

AUDITOR-GENERAL'S REPORT

PERFORMANCE AUDIT

Improving Efficiency of Irrigation Water Use on Farms

Department of Primary Industries



The Legislative Assembly
Parliament House
SYDNEY NSW 2000

The Legislative Council
Parliament House
SYDNEY NSW 2000

In accordance with section 38E of the *Public Finance and Audit Act 1983*, I present a report titled **Improving Efficiency of Irrigation Water Use on Farms: Department of Primary Industries**.

Peter Achterstraat
Auditor-General

Sydney
November 2007

State Library of New South Wales cataloguing-in publication data

New South Wales. Audit Office.

Performance audit : improving efficiency of irrigation water use on farms : Department of Primary Industries / The Audit Office of New South Wales.

9781921252105

1. New South Wales. Dept. of Primary Industries - Auditing. 2. Irrigation efficiency - New South Wales - Auditing. 3. Irrigation water - New South Wales - Management - Auditing. 4. Irrigation - Government policy - New South Wales - Auditing. I. Title: Improving efficiency of irrigation water use on farms : Department of Primary Industries. II. Title: Auditor-General's report : performance audit : improving efficiency of irrigation water use on farms : Department of Primary Industries.

354.36709944

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Foreword

Good management of scarce resources is always important. The ongoing drought and climate change has made imperative the good management of water.

Many people would be surprised to learn that irrigated agriculture uses much more water than our towns and cities; about seven times as much in a normal year.

That is why in this report we have examined how the Department of Primary Industries has been helping irrigators to use water more efficiently. In a May 2005 report the Audit Office reported on planning for Sydney's water needs.

This report is also relevant to all agencies that need to align their planning, funding, monitoring and reporting in accordance with State Plan priorities.

Peter Achterstraat
Auditor-General

November 2007

Executive summary

The focus of our audit

The Department of Primary Industries (DPI) aims to foster profitable and sustainable development of primary industries. One significant way it works to achieve this is through assisting agricultural industries to use water more efficiently and productively. While DPI offers advice and support to farmers on how to grow crops, it is not its role to tell them what they must grow.

Similarly, in conducting this audit it is not our role to decide whether or not certain crops should be grown.

The audit examines the effectiveness of DPI in assisting farmers to adopt on-farm improvements in irrigation water use.

This report answers the following questions:

- does the Department of Primary Industries have effective approaches for improving the efficiency of water use on irrigation farms?
- have the expected outcomes of the Department's initiatives for improving agricultural water use efficiency been achieved?

Introduction

Over 70 per cent of water extracted in NSW is used in irrigated agriculture. While accounting for less than one per cent of total agricultural area, irrigation contributes more than half of the profit earned by agriculture in NSW.

The 2006 NSW State Plan has a goal for improving the efficiency of water use. Underlying documents include objectives for DPI on adoption of water-efficient technologies. The State Plan also has a goal for stronger rural and regional economies, with DPI responsible for expanding its training programs, including those for water efficiency improvement in rural and regional areas.

DPI is also responsible for leading the development of a regional innovation plan which relates to the NSW Government's Statement on Innovation. This plan will have a strong emphasis on improving productivity and is expected to encompass future water use efficiency initiatives.

Australian governments have agreed that action is required to more efficiently allocate water among competing uses. The recently-announced National Plan for Water Security will place further demands on the irrigated farm sector to adjust water management practices. Through its research and development (R&D) activities and its programs to build the skills and capacity of farmers, DPI has employed a twofold strategy to achieve this: development of science-based practices to improve efficiency of water use, and initiatives to assist irrigators to adopt them.

Science-based solutions

DPI works extensively with agricultural industries and research organisations to develop improved management methods and irrigation technologies. Its R&D initiatives include techniques for identifying 'leaky' soils, breeding of cold tolerant rice varieties to reduce water requirements, and innovations which have improved water use efficiency in grapegrowing by 50 per cent. DPI attracts nearly half of its research funding from its external partners.

Key initiatives to ensure change

Central to DPI's strategy for the adoption of these improved water use practices and technologies was the WaterWise on the Farm education and training program. WaterWise provided grower awareness, education and training, advice and support for farmers to change the way they manage water on-farm. This included planning assistance to move from older methods such as flood and furrow irrigation to potentially more efficient methods such as drip irrigation. It also included techniques for minimising water losses and for scheduling of irrigation to deliver water in the 'right amount, right place and right time'.

The NSW Government provided \$7 million between 1996 and 2005 for DPI's WaterWise program to educate and train irrigators in efficiency improvements. Between 1998 and 2005 WaterWise was also supported by \$25 million in incentive funding to encourage irrigators to participate in the program and adopt improvements.

Around 5,000 of the state's 12,000 irrigators attended WaterWise courses. DPI evaluations show a high rate of adoption of improvements by farmers, and numerous case studies show improvements in water use efficiency across cotton, rice, wine grapes and vegetables.

WaterWise funding ceased in June 2005. Although DPI still delivers the WaterWise course under its PROfarm training initiative, the number of staff engaged in WaterWise and similar programs has reduced. Farmers also believe that DPI has lost many staff in recent years.

Audit opinion

DPI has a crucial role in assisting the irrigation industry to respond to the conflicting demands placed upon the state's water resources.

The State Plan emphasises the importance of water to agriculture, and gives DPI responsibility to use its training programs to help farmers continue to increase water use efficiency.

However the National Plan for Water Security and the National Water Initiative (NWI) require that water be provided for the environment. This has increased the need for DPI to assist farmers to adjust to reduced availability of water.

Water use efficiency investments produce a mix of benefits for growers and benefits for the public and the community. DPI's strategy of working with agriculture industry bodies therefore has the potential to facilitate more efficient investment in R&D by providing a framework for industry and government to fund projects in accordance with the industry and public benefits they generate.

Representatives from DPI's partner research organisations praised the constructive relationships which they share.

While DPI has developed project funding principles to assist in determining the appropriate mix of industry and government funding, it is appropriate that these continue to be improved. This should involve DPI working closely with key stakeholders, such as NSW Treasury, to make its approach increasingly transparent and to ensure opportunities for innovative approaches to water use efficiency continue to be developed.

DPI's WaterWise on the Farm education and training program was effective in increasing awareness of water use efficiency practices and technologies, in educating and training irrigators in farm water resources planning and management, and in encouraging them to change practices.

DPI needs to work closely with agencies with which it shares responsibilities in the State Plan to ensure that its water use efficiency activities contribute to the State Plan goals. It needs to work closely with Treasury to document the services it will require to do this, the resources which will be needed, and how its success will be measured.

This will ensure that DPI is well placed to continue to assist the NSW farming industry to adapt and survive periods of reduced water availability. It will keep as many farmers as possible in business and so preserve rural and regional communities which depend heavily on agriculture.

Key audit findings

Does the Department of Primary Industries have effective approaches for improving the efficiency of use of water in irrigation on-farm?

DPI has developed a number of effective approaches to improve efficiency of water use in irrigation.

DPI has sufficient information on the main uses of water to identify priorities. It has developed close partnerships with industry research organisations and community bodies to identify opportunities for improving water use practices and technologies. It has attracted investment by agriculture bodies in R&D projects helping irrigators to adapt to reduced availability of water.

Programs such as WaterWise on the Farm were effective in increasing grower awareness of water use efficiency options and technologies and in educating and training irrigators in farm water resources planning and management.

But DPI has been unable to fully maintain programs such as WaterWise as Government funding has ceased.

Have the expected outcomes of the Department's initiatives for improving efficiency of agricultural water use been achieved?

DPI has contributed significantly to developing improved irrigation practices and having them widely adopted. But there is still more that can be done.

WaterWise delivered benefits of around \$88 million on an investment of \$20 million by accelerating adoption of improved irrigation practices and technologies. It also delivered direct public benefits in the order of \$160 to \$240 million through water savings to the environment. Other benefits were reduced stream and ground water salinity and increased community capacity to respond to future challenges.

DPI is responsible under the State Plan for expanding training and for reporting on the adoption of on-farm technologies that improve water use efficiency.

DPI's achievements have depended on its R&D partnerships and on programs such as WaterWise to encourage and facilitate the adoption of improvements. To ensure that DPI's research, education and training activities maximise benefits to the community its criteria and processes for selecting R&D projects need to be made increasingly transparent to both stakeholders and clients.

DPI also needs to improve inter-agency planning with NSW Treasury to enable the efficient implementation of such programs in future.

Recommendations

DPI should work closely with agencies with which it shares responsibilities to ensure that its water use efficiency activities contribute to the State Plan goals (page 34).

DPI and its key stakeholders should maintain their close relationships to ensure that they identify opportunities for new technologies and practices with the highest potential benefit (page 34).

DPI should further develop the transparency of its R&D selection principles to demonstrate that projects and activities are funded in accordance with the mix of industry and public benefits they will generate (page 34).

DPI should negotiate with NSW Treasury the resources it will require to meet its commitments to the State Plan, the future demands of the Commonwealth (including the NWI) and the effects of climate change. In doing so it should review best practice models in other jurisdictions for assisting and encouraging growers to adopt improvements (page 34).

Response from the Department of Primary Industries

I am writing in response to your invitation of 23 October 2007 for me to provide a formal response to your final report which will be incorporated verbatim into the published report.

I would like to accept your invitation and therefore provide the attached response for inclusion in your final report.

I would like to take this opportunity to thank you and your staff for the constructive manner in which this performance audit was undertaken and the helpful recommendations that have resulted.

(signed)

B D BUFFIER
DIRECTOR-GENERAL

Date: 2 November 2007

ATTACHMENT

Thank you for providing the Department of Primary Industries (DPI) with the opportunity to comment on the findings and recommendations of the performance audit report Improving efficiency of irrigation water use on farms.

