QUESTION 5

Roadmap

How do we integrate with other natural resource management issues?

Why is this question important?

What advances have we made

Integrated natural resource management	Water yield and climate change (Page 104) Water quality (Page 105) Greenhouse (Page 105) Native vegetation (Page 106) Soil condition (Page 106)
Salinity Investment Framework	directs public funds to protect the most important high-value public assets (Page 107)
Salinity and biodiversity	looks at the threat of salinity to biodiversity in regional NRM planning (Page 109)
Catchment condition	established the biophysical condition of surface water catchments in the intensive land use zone of Australia (Page 110)
Landmark	analyses the sustainability of current land use and management practices for broad-scale dryland agriculture (Page 112)
Heartlands	investigates new land management options to repair and prevent environmental damage (Page 114)
Sediment & nutrient exports	informs end-of-valley target setting and identifies priority management areas (Page 116)
Watermark	explores irrigation issues within integrated catchment management (Page 118)
BushTender	trials an 'auction' system for conserving biodiversity (Page 119)
Ecosystem services	investigates more equitable sharing of the costs and benefits of natural resource management (Page 119)
National Market-based Instruments Pilots	uses trading mechanisms to manage natural resource issues (Page 121)
TARGET	investigates land use, change in small, medium and regional catchments affected by salinity (Page 122)

Where to from here?

QUESTION 5

How do we integrate with other natural resource management issues?

WHY IS THIS QUESTION IMPORTANT?

The earlier chapters described current research findings that directly relate to dryland salinity management, with some discussion about water yield and in-stream salt load and concentration. While Question 3 looked at the impacts and costs of dryland salinity on other natural and human resources, this chapter considers the impacts of other natural resource management decision-making on our ability to manage dryland salinity effectively.

Many catchments have developed integrated catchment management plans, and some have set targets for catchment health that are more far reaching than end-of-valley targets for salinity. For example, the Murray–Darling Basin Ministerial Council in its policy statement[1] on integrated catchment management has outlined targets for water quality, water sharing, riverine ecosystem health and terrestrial biodiversity. In taking action to achieve end-of-valley targets for salinity it will be important to consider the linkages and impacts of management actions taken to address other aspects of catchment health. 'Integrated natural resource management' requires a more spatially targeted approach and implicitly calls for trade-offs between issues to achieve multiple outcomes.

ACTION #5.1

Review the strategic plan for the National Land & Water Resources Audit Phase II (www.nlwra.gov.au) and/or speak with Audit staff to ascertain the extent to which the planned program of activities will meet your particular regional needs.

WHAT ADVANCES HAVE WE MADE?

The complexity of dryland salinity is difficult to grasp in isolation, and the earlier chapters outlined both the advances and gaps in our existing understanding. Integrated decision-making is an area of research and implementation needing significant further development, and until our understanding of each element of catchment health is well understood, progress in this area remains hampered. While the National Land & Water Resources Audit Phase I has provided a wealth of information across natural resource management themes to support integrated planning and management, much more needs to be done. Together, the NLWRA Phase II and the models described in Question 4 for testing land use and management change scenarios have good potential for development to account for integrated outcomes, and are partly down that track.

Themes of the National Land & Water Resources Audit (1997–2002)

The NLWRA comprised six research themes in addition to dryland salinity. Scientific assessments were produced on the status of and changes in the nation's land, vegetation and water resources to assist decision-makers in their efforts to achieve ecological sustainability, and to serve as a baseline or benchmark for future trend analysis. Economic, environmental and social assessments of land and water resource change (including land cover) and remedial actions were made. These resources are available on the NLWRA's on-line Atlas and provide valuable information for catchment managers in the investigation of integrated catchment management scenarios:

- Surface and groundwater management (availability, allocation, use and efficiency of use)
- Vegetation cover, condition and use
- Rangelands monitoring
- Land use change, productivity, diversity and sustainability of agricultural enterprises
- Capacity of and opportunity for farmers and other natural resource managers to implement change
- River, estuary, catchment and landscape health.

NLWRA Phase I's full recommendations on priorities for data collection, interpretation and storage are outlined in the final Audit report[2] (www.nlwra.gov.au).

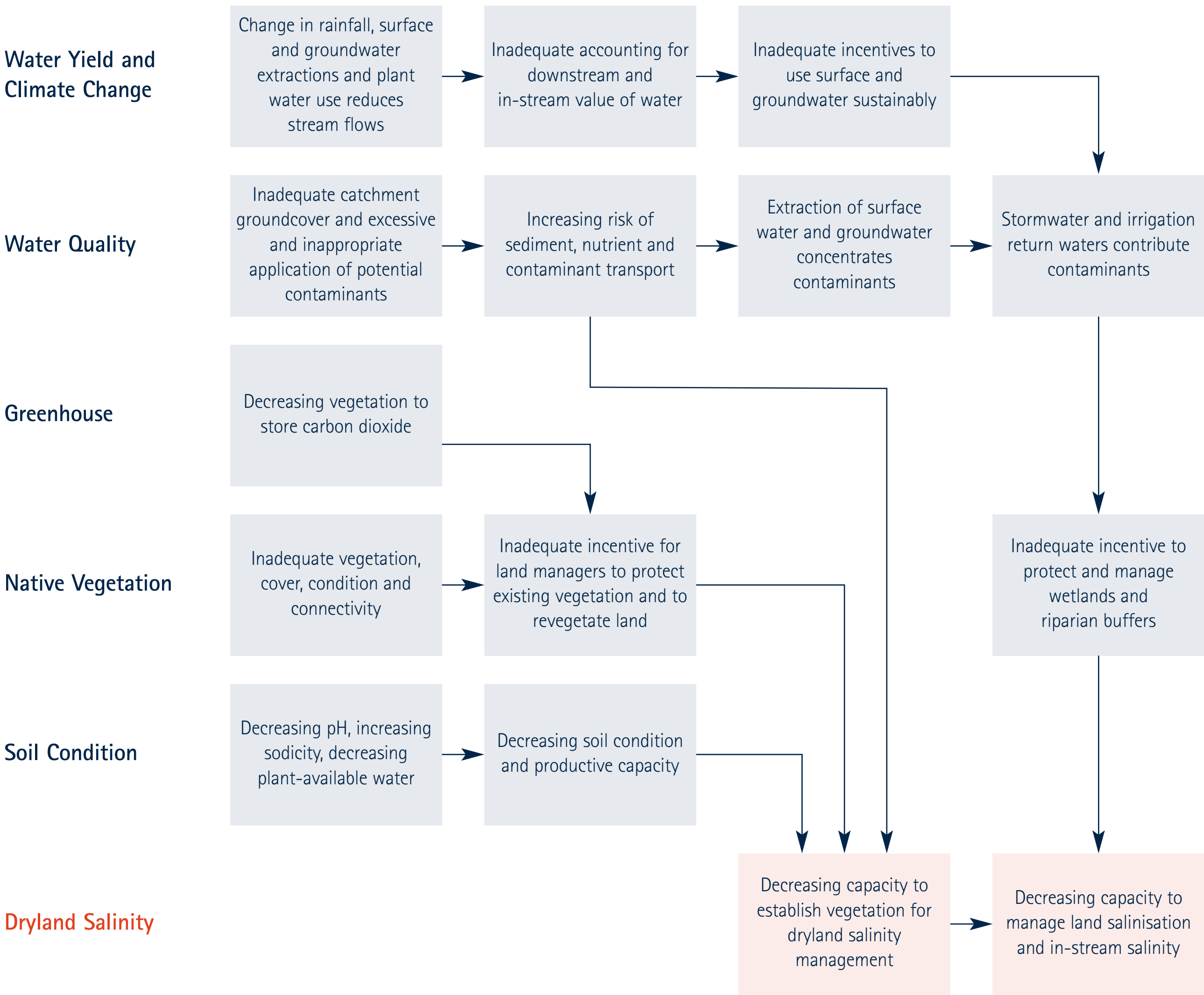
5.1 Integrated natural resource management

The sections that follow provide a general description of the major aspects of integrated natural resource management and their relationship to dryland salinity management, followed by some examples of significant work making progress in our thinking and understanding in this area. These working examples of 'integration' projects — developing approaches to consider multiple resource management issues — are provided as models from which you can learn and build.

