews of the Strategy will draw on additional information to refine priority sources and the actions in the PAP to reflect existing management activities and deal more effectively with diffuse source water pollution problems. The approach consists of two stages: priority setting and priority action planning.

Priority setting

Priority setting involves identification of the key problems associated with diffuse source water pollution based on consideration of the significant pollutants and their sources (from consultation workshops and literature reviews, including State of the Environment reports).

A wide range of issues identified at the workshops were summarised by selecting only those that were identified as priority issues in the majority of CMA areas (five or more). This resulted in a short list of 16 priority issues. The priority issues or sources are listed in Table 1 as a pollutant–source matrix, which is intended to provide an understanding of the way pollutants interact with the identified sources and how they manifest as a problem.

Table 1 demonstrates how the key sources contribute to pollutant loads based on the frequency, intensity and extent of the source contribution. The significance of the source to the CMAs and the relevance of the various sources to the common pollutants are also outlined.

Table 2 provides further analysis of the pollutants and outlines their degree of association with different sources (identified from Table 1), the impact they have on social, economic and environmental values, the geographical distribution of the pollutants and the frequency at which they occur.

This first stage analysis defined the top three priority problems that form the initial focus of the PAP – nutrients, sediments and pathogens exceeding the ANZECC guidelines (see page 12).

Priority action planning

The second stage is then carried out for each priority problem to further determine actions to be included in the PAP.

Hundreds of actions and management approaches that could potentially assist in addressing the priority problems were identified. A needs analysis was undertaken to define the priority management actions that would be included in the PAP based on:

- sources (identified in the priority setting stage)
- consequences (identified in the priority setting stage but with greater detail and statistics provided)
- management action (existing and new) which could address the problem
- effectiveness (the likely benefits and outcome of the actions)
- efficiency (ease of implementation, maximisation of existing resources).

Given that the sources and consequences were prioritised in the priority setting stage, the next step was to prioritise management actions to determine those to be included in the PAP. Therefore, the last three criteria (management actions, effectiveness, efficiency) were assigned a priority value of high, medium or low based on the considerations listed below.

High

Management action:

- significant gaps in management actions identified (determined by, for example, reviewing CAPs and stakeholder feedback)
- gaps in planning, legislation or other supporting policy tools (determined by research and reviewing existing legislation and stakeholder feedback).

Effectiveness:

- based on a qualitative response from stakeholders noting if a management action was considered to be highly effective and where research demonstrates the action is applied elsewhere and is achieving the desired outcomes
- high level of acceptance of the problem.

Efficiency:

- management action achievable within existing resources
- high level of stakeholder interest and opportunities identified for partnerships in undertaking the management action
- secondary outcomes achieved beyond improving diffuse source water pollution problems (e.g. biodiversity).

Medium

Management action:

- management program in place
- legislation or supporting tools in place.

Effectiveness:

- based on a qualitative response from stakeholders noting if a management action was considered to be partially effective
- partial acceptance of the problem.

Efficiency:

- additional resources required to support the management action (but high likelihood of funding opportunities)
- limited stakeholder interest and some opportunities identified for partnerships to implement the management action

Low

Management action:

- management program in place but requires strengthening
- legislation or supporting tools in place but require strengthening.

Effectiveness:

- based on a qualitative response from stakeholders noting if an action was considered to be ineffective
- no willingness to change behaviour.

Efficiency:

- additional resources required (low likelihood of funding opportunities)
- no stakeholder interest or identified opportunities for partnerships.

By attributing a score to these values, where high = 3, medium = 2, low = 1, a median score can be assigned to a management action to determine its priority rating. For example, an action could be assigned a median score of 2.3, equal to medium, where management action is high, effectiveness and efficiency are medium.

The initial PAP only includes management actions that received a median score of greater than medium to high (2.3–3). However, this does not mean management actions that score below 2.3 cannot be revisited when developing a PAP at a later stage.