The report confirms the importance of DPI's role in working with irrigated industries in NSW to cope with dramatically reduced water supplies. Irrigated agriculture underpins many of our rural communities, injecting many millions of dollars into regional economies and providing crucial employment opportunities. DPI's role in working with industry to enhance its water use efficiency therefore provides far reaching social benefits to the broader NSW community.

There is a tendency to negatively portray agriculture as a major low value user of the state's water resources. The more appropriate representation of the situation is that cities, towns and the environment are generally given priority access to water, with much of the residual amounts flowing to agriculture as it provides the next most profitable use of the resource.

This perspective highlights the importance of irrigated agriculture as the industry most capable of generating substantial direct and indirect benefits from the state's remaining water resources. Indeed the ability to trade water means that it will be allocated to its best use.

The report identifies that an important part of DPI's core business is to work with rural industries and other stakeholders in NSW to develop and increase the adoption of land use systems and practices that are both profitable and environmentally sustainable. The report also confirms that DPI's strategy of doing this through (i) its R&D partnerships to develop technologies and practices to improve water use efficiency, and (ii) through its education and training activities which encourage and assist irrigators to adopt them, have not only been effective, but will be fundamentally important in addressing the state's future water use challenges.

The key audit findings are that DPI has developed effective approaches to improve the efficiency of water use in irrigation and that DPI has contributed significantly to developing improved irrigation practices and having them widely adopted. Nevertheless, the Audit Office has made a number of helpful suggestions as to how DPI can further enhance its role in these areas. I welcome those suggestions and take the opportunity to thank the AO team for the constructive and helpful manner in which they undertook this important performance audit. I would also like to thank those DPI staff who assisted with the audit.

Key recommendations

The report's recommendations will enhance DPI's future capacity to help irrigators respond to drought and reduced water availability. I have made specific comments on the three key recommendations.

Recommendation 1 DPI should work closely with agencies with which it shares responsibilities to ensure that its water use efficiency activities contribute to the State Plan goals.

DPI comment *In the State Plan, DPI shares responsibility with the Department of Water and Energy for reporting on water use efficiency training programs and on the adoption of on-farm technologies to improve water use efficiency. With the Department of Education and Training it shares responsibility for expanding the provision of relevant training in rural and regional areas.*

These shared responsibilities will be reflected in future versions of DPI's Corporate Plan and its Results and Services Plan.

Recommendation 2 DPI and its key stakeholders should maintain their close relationships to ensure that they identify opportunities for new technologies and practices with the highest potential benefit.

DPI should further develop the transparency of its R&D selection principles to demonstrate that projects and activities are funded in accordance with the mix of industry and public benefits they will generate.

DPI comment *The Audit Office's findings and recommendations provide strong support for DPI continuing to work in partnership with key stakeholders, such as industry based R&D corporations, to ensure that the full range of research opportunities to increase water use efficiency are fully explored and to ensure industry and public funds are used in a manner that maximises the development of new technologies and practices. The Catchment Management Authorities are also key partners in this process, given the significant Catchment level natural resource management benefits of these activities.*

DPI has been successful in developing jointly funded projects with a mix of 'public' and 'industry' benefit outcomes, and consequently, the Department's research division attracts significant partnership funding from industry. DPI will commit to maintaining this partnership approach and to further developing our investment guidelines to ensure projects are funded in accordance with the industry and public benefits they generate.

Recommendation 3 DPI should negotiate with NSW Treasury the resources it will require to meet its commitments to the State Plan, the future demands of the Commonwealth (including the NWI) and the effects of climate change. In doing so it should review best practice models in other jurisdictions for assisting and encouraging growers to adopt improvements.

DPI comment *DPI's Results and Services Plan is the main vehicle by which this will be achieved and DPI has been, and will continue to, liaise closely with Treasury in demonstrating the benefits of its activities. The review of best practice models in other jurisdictions for assisting and encouraging growers to adopt improvements will be undertaken by DPI in 2008.*

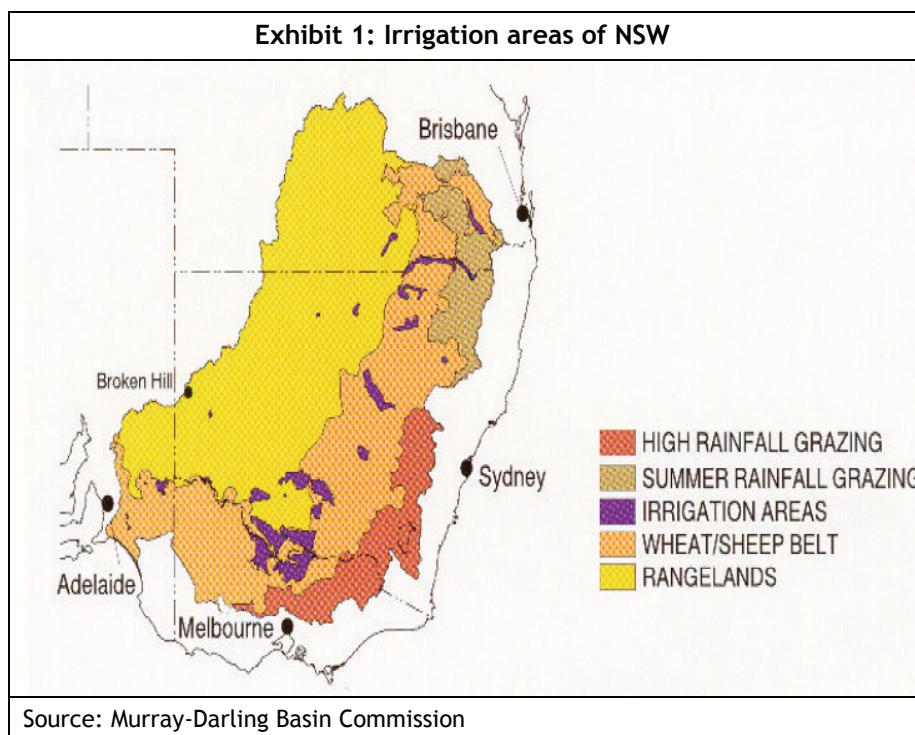
1. Why is the efficiency of irrigation water use of interest?

1.1 Introduction

Australia is the world's driest inhabited continent, with one of the most variable rainfall climates in the world.

Historically, NSW and Commonwealth government rural policies have aimed to achieve regional socio-economic development. One strategy has been the development of rural water resources in support of the irrigation industry.

However development of irrigation has not been without problems. Over the decades poor irrigation practices, inefficient systems and cheap water have contributed to degradation of the environment and natural resources. Rising water tables, increased salinity, poor water quality and loss of wetlands and riverine environments are in part the result of unsustainable water management.



But prolonged drought has continued to reduce the volume of water available in rivers and dams across NSW. There are concerns that climate change could permanently reduce water availability. Farmers have less water available now than they have been used to, and they may be paying more for it.

1.2 The importance of irrigation

Dryland agriculture

Most of Australia's agricultural production comes from rainfed agricultural systems which are entirely reliant upon seasonal rainfall. This type of farming is commonly referred to as 'dryland farming'. Most of our agricultural land is dryland, producing cereal crops such as wheat, barley, oats and oilseeds like canola, often accompanied by the grazing of sheep or cattle.

Irrigated agriculture

Irrigated agriculture uses a combination of rainfall and irrigation to meet crop water requirements. Irrigation water is applied through supply systems such as channels, drippers or sprinklers to meet the difference between plant water needs and the rainfall received. Irrigation farmers in dry environments such as western NSW will source more of their crops' water needs from irrigation than those in less dry environments such as NSW tablelands.

The major irrigation areas in NSW are in the Murrumbidgee, Murray, Lachlan and Namoi basins, accounting for over 70 per cent of area irrigated. But there are smaller-scale irrigators in coastal regions and in the Sydney basin.

According to the Australian Bureau of Statistics, irrigation has a significant influence on the Australian economy:

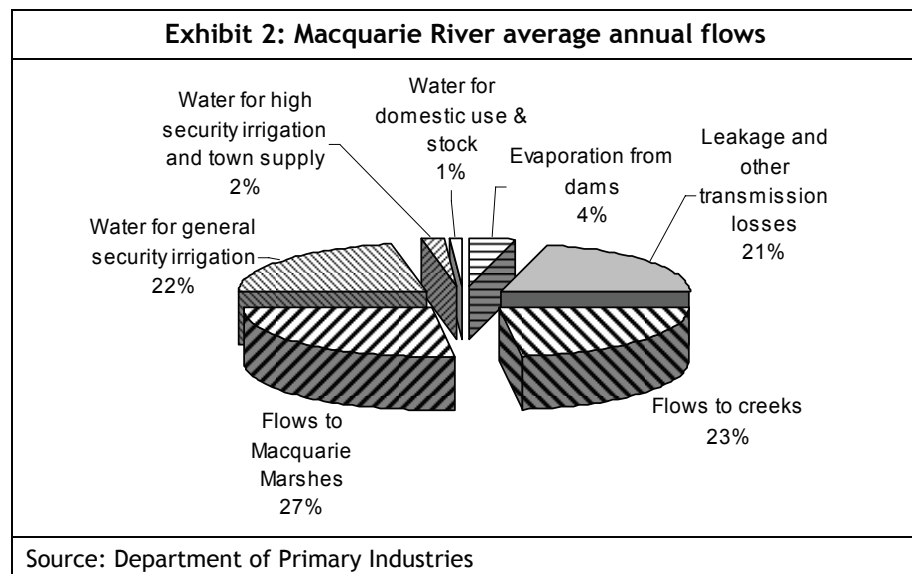
The gross value of irrigated production in Australia is estimated to have been around \$9 billion in 2003-04 – around one-quarter of the gross value of all agricultural production.

Reports by the Australian Bureau of Statistics also show that irrigation has produced a high proportion of agriculture industry profit:

Irrigated agriculture, while accounting for only 0.5 per cent of the total agricultural area, generated 51 per cent of the total agricultural profit for the five year period to 1996-97. Within the Murray-Darling Basin irrigated agriculture, utilising 1.4 per cent of the total land area, accounted for 36 per cent of the total profits generated by agriculture in 2000-01.

