

Hawkesbury-Nepean River Recovery Program Final Report

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FOREWORD

The Hawkesbury–Nepean river system is one of New South Wales' most important natural assets. A healthy, sustainable Hawkesbury–Nepean river system is vital to the people of New South Wales as it is the main source of drinking water for over four million people, or 70 per cent of the state's population. The catchment supports agricultural and horticultural industries that generate more than \$1 billion annually, including \$259 million of irrigated agriculture which supplies much of Sydney's fresh food.

Over time, the pressures of water extraction, catchment development and contaminated run-off have stressed the natural systems of the Hawkesbury–Nepean River, resulting in excessive riparian and aquatic weed growth, algal blooms and high levels of pollutants. Landholders, communities and governments have all recognised that the Hawkesbury–Nepean river system has needed help.

In May 2009, the NSW Government in partnership with the Australian Government established the Hawkesbury–Nepean River Recovery Program with the Australian Government contributing up to \$77.4 million. The NSW Climate Change Fund contributed \$3 million and partner agencies and landholders provided over \$18 million of cash and in-kind support including direct financial contributions from landholders.

The program comprised seven projects, all of which were highly successful and have seen many substantial achievements:

- Securing 8493 million litres of water per year for environmental flows and increasing Sydney's water supply security.
- Preventing an estimated 66.8 tonnes of nitrogen and 17.3 tonnes of phosphorus per year from entering the river system and encouraging weed growth.
- Strengthening relationships with catchment stakeholders and improving landholders' knowledge of nutrient and water-smart practices.
- Introducing water metering systems for 97 per cent of the active licensed entitlements for unregulated river access licences in the catchment (excluding major utilities), allowing both irrigators and government representatives to better manage and plan for water use.
- Introducing new technology for better nutrient and water management for farmers through mobile water metering and improved meter data transmission.

These achievements highlight the benefit of a collaborative approach, where many targeted initiatives were combined to produce substantial, long-term improvements to this important environmental asset. The success of the program can be attributed largely to the many government agencies that worked together to ensure that both individual project objectives as well as wider program objectives were met and, in most cases, exceeded.

The Hawkesbury–Nepean River Recovery Program leaves a valuable legacy for the catchment, provides a sturdy framework for further initiatives and will continue to help to secure Sydney's water supply into the future.



David Harriss
Commissioner for Water
NSW Department of Primary Industries, Office of Water



David Harriss,
Commissioner for
Water,
NSW Department of
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ACKNOWLEDGEMENTS

The successful completion of the Hawkesbury–Nepean River Recovery Program is a result of the hard work and dedication of many skilled individuals. The Office of the Hawkesbury–Nepean (former)* would like to thank the following people, agencies and organisations for their assistance with and contributions to the overall program management of the Hawkesbury–Nepean River Recovery Program:

- the Australian Government for funding the program under the *Water for the Future* initiative
- the NSW Government for allocating NSW Climate Change Funds to the program
- the Australian Government Department of Sustainability, Environment, Water, Population and Communities for administering the funding deed and for providing advice and support
- David Harriss, Commissioner for Water, NSW Department of Primary Industries, Office of Water for direction and guidance
- the project managers, their teams and overall support services from the NSW Department of Primary Industries, Hawkesbury City Council, the Hawkesbury–Nepean Catchment Management Authority, the Office of Environment and Heritage, the Office of Water and Sydney Water Corporation for their hard work and dedication to seeing the successful delivery of the program
- the Office of Water licensing, legal and communications staff, for administrative support and guidance
- other NSW agencies, including NSW Treasury, the NSW Crown Solicitor's Office, the NSW Department of Premier and Cabinet and the NSW Department of Finance and Services for their advice and assistance.

In addition, the Office of the Hawkesbury–Nepean would like to thank all community members who volunteered their time and knowledge to the program. Specifically, the following industry representatives are acknowledged for their contribution through active participation as members of project steering committees:

- Jo El-Boustani, Landholder and President of Greenhouse Vegetable Producers NSW (Smart Farms Project Steering Committee)
- Michael Danelon, Nursery and Garden Industry Development Officer (Smart Farms Project Steering Committee)
- Tony Har, Landholder and Vice President of the Australian Chinese Growers Association (Smart Farms Project Steering Committee)
- Bill McMahon, Landholder, President of the Free Growers Association and Secretary of the Lower Nepean/Hawkesbury Water Users Association (Smart Farms, Improving Hawkesbury–Nepean Water Balance Accounting and Nutrient Export Monitoring project steering committees)
- Greg Miller, Landholder, President of the Turf Growers Association NSW and Director of Turf Producers Australia Ltd (Smart Farms Project Steering Committee)
- Graham Radford, Landholder, representative of the South East NSW Horticultural Association and representative of the NSW Farmers Association, Camden Horticultural Branch (Improving Hawkesbury–Nepean Water Balance Accounting Project Steering Committee)
- Paul Rasmussen, President of the Lower Nepean/Hawkesbury Water Users Association (Improving Hawkesbury–Nepean Water Balance Accounting Project Steering Committee)
- John Stanham, Landholder and President of the Upper Nepean Water Users Association (Smart Farms and Improving Hawkesbury–Nepean Water Balance Accounting project steering committees)
- Steve Vella, Landholder, representing the turf industry (Smart Farms Project Steering Committee).

The Office of the Hawkesbury–Nepean would also like to acknowledge Doug Rhodes (1952–2013) for his outstanding commitment and dedication to the Hawkesbury–Nepean catchment and this program.

**The Office of the Hawkesbury–Nepean closed in 2012 and the relevant water management functions were transferred to the Office of Water.*

EXECUTIVE SUMMARY

This report presents the outcomes of the Australian Government-funded Hawkesbury–Nepean River Recovery Program and provides recommendations for future investment.

A healthy sustainable Hawkesbury–Nepean river system is vital to the people of New South Wales. The river supplies Greater Sydney with good quality water for households, industry and farming and much of the fresh food grown in the catchment is irrigated with water from the river. This competing demand for water places the river under immense pressure.

In May 2009, the Australian Government announced up to \$77.4 million of funding, under the *Water for the Future* initiative, for the Hawkesbury–Nepean River Recovery Program to improve river health by reducing demand through water efficiency, reducing nutrient exports and making more water available for the environment. In addition to this funding, the NSW Climate Change Fund contributed \$3 million and partner agencies and landholders provided over \$18 million of in-kind support.