Figure 5.1 is a simplified depiction of the relationship between five major biophysical aspects of catchment management — water yield and climate change, water quality, greenhouse, native vegetation (as a surrogate for terrestrial biodiversity) and soil condition — and dryland salinity within an integrated natural resource management framework. Management actions to tackle these issues can directly affect capacity to manage land salinisation and in-stream salinity, or have indirect impacts by decreasing capacity to establish vegetation. Each element of catchment management is briefly described below.

Figure 5.1

Diagram showing how major aspects of integrated catchment management link to dryland salinity



5.1.1 Water yield and climate change

Australia receives comparatively low rainfall which is distributed unevenly both in terms of location and season. River flow is highly variable, largely driven by an erratic climate. Climate and season have a significant influence on the surface and groundwater flows reaching waterways, and diversion of water for irrigation has significantly altered the flow patterns of water in some rivers, and has sometimes led to the reversal of the flow patterns. The National Land & Water Resources Audit[3] reported that Australia's estimated total water supply in 1996–97 was 80,363 gigalitres (GL). Of this supply, 85 per cent was 'self-extracted', 14 per cent as mains supply, and <1 per cent as effluent re-use. In addition, some 49,480 GL was supplied as regulated discharge. Of 325 basins, 34 were assessed as being over-developed or highly over-developed, as were 59 of 538 groundwater management units.

Figure 5.1 illustrates that the volume of in-stream water is affected by the amount of rainfall, the water captured by catchment storages and used by plants (grasses, shrubs, trees), and extracted from groundwater and surface waters across the landscape. Many of our management actions for dryland salinity control are in direct conflict with the need to increase surface water flows and to recharge fresh water aquifers. The value of water to in-stream life and down-stream users (both in quantity and in quality) is not accounted for in management of catchment water supplies, and this reduces capacity to manage land salinisation and in-stream salinity concentrations and salt loads.

5.1.2 Water quality

The degradation of surface water and groundwater supplies by contaminants such as sediment, nutrients, salts or chemicals is a significant issue for catchment managers, and is exacerbated by water extraction that concentrates the contaminants. The National Land & Water Resources Audit[4] reported that the dominant erosion processes vary from sheet wash erosion in Queensland, to gully erosion over much of southern Australia, and stream bank erosion particularly in eastern Victoria. River sediment loads are generally 10 to 50 times greater than pre-European loads in intensively-used river basins, and 90 per cent of the suspended sediment loads reaching estuaries are derived from only 20 per cent of catchment areas.

The relative importance of different sources of nitrogen and phosphorus varies between river basins. The dominant sources of phosphorus (over 50 per cent) are: hill-slope erosion in Queensland and New South Wales; gully and river bank erosion, and dissolved phosphorus in run-off in coastal Victoria, South Australia, Western Australia and Tasmania; and urban point source discharges in some basins (e.g. 30 per cent of the total load for Moreton Bay). Dissolved nitrogen in run-off comprises more of the total load than dissolved phosphorus. Total nitrogen loads come mainly from hill-slope erosion in Queensland and coastal New South Wales; contributions from hill-slope erosion and dissolved nitrogen loads in run-off in the Murray–Darling Basin are comparable in magnitude; and over 60 per cent of the total load occurs as dissolved run-off in coastal Victoria, South Australia, Tasmania and much of Western Australia.

Figure 5.1 illustrates that the risk of contaminant transport increases with inadequate catchment cover, and excessive and inappropriate application of nutrients and chemicals. Extraction of surface water and groundwater reduces dilution of these contaminants, and their concentration can be further increased by the addition of irrigation-return waters and urban run-off via stormwater drains. Inadequate incentives to use and manage water sustainably drive off-site impacts on water quality and in-stream life. The movement of soil, nutrients and chemicals diminishes the capacity of land managers to establish vegetation to control dryland salinity across the landscape. The capacity to manage soil and in-stream salinity is decreased by inadequate incentives for land managers to protect and manage riparian and wetland vegetation.

5.1.3 Greenhouse

Sustainable land management practices in forestry, vegetation management and agriculture provide important opportunities for reducing greenhouse gas emissions and enhancing greenhouse sinks. Limiting the loss of native vegetation and increasing greenhouse sinks through revegetation and plantation establishment provide effective and practical means for reducing emissions to help meet National and State greenhouse abatement strategy targets. It is widely recognised that vegetation and forestry activities can produce good greenhouse outcomes while helping to manage major natural resource issues, including mitigating dryland salinity, protecting water quality and conserving biodiversity at a landscape scale.

The Australian Greenhouse Office[5] reports that greenhouse gas emissions from agricultural production represented 20 per cent of national emissions in 1999 (excluding land clearing), much higher than that of any other OECD country apart from New Zealand. The bulk of agricultural emissions come from livestock, particularly methane from sheep and cattle and nitrous oxide from animal wastes. The sector needs to consider both the potential impacts of climate change, to which it is vulnerable, and the national policy and program response to reducing emissions, which can offer both opportunities and challenges.

Figure 5.1 illustrates only the woody vegetation component of greenhouse abatement. It shows that vegetation clearance reduces the store of carbon dioxide in the landscape, and that creation of carbon sinks through woody perennial vegetation establishment is currently very limited. Inadequate incentives for land managers to protect vegetation and invest in revegetation for carbon sequestration or other purposes further decrease the capacity for retaining and establishing vegetation in the landscape. This, in turn, has implications for dryland salinity management, with consequent capacity to manage in-stream and soil salinisation diminished.

5.1.4 Native vegetation

The National Land & Water Resources Audit[6] reported the first Australia-wide, regional level, collaborative assessment of the type, extent and change in native vegetation cover. It reported on the status of native vegetation using the *National Vegetation Information System* and other sources of mapped vegetation information.

The *Australian Native Vegetation Assessment 2001* presents a range of information products about native vegetation including examples and applications of the native vegetation information at scales appropriate for Australia-wide policy development and program evaluation. Knowledge and information gaps are also identified.

Figure 5.1 illustrates that declining vegetation cover, condition and connectivity is partly driven by inadequate incentives for land managers to protect and restore native habitat. The on-going clearance of native vegetation and its limited re-establishment for nature conservation benefits also impacts on capacity to manage leakage to groundwater and the mobilisation of salts in the landscape. This has implications for in-stream salinity concentrations and salt loads, as well as the spread of salinity on land.

5.1.5 Soil condition

Soil condition (factors such as pH, sodicity, water-holding capacity, erosion, nutrients) affects plant growth and farm productivity, and can impact on nearby streams. The National Land & Water Resources Audit[7] reported that surface and sub-soil acidity exists in all States and is estimated to total eight to nine times the area affected by dryland salinity. The largest areas of acid soils are in New South Wales, Western Australia, Victoria and Queensland.

Figure 5.1 illustrates that declining soil condition and productive capacity reduce yield and farm profits, thereby reducing the capacity of land managers to invest in vegetation for dryland salinity management — either perennial grasses or woody perennials. Capacity to manage the spread of salinisation on land and the movement of salt to streams is diminished as a consequence.

5.2 Salinity Investment Framework

The *Salinity Investment Framework*[8] (SIF) is a system developed in Western Australia to help ensure that public money to counter salinity is spent effectively, by directing it to projects with the best chance of protecting important high-value public assets.

Initiated in March 2002, the SIF identified important natural assets which fall into four main classes – biodiversity, water resources, agricultural land, and rural infrastructure such as towns and roads. It then set priorities based on eight principles related to the value of the natural asset, threat to it, and feasibility of options available to protect it.