Water used by irrigation

The Macquarie River provides a typical example of water use. Only twenty five per cent of all water used from the river is consumed by irrigation, domestic uses, stock watering and town water supply. Around three-quarters of water in this system provides flows to the environment.



After the environment, irrigation is the largest consumer of water. The State of the Environment report in 2003 showed that approximately 86 per cent of water extracted by users in NSW was for irrigated agriculture, 11 per cent for urban and industrial and three per cent for other rural uses. The proportion used by agriculture has decreased significantly since then due to the effect of drought, but it still exceeds all other uses of water.

1.3 Who manages water for irrigation?

Since the 1980s governments have been increasingly concerned with the environmental consequences and sustainability of irrigation farming.

National reforms

In 1994 the Council of Australian Governments (COAG) agreed that action was required to arrest natural resource degradation caused by water use. It developed a national policy - the COAG water reform framework - for reforming Australia's rural and urban water industries.

In 1995 the Murray-Darling Basin Ministerial Council established a cap on water extractions within the Murray-Darling Basin at 1993-94 levels. The cap sought to ensure that water extraction within each state could not increase. Three-quarters of NSW is within the Murray-Darling Basin.

The National Water Initiative

The NWI was signed by all state and territory governments to reflect 'the continuing national imperative to increase the productivity and efficiency of Australia's water use'. The NWI agreement 'signifies a commitment to identifying over-allocated water systems, and restoring those systems to sustainable levels'. It includes objectives, actions and outcomes to be undertaken by governments for water management. It requires that the environment must be taken into account when allocating water.

The NSW Implementation Plan for the NWI includes DPI's role in providing practical assistance to irrigators through training in best practice irrigation management techniques.

The Commonwealth's water security plan

On 25 January 2007 the Prime Minister announced a National Plan for Water Security to improve water efficiency and address over-allocation of water in rural Australia. The plan aims to secure additional water for the environment and use the accrued water savings to achieve environmental outcomes. The plan includes a nationwide program to improve on-farm irrigation technology and metering.

Reform in NSW

In 1995 NSW water policy reforms included developing interim objectives for the flow and quality of the state's waters. They also privatised government-owned irrigation districts and extended environmental flows to the Macquarie and Gwydir wetlands. The Independent Pricing and Regulatory Tribunal (IPART) was required to set prices for water that more closely reflect costs.

In 1997 NSW introduced a water reform program to move water management to a more sustainable footing. The reforms established water sharing plans that defined the environment's right to water and shared the remaining water amongst urban, stock and domestic, industry and irrigation sectors. The irrigation industry received amongst the lowest priority.

Irrigation farmers may purchase the water allocation to which their licences entitle them, and are free to use it on their farms or to sell or lease it.

The agency responsible for the NSW Water Acts manages resources by creating water sharing plans for each water source, issuing licences to extract and use water, and through ensuring compliance with regulations. Initially the Department of Natural Resources (DNR) was the lead NSW agency responsible for implementing the NWI. From 27 April 2007 the Department of Water and Energy (DWE) assumed these responsibilities.

**Catchment
Management
Authorities**

NSW's 13 Catchment Management Authorities (CMAs) are regional bodies that work in partnership with farmers, community groups, Aboriginal communities, local government, industry and state government agencies. They develop and implement policies and programs for managing all natural resources - not just water - in their catchment areas.

**Reduced
availability of
water for
irrigation**

Because of the drought DWE, and its predecessor DNR, have had to reduce allocations of water in some catchments to ensure that sufficient water is available for the environment. Because of this many farmers in these catchments have not been allocated their full licence entitlements.

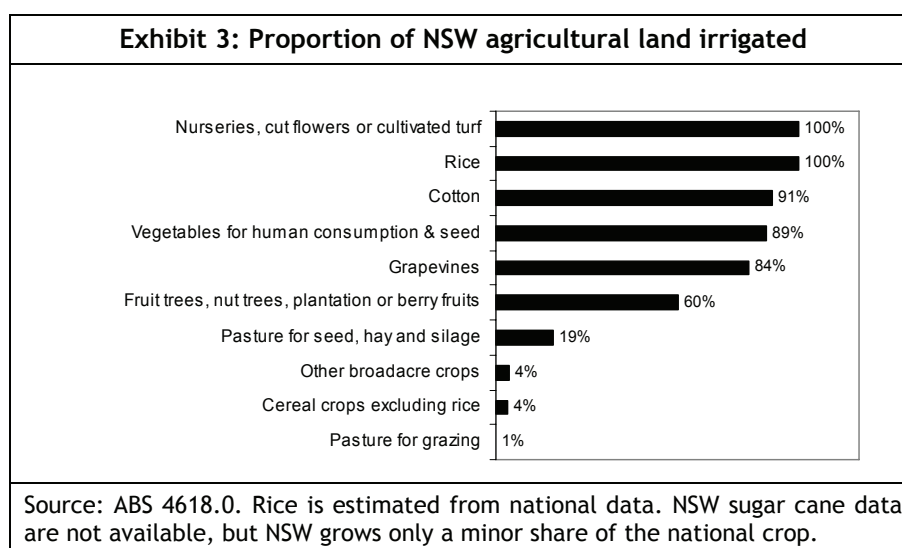
For most of the 2005-06 and 2006-07 seasons Murray and Murrumbidgee Valley irrigators with general security licences have been allocated less than half of their entitlements. General security irrigators in the Lachlan Valley received a maximum of 19 per cent of their 2005-06 allocation and currently expect zero allocation.

1.4 How are crops grown using irrigation?

While only around one-quarter of all agricultural production is grown by irrigation, irrigation farming is highly productive because it has a more reliable supply of water. Farms with irrigation generated, on average, 55 per cent more output per farm in 2003-04 than those which did not irrigate, although their average land area was less.

**Crops have
differing
dependence on
irrigation**

Some agricultural products are so highly dependent on irrigation that they could not be grown in NSW without it. More than 80 per cent of land used in 2004-05 for production of rice, cotton, grapes, vegetables, nursery production, cut flowers and turf was irrigated.



Different irrigation methods

Irrigation practices differ depending on the combination of crops, access to water, soil types and management practices. In low rainfall parts of NSW irrigation may be the primary source of water, with the crops more or less totally dependent on irrigation. In higher rainfall regions irrigation may be supplementary to rainfall.

Surface irrigation

Surface or flood irrigation is mainly used for crops such as pastures, wheat, barley, oats, lucerne and rice. Rice plants are immersed during their crucial reproductive phase to ensure that the water insulates them against cold temperatures.

Flood irrigation of rice



Furrow irrigation

Furrow irrigation is frequently used for horticultural and field crops. Older irrigation schemes use this method for vines and tree crops. The plants are irrigated when required by running water down furrows between them.

Furrow irrigation of cotton



Sprinklers

Overhead sprinklers are usually used for tree crops and vines. Centre pivot irrigators are used for fodder crops, lucerne, vegetables and increasingly for field crops. Sprinklers can be fixed or portable. Under-tree sprinklers are increasingly used for citrus and other tree crops.

Overhead sprinkler for vegetables



Trickle and drip systems

Trickle and drip systems are mostly used for tree and vine crops such as citrus and grapes. Some growers of vine and broad area crops use sub-surface drip systems.

Drip irrigation of grapevines



While sprinkler and drip systems generally result in more efficient water use, this depends on the management skills of the irrigator. DPI studies have shown that drip irrigation systems, if poorly used, can be no more efficient than furrow irrigation.

1.5 DPI and the State Plan

The State Plan includes two goals which are relevant to DPI:

- stronger rural and regional economies
- securing our supply of water and energy.

State Plan papers by the Department of Education and Training (DET) and DWE detail DPI's role in education and training and in improving water use in irrigation.

DPI's role in education and training

The State Plan notes that stronger rural and regional economies depend upon profitable and sustainable primary industries. To promote sustainable development in rural and regional NSW, the Government will provide better access to training.

The DET paper emphasises the strong link between the level of economic activity in a region and the demand for skills. It acknowledges the contribution of DPI's PROfarm training program in accessing farmers and rural communities that are otherwise difficult to reach. It shares with DPI responsibility for expanding commercial training in rural and regional areas, and for maximising funding from CMAs and research organisations for this training.

DPI's role in improving water use efficiency

The State Plan also notes the importance of water to agriculture and of improving the efficiency of its use:

Meeting our water needs in the face of drought, climate change and population growth requires a sustained effort to balance supply and demand, increase recycling and improve efficiency of water use. NSW communities need secure supplies of quality water for drinking, farming, industry and residential use, and for sustaining the health of our rivers and wetlands.

The DWE paper notes DPI's contribution to both developing new water use efficiency technologies and, through its PROfarm industry training programs and field staff, to having them adopted on-farm. It gives DPI responsibility and targets for reporting on completion of water use efficiency training programs and on adoption of improvement technologies on-farm.

1.6 How does DPI invest in improving irrigation?

An important part of DPI's core business is to work with rural industries in NSW and other stakeholders to develop and increase the adoption of land use systems and practices that are both profitable and environmentally sustainable. It does this through R&D to develop technologies and practices to improve efficiency of water use, and through encouraging and assisting irrigators to adopt them.

Developing innovations through R&D

DPI has developed cooperative R&D alliances with universities, research organisations and other state and national agencies and CMAs. Its R&D activities are aimed at improvements in many areas of primary production, not only irrigation farming.

DPI has noted that R&D may produce a range of outcomes which affect different stakeholders:

The nature of applied primary industries research and development is such that nearly all research projects provide a complex mix of public and industry benefits which are economic, environmental and social in nature. But, unlike economic benefits, environmental and social impacts are difficult to assess.

A Victorian publication summarises the impact which this may have on government decisions on R&D investments:

An important role of government is to fund those R&D projects that benefit society and are unlikely to attract private sector investment. It is important that government does not fund R&D projects where the private sector is the primary beneficiary and should be the primary funder. To do so would reduce funds for R&D projects where government investment is needed.