Table 1: Short list of priority issues

DSW pollutants ► **Priority sources ▼**	Nutrients	Sediment	Pathogens	Toxicants	Salinity	Gross pollutants	Acid sulfate soils
Intensive animal industry (including dairies)	✓	✓	✓	✓			
Streambank and gully erosion	✓	✓					
Rural residential development and land management	✓	✓					
Boating (including houseboats)	✓	✓	✓				
Contaminated land (including old tips)				✓			
Land clearing: development	✓	✓					✓
Salt-affected land					✓		
Bushfires Controlled burning	✓	✓					
Irrigated agriculture (mainly cropping)	✓	✓		✓	✓		
Cropping (including broadacre, horticulture)	✓	✓		✓	✓		
Cleared agricultural land	✓	✓			✓		✓
Livestock (including broadacre)	✓	✓	✓				
Roadways, unsealed and utility easements		✓					
Leaking on-site systems On-site effluent disposal	✓		✓				
Degraded riparian zones	✓	✓					
Stormwater (urban)	✓	✓	✓	✓		✓	

No. CMA areas source identified		Extent of source impact	**Frequency and intensity of source contribution**
Coastal (total 5)	Inland (total 8)		
2	2	Small scale, widespread	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
3	4	Extensive, widespread	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
3	2	Rural, peri-urban areas	Higher frequency during development with intermittent ongoing impacts
4	1	Navigable waterways, specific hotspots	Ongoing, more intense during peak seasons
3	2	Small scale, widespread	Continual leaching, increasing following rain
5	1	Urban fringe, peri-urban areas	More frequent during development phase with intermittent impacts ongoing
1	5	Widespread, hotspots with greater site specific problems	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
4	3	Widespread, mainly forested or heavily vegetated areas	Generally infrequent and intense
5	5	Widespread small scale, ~10% of agricultural area	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
5	6	Widespread small area, 10% of total agricultural area	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
4	4	Extensive, widespread	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
4	7	Extensive, widespread	Rainfall driven, dependent on slope, geology, land use intensity, ground cover
5	4	Extensive, widespread	Rainfall driven, dependent on slope, geology, condition, ground cover
5	4	Widespread, increasing in frequency near urban fringe	Ongoing leaking to groundwater, dependent on degree of surface and groundwater interaction – overflow can cause intermittent impacts
4	7	Widespread, particularly in lower order streams	Rainfall driven, dependent on slope, geology, event intensity, ground cover, vegetation extent and condition
5	7	Urban, peri-urban areas	Rainfall event driven, dependent on intensity, overall catchment condition

Table 2: Analysis of short-listed issues

DSW pollutants ▶	Nutrients	Sediment	Pathogens	Toxicants	Salinity	Gross pollutants	Acid sulfate soils
Pollutant association with different sources*	H	H	M	M	M	L	L
Social consequence	L – reduced recreational amenity	L – reduced recreational or visual amenity	H – reduced human health and recreational amenity, contaminated aquatic food	M – reduced human health and recreational amenity, contaminated aquatic food	M – reduced recreational amenity, poor water taste, reduced recreational fishing	L – reduced visual amenity, and recreational and physical hazards	L – reduced recreational amenity, fishing and health impacts
Economic consequence	M – increased water and effluent treatment costs, fouling of irrigation systems and channels	M – increased costs of water infrastructure maintenance, irrigation maintenance and water treatment	H – closures of aquaculture industry and recreational uses	M – impact on aquaculture, water treatment	M – increased treatment costs, infrastructure corrosion and irrigation impacts	M – increased cost of control, capture and disposal of waste, impacts on tourism and recreational industry	M – reduced productivity of aquaculture, infrastructure corrosion and increased costs
Environmental consequence	H – growth of nuisance aquatic plants and algal blooms, reduced dissolved oxygen, altered vegetation, reduced biodiversity, choking of waterways	H – smothering of habitat and spawning areas, reduced light availability, productivity and biodiversity and increased weed growth	L – negligible	M – temporary acute impacts sich as fish and bird kills; chronic impacts not well understood and bioaccumulation may cause ongoing impacts and affect biodiversity	H – reduced biodiversity, direct toxic effects	M – smothering of plants and animals, release of toxicants and reduced dissolved oxygen, injury to wildlife	H – fish kills, increased disease, reduced biodiversity, increased availability of toxicants
Geographic occurrence – coastal	Common across all coastal CMA areas. Increased contribution from lower order streams with greater slopes and higher rainfall intensity	Common to coastal CMA areas Hawkesbury–Nepean, Northern, Hunter and Southern; increased contribution from lower order streams with greater slopes and higher rainfall intensity.	All coastal CMA areas with aquaculture – highest risk near urban areas and intensive animal industries	Dispersed across all coastal CMA areas mainly near intensive agriculture, urban areas and contaminated sites; groundwater impacts poorly understood	Mainly specific areas of the Hunter and Hawkesbury–Nepean, isolated incidences elsewhere	All CMA areas, predominantly near urban areas	Coastal CMA areas (mainly central to north coast), some acid sulfate soil risk dispersed across all areas