The Hawkesbury–Nepean River Recovery Program had the following specific objectives:

1. Legally securing 7240 million litres per year for additional environmental flows in the Hawkesbury–Nepean river system below the major dams and, where NSW Climate Change Funds were used, for increasing Sydney's water supply security.
2. Reducing nutrient inputs to the river system by at least 48.2 tonnes per year.
3. Achieving these reduced river extractions, potable water savings and reduced nutrient inputs by engaging with relevant state agencies, local government and landholders across the Hawkesbury–Nepean catchment.

The program was managed by the NSW Government's Office of the Hawkesbury–Nepean in partnership with other NSW agencies, and comprised seven projects:

- The **Improving Hawkesbury–Nepean Water Balance Accounting Project** ensured equitable and efficient water use by installing and upgrading water metering systems for licensed water users.
- The **Licence Purchase Project** bought all or part of unregulated river licences from willing sellers across the catchment to increase the amount of water that stays in the river system.
- The **Water Smart Farms Project** made more efficient use of river and town water for irrigated agriculture by upgrading irrigation systems, improving water harvesting and reuse, and through education and training.
- The **Nutrient Smart Management Project** reduced nutrient run-off from agricultural activity through landholder education and on-ground works, including compost treatment.
- The **Nutrient Export Monitoring Project** quantified nutrient exports from agricultural land within the catchment and evaluated the extent of nutrient reductions achieved by the Nutrient Smart Management and Water Smart Farms projects.
- The **Irrigation and Landscape Efficiency Project** helped improve irrigation efficiency in non-agricultural activities by offering subsidies to local councils, schools and golf courses to help assess their open space irrigation and implement on-ground works to improve practices.
- The **South Windsor Effluent Reuse Scheme Project** constructed a recycled water plant at Hawkesbury City Council's South Windsor sewage treatment plant, along with a distribution system to supply the recycled water to council reserves, schools and other customers.



The Hawkesbury–Nepean river system supplies Greater Sydney with good quality water for households, industry and farming and much of the fresh food grown in the catchment is irrigated with water from the river



The Hawkesbury–Nepean River Recovery Program concluded at the end of 2011, having achieved its objectives on time and under budget.

Overall, the Hawkesbury–Nepean River Recovery Program achieved an estimated 12,433 million litres of secured, unsecured and irrigator water savings per year, exceeding the 11,590 million litre objective by 7.3 per cent.

The secured water savings component of this total was 8493 million litres per year, exceeding the objective by 17.3 per cent. Over 82 per cent of the secured water savings were achieved through improved river water-use efficiency and the purchase and legal transfer of river water and will contribute to additional environmental flows. Over 17 per cent of the secured water savings were achieved through potable water supply savings, where 1190 million litres of potable water savings will contribute to additional environmental flows and 262 million litres of additional water will be available for increasing Sydney's water supply security.

Nutrient inputs to the river system have been reduced by at least 84.1 tonnes per year, comprising 66.8 tonnes of nitrogen and 17.3 tonnes of phosphorus. Thus, the combined nitrogen and phosphorus export reduction objectives were exceeded by 65 per cent and 137 per cent respectively.

The Hawkesbury–Nepean River Recovery Program achieved these objectives by successfully engaging relevant catchment stakeholders and improving landholder knowledge of nutrient and water-smart practices. The program presented a cohesive network with effective and efficient communication between the individuals and organisations involved.

The seven projects had a number of significant outcomes:

- The meters installed through the Improving Hawkesbury–Nepean Water Balance Accounting Project monitor 97 per cent of active licensed entitlements for unregulated river access licences in the catchment, excluding major utilities such as Sydney's major water suppliers (e.g. the Sydney Catchment Authority) as they are managed and metered under separate licensing arrangements. This exceeds the objective of 95 per cent.
- The Improving Hawkesbury–Nepean Water Balance Accounting Project fast tracked the development of new meter display technology, which allows for increased data accuracy and future maintenance savings.
- The policies and procedures developed for the Improving Hawkesbury–Nepean Water Balance Accounting Project provide a sound base for subsequent river water metering across NSW and similar future initiatives elsewhere in Australia.
- The Licence Purchase Project provided an indication of the market value of water and the reported outcomes of the project are expected to inform the water market.
- The Nutrient Smart Management Project helped landholders to develop and fund 187 nutrient-smart on-ground works projects and the Water Smart Farms Project helped landholders to develop and fund 131 water-smart on-ground works projects that may otherwise not have occurred.
- The Nutrient Export Monitoring Project quantified the nutrient export of primary industries within the Hawkesbury–Nepean catchment. The data is of particular value to catchment managers, planners and policy makers as it will help to inform decisions regarding where to target nutrient export reduction measures in the future.
- The Irrigation and Landscape Efficiency Project engaged 23 participating organisations and facilitated works to improve water efficiency at 133 sites across Sydney. The project also helped participating organisations implement larger scale projects, which might otherwise not have been possible, such as stormwater harvesting and recycled water schemes.
- Eight schools and sporting groups are directly benefiting from the South Windsor Effluent Reuse Scheme Project. A continuous source of recycled water for irrigating playing fields and open space areas is continuing to improve surfaces, which provides safer conditions for players and recreational users.

The Hawkesbury–Nepean River Recovery Program achieved an estimated 12,433 million litres of water savings per year



The program's achievements were formally recognised when it was named winner of the government category at the 2012 savewater! awards® and winner of the program innovation category at the 2013 Australian Water Association NSW Branch Awards.

The savewater! awards® are considered Australia's leading awards for water sustainability. The 2012 awards received 1000 entries from 54 countries with winners chosen by an independent judging panel consisting of 40 industry experts from 28 organisations around the world.

The Australian Water Association NSW Branch Awards provide the highest accolade that currently exists in the NSW water industry. The NSW awards acknowledge the best of the best in the NSW water sector as well as recognising exceptional achievements in a range of project and individual categories. Following its success at the NSW Branch awards (and as this report goes to print), the Hawkesbury–Nepean River Recovery Program has also been named a finalist in the program innovation category at the Australian Water Association National Awards, announced at the Ozwater conference in May 2013.

The program leaves a valuable legacy for the catchment and should be used to support existing policy and provide a model for similar coastal systems facing competing demands for water.