The eight principles are:

- The top priority public investments are those that generate the greatest public benefits per dollar of public investment
- Direct financial assistance to landholders to undertake salinity action should be strategic and should not exceed the public benefits that result
- Where the priority is high and net public benefits are sufficient, Government should be prepared to take strong action to ensure protection of the asset
- Where the public priority is low but there are extensive private assets at risk, public investment should be aimed at industry development
- Inevitably, a targeted investment strategy in salinity management will result in an unequal distribution of investment across the State
- Government must fulfil its statutory obligations for land, natural resources and functions (such as research) when it sets its priorities for investment in salinity action
- The processes required for priority-setting will involve ongoing learning and need constant feedback
- Setting priorities must proceed even when there is only limited or imperfect information on prevailing environmental, social and economic circumstances.

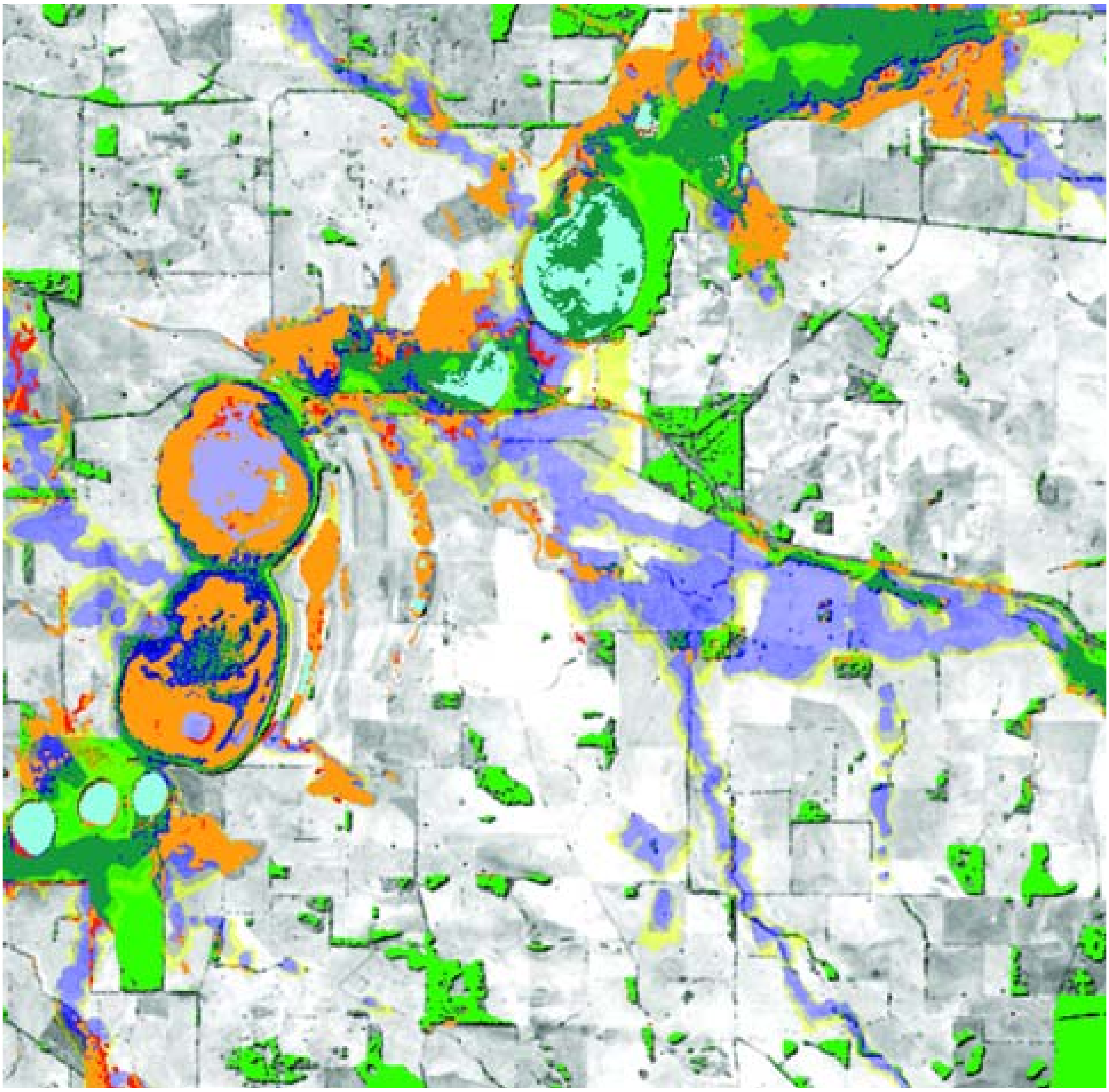
Establishing the priority assets within the SIF threat and feasibility framework required analysis of the extent and trends in salinity not previously considered. Firstly, detailed assessments of the current extent of salinity and future valley hazard were updated from the Land Monitor project methods (see Figure 5.2, and discussed earlier in Question 1 section 1.3.3). Total area affected and times to equilibrium for each of the 31 Soil Landscape Zones (used as surrogates for groundwater flow systems in Western Australia was then established. Management options (based on technical feasibility factors) and estimates of adoption were then used to create predictions of the amount of land that would be treated within the established strategies of recovery, containment and adaptation. Estimates of the impact in each zone were then assessed and the economic benefit of management evaluated. Sensitivity analysis was conducted on each of the factors.

The following conclusions can be drawn from this analysis:

- Salinity currently affects 0.821 million hectares or threatens 4.4 million hectares of agricultural land and over 40 towns containing high value infrastructure. Over 3640 km of primary roads are affected, with 16,090 km at risk. Of the area at risk, current trends in adoption and analyses of the effectiveness of practices suggest that less than 800,000 hectares can be recovered or contained, and a similar area of land managed by systems of adaptation. A large area of the land at risk has no options for management (but may have in the future).

Figure 5.2

An example of a map product from the Land Monitor project. The Landsat™ derived image shows Lake Toolibin (300 ha – north) and Lake Taarblin (900 ha – south) in Western Australia. (Source: Department of Environment, Western Australia – *Land Monitor* project.)



Light blue	Water
Grey	Crop and pasture
Orange	Current salinity derived by mapping areas of consistently low productivity
Red	Recently developed salinity (from multi temporal analysis of Landsat TM)
Dark Blue	Valley Hazard – forecast to have potential to develop a shallow water table (< 1 m above lowest point),
Yellow	Valley Hazard (<2 m above lowest point)
Green	Show extent and trends in remnant vegetation condition
	Light Green – good condition
	Dark Green – poor/worsening condition

- Most of the benefits (and losses avoided) for farmers from the adoption of factors assessed in this review stem from the containment of salinity. Benefits from recovery of salt-affected areas are imputed to be higher than those for the improved management of saline areas, although this is dependent on actual costs of recovery. Recovery technologies are poorly developed.
- There is a high degree of variability between the zones where benefits were incurred (or losses avoided), with many eastern zones having a lower return on investment than those to the west. Net return per hectare needs to be considered along with return per zone.
- Improving either the technical feasibility or adoption rate greatly boosts the potential returns on investment in many zones.
- Further analysis of the economics is warranted as this analysis was only undertaken at regional scale and was related to agriculture and infrastructure alone. An analytical tool that allows further sensitivity analysis to be undertaken and regional variations better accounted for, is being developed.

The second phase will address the feasibility of achieving the management goal for priority assets (to contain salinity, recover the assets, or adapt to salinity) and regional application in the Avon catchment. Regional groups will use it to assist with their regional plans.

ACTION #5.2

Consider the application of the Salinity Investment Framework *in your regional context as an approach to deciding between multiple objectives and prioritising investment.*

5.3 Salinity and biodiversity

The report *Review of SA regional planning and investment concerning the impacts of salinity and salinity management on biodiversity values*[9] seeks to identify the extent to which the threat of salinity to biodiversity has been recognised and integrated into natural resource management regional plans in South Australia. It also reviews regional initiatives and assessment processes for evident recognition of both positive and negative impacts of salinity management options on biodiversity conservation. The report collates several decision support tools (existing and under development), and makes recommendations on assessing and prioritising the impact of salinity and salinity management options on biodiversity.