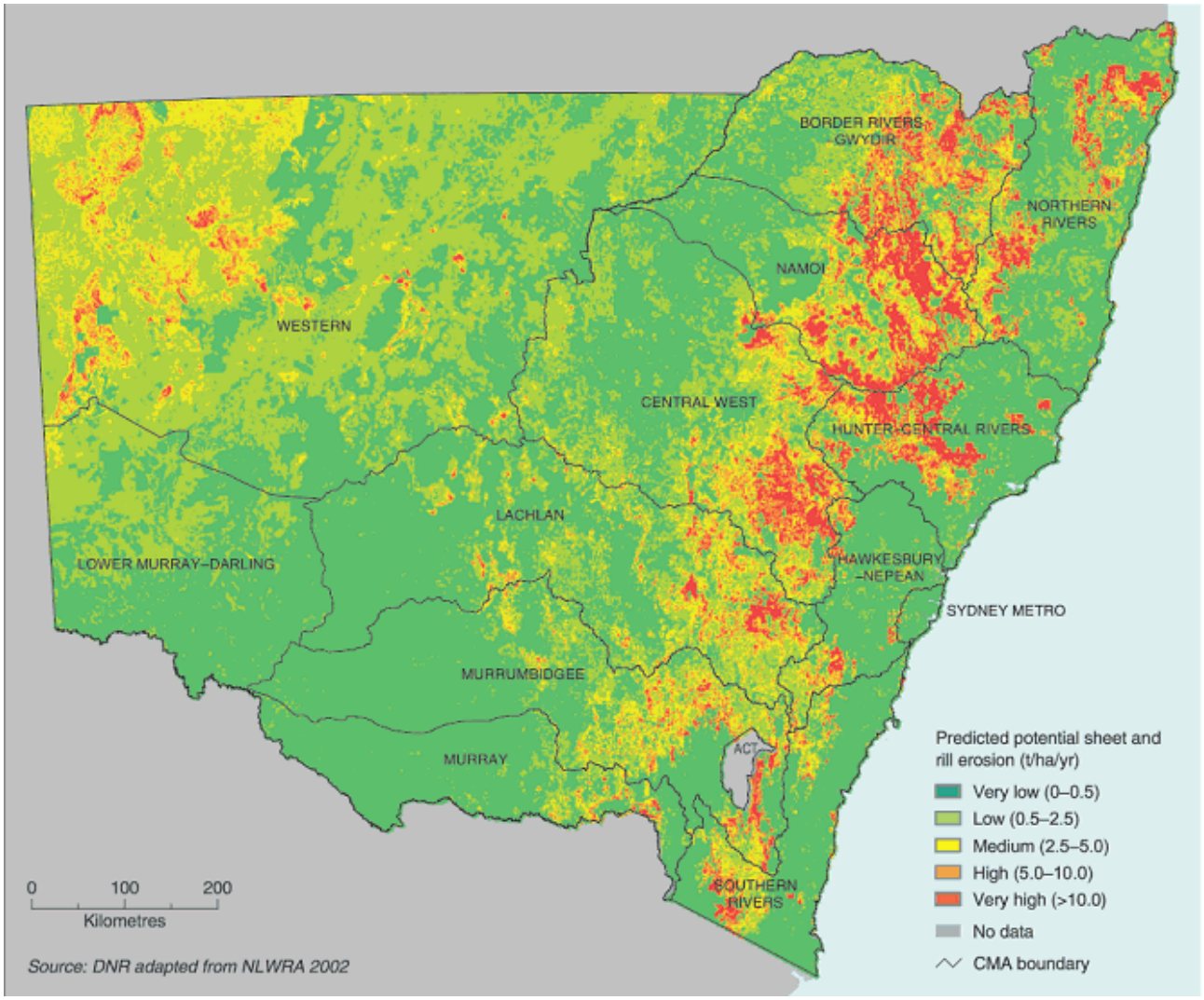
Geographic occurrence – inland	Common across all inland CMA areas except less developed areas	Common across all inland CMA areas of the Murray–Darling basin	All inland CMA areas with hotspots near urban and higher intensity grazing areas	Hotspots mainly near urban, intensive agriculture and contaminated sites in all inland CMA areas. Also widespread in the central west and north west (mainly in summer); groundwater impacts poorly understood	Widespread across Murray, Lower Murray Darling, Murrumbidgee, Lachlan, Gwydir, Namoi, Castlereagh, Macquarie–Bogan	Restricted to vicinity of urban areas	Soil acidification in upland areas of central west, Lachlan and Murray–Murrumbidgee; a significant issue in the Lower Murray–Darling
Frequency	Intermittent, mainly rainfall driven from runoff or high flows	Intermittent, mainly rainfall driven from runoff or high flows	Varies, dependent upon source – rainfall driven or continual seepage	Dependent upon source – can be rainfall driven, continual or seasonal (e.g. blue–green algae toxins)	Continual – fluctuates	Intermittent, mainly rainfall driven from runoff	Continual once acid sulfate soil is disturbed, mainly from rainfall runoff in acidic topsoils
Priority problems	Nuisance weed growth, harmful algal blooms, increased treatment costs	River health and increasing water infrastructure maintenance costs	Impacts on health and, in estuaries, commercial oyster growing, recreational amenity and tourism	Affects on sensitive aquatic life and human health	Aquatic biodiversity and increased infrastructure costs	Reduced visual amenity and impacts on aquatic life	Impacts on aquatic biodiversity and increased infrastructure costs
Priority problems	Nuisance weed growth, harmful algal blooms and increased treatment costs	River health and increasing water infrastructure maintenance costs.	Impacts on health, and in estuaries on commercial oyster growing, recreational amenity and tourism	Affects on sensitive aquatic life and human health	Aquatic biodiversity and increased infrastructure costs	Reduced visual amenity and impacts on aquatic life	Impacts on aquatic biodiversity and increased infrastructure costs