This report concludes with the following key recommendations to guide future investment:

- The intricacies of water and river management should be recognised at the funding stage and sufficient time should be allocated for program completion. Programs of similar complexity, scale and type require a minimum of four to five years for successful stakeholder engagement, planning, implementation, evaluation and reporting.
- Future initiatives should have a robust stakeholder engagement strategy, which aims to involve stakeholders in the planning process before implementation commences. Stakeholder engagement should continue throughout the life of the program to inform implementation and ensure ongoing improvement.
- Processes and policies required for program implementation should be in place before funding is released to avoid any delays at the outset.
- Future initiatives should have a continuous learning and improvement framework to evaluate the success of program objectives throughout the implementation process.
- Funding programs should be flexible to allow ongoing support and investment over the longer term. This may include staged investment over a number of years following program completion to allow for more rigorous and comprehensive evaluation and monitoring.
- Future programs should appoint a central coordinating body with overall responsibility for the program. The Office of the Hawkesbury–Nepean played a critical role as broker and coordinator for the Hawkesbury–Nepean River Recovery Program. The success of the program also confirmed that the program manager position is essential to effective coordination and should be appointed in addition to the project managers appointed for individual projects.



The program leaves a valuable legacy for the catchment and should be used to support existing policy and provide a model for similar coastal systems facing competing demands for water

INTRODUCTION

This report presents the outcomes of the Australian Government-funded Hawkesbury–Nepean River Recovery Program and provides recommendations for future investment. The report evaluates the overall program's objectives and achievements and then provides a more detailed review of the program's seven projects. The report is structured in accordance with the requirements of the program's funding deed.

The Hawkesbury–Nepean river system is one of New South Wales' most important natural assets. Its catchment covers 2.2 million hectares, framing the northern and western edges of the Sydney Basin. It is the main source of drinking water for over four million people, or 70 per cent of the NSW population. Its waters also support agricultural and horticultural industries that generate more than \$1 billion annually, including \$259 million of irrigated agriculture which supplies much of Sydney's fresh food. Each year more than 10 million people visit the Hawkesbury–Nepean catchment to experience its natural assets including World Heritage listed wilderness, rainforests, open woodlands, wetlands and heath lands, and the spectacular Hawkesbury estuary. Figure 1 shows the Hawkesbury–Nepean catchment.

Over time, the pressures of water extraction, catchment development and contaminated run-off have stressed the natural river systems of the Hawkesbury–Nepean catchment, resulting in excessive riparian and aquatic weed growth, algal blooms and high levels of pollutants. Landholders, communities and governments have all recognised that the Hawkesbury–Nepean river system has needed help.

In May 2009 the Australian Government, through its *Water for the Future* initiative, provided up to \$77.4 million of funding for the Hawkesbury–Nepean River Recovery Program. The program sought to improve the health of the river system by engaging the catchment community in making more water available for environmental flows and reducing the amount of nutrients entering the river system.

Environmental flows can be achieved through various methods. For example, releasing water from dams or making water available for environmental benefit through water-use efficiency and licence purchases. For the purpose of this project, water savings that will contribute to additional environmental flows are generically referred to as environmental water.

Increasing river flows and reducing the level of nutrients (nitrogen and phosphorus) in the river helps control excessive growth of riparian and aquatic weeds and algae. Nutrients enter the river through 'point source' discharges such as sewage treatment plants, and 'diffuse' sources such as run-off from urban and agricultural areas within the catchment. The Hawkesbury–Nepean River Recovery Program addressed both point and diffuse nutrient sources, through reuse of treated sewage effluent and the implementation of improved nutrient management practices on agricultural lands.

There is no simple or single solution to improving river health and sustainability. A range of integrated actions that reduce water use, make more water available for rivers and reduce nutrients is required to address the underlying causes. This program was developed to support the existing NSW Government reforms to improve water use and river health in the Hawkesbury–Nepean catchment. Many of the NSW Government initiatives currently in place deal with the improvements to major infrastructure, such as modifying the Upper Nepean dams and weirs to allow variable environmental flows to move unimpeded downstream of these flow barriers and upgrading sewage treatment plants to reduce nutrient exports to the river.

A range of integrated actions that reduce water use, make more water available for rivers and reduce nutrients is required to improve river health





The Hawkesbury–Nepean River Recovery Program focused primarily on diverse and geographically spread small-scale operations such as individual irrigators' and councils' water use and nutrient exports. It is expected that the cumulative benefits of the activities including education and training will enhance the current integrated suite of river-health initiatives for the Hawkesbury–Nepean.

The program was managed by the NSW Government's Office of the Hawkesbury–Nepean in partnership with other NSW agencies. It comprised seven projects:

- The **Improving Hawkesbury–Nepean Water Balance Accounting Project** ensured equitable and efficient water use by installing and upgrading water metering systems for licensed water users. Managed by the Office of Water.
- The **Licence Purchase Project** bought all or part of unregulated river licences from willing sellers across the catchment to increase the amount of water that stays in the river system. Managed by the Office of Environment and Heritage.
- The **Water Smart Farms Project** made more efficient use of river and town water for irrigated agriculture by upgrading irrigation systems, improving water harvesting and reuse, and through education and training. Managed by the Department of Primary Industries.
- The **Nutrient Smart Management Project** reduced nutrient run-off from agricultural activity through landholder education and on-ground works, including compost treatment. Managed by the Department of Primary Industries and the Hawkesbury–Nepean Catchment Management Authority.
- The **Nutrient Export Monitoring Project** quantified nutrient exports from agricultural lands within the Hawkesbury–Nepean catchment and evaluated the extent of nutrient reductions achieved by the Nutrient Smart Management and Water Smart Farms projects. Managed by the Office of Environment and Heritage.
- The **Irrigation and Landscape Efficiency Project** helped improve irrigation efficiency in non-agricultural activities by offering subsidies to local councils, schools and golf courses to help assess their open space irrigation and implement on-ground works to improve practices. Managed by Sydney Water Corporation.
- The **South Windsor Effluent Reuse Scheme Project** constructed a recycled water plant at Hawkesbury City Council's South Windsor sewage treatment plant, along with a distribution system to supply the recycled water to council reserves, schools and other customers. Managed by Hawkesbury City Council.