DPI's criteria for investing in R&D

Given the mix of industry and public benefits associated with primary industry R&D and education and training investments, it is essential that the industry and government organisations involved negotiate appropriate R&D priorities which reflect the likely sharing of costs and benefits. To ensure that its research produces an appropriate mix of benefits, DPI has developed a research planning framework which includes the following criteria:

- appropriateness of the issues
- efficiency of investment strategies
- effectiveness of research and development approaches.

Encouraging adoption by irrigators

DPI's key responsibilities include delivering education and training services and devising sustainable production solutions for agriculture. An important initiative to encourage irrigators to adopt the water use efficiency improvements developed by its R&D activities has been the WaterWise on the Farm program.

DPI's role complements that of NSW regulatory agencies such as DWE. By working with industries and producers to encourage changes in practice, DPI's R&D, education and training activities reduce the need for regulatory measures.

Comparisons with R&D investment in other jurisdictions

It has not been possible to use benchmarking across jurisdictions to demonstrate the effectiveness of different research, education and training approaches. The portfolios of interstate agencies equivalent to DPI differ greatly, and publicly available data (e.g. in budget statements) are not comparable.

An internal study by DPI suggests that government expenditure on agricultural research may be comparatively less than other states:

A measure of public support for agricultural research is the ratio of expenditure on research to the value of production of agriculture in NSW, a measure known as research intensity ... research intensity in NSW is likely to be below the average of all states.

Nonetheless, NSW has increased the amount of external research funding that it attracts:

Prior to the late 1980s, DPI was the least successful [Australian agricultural agency] in attracting external funding. That performance has since been reversed so that between 40 and 50 per cent of research expenditure is now externally funded which compares favourably with other states and is above CSIRO for like research.

DPI's annual report notes that external parties invested approximately \$48 million in 2005-06 in agricultural research undertaken in collaboration with DPI. Significant providers of research funds were Research and Development Corporations, Cooperative Research Centres, the National Heritage Trust, the Australian Centre for International Agricultural Research and the NSW government's Biofirst program.

2. Does the Department of Primary Industries have effective approaches?

At a glance

The key question we wanted to answer was:

Does the Department of Primary Industries have effective approaches for improving the efficiency of use of water in irrigation on-farm?

Our overall assessment:

DPI has developed a number of effective approaches to improve efficiency of water use in irrigation.

DPI has sufficient information on the main uses of water to identify priorities. It has developed close partnerships with industry research organisations and community bodies to identify opportunities for improving water use practices and technologies. It has attracted investment by agriculture bodies in R&D projects helping irrigators to adapt to reduced availability of water.

Programs such as WaterWise on the Farm were effective in increasing grower awareness of water use efficiency options and technologies, and in educating and training irrigators in farm water resources planning and management.

DPI has been unable to fully maintain programs such as WaterWise as Government funding has ceased.

2.1 Have the main uses of water in agriculture been identified?

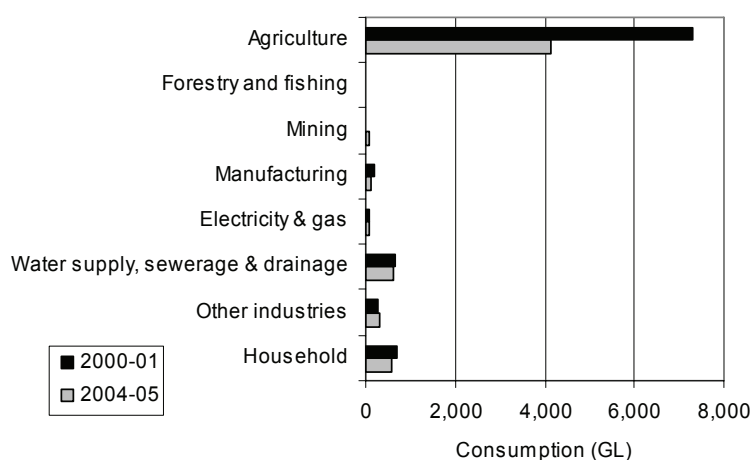
Our assessment

Reports by Commonwealth and NSW government agencies provide extensive data on the use of water for irrigation. While these have some limitations, sufficient relevant information is available to guide DPI's decision-making in its irrigation activities.

ABS reports on water use

Reports produced by the Australian Bureau of Statistics (ABS) show the consumption of water by different industries and reveal the effects of drought on water use in agriculture. In 2000-01 all types of agriculture (including irrigation) accounted for 79 per cent of water consumed in NSW; this fell to 70 per cent in 2004-05.

Exhibit 4: NSW and ACT water consumption 2000-01 and 2004-05



Source: ABS 4610.0 Water Account Australia, 2004-05, Table 2.2

ABS reports also show the agricultural products where irrigation water is used, the area used for irrigation and non-irrigation growing, the volume of water used and the irrigation method. They show that cotton, pasture, cereal crops (including rice), grapevines and fruit, nuts, and berries account for around 95 per cent of irrigation water used.

Exhibit 5: Major uses of water in irrigation in NSW 2004-05			
	Area irrigated	Water applied	
	000 ha	ML	%
Cotton	146	964,306	26
Cereal crops excluding rice	262	719,965	19
Pasture for grazing	277	706,139	19
Rice	51	618,964	17
Pasture for seed, hay and silage	51	200,185	5
Grapevines	36	171,629	5
Fruit trees, nut trees, plantation or berry fruits	26	133,561	4
Other broadacre crops	30	94,925	3
Vegetables for human consumption & seed	17	68,290	2
Nurseries, cutflowers or cultivated turf	4	20,712	1
Total	900	3,698,676	100
Source: ABS 4618.0 Water use on Australian farms 2004-05, Table 2.2. The area of rice irrigated is the lowest for 35 years as a result of the drought and low water allocations and is not typical of earlier years.			

Commonwealth and NSW reports

Commonwealth and NSW government agencies produce a number of reports on water use. For example the *Australian Water Resources Assessment 2000: Surface water and groundwater availability and quality* was published by the National Land and Water Resources Audit in 2001.

The Water Use Efficiency Advisory Unit, a joint initiative between NSW Agriculture (now DPI) and the former Department of Land and Water Conservation prepared irrigation profiles for most regions and catchments. Profiles for all catchments except for the Murray, Darling-Barwon and Namoi were produced between 2001 and 2003.




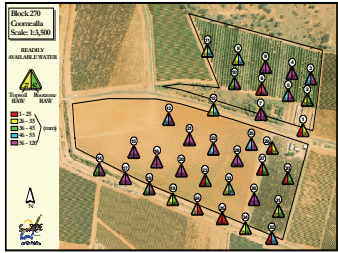
The National Water Commission recently assessed the availability, accessibility, and suitability of data on water use, water access entitlements, allocations and water trading for 2004-05. It concluded that, with the exception of the ABS publications, information on water use is not timely, comprehensive or consistent. At the time of its assessment only the ABS was expected to have 2004-05 water use data available by June 2006.

Most information on water use is provided by organisations other than DPI. While more timely information would assist planning and implementation of programs, this has not represented any significant constraint to DPI.

2.2 Has a range of improvement initiatives been developed for all main uses of irrigation water?

Our assessment	DPI uses its R&D capabilities and its relationships with growers, agricultural groups, research organisations and stakeholders to identify and develop various ways to improve the efficiency of water use in irrigation.
Major strategy	<p>DPI has had a twofold strategy for encouraging irrigation farmers to improve their water use efficiency:</p> <ul style="list-style-type: none">▪ it has developed improvements through its R&D activities and partnerships that will assist irrigation farmers▪ it has developed practices to help irrigation farmers to develop their skills and to encourage them to adopt these improvements.
DPI's R&D performance	<p>DPI's Science and Research Division budget in 2005-06 was \$81 million, with half of those funds coming from external sources. DPI estimates that the return on its R&D investment is in the order of 15 to 40 per cent with additional environmental and social benefits of at least the same order.</p> <p>We visited several of DPI's R&D partners and stakeholders in the cotton, winegrape and rice industries. We saw evidence of cooperative relationships and sharing of information between the parties. Growers and representatives of the agricultural industries we visited praised the outcomes.</p> <p>We also saw how DPI's R&D partners cooperate with its education and training staff, who are responsible for assisting farmers to adopt the results of R&D.</p>
DPI's approaches to encourage adoption of improvements	<p>DPI has developed techniques and practices to demonstrate the benefits of improved water use efficiency to irrigators, to help them develop their skills in the techniques and approaches discussed above, and to encourage them to adopt and implement improvements on their farms.</p> <p>Within the agricultural community the work done by DPI to build farmers' skills and their capacity to embrace change and improvement is known as extension.</p>
WaterWise on the Farm	<p>The flagship of DPI's irrigation training and education activities has been the WaterWise on the Farm program. WaterWise ran from 1996 until 2005. The NSW Government provided \$7 million for WaterWise. From 1998 to 2005 it also provided \$25 million in incentive funding to encourage irrigators to participate in the program and adopt improvements.</p> <p>The objective of WaterWise was to assist NSW irrigators to improve the efficiency of their use of irrigation water. This helped offset the reduction in average long term irrigation extractions from rivers and groundwater systems which resulted from reforms such as the NWI.</p>

The core WaterWise training product has been the four day Introduction to Irrigation Management course. A typical course was one day per fortnight with a DPI instructor and ten to 15 growers from the same region, with similar crops and farming systems. Instruction was delivered on the farms of participants to ensure that it retained a practical 'hands-on' focus. Assignments were set as homework to be completed on participants' own farms between days.