* See Table 1, H = high, M = medium, L = low

Appendix VII: Diffuse source water pollution and land use

The type of land use and the condition of the catchment as a whole plays a major role in dictating the type and quantity of pollutants transported by rain. Erosion rates, for example, increase in areas with greater slope and where groundcover has been reduced (Merritt et al. 2003). Groundcover is the key factor influencing the removal of soil by rainfall and runoff, particularly where there is hill-slope erosion (sheet and rill erosion) (Scott 2001).

The predicted potential mean annual sheet and rill erosion rates for NSW catchments is shown on the following map (DEC 2006, section 4).



Source: DEC (2006b, section 4)

Agriculture is the dominant land use in NSW, accounting for 76% of the total land area. Grazing (69.8%) is by far the largest land use, followed by cropping (7.9%), forestry (approximately 3.6%) and mining (approximately 0.1%), with irrigation and other intensive uses accounting for less than 1%. Conservation lands (managed by DECC) occupy 7.8% of the total area, while urban development is less than 0.2% (DEC 2006b, section 4.1).

The scale of land use activities, including changes that result in elevated loads of suspended sediment and nutrients, changes to the hydrological regime and loss of riparian vegetation, is an important factor affecting how diffuse source water pollution impacts on the environment (Norris et al. 2001). Impacts from some

pollutants, such as fertilisers or pesticides used in intensive agriculture and horticulture, are more significant at a local level. However, the contribution of some pollutants becomes more significant when considered across the whole catchment, for example 'nutrient budgets often point to a more significant contribution from other diffuse sources such as soil erosion and domestic animal wastes' (ANRA 2007).

Another crucial factor is the intensity of the activity, with more intensive land uses having a greater capacity for producing diffuse source water pollution. An assessment of the Murray–Darling Basin showed cropping generated just over 50% of the total phosphorus load, despite making up less than 10% of land use (Atech Group 2000). Soil erosion rates for different land uses are given in the table below (DEC 2006b, section 4.1).

The dominant component of total nutrients from catchments is invariably from diffuse sources. However, the relative importance of diffuse sources of pollutants varies from catchment to catchment and with the type of pollutant.

Soil erosion rates for a variety of land uses in Australia

Land use	Event	Range of potential erosion rates t/ha/yr	Comments
Forested catchments	Undisturbed	0–1	
	Storms after bushfires	10–50	Erosion highest before vegetation has regenerated
Agriculture	Pasture	1–50	Where ground cover is maintained at >70% plots
	Cropping	1–50	Seasonally affected: lowest erosion rates are for winter cropping in southern NSW; highest erosion rates are for summer cropping in northern NSW
	Bare fallow	0–100	In the temperate cereal belt
All	Intense rainfall on unprotected bare soil	0–700*	Erosion rates can be much higher and many times the mean annual loss during such events.

* Units of t/ha/event.

Adapted from Edwards and Zierholz (2006).

Appendix VIII: Management roles and responsibilities

The government's responsibility for water quality and waterway health is shared amongst key agencies and regional bodies with individual roles and responsibilities described below.

Natural Resources Commission recommended the State-wide standard and targets for NRM to the government for endorsement. Environmental objectives for water quality and river flows are a fundamental underpinning of these targets. The Natural Resources Commission will also play a key role in auditing progress by CMAs against the standard and targets, including review of CAPs and investment programs prepared by CMAs.

Natural Resources and Environment CEOs Cluster Group sets the strategic direction for NRM in NSW. It focuses efforts on improved service delivery to stakeholders and reduced complexity in the NRM system to increase efficiencies through improved coordination and sharing of information. As such, the Cluster Group is responsible for the endorsement and monitoring of the Strategy.

The Cluster Group also has a Natural Resources Information Needs Committee which developed the MER Strategy to address the NRM standard and targets. The Cluster Group is accountable for implementation of the MER Strategy, supported by the Natural Resources Information Needs Committee and the Data and Information Management Working Group.

The Cluster Group comprises the CEOs of the following NSW agencies:

- Department of Aboriginal Affairs
- DECC
- Department of Lands
- Department of Planning
- Department of Premier and Cabinet
- Department of Primary Industries
- Department of Water and Energy
- NSW Treasury.

Department of Environment and Climate Change (DECC) is the lead agency advising government on water quality and ecosystem health. DECC regulates water quality through the POEO Act (licensing, pollution reduction programs, load reduction agreements, pollution offsets and trading schemes) as well as cleaner industry programs. Technical guidelines are produced for activities that pollute waters (such as sewage treatment plants, effluent irrigation and slipways).

DECC has also been a strong supporter of local councils and industry with education and community programs on water quality and stormwater management. Beachwatch and Harbourwatch programs have been used to build capacity with councils for recreational water quality monitoring and reporting. DECC also regulates vegetation clearing (including riparian zone vegetation and wetlands) and has a key role in the management of salinity, both of which are major contributors to water quality and river health. DECC has developed guidelines and decision support tools to assist CMAs and councils use WQOs in planning and prioritisation of investment. The parks and reserves across NSW managed by DECC are also a significant contributor to river health. Under the MER Strategy DECC is responsible for leading the monitoring, evaluation and reporting for the following relevant State-wide NRM targets: 1 (native vegetation), 2 (some native fauna), 3 (threatened species), 8 (wetlands) and 9 (estuaries and coastal lakes). DECC is accountable for State of the Environment reporting and also contributes the macroinvertebrate component of the Sustainable Rivers Audit (MDBC 2008).