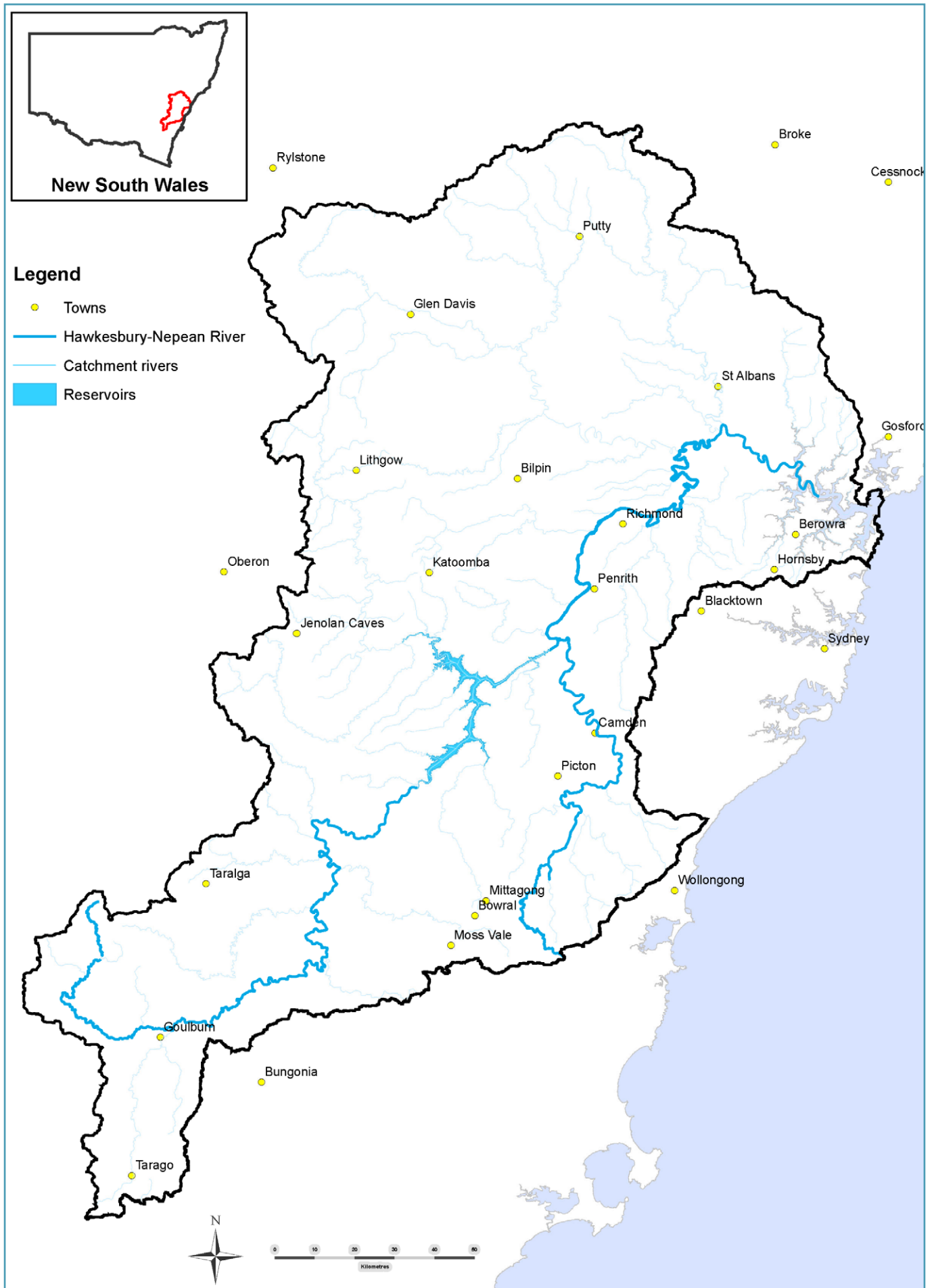
The Hawkesbury–Nepean River Recovery Program concluded at the end of 2011, having achieved its objectives on time and under budget. In addition to the final expenditure of \$66 million from the Australian Government, the NSW Climate Change Fund contributed \$3 million and partner agencies and landholders provided over \$18 million of in-kind support including direct financial contributions from landholders.



The Hawkesbury–Nepean River Recovery Program concluded at the end of 2011, having achieved its objectives on time and under budget



Figure 1. The Hawkesbury–Nepean catchment



PROGRAM OBJECTIVES

The Hawkesbury–Nepean River Recovery Program had three main objectives:

1. Legally securing 7240 million litres of water per year for additional environmental flows in the Hawkesbury–Nepean river system below the major dams and, where NSW Climate Change Funds were used, for increasing Sydney’s water supply security. The water savings for additional environmental flows were to be secured under the NSW Government’s *Water Management Act 2000* (section 8). The Act provides the legal mechanism which enables the protection and accounting of reduced river extractions or potable water savings achieved through the program.
2. Reducing nutrient inputs to the river system by at least 48.2 tonnes of nitrogen and phosphorus per year.
3. Achieving these reduced river extractions, potable water savings and reduced nutrient inputs by engaging with relevant state agencies, local government and landholders across the Hawkesbury–Nepean catchment.



Increasing river flows and reducing the level of nutrients in the river helps control excessive growth of riparian and aquatic weeds and algae

These objectives were to be achieved by the seven projects of the Hawkesbury–Nepean River Recovery Program, with the estimated nutrient savings and water savings from each project shown in Table A1.

Project	Water savings (million litres per year)			Nutrient reductions (tonnes per year)	
	Legally secured	Unsecured	Remaining with irrigators	Total nitrogen	Total phosphorus
Improving Hawkesbury–Nepean Water Balance Accounting	0	2850	0	1.4	0.1
Licence Purchase	1680	0	0	0.3	0
Water Smart Farms	4400*	0	1500*	11.8	1.2
Nutrient Smart Management	0	0	0	27	6
Nutrient Export Monitoring	0	0	0	0	0
Irrigation and Landscape Efficiency	1060	0	0	0	0
South Windsor Effluent Reuse Scheme	100	0	0	0.4	0
Subtotals	7240	2850	1500	40.9	7.3
Totals	Total water savings 11,590 million litres per year			Total nutrient reductions 48.2 tonnes per year	

*The total water savings from the Water Smart Farms Project were estimated to be 5900 million litres per year. The actual allocation of water savings between legally secured water and water remaining with irrigators depended on the final ratio of water savings made from potable water users and irrigators. The objective of 1500 million litres per year to remain with irrigators represented an upper estimate and assumed all on-ground works would be undertaken at irrigator properties.

Program development

Planning for the Hawkesbury–Nepean River Recovery Program commenced in early 2008 when the NSW Government initiated the development of a proposal for funding from the Australian Government's Water Smart Australia Program. This program, a component of the Australian Government's *Water for the Future* initiative, aimed to accelerate the development and uptake of smart technologies and practices in water use across Australia.