Exhibit 6: A typical WaterWise course (NSW North Coast)	
<p>Day 1: The farm's soil and water resources</p> 	<p>Day 2: Evaluating the current irrigation system</p> 
<p>Day 3: Soil moisture monitoring and irrigation scheduling</p> 	<p>Day 4: Planning the best irrigation scheme</p> 
<p>Source: Department of Primary Industries</p>	

Implementing efficiency improvements

NSW DPI has had a major role in developing or adapting initiatives for improving water use in irrigation and in ensuring, mainly through the WaterWise program, that farmers are able to adopt them.

The main technical improvements developed and implemented are:

- drip or trickle irrigation (replacing surface and flood irrigation)
- laser levelling
- mapping of soil types and identification of 'leaky' soils
- scheduling of water supply for irrigation: 'right amount, right place, right time'
- soil water monitoring
- irrigation and drainage management plans
- lateral move and centre-pivot irrigators
- development of different plant varieties
- water metering.

These techniques have contributed in varying degrees to improving water use efficiency through ensuring that water is more accurately applied when, where and in the quantities needed.

DPI's education and training performance	Across NSW, more than 5,000 of the state's estimated 12,000 irrigators attended the WaterWise Introduction to Irrigation Management course. DPI's evaluation of WaterWise (detailed in later chapters) showed that the course had a benefit-cost ratio of 4.45 to 1 and that there was a high rate of adoption of improvements by growers across different agricultural industries.
Other improvement opportunities	DPI has developed partnerships with the State's 13 CMAs to ensure sustainable use of natural resources.
Catchment Management Authorities	<p>CMAs and DPI delivered \$9.5 million worth of joint projects in 2005-06. The objectives of these projects ranged from increasing water efficiency on farms to training farmers on how to improve pasture management. The Commonwealth Government provides funding for regional natural resource management strategies under the National Action Plan for Salinity and Water Quality and the Natural Heritage Trust.</p> <p>Some CMAs have offered incentives to encourage irrigators to adopt improvements:</p> <p>NSW Lower Murray-Darling ... irrigators can now apply for up to \$15,000 when converting their systems from flood or overhead [sprinklers] to low level [sprinklers] or drip irrigation ... Immediate dollar Incentives include:</p> <ul style="list-style-type: none">▪ preparation of Irrigation and Drainage Management Plans up to a maximum of \$7,500 per irrigator▪ installation of irrigation system upgrades up to a maximum of \$15,000 per irrigator▪ purchase and installation of irrigation scheduling equipment up to a maximum of \$7,000 per irrigator. <p>Irrigation Management Training courses (basic and advanced) are also available. Completion of the basic course is a requirement/prerequisite to receiving incentive dollars.</p> <p>The Commonwealth Government's Natural Resource Management website lists, in October 2007, 118 recently funded natural resource management projects across the NSW CMAs. Only two of these included improvements in on-farm irrigation water use practices. As CMA projects focus on natural resource management improvements this suggests that water use efficiency improvements are receiving low priority.</p> <p>The WaterWise program and its incentive funding was concluded in June 2005. It can still be run when demand justifies it and is delivered as part of DPI's PROfarm training initiative.</p> <p>DPI's field staff continue to provide advice to farmers on the techniques and technologies which WaterWise included, and the content of the course is available on DPI's website and in its publications. Its <i>Agriculture Today</i> periodical includes articles on successful adoption of improvements in water use efficiency.</p>

WaterWise was introduced prior to the current drought. Water was readily available and of lower cost than today: even in 2005-06 water was estimated to represent only two or three per cent of total farm cash costs. A survey of irrigators at that time showed that greater profitability or increased cost of water offered significant motivation to change irrigation practices. However one quarter of irrigators believed that nothing would motivate them to change practices.

Circumstances have now markedly changed because of reforms in the way in which water is managed. The National Plan for Water Security and the NWI require that more water be provided for the environment, and the drought has compounded their impact. Water allocations for irrigators in some catchments have been reduced, and the cost of water for irrigators has increased.

More than half of irrigators have not attended WaterWise training courses. The WaterWise program now has a much lower profile, and little of the incentive funding available to CMAs is being applied to irrigation water efficiency improvements.

Impact of off-farm changes

While this audit only considers on-farm practices, in some parts of the state off-farm changes have facilitated improvements in water use efficiency on-farm.

The Pomona Irrigation District in south-western NSW, like many others, supplied water through open channels. It supplied water to its 60 grape and citrus growers on rotation, with each farm receiving water about once every 25 days throughout the season. This was not frequent enough. When growers did irrigate, they applied excessive amounts of water to try and get through to the next irrigation opportunity.

In 1995 the irrigation trust conducted a Land and Water Management Plan which showed that the earthen channels needed to be replaced. With funding through the Natural Heritage Trust and in-kind support from volunteer irrigators and retired community members, the open water channels were replaced by 14.5 km of pipelines.

When the upgrade was opened in 2000 many farmers replaced furrow irrigation with drip irrigation or sprinklers, using the financial assistance measures then available. Water use has dramatically reduced, and water tables which contribute to salinity have fallen.

2.3 Are initiatives assessed for their technical, environmental and economic improvement potential?

Our assessment

DPI, its research partners and other organisations have evaluated improvements in irrigation practice and technology. Many case studies which demonstrate the effectiveness of these improvements are included in DPI's literature to inform other farmers.

Evaluations of drip irrigation	<p>DPI has conducted economic evaluations of the conversion from furrow to drip irrigation for citrus and wine grapes which document:</p> <ul style="list-style-type: none">▪ improvements in quality▪ improvements in yield▪ water savings▪ labour savings▪ reduced seepage▪ reduction in surface and subsurface drainage. <p>DPI publications such as <i>Drip irrigation: a citrus grower's guide</i> include case studies by growers who have adopted drip irrigation. This guide includes a chapter on financial aspects of drip irrigation which compares the capital and operating costs of furrow, overhead sprinkler, low level sprinkler and drip irrigation systems.</p> <p>Trials with drip-irrigated grapes have demonstrated the potential for significant water use efficiency improvements - as high as 50 per cent - by reducing the supply of water to vines at different stages of their growth.</p> <p>The NSW Water Conservation Strategy, produced by the Department of Land and Water Conservation in 2000, included examples of improvements achieved in irrigated agriculture:</p> <p>For vegetable production in the Murrumbidgee Irrigation Area, changing from furrow to drip irrigation has resulted in a doubling of yield per unit volume, from 6.2 tonnes/ML for furrow to 13 tonnes/ML for drip. In many areas of irrigated agriculture, on-farm water efficiency improvements measured as increased yield per unit volume of 20-50 per cent are not unusual.</p>
Evaluation of soil monitoring technology	<p>DPI's research has made an important contribution to the development of technology for soil mapping, which can minimise water losses by identifying potentially 'leaky' rice paddocks. The Rural Industries Research and Development Corporation commissioned a study of soil mapping, and concluded that the technology had:</p> <p>... an excellent pay-off with a net present value of \$157 million, a net benefit investment ratio of 99 and achieved an internal rate of return of 81 per cent. Of this 24 per cent accrued to growers in lower water costs and expansion in area of rice production, with the rest (\$120 million) a return to the environment. And this potentially under estimates the benefits as we were not able to estimate the impact on the water tables and hence on salinity with associated on and off farm benefits.</p>
Evaluation of R&D in the winegrape industry	<p>The National Wine and Grape Industry Centre has evaluated the economic impact of the R&D activities of the Cooperative Research Centre for Viticulture between 1999 and 2006. It concluded that:</p> <ul style="list-style-type: none">▪ wine and grape industry R&D is forecast to generate \$1.2 billion (in net present value terms) in direct benefit for industry to 2025. This reflects an overall benefit-cost ratio of 5.6 to 1▪ the total net present value (1999-2025) of the Research Centre's research to NSW is \$335 million.

3. Has the Department of Primary Industries achieved expected outcomes?

At a glance

The key question we wanted to answer was:

Have the expected outcomes of the Department's initiatives for improving efficiency of agricultural water use been achieved?

Our overall assessment:

DPI has contributed significantly to developing improved irrigation practices and having them widely adopted. But there is still more that can be done.

WaterWise delivered benefits of around \$88 million on an investment of \$20 million by accelerating adoption of improved irrigation practices and technologies. It also delivered direct public benefits in the order of \$160 to \$240 million through water savings to the environment. Other benefits were reduced stream and ground water salinity and increased community capacity to respond to future challenges.

DPI is responsible under the State Plan for expanding training and for reporting on the adoption of on-farm technologies that improve water use efficiency.

DPI's achievements have depended on its R&D partnerships and on programs such as WaterWise to encourage and facilitate improvements. To ensure that DPI's research, education and training activities maximise benefits to the community its project selection criteria and processes need to be made increasingly transparent to both stakeholders and clients.

DPI should improve inter-agency planning with NSW Treasury to enable the efficient implementation of such programs in future.

3.1 Have the improvement initiatives been adopted by farmers?

Our assessment

DPI's assessments of practices and technologies demonstrate significant adoption of change and improvement by farmers. Some irrigation-based industries, conscious of their public image, are eager to publicise their adoption of best practice in water use efficiency. And individual growers visited were enthusiastic about the results of adopting improvements.

Adoption of improvement initiatives

DPI's assessments and evaluations of the effectiveness of improvements demonstrate significant acceptance by growers in different irrigated industries of changes in practice which have improved water use efficiency.