The report discusses the following list of decision support tools:

- The Australian Natural Resource Atlas & Data Library
- The Groundwater Flow Systems Framework
- Managing groundwater and surface water for native terrestrial vegetation health in saline areas – a guideline report
- GIS mapping
- Economic and groundwater modelling
- Environmental weed risk assessment
- The biodiversity toolbox for local government (www.ea.gov.au/biodiversity/toolbox)
- Engineering options decision support tool
- A system for predicting the loss of aquatic biodiversity from changes in salinity
- A decision tree approach to management/restoration of remnant vegetation in salinising landscapes.

The report's primary conclusion is that the critical factors for effective regional natural resource management planning and investment into salinity/biodiversity issues is an adequate and accessible information base that can be meaningfully interpreted to inform priority-setting processes. Promotion of currently available decision support tools and those under development is needed, and regional groups require technical and facilitative support to access and interpret information to manage their investment strategies and proposed projects.

ACTION #5.3

Review the SA report on salinity and biodiversity and the decision support tools identified and consider whether your regional plans give adequate recognition of the threat of salinity to biodiversity.

ACTION #5.4

Consider the map products and methods developed by the 'Catchment condition' project within the context of your regional planning.

5.4 Catchment condition

The report *Assessment of catchment condition*[10] established the biophysical condition of surface water catchments in the intensive land use zone of Australia using land, water and biological measures as part of the National Land & Water Resources Audit river, estuary and catchment condition assessment.

The 14 individual indicators used in the assessment are shown in Table 5.1. These indicators were aggregated using a decision support system called CatCon, resulting in an overall catchment condition index, or sub-indices for water (6 indicators), land (3 indicators) or biota (6 indicators).

The result of the land condition assessment at ~500km^2 scale is shown in Figure 5.3 using the three indicators for the land sub-index shown in Table 5.1. The assessment indicates that poor condition areas are found in:

- South-west Western Australia where the largest area of poor land condition occurs compared with other regions
- Upper Condamine and large areas of the Fitzroy catchments in Queensland
- Coastal floodplains in parts of central Queensland
- Hunter River Basin in New South Wales
- Catchments west of Melbourne in Victoria.

This national-scale study was also trialed at the State and regional levels, for Victoria and the Sydney catchment. It provides a framework and selection criteria to establish indicators, and context and database to guide more detailed and specific assessments at State and regional scales.

Table 5.1

The 14 indicators used in the assessment of catchment condition

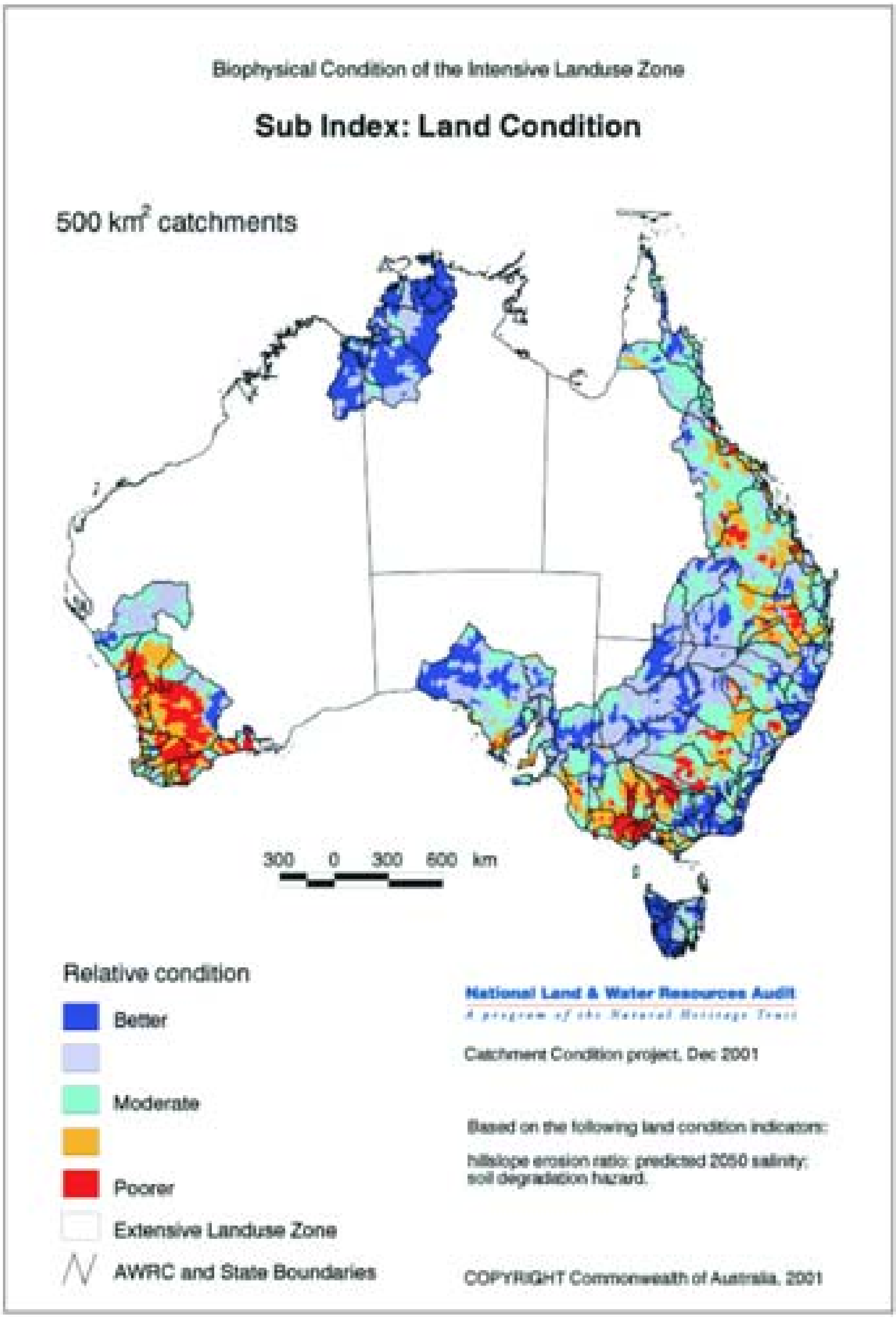
(Source: Walker J., Veitch S., Dowling T., Braaten R., Guppy L., and Herron N., 2002, *Assessment of catchment condition – The intensive land use zone in Australia*, CSIRO Land and Water, Canberra ACT.)

Water condition *(sub-index)*	**Land condition** *(sub-index)*	**Biota condition** *(sub-index)*
Suspended sediment ratio	Predicted 2050 salinity	Native vegetation fragmentation
Pesticide hazard	Soil degradation hazard	Native vegetation extent
Industrial point source hazard	Hillslope erosion ratio	Protected areas
Nutrient point source hazard		Road density
Impoundment density		Feral animal density
		Weed density

Figure 5.3

Land condition sub-index assessment at ~500km² scale

(Source: Walker J., Veitch S., Dowling T., Braaten R., Guppy L., and Herron N., 2002, *Assessment of catchment condition – The intensive land use zone in Australia*, CSIRO Land and Water, Canberra ACT.)



5.5 Landmark

The primary objective of the Landmark[11] project was to identify the need for land use and land management change and policy responses to facilitate change in broad-scale dryland regions. Landmark provides the scientific foundation for determining whether current land uses and recommended practices achieve, or are likely to achieve, government and community goals for sustainability. It uses a logical approach to determine whether, what scale and what type of change might be required. This methodology is documented in detail in *Landmark: A method for testing dryland agriculture sustainability*[12].

The work was undertaken in three pilot regions – the Upper Goulburn-Broken (Vic)[13], Upper Billabong Creek (NSW)[14] and Upper Condamine (Qld)[15] catchments. The Landmark project has produced a quantitative, spatial analysis of the sustainability of current land use and management methods for broad-scale dryland agriculture in these three focus catchments. The indicators used to assess sustainability include biophysical measures (soil acidity, soil erosion, nutrients, biodiversity, water balance), economic data (e.g. growth in regional productivity) and social factors (e.g. population age structure, access to services).