Development of the funding proposal involved:

1. Establishing a steering committee.
2. Developing project concepts for consideration.
3. Selecting concepts for detailed investigations.
4. Consulting with stakeholders directly associated with selected project concepts.
5. Defining, costing and verifying expected outcomes from selected project concepts.
6. Conducting risk assessments for selected project concepts.
7. Prioritising selected project concepts.

The development of the proposal was guided by a steering committee established in May 2008 which comprised representatives of NSW Government agencies and the Australian Government.

The steering committee identified 23 project concepts, and a lead NSW agency for each concept was nominated to develop the concept description and identify expected outcomes, planned delivery arrangements, initial cost estimates, risks, and relationships to other existing programs. All project concepts sought to meet one or both of the Australian Government's specified objectives for the proposal of additional environmental water and improved water quality in the Hawkesbury–Nepean catchment.

The steering committee identified principles against which the 23 project concepts were filtered. The principles were that project concepts should:

- achieve nutrient reductions or water savings that can be protected as environmental water
- be deliverable by 30 June 2011
- be acceptable to key stakeholders
- have outcomes that could be sustained over the long term
- leverage more funds than would otherwise be available for water savings and nutrient management
- be relatively cost effective (highest water savings and/or highest nutrient reduction compared to funding investment)

- contribute broadly to NSW State Plan outcomes
- contribute to Hawkesbury–Nepean Catchment Management Authority performance targets
- minimise or avoid legacy issues
- identify and minimise risks
- propose actions that are additional to activities already planned by the NSW Government.

Ten project concepts were rejected as a result of this filtering process. Generally, these concepts had expected high costs, uncertain outcomes, were not consistent with the funding objectives specified by the Australian Government, or could not be delivered in the required timeframe.

Relevant stakeholders for the remaining 13 project concepts were consulted. Discussions covered stakeholder interest in participation, requirements for securing stakeholder participation, likely associated issues, and the provision of data and information by stakeholders for the analysis of project concepts by a professional services consultancy.

Through a NSW Government tender process, professional consultancy services were commissioned to assist with defining and scoping the remaining 13 project concepts, involving:

- costing each concept
- providing independent verification of water savings and nutrient reductions from each concept
- examining the technical, financial and management risks of each concept
- prioritising the concepts.

In defining and scoping the project concepts, multiple options for several project concepts were developed.

The 13 project concepts, including the options developed within several of the concepts, were assessed by the consultants in a risk assessment framework compliant with the Australian Standard for Risk Management (AS/NZS 4360:2004) against the following broad risk categories:

- cost
- feasibility
- environmental risks
- landholder/stakeholder engagement
- requirement that funding be spent by June 2011
- interrelationships with other projects (conflict or overlap)
- ownership and maintenance/monitoring
- ongoing costs beyond 2011
- realisation of benefits.



This risk assessment process resulted in several project concepts and options being rejected and also prompted refinement of several other options to address risk.

The 13 project concepts, and options within concepts, were prioritised using a combination of a quantitative multi-criteria analysis to identify projects that were high priority and low priority, and then a subsequent consideration of remaining projects in the context of other non-quantifiable criteria.

Multi-criteria analysis is a tool used to assist decision makers to quantitatively compare a range of options based on a set of criteria, and weightings for the relative importance of those criteria. The multi-criteria analysis framework for this proposal was developed by the consultants in consultation with the NSW Government, with the major criteria of:

- risk, based on the risk categories in the risk assessment framework
- cost-benefit, based on value for money for water savings and nutrients
- sustainability, based on energy consumption and longevity of outcomes.

The non-quantifiable approach included an assessment of whether the project concept:

- contributed to an overall project mix to complement other activities occurring in the catchment
- could be funded through other sources in the near future
- contributed to the final project mix to engage as many relevant stakeholders in the catchment as possible.

The steering committee examined the outcomes of the prioritisation analysis and developed a final list of eight projects for inclusion in the funding proposal for the Hawkesbury–Nepean River Recovery Program. The steering committee also identified that an overall program management component would be required to coordinate the program and its components.

The funding proposal for the Hawkesbury–Nepean River Recovery Program was submitted to the Australian Government in September 2008. The NSW Government and Australian Government then negotiated the development of a funding deed to facilitate the Australian Government's significant investment in the program and the NSW Government agency arrangements that would be required for program delivery. During the negotiations the list of projects was reduced from eight to seven, being:

- Improving Hawkesbury–Nepean Water Balance Accounting
- Licence Purchase
- Water Smart Farms
- Nutrient Smart Management
- Nutrient Export Monitoring
- Irrigation and Landscape Efficiency
- South Windsor Effluent Reuse Scheme.

Through the negotiations, the Australian and NSW Governments were also able to identify arrangements to enable the program completion date to be extended from June 2011 to September 2011, even though the Australian Government's Water Smart Australia Program would be concluding in June 2011.