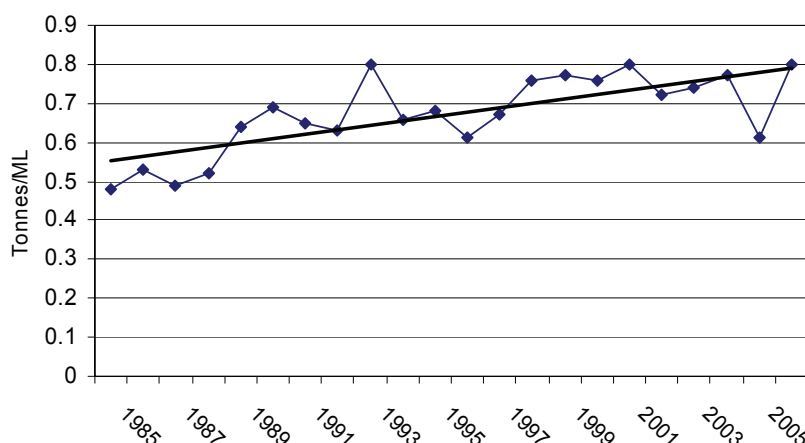
In the Lower Murray-Darling irrigation region winegrape and citrus farmers have moved from predominantly furrow irrigation to higher-efficiency drip irrigation. In 2005, 76 of the 200 irrigators in the Pomona and Coomealla irrigation districts had adopted drip irrigation, whereas in 1997 there were only 17. In the same period the number using furrow irrigation has fallen from 113 to 48. This change was facilitated by the project discussed in 2.2 which replaced the districts' open irrigation channels with pipelines.

	<p>DPI evaluated the adoption of initiatives for improving the water use efficiency in cotton growing:</p> <ul style="list-style-type: none">▪ 70 per cent of irrigators implemented change to improve irrigation practices over the previous 5 years▪ 46 per cent improved application systems▪ 37 per cent improved water scheduling▪ 15 per cent invested in on-farm water monitoring. <p>DPI also evaluated a major project in the Southern Murray-Darling Basin for improving the water use efficiency of vegetable growing. Use of drip irrigation increased between 1996 and 2001 from 27 per cent to over 53 per cent of the area reviewed. Other improvement technologies adopted included soil moisture monitoring and salinity mapping.</p>
Importance of incentive funding to success of WaterWise	<p>Evaluation of the economic benefits of WaterWise are reported above. However other assessments have identified that factors critical to the success of WaterWise included:</p> <p>... funding for the Water Reform Structural Adjustment Program to enable delivery of complementary [education and training] and incentive-loans programs.</p> <p>Many of the irrigators interviewed volunteered the importance of incentive funding in encouraging them to adopt changes in practice, all of which require significant on-farm expenditure.</p>
	<h3>3.2 Have the initiatives improved efficiency of water use on farms?</h3>
Our assessment	<p>DPI's initiatives have improved the efficiency of water use. DPI's case studies and evaluations quantify their effectiveness, and DPI's literature includes many testimonials from growers. Other stakeholders and agriculture industry groups also provide evidence of improved water use efficiency.</p>
Evaluation of effectiveness of initiatives	<p>DPI has conducted a range of evaluations which demonstrate improvements in water use efficiency across a number of agricultural industries. In some cases it is also possible to identify improvements in the environment which have followed improved water use practices in irrigation.</p>
Specific improvements: cotton	<p>DPI evaluations show the effect of improved practices in cotton growing:</p> <ul style="list-style-type: none">▪ cotton growers have increased water use efficiency by 11 per cent since 1999▪ the cotton industry's top growers have doubled the efficiency of their water use in the last five years.
Specific improvements: tomatoes	<p>DPI's evaluation shows that the vegetable industry is roughly twice as efficient in its use of water as it was a decade ago. The return from vegetable production increased from \$1,762 per ML of water in 1996-97 to \$3,207/ML in 2000-01. The productivity increases were partly attributed to increased use of water efficient delivery systems such as drip irrigation, increased use of recycling, adoption of irrigation scheduling and soil moisture monitoring and increased use of farm planning and soil mapping.</p>

Specific improvements: rice

DPI has facilitated improvements in the water use efficiency of rice. Some improvement has followed the development of cold tolerant varieties of rice which germinate at lower temperate and require shorter periods of immersion. The overall impact has been to increase the rice yield (tonnes per hectare) in the Murrumbidgee Irrigation Area and productivity (tonnes per ML of irrigation water) over the last 20 years.

Exhibit 7: Water productivity of rice: Murrumbidgee Irrigation Area 1985-2006 (tonnes of rice/ML)

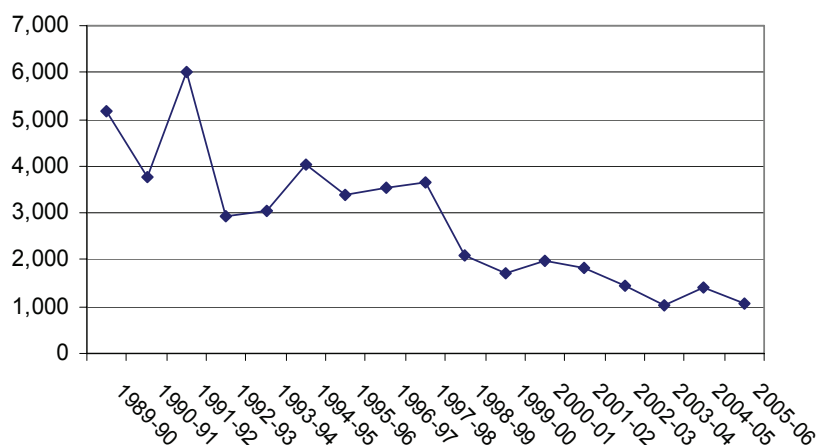


Source: Department of Primary Industries

Effect of improvements on water use

In the Lower Murray-Darling irrigation region, efficiency improvements such as increased adoption of drip irrigation have reduced overall water consumption over the long term.

Exhibit 8: Irrigation water used in the Pomona irrigation district (ML)



Source: Department of Primary Industries

While there are no data to demonstrate whether production has changed markedly over the period, DPI staff advise that it has been maintained or improved. Many irrigators have converted from other crops to wine grapes over the period, and some vacant areas have been planted with new crops such as asparagus, stone fruit and pasture.

While there have been off-farm changes such as the conversion of irrigation channels to pipelines, much of this improvement is attributed to the widespread conversion of growers to drip irrigation after completion of the pipeline in 2000.

The reduced consumption of water can also have environmental benefits. In the Lower Murray-Darling it has been accompanied by a fall in groundwater level. This has a beneficial effect on soil salinity.

Testimonials by growers

The rice growers' industry body has emphasised how R&D investment and improved farm practices by Australian producers has improved their water use efficiency and productivity compared to other countries:

Australian rice producers	World rice producers
Low water use (14 ML/ha)	High water use (up to 50 ML/ha)
High yields (10 tonnes/ha)	Lower yields (average 3.9 tonnes/ha)

DPI's WaterWise series of brochures included testimonials from farmers who had participated in earlier WaterWise courses. This provides another demonstration of the improvements in water use efficiency.

Improvements in potato growing

A grower of potatoes described his experience with monitoring moisture content of the soil:

'My crop yields have increased by seven tonnes per hectare since I started using [soil moisture monitoring] ... They tell me how far the water I am applying is penetrating, so I know if I have put on too much and wasted water, or if I need to apply more ... Soil moisture monitoring is the best way of saving water and using it better'.

Improvements in cotton growing

A Namoi Valley cotton grower described the effect of changing the spacing between rows of plants and monitoring soil moisture content:

Irrigating more often, but with reduced volume per irrigation, has translated to a water saving over the growing season of approximately 1.2 ML/ha. 'We have gone from 6 ML/ha (in six irrigations of 1 ML) to 4.8 ML/ha for the season (0.6 ML over eight irrigations). We can now irrigate 2,500 ha in around six days, instead of ten to 12 days, which means we can react more quickly and be more specific in our application'.

Improvements in pasture for dairy farming

Dairy farmers in the North Coast improved their ability to grow stock feed on irrigated pasture which had formerly turned to impassable mud during the wet season:

Working with their local officers, the farmers put in a drainage system that combined laser levelling with shallow drains which are sown, irrigated and grazed just like the rest of the paddocks. 'We have been able to establish good rye and clover pastures which has enabled us to increase stock numbers and double our milk production'.

Improvements in melon growing	<p>A trial of drip irrigation of melons near Griffith showed savings compared to traditional practices:</p> <p>Along with comparable furrow-irrigated blocks, the farmers sowed a crop of rockmelons in a 0.7 ha field with drip irrigation installed. The drip block used only 3.1 ML/ha compared to 4.8 ML/ha for the furrow system. With the increase in yield and the decrease in water use, melons from the drip area had more than twice the water use efficiency of the furrow-irrigated melons.</p>
Evaluation of effectiveness of WaterWise	<p>In 2004 DPI commissioned an assessment of the economic, social and environmental impacts of WaterWise:</p> <p>WaterWise was evaluated as an [education and training] program attempting to hasten the adoption of technologies and practices related to improving water use efficiency. The economic benefits from WaterWise were estimated to be approximately \$88 million (in 2002 dollars), exceeding estimated total expenditure on the initiative from 1999 to 2005 of \$19.8 million (also in 2002 dollars). Hence the net present value from this investment is estimated to be \$68.2m, the benefit-cost ratio is 4.45. Investments by the initiative in the lucerne and cotton industries generated the greatest benefits in absolute terms.</p>

3.3 Has DPI identified its future role and resources?

Our assessment	<p>We believe that DPI could better identify and communicate its future role in improving water use and the resources it will need. The plans which it prepares for NSW Treasury do not link activities such as WaterWise to the State Plan. They do not provide an adequate basis for negotiating with Treasury the resources which it will require to continue to contribute to improving efficiency of water use in irrigation.</p>
Demand for services	<p>WaterWise was developed in the 1990s, when water was more readily available. Since then NSW has suffered from several years of drought, and the National Plan for Water Security and NWI are requiring that more water be provided for the environment. Climate change is seen as a possible threat to the long term security of water supply.</p> <p>Some farmers visited have had their water allocations reduced or were expecting to lose allocations. In the short term, reduced availability of water is forcing some growers to more actively consider alternative crops or practices:</p> <p>If little water is available for irrigation there will be substantial economic impacts. Irrigators who grow annual crops, such as rice, adjust their planting area depending on water availability. Irrigators who grow perennial crops will be impacted in the long term if they are unable to ensure survival of crops. Irrigators can seek advice from agronomists and horticulturalists within DPI about options for speculative sowing of rainfed crops such as barley ...</p>

DPI also notes possible longer-term impacts on irrigators and on what services DPI may need to provide:

Climate change and more variable climate conditions will have an enormous impact in agriculture ... It is apparent that NSW needs to make significant investments on behalf of the NSW public in quantifying the likely biophysical as well as socio-economic impacts, and developing new technologies and practical adaptive management approaches to maintain the State's productive capacity and to avoid significant social dislocation.