Reports can be accessed on the Landmark web-site (www.mdbc.gov.au/landmark/index.html).

Figure 5.4 provides an example of the acidity results for the Goulburn-Broken catchment, which show that direct off-site impacts from declining paddock soil pH, such as a decline in stream pH and inability to establish native vegetation, are not evident at this stage. Although declining stream pH has been measured for a number of years, such declines have been occurring in forested parts of the region. The causes of stream pH decline are currently unknown and more research and interpretation is needed before the off-site impacts from agriculturally-induced soil acidity can be assessed.

Landmark has developed and evaluated a set of methods, and applied them in three pilot regions. The broad results from these analyses provide a set of quantitative and spatial data than can be further interrogated to help guide catchment plans, program development and delivery, and the use of policy instruments to help improve sustainability. It provides valuable information to support decision-making processes at regional, State and National levels and will inform the implementation of the *Integrated Catchment Management in the Murray–Darling Basin 2001–10* and the *Basin Salinity Management Strategy 2001–15*.

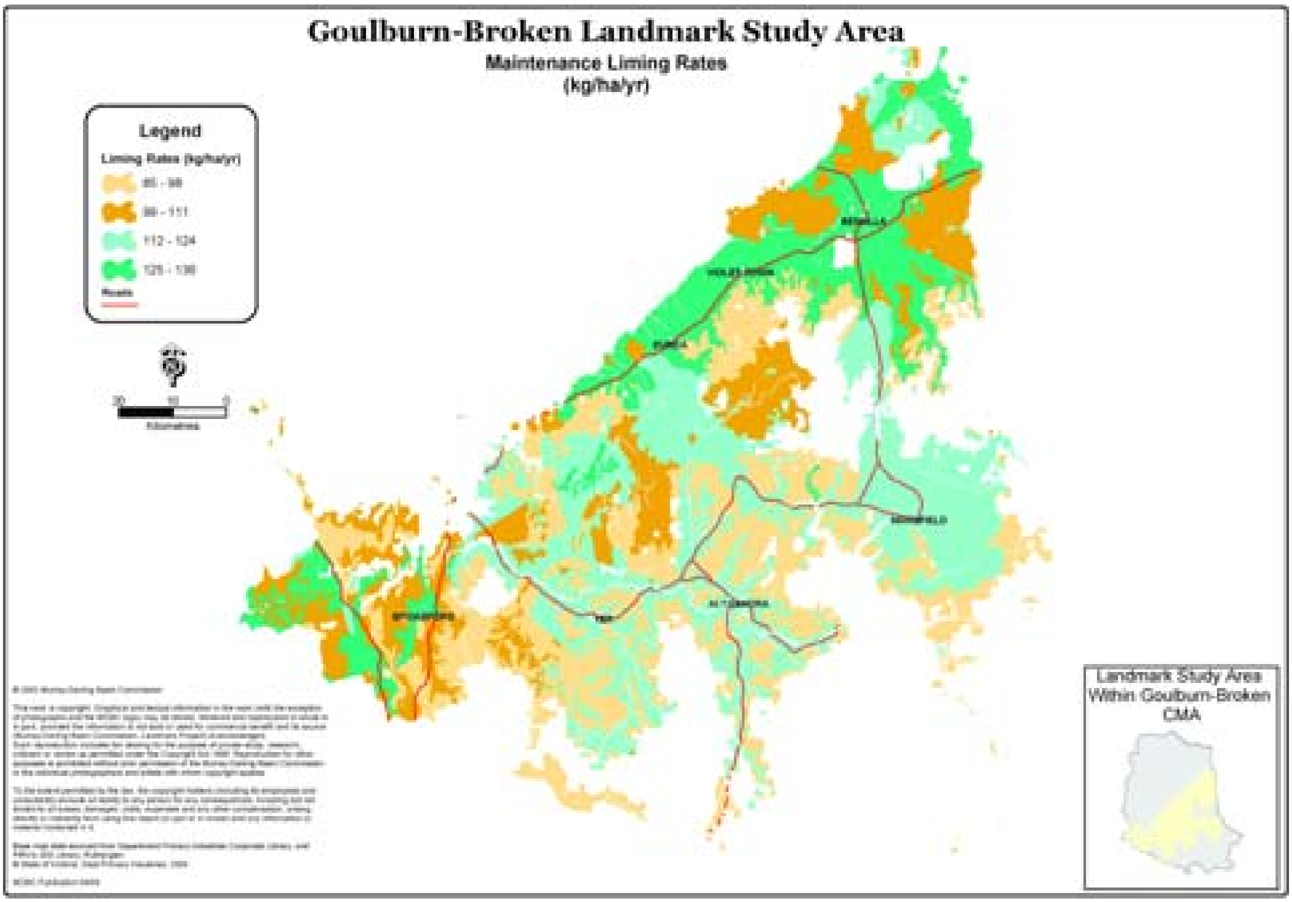
ACTION #5.5

Consider the integrated, catchment-scale method developed by the Landmark *project to assess the sustainability of current land use and scenarios for land use change for application in your region.*

Figure 5.4

Map showing liming rates needed to maintain current soil pH levels in the Upper Goulburn-Broken pilot region.

(Source: Avery A., Barr N., Beverly C., Cary J., Clarke D., Clifton C., Eigenraam M., Gallant J., Madden B., McKenzie N., Price P., Ridley A., Robins L., Stoneham G., Thomson D., and Webb T., (in press), *Landmark: Testing sustainability of high rainfall grazing systems – Upper Goulburn Broken (Vic).* Murray–Darling Basin Commission, Canberra ACT.)



5.6 Heartlands

The *Heartlands*[16] initiative aims to improve land use in the Murray–Darling Basin to protect land and water resources and sustain commodity production. It combines a research program with implementation of on-ground works such as tree planting, protection of remnant vegetation, establishment of perennial pastures and erosion protection. The research guides on-ground works to ensure maximum environmental benefit from the investment. The close link with on-ground implementation ensures that the research remains relevant and well focussed.

In particular, *Heartlands* focuses on:

- Integrated catchment management strategies
- Salinity
- Water yield
- Water quality
- Biodiversity
- Carbon sequestration potential
- Commercially viable systems of farm forestry and mosaic agriculture.

Heartlands operates in four catchments to investigate new land management options that will be effective in repairing and preventing environmental damage. These strategies for targeted land use change will address economic and social objectives. The effectiveness of revegetation options will be measured to ensure their success, and support local communities in implementing improved management of their farms and catchments.

The focus catchments are:

- Billabong Creek, Upper Murray, New South Wales
- Kyeamba Creek, Murrumbidgee, New South Wales
- Honeysuckle and Sheep Pen Creeks, Goulburn-Broken, Victoria
- Mid Ovens basin, North-East, Victoria.

Figure 5.5 provides an example of the water yield results for the Ten Mile Creek pilot study. The water yield reduction shown is based on the integrated land use scenario modelled to achieve optimal outcomes across a range of land management objectives. The land use map does not represent a socially optimal outcome, and is only a working draft to inform on-going discussions with the community.

On-ground works such as agroforestry and environmental plantations are taking place in all four catchments, however most of the research will be focussed on the Billabong Creek and Honeysuckle Creek catchments. Technology developed from such research may later be applied and tested in the Kyeamba Creek and the Ovens Basin catchments. It is intended that results and recommendations can be extended to other areas.