Delivery and governance

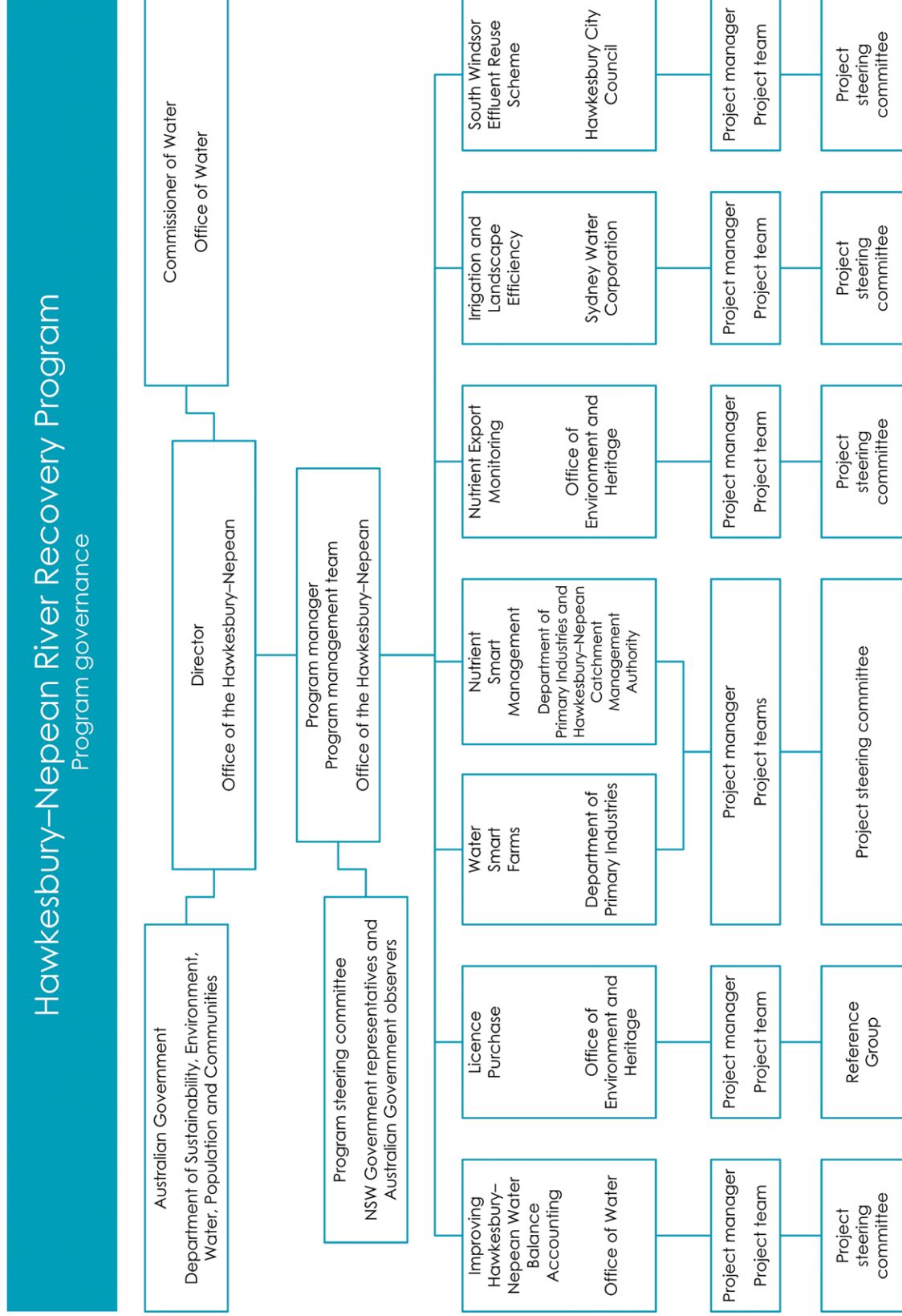
In May 2009 the Australian Government announced its allocation of up to \$77.4 million of funding for the Hawkesbury–Nepean River Recovery Program, following the signing of the program funding deed between the Australian Government Department of Sustainability, Environment, Water, Population and Communities and the Office of Water. This facilitated commencement of the program and its components in June 2009.

Overall program management

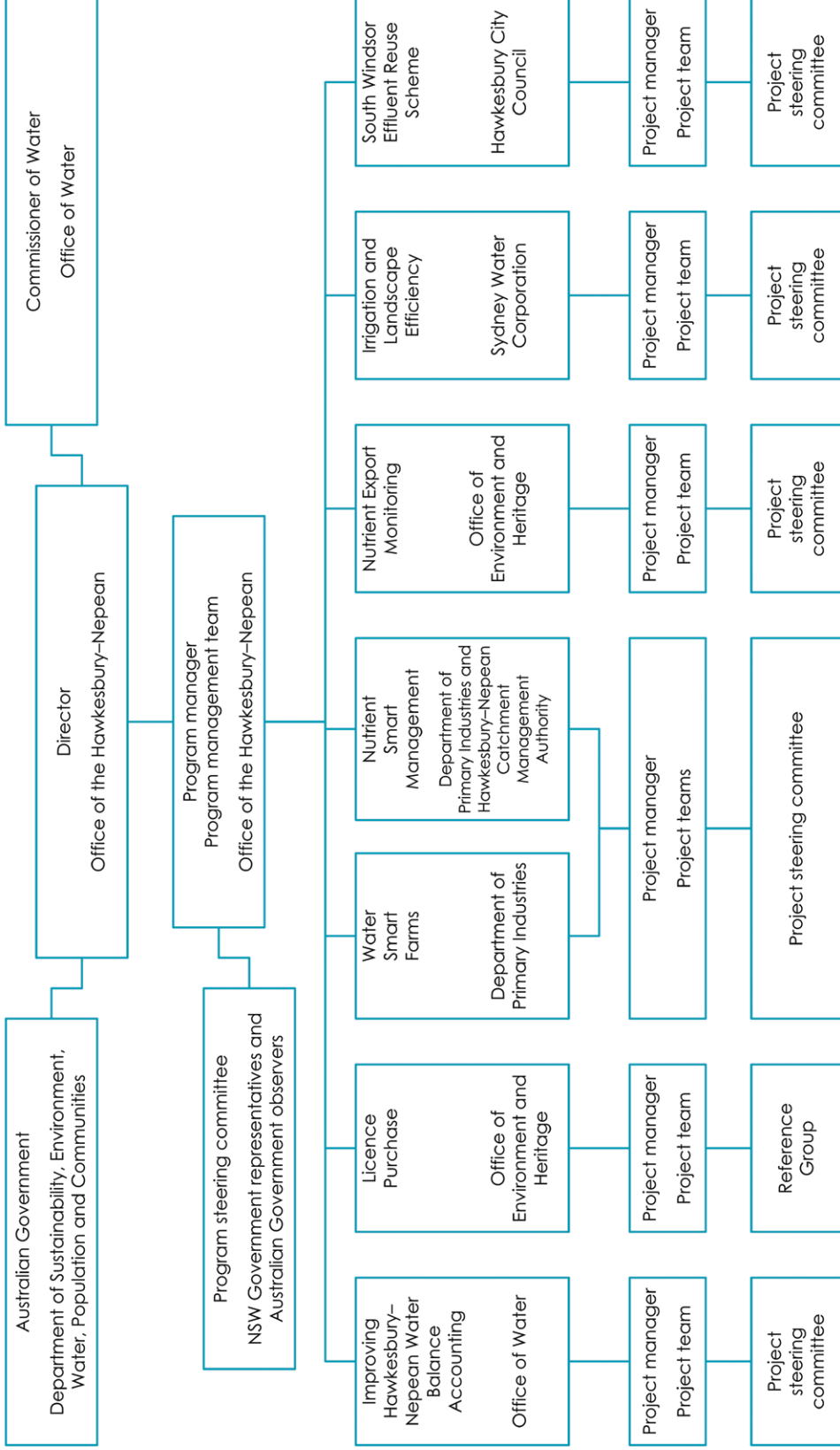
The NSW Government appointed the Office of the Hawkesbury–Nepean to carry out overall program management of the Hawkesbury–Nepean River Recovery Program on behalf of the Office of Water. Figure 2 shows the governance structure for the Hawkesbury–Nepean River Recovery Program.