In addition to these short and long term pressures on the state's irrigators, less than half of them attended WaterWise courses. Many of those who did not may have improved their water use practices in response to drought and reduced allocations. But some may have persevered with inefficient and wasteful practices and may still need advice and support from DPI to change.

Availability of staff Several growers interviewed perceived that DPI's research, education and training workforce had decreased: they were aware of reductions in the number of field staff and specialists such as plant pathologists. Some DPI staff also believed that staff numbers had fallen. They were concerned that, with its current staffing, DPI may be unable to continue to provide the service that growers need.

Trends in DPI's R&D, education and training workforce are not obtainable because of the amalgamation of different agencies to form DPI in 2004. However an internal DPI paper noted that between 1998 and 2003 DPI had over 60 staff engaged in delivering WaterWise and related activities, whereas it expected only 11 staff to continue this from 2005.

DPI's State Plan priorities As noted above, the State Plan includes priorities for better access to training in rural and regional NSW and for improving efficiency of water use. In their detailed State Plan papers DWE and DET share responsibility with DPI for expanding training and for reporting on the adoption of on-farm technologies that improve water use efficiency.

DPI's Results and Services Plan All agencies such as DPI are required to prepare a Results and Services Plan (RSP). NSW Treasury requires that the RSP set out linkages between State Plan priorities, the results that an agency is working towards, the services it delivers to contribute to those results, and the cost of delivering those services.

DPI's RSP for 2007-08 includes DPI's contribution to the State Plan's priority for better access to training in rural and regional NSW:

Delivery of adult education based training to landholders, employees and agribusiness improves skills and risk management capacity ... DPI has developed a comprehensive suite of training programs, through PROfarm, focusing on business risks including climate risks ... the current drought will create additional pressures on the ability of rural landholders to invest in training and skills development.

	<p>However it does not include DPI's contribution to the State Plan's priority for a secure and sustainable water supply. It does not mention the work of the WaterWise program in improving efficiency of irrigation water use. It does not mention the responsibilities it shares with DWE and DET or how it works with them to deliver the State Plan requirements.</p>
Recommendation	<p>DPI should work closely with agencies with which it shares responsibilities to ensure that its water use efficiency activities contribute to the State Plan goals.</p>
DPI's R&D, education and training model	<p>It is evident from the examples given in the previous chapter that while the environment may benefit from more efficient use of water, farmers have also benefited through improvements in their productivity. It is important that DPI continue to focus on selection of R&D projects with an appropriate mix of public and industry benefits, and that funding reflects the distribution of benefits.</p>
Recommendations	<p>DPI and its key stakeholders should maintain their close relationships to ensure that they identify opportunities for new technologies and practices with the highest potential benefit.</p> <p>DPI should further develop the transparency of its R&D selection principles to demonstrate that projects and activities are funded in accordance with the mix of industry and public benefits they will generate.</p>
Models in other jurisdictions	<p>Some jurisdictions have made structural changes in the way in which they deliver agricultural education and training:</p> <p>In New Zealand there is no government-funded agricultural [education and training] organisation ... The [education and training] organisation changed to a fee-for-service consultancy ... staff numbers declined from a peak of 310 in 1987 to 120 in 1993.</p> <p>However a Commonwealth Government report released in February 2007 noted the adverse consequences of some of these changes:</p> <p>There is a concern that much of the [agricultural] research being done is not reaching farmers. The links between research and [education and training] must therefore be enhanced ... The provision of high quality [education and training] and advisory services is essential to the progress of rural and regional Australia.</p>
Recommendation	<p>DPI should negotiate with NSW Treasury the resources it will require to meet its commitments to the State Plan, the future demands of the Commonwealth (including the National Plan for Water Security and the NWI) and the effects of climate change. In doing so it should review best practice models for assisting and encouraging growers to adopt improvements in other jurisdictions.</p>

Appendix

Appendix 1: About the audit

Audit objective	This performance audit assessed the effectiveness of DPI in assisting farmers to adopt on-farm improvements in irrigation water use.
Lines of inquiry	<p>In reaching our opinion against the audit objective, we sought to answer the following questions:</p> <ul style="list-style-type: none"> ▪ does DPI have effective approaches for improving the efficiency of water use on irrigation farms? ▪ have the expected outcomes of DPI's initiatives for improving agricultural water use efficiency been achieved?
Audit criteria	<p>In answering the lines of inquiry, we used the following audit criteria (the 'what should be') to judge performance. We based these standards on our research of current thinking and guidance on better practice. They were discussed and agreed with DPI.</p> <p>For line of inquiry 1, we assessed the extent to which DPI:</p> <ul style="list-style-type: none"> ▪ has identified the main uses of water in agriculture ▪ has developed a range of improvement initiatives for all main uses of water in irrigation ▪ has assessed these initiatives for their technical, environmental and economic improvement potential. <p>For line of inquiry 2, we assessed the extent to which:</p> <ul style="list-style-type: none"> ▪ DPI's improvement initiatives have been adopted by farmers ▪ the initiatives have improved efficiency of water use on farms ▪ DPI has identified its future role in improving water use in irrigation and the resources it will require for this.
Audit scope	<p>The audit focused on the impact of DPI's research and advisory programs for helping farmers use water more efficiently on their farms.</p> <p>The audit did not examine water sharing plans, Catchment Action Plans, implementation of the National Water Initiative or progress with other COAG water reforms. These are already audited by the Natural Resources Commission or the National Water Commission.</p> <p>It did not examine water supply and demand in metropolitan areas, as this was included in the performance audit <i>Planning for Sydney's Water Needs</i> (May 2005).</p>
Audit approach	<p>We acquired subject matter expertise through:</p> <ul style="list-style-type: none"> ▪ interviewing DPI staff responsible for: <ul style="list-style-type: none"> - developing strategies for improving efficiency of water used on farms - coordinating and implementing strategies and programs to improve the efficiency of water use in irrigation - analysing outcomes of activities to improve the efficiency of irrigation water use.

We reviewed:

- documentation such as plans, guidelines and processes to improve the efficiency of water use
- DPI's processes for identifying and consulting with stakeholder and industry groups affected by water use efficiency initiatives and programs
- documentation on evaluation and performance reporting of programs to improve the efficiency of water use on farm.

We also visited several locations where DPI's programs had been implemented or its initiatives were being tested and evaluated.

Audit selection	We use a strategic approach to selecting performance audits which balances our performance audit program to reflect issues of interest to Parliament and the community. Details of our approach to selecting topics and our forward program are available on our website.
Audit methodology	Our performance audit methodology is designed to satisfy Australian Audit Standards AUS 806 and 808 on performance auditing, and to reflect current thinking on performance auditing practices. We produce our audits under a quality management system certified to International Standard ISO 9001. Our processes have also been designed to comply with the auditing requirements specified in the <i>Public Finance and Audit Act 1983</i> .
Acknowledgements	<p>We gratefully acknowledge the cooperation and assistance provided by DPI. In particular we wish to thank our liaison officers Scott Davenport and Stephen Elliott and other DPI staff who participated in interviews, assisted with research and provided information relevant to the audit.</p> <p>We would also like to thank those members of the irrigation industry who participated in interviews and provided information.</p>
Audit team	Our team leader for the performance audit was Geoff Moran, who was assisted by Sandra Tomasi. Sean Crumlin provided direction and quality assurance.
Audit cost	Including staff costs, printing costs and overheads, the estimated cost of the audit is \$357,000.

Performance audits by the Audit Office of New South Wales

Performance Auditing

What are performance audits?

Performance audits determine whether an agency is carrying out its activities effectively, and doing so economically and efficiently and in compliance with all relevant laws.

Performance audits may review a government program, all or part of a government agency or consider particular issues which affect the whole public sector.

Where appropriate, performance audits make recommendations for improvements.

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Why do we conduct performance audits?

Performance audits provide independent assurance to Parliament and the public that government funds are being spent efficiently and effectively, and in accordance with the law.

Performance audits seek to improve the efficiency and effectiveness of government agencies so that the community receives value for money from government services.

Performance audits also assist the accountability process by holding managers to account for agency performance.

What are the phases in performance auditing?

Performance audits have three key phases: planning, fieldwork and report writing.

During the planning phase, the audit team will develop audit criteria and define the audit field work.

At the completion of field work we will meet with agency management to discuss all significant matters arising out of the audit. Following this, we will prepare a draft performance audit report.

We meet with agency management to check that facts presented in the report are accurate and that recommendations are practical and appropriate. Following this, a formal draft report is provided to the CEO for comment. The relevant Minister is also provided with a copy of the final report. The final report, which is tabled in Parliament, includes any comment made by the CEO on the conclusion and the recommendations of the audit.

Depending on the scope, performance audits can take several months to complete.

Copies of our performance audit reports can be obtained from our website or by contacting our Office.

How do we measure an agency's performance?

During the planning phase, the team develops the audit criteria. These are standards of performance against which the agency or program is assessed. Criteria may be based on best practice, government targets, benchmarks, or published guidelines.

Do we check to see if recommendations have been implemented?

Every few years we conduct a follow-up audit. These follow-up audits look at the extent to which action has been taken to address issues or recommendations agreed to in an earlier performance audit.

The Public Accounts Committee (PAC) may also conduct reviews or hold inquiries into matters raised in performance audit reports. Agencies are also requested to report actions taken against each recommendation in their annual report.

Who audits the auditors?

Our performance audits are subject to internal and external quality reviews against relevant Australian and international standards. This includes ongoing independent certification of our ISO 9001 quality management system.