Department of Water and Energy (DWE) is the lead agency for the implementation of the *Water Management Act 2000*, regulating water access and use. DWE is also responsible for the hydrology indicator in the Sustainable Rivers Audit, has a key role in management of groundwater, and has the best expertise, monitoring and modelling capability for river and groundwater hydrology. Under the MER Strategy, DWE is responsible for leading the monitoring, evaluation and reporting for the following relevant State-wide NRM targets: 5 (riverine ecosystems) and 6 (groundwater).

Since the integration of the Department of Energy, Utilities and Sustainability, DWE is also now responsible for leading integrated water cycle management across local water utilities and for the administration of the Country Towns Water Supply and Sewerage Program. This program provides management, technical and financial support for water and sewerage for non-metropolitan local water utilities in NSW. DWE has a role in ensuring that these facilities are properly maintained and operated to improve the environment and the health of the community.

Department of Planning (DoP) is responsible for strategic and statutory land use planning, which is an important tool for the protection of water quality and river health. SEPPs provide statutory protection to specific natural assets such as coastal wetlands, drinking water catchments and urban bushland, and appropriate management and development of areas of significance for NSW such as the coastal zone. These support the achievement of water quality and aquatic ecosystem health. Development assessment processes under the EP&A Act ensure that the environmental impacts of proposals are appropriately assessed and necessary mitigation measures incorporated. Regional strategies have been developed for major growth areas and others are in progress. A standard instrument or template for LEPs has been developed and all local councils have been required to prepare new principal LEPs that are consistent with the relevant regional strategy and the LEP template. As well as four environmental protection zones, the template allows the use of overlays and additional local clauses. DoP is currently drafting model provisions, or local clauses, for specific natural resource outcomes in consultation with NR&E agencies. These will further support environmental outcomes including water quality, and will assist councils to implement a consistent approach.

Department of Primary Industries (DPI) is the primary agency for the protection and management of aquatic species under the *Fisheries Management Act 1994*, including threatened species and aquatic habitat protection. DPI is also working in partnership with other agencies to implement the NSW strategy to mitigate the impacts of cold water releases from the State's largest dams and is conducting the fish related component of the Sustainable Rivers Audit. DPI works closely with farmers and land managers on improved land management practices that also can protect waterways and wetlands. As such, DPI has a key role in progressing management of diffuse source water pollution, particularly primary industry sources. Some examples include managing effluent high in sediment, nutrients, chemicals and pathogens, or partnerships to improve water quality from acid sulfate soil areas (North Coast Floodgate Project, Acid Sulfate Soil Hot Spot Program). Under the MER Strategy DPI is responsible for leading the monitoring, evaluation and reporting for the following water-related State-wide NRM targets: invasive species (Target 4), and marine waters and ecosystems (Target 7).

Department of Lands (DoL) is responsible for the management and implementation of the *Soil Conservation Act 1938* (NSW). This enables a range of planning and implementation responsibilities related to landscape stability through the encouragement and guidance of research and investigations; collection, collation and promulgation of relevant data; evaluation of the condition of the soils of NSW; surveying and mapping of soils and associated constraints. It also provides for the development of NSW soil policy, which is also directed by Milestone 49 of the Priority Delivery Plan for Priority E4 of the NSW State Plan. DoL contains the Soil Conservation Service which provides specialist advice and implementation capacities for conservation earthworks, resource planning, erosion control and rehabilitation, water resource management, education and training, and rural property planning across the catchments of NSW.

DoL administers the *Western Lands Act 1901* covering the Western Division of NSW – almost half the State. Most Western Division land is held under lease and managed under the Act to ensure appropriate administration and management.

Significant areas of Crown land are in the Central and Eastern divisions. Tenured Crown land is occupied under a range of tenure types including leases, licences and permissive occupancies for essentially private purposes, while reserved and dedicated Crown land is managed by community trusts, local government or DoL directly, for a variety of public purposes (including future public requirements).