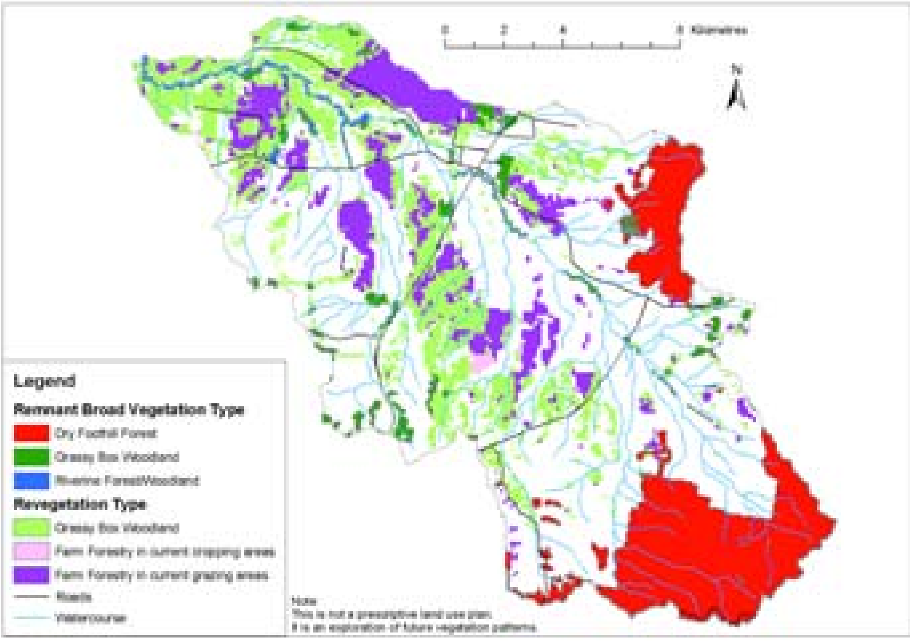
Several reports and a seven-part fact sheet series on findings from Heartlands are available, and include:

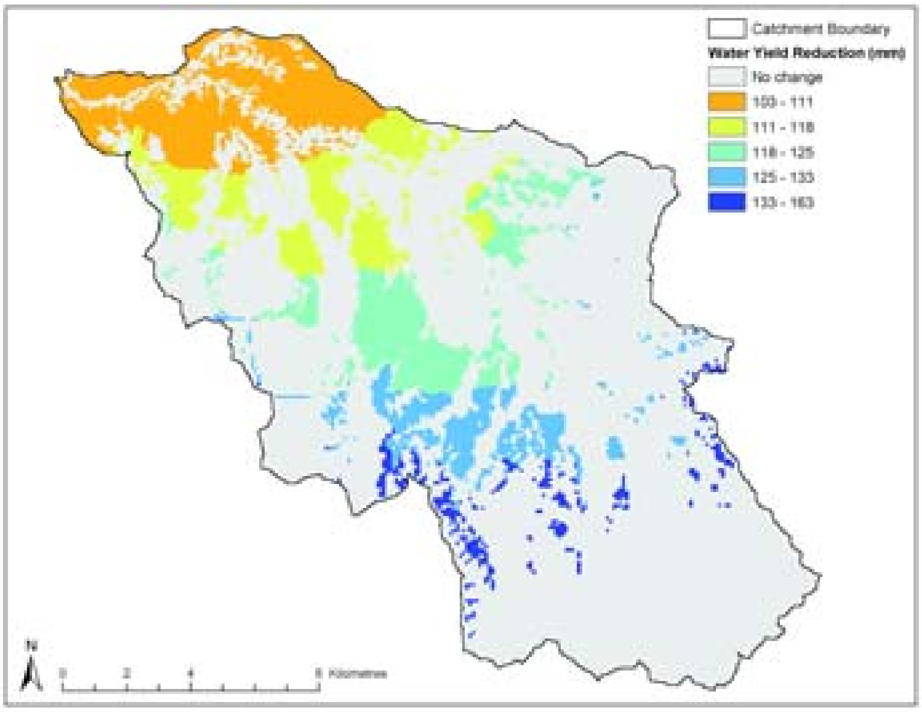
- *Learning from the Heartlands experience*[17]
- *Heartlands* — Planning for sustainable land use and catchment health[18]
- *Heartlands* — Low to medium rainfall farm forestry[19]
- *Heartlands* — Mosaic farming feasibility[20]

Figure 5.5

Map 1 of Ten Mile Creek (NSW) showing the outcome of the integrated (multiple theme) revegetation allocation. Map 2 of Ten Mile Creek (NSW) showing the mean annual water yield reduction under the integrated revegetation scenario

(Source: Cresswell H. (ed), 2004 (in press), *Planning for sustainable land use and catchment health*, A report of the Heartlands Initiative, Technical Report No. 1., CSIRO and Murray–Darling Basin Commission, Canberra, ACT.)





ACTION #5.6

Consider the method trialed by the Heartlands *initiative to develop an integrated land use map for sub-catchment-scale planning and implementation in your region.*

- Fact sheets
  - No 1 — The *Heartlands* overview[21]
  - No 2 — Mosaic farming: Agricultural landscapes of the future[22]
  - No 3 — Assessing and managing dryland salinity[23]
  - No 4 — Low rainfall farm forestry[24]
  - No 5 — Trees, groundwater and river flow[25]
  - No 6 — Restoring biodiversity — Some practical guidelines[26]
  - No 7 — Integrated land use planning.[27]

Learning from the Heartlands experience is a plain-English publication summarising the project, its management structure and processes, and key findings. Other reports form part of a technical series.

Planning for sustainable land use and catchment health presents spatially explicit land use maps in draft form for three pilot areas within two focus catchments — Simmons Creek and Ten Mile Creek (sub-catchments of the Billabong Creek catchment), as well as Sheep Pen Creek. All three studies use spatial information derived from airborne geophysics investigations.

The work builds on the land use scenarios investigated in the 'Salt Delivery'[28] project for the Simmons Creek catchment. Complete assessments of priorities for restoration of biodiversity and landholder evaluation of the costs, synergies and trade-offs between alternative land use options are in progress. The web-based Billabong Land Information System[29] is being used to facilitate knowledge exchange and community engagement, and represents an innovative means of providing information to catchment managers and landholders. The aim of the work is to produce a balanced and spatially explicit land use plan that is acceptable to the community and one that is based on sound science.

ACTION #5.7

Consider the benefits from additional data and information to inform investment decisions, as demonstrated by the Sediment & nutrient exports *project, and the potential to optimise investment benefits by using the prioritisation framework coupled with salinity modelling (such as BC2C) to prioritise work in your region.*

5.7 Sediment & nutrient exports

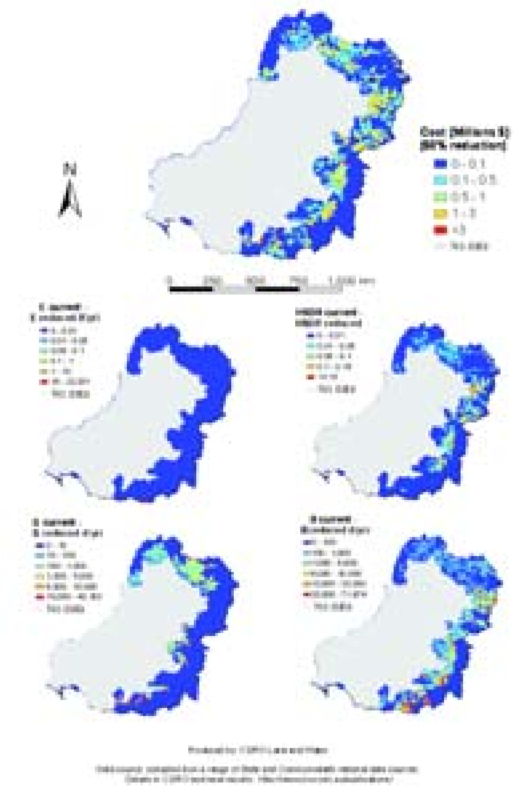
The *Sediment and nutrient exports*[30] project synthesised existing information on sediment and nutrient transport across the Murray–Darling Basin, improving upon earlier investigations undertaken for the National Land & Water Resources Audit. Tools were developed to inform decision-making on achieving end-of-valley targets, the most effective means of controlling suspended sediment loads, identifying priority management areas, and demonstrating water quality benefits downstream for different levels of investment and different investment strategies.