As the program had multiple components delivered by numerous partners, the Office of the Hawkesbury–Nepean adopted a program management approach. The terms 'program management' and 'project management' are often used interchangeably but there are important distinctions between the two disciplines (Martinelli and Waddell, 2005). Program management typically focuses on achieving the intended strategic objectives through the coordination of multiple projects whereas project management focuses on the tactics of planning and execution of the work output.

Figure 2. Hawkesbury–Nepean River Recovery Program governance



Hawkesbury–Nepean River Recovery Program Program governance



In its overall program management role, the Office of the Hawkesbury–Nepean was responsible for:

- coordinating project milestone and financial reporting to the Australian Government and Office of Water including financial auditing
- coordinating the Hawkesbury–Nepean River Recovery Program steering committee
- acting as the interface between the agencies responsible for each project and the Australian Government, including coordinating the negotiation of project variations with the Australian Government
- coordinating program and project media and communications
- overall program risk management and coordinating risk management for the projects.

The Office of the Hawkesbury–Nepean established the program steering committee and convened and chaired its three-monthly meetings. The steering committee was responsible for:

- coordinating and overseeing the performance of the program and its projects
- enabling the members and observers of the program steering committee to obtain information regarding the progress of the program and all projects
- providing comment and guidance regarding the performance of the program and projects
- reviewing project progress reports prior to submission to the Australian Government.

As required by the program funding deed, project steering committees were established for the Improving Hawkesbury–Nepean Water Balance Accounting, Water Smart Farms, Nutrient Smart Management, Irrigation and Landscape Efficiency, South Windsor Effluent Reuse and Nutrient Export Monitoring projects. Due to their integrated operation, the Water Smart Farms and Nutrient Smart Management projects established a single Smart Farms steering committee. While not required to establish a steering committee, the Licence Purchase Project established a reference group to assist with project planning and delivery. Details of the project steering committees and reference group can be found in the project sections of this report.

Communications and media

At its first meeting, the program steering committee decided that while each project agency should be responsible for media and communications associated with their project, the Office of the Hawkesbury–Nepean should establish communication, branding and media protocols to:

- define consistent branding and terminology including a program logo and defined statements acknowledging the Australian Government funding
- establish the Office of the Hawkesbury–Nepean as the central coordinating body for communications and media.

The Office of the Hawkesbury–Nepean appointed a communications officer to oversee the communication and media coordination and approval processes defined in the protocols. The officer was shared with the Improving Hawkesbury–Nepean Water Balance Accounting Project for much of the program period, transitioning to a full-time role within the Office of the Hawkesbury–Nepean when preparation of this final report commenced.

The program steering committee visiting a dam spillway project at Wallacia, September 2010



Risk management

The Office of the Hawkesbury–Nepean was required under the Hawkesbury–Nepean River Recovery Program funding deed to conduct, and revise as required, risk assessments for the program and its components in accordance with the Australian Standard for Risk Management (AS/NZS 4360:2004).

A risk assessment workshop involving staff from the Office of the Hawkesbury–Nepean and the NSW Government agencies managing each project was held. The workshop, facilitated by an external service provider, used a risk library approach (Robinson, 2006) to ensure that all possible risks were thoroughly explored. Subsequent to the workshop, detailed risk assessments for the overall program management and each project were prepared.

As part of the three-monthly milestone reporting to the Australian Government, the Office of the Hawkesbury–Nepean and the NSW Government agencies managing each project were required to review the risk assessments and, if required, update them and provide the updates as part of their reports.

Milestone and financial reporting and auditing

The projects were required under the program funding deed to report progress against milestones to the Australian Government every three months. They were also required to report financial expenditure and budget forecasts to the Australian Government every six months coinciding with the three-monthly milestone report or every three months where a milestone report coincided with a progress payment from the Australian Government.

The Office of the Hawkesbury–Nepean coordinated the milestone and financial reporting by preparing project milestone and financial progress report templates. These templates assisted project managers to provide the specific information required for the reports and facilitated consistent and timely reporting across the projects.

The Office of the Hawkesbury–Nepean also coordinated, collated and submitted the required review of the project milestone and financial progress reports by the program steering committee to the Australian Government by the due date. All reports were submitted on time.

The Office of the Hawkesbury–Nepean was also required under the funding deed to facilitate the conduct of independent financial audits for the overall program and each of its projects. The audits were conducted after the end of each financial year during the program period and after the program completion at the end of September 2011. The Office of the Hawkesbury–Nepean engaged IAB Services to conduct these audits.

Four financial audits were completed during the life of the program with the auditor finding that the program satisfied standard auditing requirements and that the financial information provided for the program was based on proper accounts and records and represented the financial transactions fairly.



The program steering committee visiting Irrigation and Landscape Efficiency Project works in Bradfield Park, September 2010



Summary of outcomes against program objectives

The overall objectives of the Hawkesbury–Nepean River Recovery Program were to contribute to improving river health below the major water storages by engaging the community in initiatives that increased water savings and reduced nutrient exports to the river system. Table A2 summarises the overall outcomes of the program's three key objectives.

Objective	Outcome
Legally securing 7240 million litres per year for additional environmental flows in the Hawkesbury–Nepean river system below the major dams and for increasing Sydney's water supply security.	8493 million litres of water savings per year have been legally secured for additional environmental flows and for increasing Sydney's water supply security.
Reducing nutrient inputs to the river system by at least 48.2 tonnes per year.	Nutrient inputs have been reduced by at least 84.1 tonnes per year.
Achieving these reduced river extractions, potable water savings and reduced nutrient inputs by engaging with relevant state agencies, local government and landholders across the Hawkesbury–Nepean catchment.	1145 licence holders and landholders and 31 organisations were engaged and have directly benefited from the program. 3899 attendees participated in Smart Farms activities such as field days, training workshops, meetings and presentations. The activities were used in conjunction with individual interactions and communications materials to build knowledge and capability amongst participants.

Increasing environmental flows and Sydney's water supply security

One of the three objectives of this program was to make more water available in the Hawkesbury–Nepean river system to improve river health. This was achieved primarily through purchasing all or part of unregulated river licences and increasing both river and potable water-use efficiency.