The PAC is also responsible for overseeing the activities of the Audit Office and conducts a review of our operations every three years.

Who pays for performance audits?

No fee is charged for performance audits. Our performance audit services are funded by the NSW Parliament and from internal sources.

Further information

Further information can be obtained from our website www.audit.nsw.gov.au or by contacting us on 9275 7277.

Performance Audit Reports

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
87	E-government	<i>Use of the Internet and Related Technologies to Improve Public Sector Performance</i>	19 September 2001
88*	E-government	<i>e-ready, e-steady, e-government: e-government readiness assessment guide</i>	19 September 2001
89	Intellectual Property	<i>Management of Intellectual Property</i>	17 October 2001
90*	Intellectual Property	<i>Better Practice Guide Management of Intellectual Property</i>	17 October 2001
91	University of New South Wales	<i>Educational Testing Centre</i>	21 November 2001
92	Department of Urban Affairs and Planning	<i>Environmental Impact Assessment of Major Projects</i>	28 November 2001
93	Department of Information Technology and Management	<i>Government Property Register</i>	31 January 2002
94	State Debt Recovery Office	<i>Collecting Outstanding Fines and Penalties</i>	17 April 2002
95	Roads and Traffic Authority	<i>Managing Environmental Issues</i>	29 April 2002
96	NSW Agriculture	<i>Managing Animal Disease Emergencies</i>	8 May 2002
97	State Transit Authority Department of Transport	<i>Bus Maintenance and Bus Contracts</i>	29 May 2002
98	Risk Management	<i>Managing Risk in the NSW Public Sector</i>	19 June 2002
99	E-Government	<i>User-friendliness of Websites</i>	26 June 2002
100	NSW Police Department of Corrective Services	<i>Managing Sick Leave</i>	23 July 2002
101	Department of Land and Water Conservation	<i>Regulating the Clearing of Native Vegetation</i>	20 August 2002
102	E-government	<i>Electronic Procurement of Hospital Supplies</i>	25 September 2002
103	NSW Public Sector	<i>Outsourcing Information Technology</i>	23 October 2002
104	Ministry for the Arts Department of Community Services Department of Sport and Recreation	<i>Managing Grants</i>	4 December 2002
105	Department of Health Including Area Health Services and Hospitals	<i>Managing Hospital Waste</i>	10 December 2002
106	State Rail Authority	<i>CityRail Passenger Security</i>	12 February 2003
107	NSW Agriculture	<i>Implementing the Ovine Johne's Disease Program</i>	26 February 2003
108	Department of Sustainable Natural Resources Environment Protection Authority	<i>Protecting Our Rivers</i>	7 May 2003
109	Department of Education and Training	<i>Managing Teacher Performance</i>	14 May 2003

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
110	NSW Police	<i>The Police Assistance Line</i>	5 June 2003
111	E-Government	<i>Roads and Traffic Authority Delivering Services Online</i>	11 June 2003
112	State Rail Authority	<i>The Millennium Train Project</i>	17 June 2003
113	Sydney Water Corporation	<i>Northside Storage Tunnel Project</i>	24 July 2003
114	Ministry of Transport Premier's Department Department of Education and Training	<i>Freedom of Information</i>	28 August 2003
115	NSW Police NSW Roads and Traffic Authority	<i>Dealing with Unlicensed and Unregistered Driving</i>	4 September 2003
116	NSW Department of Health	<i>Waiting Times for Elective Surgery in Public Hospitals</i>	18 September 2003
117	Follow-up of Performance Audits	<i>Complaints and Review Processes (September 1999) Provision of Industry Assistance (December 1998)</i>	24 September 2003
118	Judging Performance from Annual Reports	<i>Review of Eight Agencies' Annual Reports</i>	1 October 2003
119	Asset Disposal	<i>Disposal of Sydney Harbour Foreshore Land</i>	26 November 2003
120	Follow-up of Performance Audits NSW Police	<i>Enforcement of Street Parking (1999) Staff Rostering, Tasking and Allocation (2000)</i>	10 December 2003
121	Department of Health NSW Ambulance Service	<i>Code Red: Hospital Emergency Departments</i>	15 December 2003
122	Follow-up of Performance Audit	<i>Controlling and Reducing Pollution from Industry (April 2001)</i>	12 May 2004
123	National Parks and Wildlife Service	<i>Managing Natural and Cultural Heritage in Parks and Reserves</i>	16 June 2004
124	Fleet Management	<i>Meeting Business Needs</i>	30 June 2004
125	Department of Health NSW Ambulance Service	<i>Transporting and Treating Emergency Patients</i>	28 July 2004
126	Department of Education and Training	<i>School Annual Reports</i>	15 September 2004
127	Department of Ageing, Disability and Home Care	<i>Home Care Service</i>	13 October 2004
128*	Department of Commerce	<i>Shared Corporate Services: Realising the Benefit including guidance on better practice</i>	3 November 2004
129	Follow-up of Performance Audit	<i>Environmental Impact Assessment of Major Projects (2001)</i>	1 February 2005
130*	Fraud Control	<i>Current Progress and Future Directions including guidance on better practice</i>	9 February 2005
131	Follow-up of Performance Audit Department of Housing	<i>Maintenance of Public Housing (2001)</i>	2 March 2005
132	Follow-up of Performance Audit State Debt Recovery Office	<i>Collecting Outstanding Fines and Penalties (2002)</i>	17 March 2005

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
133	Follow-up of Performance Audit Premier's Department	<i>Management of Intellectual Property (2001)</i>	30 March 2005
134	Department of Environment and Conservation	<i>Managing Air Quality</i>	6 April 2005
135	Department of Infrastructure, Planning and Natural Resources Sydney Water Corporation Sydney Catchment Authority	<i>Planning for Sydney's Water Needs</i>	4 May 2005
136	Department of Health	<i>Emergency Mental Health Services</i>	26 May 2005
137	Department of Community Services	<i>Helpline</i>	1 June 2005
138	Follow-up of Performance Audit State Transit Authority Ministry of Transport	<i>Bus Maintenance and Bus Contracts (2002)</i>	14 June 2005
139	RailCorp NSW	<i>Coping with Disruptions to CityRail Passenger Services</i>	22 June 2005
140	State Rescue Board of New South Wales	<i>Coordination of Rescue Services</i>	20 July 2005
141	State Budget	<i>In-year Monitoring of the State Budget</i>	28 July 2005
142	Department of Juvenile Justice	<i>Managing and Measuring Success</i>	14 September 2005
143	Asset Management	<i>Implementing Asset Management Reforms</i>	12 October 2005
144	NSW Treasury	<i>Oversight of State Owned Electricity Corporations</i>	19 October 2005
145	Follow-up of 2002 Performance Audit	<i>Purchasing Hospital Supplies</i>	23 November 2005
146	Bus Transitways	<i>Liverpool to Parramatta Bus Transitway</i>	5 December 2005
147	Premier's Department	<i>Relocating Agencies to Regional Areas</i>	14 December 2005
148	Department of Education and Training	<i>The New Schools Privately Financed Project</i>	8 March 2006
149	Agency Collaboration	<i>Agencies Working Together to Improve Services</i>	22 March 2006
150	Follow-up of 2000 Performance Audit	<i>Fare Evasion on Public Transport</i>	26 April 2006
151	Department of Corrective Services	<i>Prisoner Rehabilitation</i>	24 May 2006
152	Roads and Traffic Authority	<i>The Cross City Tunnel Project</i>	31 May 2006
153	Performance Information	<i>Agency Use of Performance Information to Manage Services</i>	21 June 2006
154	Follow-up of 2002 Performance Audit	<i>Managing Sick Leave in NSW Police and the Department of Corrective Services</i>	June 2006
155	Follow-up of 2002 Performance Audit	<i>Regulating the Clearing of Native Vegetation</i>	19 July 2006
156*	Fraud Control	<i>Fraud Control Improvement Kit: Meeting Your Fraud Control Obligations</i>	20 July 2006

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
157	Roads and Traffic Authority	<i>Condition of State Roads</i>	16 August 2006
158	Department of Education and Training	<i>Educating Primary School Students with Disabilities</i>	6 September 2006
159	NSW Health	<i>Major Infectious Disease Outbreaks: Readiness to Respond</i>	22 November 2006
160	NSW Health	<i>Helping Older People Access a Residential Aged Care Facility</i>	5 December 2006
161	Follow-up of 2003 Performance Audit	<i>The Police Assistance Line</i>	6 December 2006
162	NSW Health	<i>Attracting, Retaining and Managing Nurses in Hospitals</i>	12 December 2006
163	Legal Aid Commission of NSW	<i>Distributing Legal Aid in New South Wales</i>	13 December 2006
164	Department of Juvenile Justice NSW Police Force	<i>Addressing the Needs of Young Offenders</i>	28 March 2007
165	Homelessness	<i>Responding to Homelessness</i>	2 May 2007
166	Follow-up of Performance Audit Department of Education and Training	<i>Using Computers in Schools for Teaching and Learning</i>	9 May 2007
167	Follow-up of 2001 Performance Audit: Ambulance Service of New South Wales	<i>Readiness to Respond</i>	6 June 2007
168	Ministry of Transport	<i>Connecting with Public Transport</i>	6 June 2007
169	NSW Police Force	<i>Dealing with Household Burglaries</i>	27 June 2007
170	RailCorp	<i>Signal Failures on the Metropolitan Rail Network</i>	15 August 2007
171	Department of Premier and Cabinet Department of Commerce	<i>Government Advertising</i>	29 August 2007
172	Department of Primary Industries	<i>Improving Efficiency of Irrigation Water Use on Farms</i>	November 2007

* Better Practice Guides

Performance audits on our website

A list of performance audits tabled or published since March 1997, as well as those currently in progress, can be found on our website www.audit.nsw.gov.au.

If you have any problems accessing these reports, or are seeking older reports, please contact our Office Services Manager on (02) 9275 7116.