Spatial modelling was used to quantify the patterns and rates of current sediment and nutrient transport, and methods were developed for effectively controlling sediment and nutrient sources, and quantifying the benefits resulting from different investment scenarios. Results show that effective targeting of restoration work can reduce the cost by many times (see Figure 5.6).

Figure 5.6

Map showing some results from the *Sediment and nutrient exports* project on prioritising investment for soil erosion control — Total cost, reduction in hillslope, sheet and rill erosion, sediment delivery ratio, gully erosion and bank erosion for 60 per cent of fine sediment reduction at control locations.

(Source: Lu H., Moran C., DeRose R., and Cannon G., 2003, *Spatially distributed investment prioritisation for sediment control in the Murray Darling Basin — Report G to project D10012 of Murray Darling Basin Commission: Basin-wide mapping of sediment and nutrient exports in dryland regions of the MDB*, CSIRO Land and Water Technical Report 31/03, CSIRO Land and Water, Canberra ACT.)



5.8 Watermark

Watermark[31] is a group of projects that aims to make a significant contribution to strategic development of sustainable irrigation practices by exploring irrigation issues within integrated catchment management.

Collectively, *Watermark* projects will develop an integrated package of measures to provide catchment managers with:

- Reliable information and decision support tools to establish irrigation water priorities, targets and response plans
- Policy options to underpin improvements to land use planning, groundwater management, water use efficiency and biodiversity.

Individually, projects will develop:

- A user-friendly, affordable method for measuring and recording on-farm water use efficiency for irrigated horticulture, linked to reporting water use efficiency at regional scale (*Improving water use efficiency across the Murray–Darling Basin*)[32]
- A framework to facilitate basin-wide alignment of irrigation data collection, storage and retrieval enabling collection of consistent, repeatable and reliable irrigation data, accessible to all stakeholders (*Developing a management information and reporting system for the Murray–Darling Basin*)[33]
- Planning guidelines for new and redeveloping irrigation areas to support sustainable irrigation practices and development (*Guidelines for land use, suitability and capability for irrigation planning and development*)[34]
- A voluntary, user-friendly Environmental Stewardship Program to improve environmental management at farm-scale linked to catchment outcomes (*The environmental stewardship program*)[35]
- A set of guiding principles to underpin strategies to achieve sustainable groundwater use in irrigated catchments (*Sustainable groundwater use within irrigated catchments*)[36]
- A decision-support framework manual and software package that can be used to assess the most effective use of water available for irrigation (*A framework to optimise irrigation water use*)[37]
- Tools to improve understanding, decision-making and uptake of best practice for water quality management by the irrigation industries (*Managing water quality in irrigated catchments*)[38]
- Feasible options and opportunities for catchment water management through improved strategic management of water use efficiency of on-farm and delivery systems (*Developing a policy framework for water use efficiency*).[39]

Most Watermark projects commenced in April 2002, and reporting is anticipated in 2004–05. An integrated report on outcomes should be available by mid-2005.

ACTION #5.8

Use the findings, guidelines and tools developed by the Watermark projects to link dryland salinity management decision-making more closely with irrigation management in your catchment.

5.9 BushTender

BushTender[40] is a biodiversity conservation program in Victoria applying an 'auction' system based on economic theory outlined in the report *Mechanisms for biodiversity conservation on private land.*[41] Landholders make an offer to receive a given price for entering agreements to provide management services that improve the quality or extent of native vegetation on their land. These services are based on management commitments over and above those required by current obligations and legislation. This price forms the basis for their bid, which is compared with bids from other participating landholders. The successful bids are those that offer the best value for money.

This approach to biodiversity conservation was trialed in Gippsland in 2002–03, where there are 255,000 hectares of native vegetation on private land. Much of this vegetation is important for land protection, water quality, salinity control and environmental significance. The trial was conducted in Trafalgar, Bairnsdale East and Buchan-Snowy.

Seventy three bids were received from 51 landholders (some having bid separately on each of their sites). There were 33 successful bids and management agreements have been signed.

Management agreement periods of three or six years were offered to landholders in the Gippsland trial, with the further option of 10-year protection or permanent protection covenants. Of the successful bidders, all but one opted for at least a six-year management agreement period, with almost half committing to further protection.

In total, 1684 hectares of vegetation has been protected under 'BushTender' management agreements in Gippsland. About half of that area is vegetation considered to be of high or very high conservation significance. The program has been extended under the National Market-based Instruments Pilots described in section 5.10.

ACTION #5.9

Consider the auction approach trialed in the 'BushTender' program in achieving multiple benefits from remnant vegetation protection in your region.

5.10 Ecosystems services

The *Ecosystem services* project (www.ecosystemservicesproject.org) is working to better understand the benefits and beneficiaries of ecosystem services, and provide direction on more equitable sharing of the costs and benefits of natural resource management. It is investigating these free natural services that support the production of goods such as fruit and grain, and other services such as cleaning water, keeping air breathable, controlling pests and diseases and providing other benefits.

The project is working to address questions such as who benefits from these services?; what are current land management practices doing to them?; what will happen under future land use scenarios?; and how far can land use intensification proceed before environmental thresholds are crossed and systems start to collapse?

QUESTION 5

ACTION #5.10

Consider ways of valuing and investing in ecosystem services to support integrated catchment management in your region, using the resources developed by the Ecosystem services *project (www.ecosystemservicesproject.org).*

In many instances there is either no substitute or very expensive technological substitutes for these ecosystem services. The project is working with communities around Australia to understand and recognise the importance of ecosystem services, and consider them when making catchment-scale land use decisions. The regions include:

- Atherton Tablelands, Queensland
- Blackwood catchment, Western Australia
- Brigalow Region, Queensland
- Goulburn-Broken catchment, Victoria[42]
- Gwydir catchment, New South Wales
- Onkaparinga catchment, South Australia
- Rangelands, New South Wales.

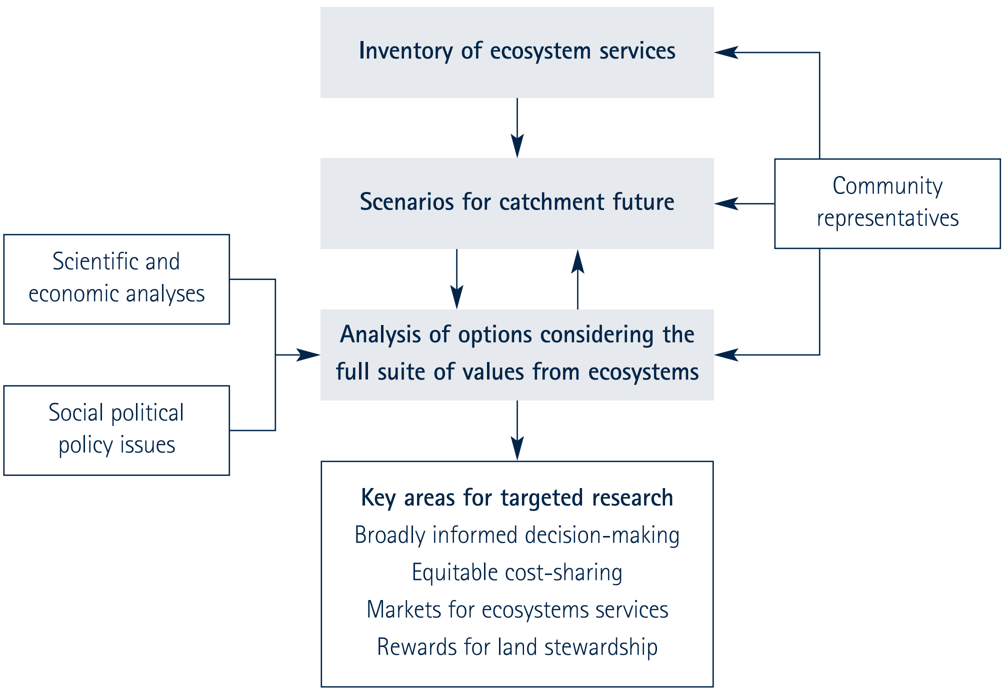
These seven different regions provide a diversity of approaches to studying ecosystem services, a mixture of regional economic and social issues and differing natural resource characteristics. The analysis framework used in these studies is shown in Figure 5.7. The project will provide a multitude of processes and tools with which to study ecosystem services including:

- Methods for inventory of ecosystem services at a catchment scale
- A scenarios and modelling process which illustrates the interaction of ecosystem services and the economic and social impacts related to different land uses
- Decision-making aids which incorporate preferences and values of community members
- Provision of an action research methodology that engages communities and stakeholders.