Some landscape units critical to diffuse source water pollution are on crown land, including areas in NSW referred to as 'beds and banks', of rivers and streams, and coastal estuaries. Use of these areas for agriculture, recreational and commercial activities is regulated through conditional tenure under the *Crown Lands Act 1989*. DoL has a key role in the management of diffuse source water pollution through provision of improved soil conservation and catchment management, and regulation of access to critical areas in and adjacent to water bodies in NSW.

State Water is responsible for operating the water storages and regulating structures on regulated rivers to deliver water needed for agriculture, industry, town supplies and the environment. State Water monitors water quality in its storages for reservoir operation purposes.

NSW Health is involved in developing various standards and guidelines for water quality for different purposes such as drinking water, rainwater tanks, and the safe reuse of treated effluent or reclaimed water. This guidance encourages the appropriate and efficient use of our existing water resources, and thereby contributes to improved water quality and river health. NSW Health has worked very closely with the Sydney Water Corporation (SWC) on recycling schemes such as the Rouse Hill Reuse Scheme and the Replacement Flows Project under the Western Sydney Recycled Water Initiative. NSW Health also accredits sewage management facilities under the provisions of the Local Government (General) Regulation 2005.

NSW Maritime is responsible for marine safety, regulation of commercial and recreational boating and oversight of port operations. It also provides strategic advice on ports and maritime matters to the NSW Government.

NSW Maritime is the appropriate regulatory authority for waste from small commercial and recreational vessels under the POEO Act and responds to oil spills that occur outside of the three NSW Port Corporation areas of responsibility. It is also responsible for property management of submerged lands in Sydney Harbour, Newcastle Harbour, Botany Bay and Port Kembla.

NSW Maritime is dedicated to safe waterways, improving maritime infrastructure and protecting the environment on the State's navigable waterways. Part of this is being achieved by:

- providing funding for public vessel sewage pumpout facilities
- conducting public education and awareness programs to encourage the boating community to identify and respond to environmental issues.

Sydney Catchment Authority (SCA) is the bulk water supplier for Sydney, Illawarra and the Blue Mountains and is responsible for managing and protecting the catchments that supply this water, as outlined in the *Sydney Water Catchment Management Act 1998*. It has responsibility for bulk water supply and environmental flows under the Metropolitan Water Plan.

SCA is responsible for strategic assessment of water quality risks for its catchments (through its Water Quality Risk Management Framework) and undertakes rectification action planning and funding of works to address critical water quality issues as part of the implementation of the Sustaining the Catchments – the Regional Plan for the drinking water catchments of Sydney and adjacent regional centres**.** This is a regional plan which provides a framework for action that supports sustainable development and improves knowledge as a basis for management decisions in Sydney's drinking water catchments. The statutory components of the regional plan are provided in the Drinking Water Catchments Regional Environmental Plan No 1 which provides comprehensive planning and development control provisions for the protection of water quality, including a requirement to satisfy the neutral or beneficial effects test and a concurrence role for the SCA.

NSW Food Authority is the state government agency responsible for food regulation to assist industry produce safe and correctly labelled food. It does this by contributing to national food policies and standards, establishing NSW regulations and food safety programs, developing food laws in consultation with stakeholders, and auditing, inspecting and enforcing food regulations.

The NSW Food Authority runs the NSW Shellfish Program. This sets standards for the harvesting of all oysters and mussels in NSW. Shellfish harvest areas may be temporarily closed by the NSW Food Authority for a number of reasons, including diffuse source water pollution in runoff that can pollute estuaries containing the shellfish. The NSW Food Authority works with the shellfish industry to close harvest areas when necessary and re-open them when microbiological testing indicates that the estuaries have become clean again and the shellfish have been given adequate time to purge themselves of all contaminants.

The NSW Shellfish Program uses a risk based classification system to evaluate the level of pollution that each shellfish harvest area is subject to and develop a management plan in accordance with the outcome of the risk assessment.

As part of the classification process the NSW Shellfish Program also undertakes comprehensive field surveys of potential pollution sources, including diffuse source water pollution, which have the potential to affect shellfish harvest areas. These surveys are updated annually. Environmental data from ongoing monitoring undertaken by industry is used to update the risk classification and management plan of each shellfish harvest area also on an annual basis.

This process provides a useful source of ongoing information on the level and sources of diffuse source pollutants entering waterways where oysters and mussels are grown commercially.

Sydney Water Corporation (SWC) is the major water utility for Sydney for both water supply and sewage services. SWC provides water to domestic and industrial water users and monitors water quality and river health as required by POEO Act licences. SWC is a major participant in delivering the Metropolitan Water Plan.

The Department of Premier and Cabinet, in particular the Premier's Regional Coordinators and the Regional Coordination Management Groups, foster cooperation between government agencies and coordinate incident responses on water quality management. For example, the department has a key coordination role in implementing the Incident Response Protocol for responding to problems with water quality affecting aquaculture in estuaries in NSW.

Catchment Management Authorities play a major role in contributing to improvement in water quality and river health by working with the community and local government in delivering on-ground actions through investment programs in line with CAPs. Some CMAs use WQOs in developing their CAPs or draw on advice and decision support tools developed by agencies. DECC has developed decision support tools, for example, for assessing the biggest contributors to sediment and nutrients in a catchment and for assessing the most cost effective management actions (for example Chifley Tool, Sustainable Loads Models). All CMAs are required to contribute to the achievement of the State-wide NRM targets through their CAPs. CMAs are largely responsible for NRM MER at a project and catchment scale.

Local councils have a role in managing water quality and have responsibilities and powers under the *Local Government Act 1993*, POEO Act and EP&A Act. Councils have already made significant progress in areas such as the management of septic tanks and stormwater pollution, and improved water quality in local planning. Councils are also empowered to enter into partnerships with farmers and businesses to improve water quality and have opportunities to work with CMAs in river health programs.

Regional organisations of councils (ROCs) are regional bodies established voluntarily by groups of councils to develop advocacy positions, collaborate on the sharing of resources, or better coordinate responses to issues of common interest (for example environmental issues, biophysical characteristics of LGAs, state planning initiatives and/or similar development pressures). All councils in NSW now belong to one or more of these bodies, with membership ranging from two to 15 councils (DLG 2007).

A key driver for ROCs with an environmental focus (such as Hunter Councils or Sydney Coastal Councils) is often to address more effectively an NRM issue that spans member council boundaries. Streams, wetlands and coastal lakes are commonly 'transboundary', as are their catchments. They will often develop collaborative programs or projects in partnership with CMAs and state and federal agencies to ensure a strategic regional approach to these issues. In addition, a primary role is to provide technical advice, resources and a single gateway for the flow of information to and from member councils and to other bodies, particularly state government agencies in relation to statutory and NRM issues or provisions.

Some ROCs have developed regional resources to achieve better stormwater outcomes, including regional education kits, resource data, online information, tools and activities for council staff, the general public, children and industry. Some have specialist technical or educational staff to assist the uptake and application of these resources via regular activities, workshops and seminars.

Abbreviations

ANZECC	Australian and New Zealand Environment Conservation Council
CEO	Chief Executive Officer
CMA	catchment management authority
CRC	Co-operative Research Centre
DCP	development control plan
DECC	Department of Environment and Climate Change
DoL	Department of Lands
DoP	Department of Planning
DPI	Department of Primary Industries
DST	decision support tool
DWE	Department of Water and Energy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
LEP	local environmental plan
LGA	local government area
MA	State-level management action
MER	monitoring, evaluation and reporting
NR&E	natural resources and environment
NRM	natural resource management
PAP	priority action plan
POEO Act	*Protection of the Environment Operations Act 1997*
PVP	property vegetation plan
ROC	Regional Organisation of Councils
SCA	Sydney Catchment Authority
SEPP	State Environmental Planning Policy
SWC	Sydney Water Corporation
WQO	water quality objective

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