Figure 5.7

Ecosystem Services Analysis Framework used in the 'Ecosystems services' project

(Source: Abel N., Cork S., Gorddard R., Langridge J., Langston A., Plant R., Proctor W., Ryan P., Shelton D., Walker B., and Yialeloglou M., 2003, *Natural values: Exploring options for enhancing ecosystem services in the Goulburn Broken Catchment*, Ecosystem Services Project, CSIRO Sustainable Ecosystems, Canberra ACT.)



5.11 National Market-based Instruments Pilots

The National Market-based Instruments (MBI) Pilots Program (see www.napswq.gov.au) seeks to increase Australia's capacity to use MBIs in managing natural resource issues, in particular to address salinity and water quality. MBIs use trading mechanisms, auctions and price signals to change behaviour.

In April 2003 the Natural Resource Management Ministerial Council announced 10 pilot projects shown below, funded under a $5 million first round. As a follow-up, the Ministerial Council launched the Tender for a Pilot of Dryland Salinity Trading and Offset Schemes in June 2003.

- 'Multiple-outcome auction of land use change'. Department of Primary Industries, Victoria to extend the auction approach trialed in the 'BushTender' program (Goulburn-Broken NAP region, Victoria) — see section 5.8 for more details.
- 'Tradable net recharge contracts in Coleambally Irrigation Area'. CSIRO Sustainable Ecosystems to test on the ground the effectiveness of trading schemes for managing salinity (Lachlan-Murrumbidgee NAP region, NSW).
- 'Farming Finance: Creating positive land use change with a Natural Resource Management Leverage Fund'. Greening Australia to set up a fund to leverage private sector investment to deliver natural resource management outcomes and private returns to investors (Lachlan-Murrumbidgee NAP region, NSW; South Coast NAP region, WA).
- 'Auction for landscape recovery (south west Australia)'. WWF Australia to design and trial an auction to provide incentives for diffuse source salinity and biodiversity outcomes (Avon NAP region, WA).
- 'Adoption of New Land Management Practices through Conservation Insurance'. Department of Water, Land and Biodiversity Conservation, SA to undertake a scoping study into the use of insurance as a means of supporting changes in farming practices where risk is perceived to be a major barrier to implementation (Lower Murray NAP region, SA).
- 'Cap and Trade for Salinity: Property Rights and Private Abatement Activities, a Laboratory Experiment Market'. Department of Primary Industries, Victoria to examine the economic efficiency and cost-effectiveness of a cap and trade approach to managing salinity from irrigated agriculture, compared to current policy instruments (Lower Murray NAP region, Victoria/South Australia).
- 'Catchment Care — Developing an auction process for biodiversity gains and water quality outcomes'. Onkaparinga Catchment Water Management Board to test a low-cost biodiversity and water quality assessment and auction tool for use by regional natural resource management bodies (Mt Lofty-Kangaroo Island NAP region, SA).
- 'Green Offsets for Sustainable Regional Development'. NSW Environment Protection Authority to implement three field-based salinity offset schemes to demonstrate how offset works can facilitate economic expansion, while avoiding addition of salt loads to stressed rivers in the Murray–Darling Basin (Namoi-Gwydir/Macquarie-Castlereagh/Murray NAP regions, NSW).
- 'Establishing East-west Landscape Corridors in the Southern Desert Uplands'. Desert Uplands Build-up and Development Committee to investigate the design of auctions to create biodiversity corridors (Burdekin-Fitzroy NAP region, Qld).

ACTION #5.11

Consider the wide array of mechanisms being tested under the National Market-based *Instruments* Pilots Program *to value and invest in ecosystem services to support integrated catchment management in your region.*

- 'Establishing the potential for offset trading in the lower Fitzroy River.' Central Queensland University to examine how a salinity trading scheme might work in new and developing irrigation areas (Burdekin-Fitzroy NAP region, Qld).

ACTION #5.12

Consider the final reports from the TARGET *project within the context of your regional planning, particularly the integration of salinity and biodiversity using 'bio-indicators'.*

5.12 TARGET

The *TARGET*[43] project (Tools to Achieve landscape Redesign Giving Environmental/Economic Targets) investigated land use change in small, medium and regional catchments affected by salinity. It identified the barriers to and incentives for implementing change, integrating social, economic and environmental factors in salinity management.

'Landholder Profile Surveys' examined the social and economic barriers to implementing land management change and a 'Farm Economic Analysis' evaluated the profitability of current enterprises, enterprises associated with the strategic management of salinity and the impact of a range of market-based incentives.

'Ecological Surveys' were conducted in catchments of small (Warrengong and Mid-Talbragar) and medium (Little River and Weddin) size, and birds were used as 'bio-indicators' to give a relative measure of catchment health. Within each catchment, the diversity and abundance of bird species was assessed and the existing native vegetation was surveyed. Data was collected on the structural and floristic diversity of the vegetation, and the condition of the vegetation and habitat was assessed.

The use of 'bio-indicators' (birds) was a valuable tool for determining catchment health. Land managers and agency staff increased their awareness of biodiversity issues and could relate the survey results to vegetation condition and catchment health. The size of the vegetation remnant and its location in the landscape was an important consideration for increasing biodiversity. Land managers used this information to determine where vegetation needed to be put back into the landscape for on-ground works to have salinity and biodiversity outcomes. This information will be used in New South Wales to help Catchment Management Authorities better target their management actions.

WHERE TO FROM HERE?

Modelling and methodological developments through the *Catchment condition* project, *Landmark* project, *Heartlands* initiative and TARGET project provide frameworks for advancing the integration of salinity management with other catchment health considerations, with potential for improved dryland salinity outcomes through linkages to models like BC2C, CAT and Catsalt.

The *Salinity Investment Framework* provides a model for guiding the cost-effective allocation of resources within an integrated natural resource management framework. Further refinement of the framework developed under the *Sediment & nutrient exports* project and its development to account for dryland salinity and other natural resource management priorities could significantly enhance its value in directing investment priorities for multiple benefits at the catchment to national level. It also clearly demonstrated the value of accurate data to inform investment decisions.

Finding ways of streamlining modelling approaches will be important, as we need relatively simple, cost-effective approaches at different scales, that can be transferred between landscapes, to confidently inform our decision-making processes.

The *Ecosystem* services project and the *BushTender* program provide both a theoretical foundation and operational tools for establishing instruments to account for non-market values such as nature conservation and greenhouse abatement, that require recognition and valuation in the market place. The *National Market-based Instruments Pilot Program*, including the *Pilot of Dryland Salinity Trading and Offset Schemes* will add significant understanding and tools.

Alignment of dryland salinity management with broader decision-making processes on catchment water yield and water sharing requires much greater attention. The *Watermark* projects provide some data, guidelines and tools for making in-roads to better define these potential opportunities and synergies.

The need to plan for and manage dryland salinity with other natural resource management issues within an integrated framework is critical for achieving effective on-ground results. The National Land & Water Resources Audit Phase II[44] will be important in collating data and information to support this need.

Link back to Introduction

Link to Q.1 - Extent and Risk

Link to Q.2 - Causes and Processes

Link to Q.3 - Impacts and Costs

Link to Q.4 - What can we do?

Link to a checklist of actions

Link to - Where to get help

Link to Glossary and References