This section discusses the different types of water savings the program achieved and how they are accounted for and/or protected under the relevant legislation or accounting framework within the Hawkesbury–Nepean river system.

The Hawkesbury–Nepean river system is classified as an unregulated river under the *Water Management Act 2000*. Even though it is heavily regulated by the presence of large dams and weirs, it is considered an unregulated river because water extraction depends on availability of flows as water is not stored or released on demand for downstream users. In contrast, regulated rivers, such as the Murrumbidgee River, release water stored in dams (subject to availability and demand) for downstream users.

Figure 3 illustrates greater Sydney's water supply system, which includes the metropolitan dams in the Hawkesbury–Nepean catchment.

As shown in Table A3, the Licence Purchase, Water Smart Farms, Irrigation and Landscape Efficiency and South Windsor Effluent Reuse Scheme projects collectively aimed to achieve around 7240 million litres per year of secured water savings for environmental benefit and, where NSW Climate Change Funds were used, to increase Sydney's Water supply security. The program also aimed to achieve 2850 million litres per year of unsecured water savings through the Improving Hawkesbury–Nepean Water Balance Accounting Project and up to 1500 (later revised to 1100) million litres per year of savings which would remain with irrigators through water-use efficiency measures. The overall Hawkesbury–Nepean River Recovery Program water savings objective, including the secured and unsecured water savings and water to remain with irrigators, was 11,590 million litres per year.



Figure 3. Greater Sydney's water supply system

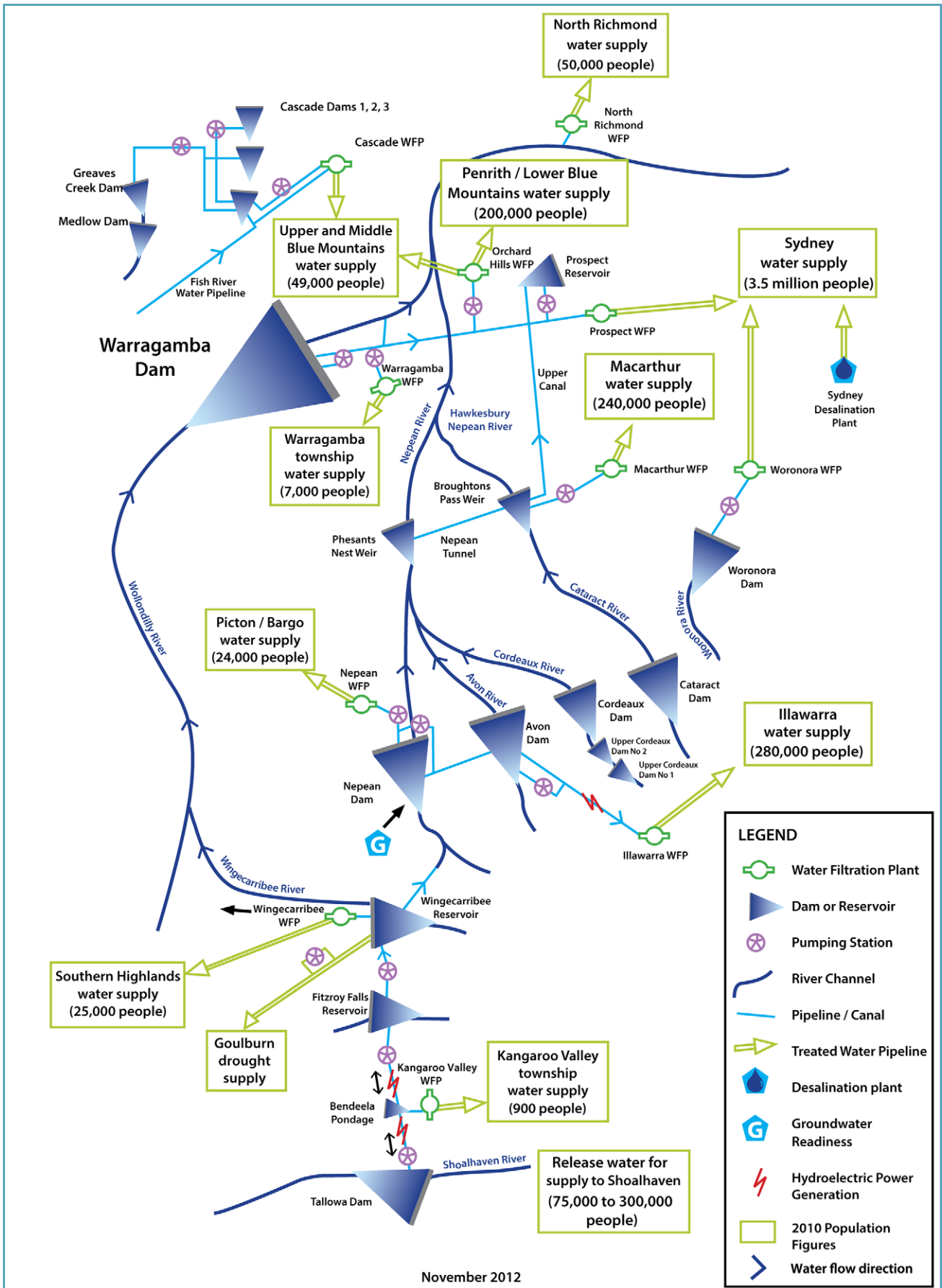


Table A3

Water savings outcomes against objectives (million litres per year)

Project	Secured water savings			Unsecured water savings		Water to remain with irrigators	
	Objective	Outcome		Objective	Outcome	Objective	Outcome
		Average annual contribution to environmental flows from licence purchase, river water-use efficiency and potable water savings	Potable water savings to increase Sydney's water supply security				
Improving Hawkesbury–Nepean Water Balance Accounting	0	0	0	2850	2830	0	0
Licence Purchase	1680	2755	0	0	0	0	0
Water Smart Farms	4400	4286	262	0	0	1500 (later revised to 1100) ¹	1110
Nutrient Smart Management	0	0	0	0	0	0	0
Nutrient Export Monitoring	0	0	0	0	0	0	0
Irrigation and Landscape Efficiency	1060	1090	0	0	0	0	0
South Windsor Effluent Reuse Scheme	100	100	0	0	0	0	0
Total	7240	8493	9684	2850	2830	1500 (later revised to 1100)	1110
							Objective total 11,590²
							Outcome total 12,433

Black: Objective **Blue: Outcome** **Green: Total river water purchased plus potable water savings**

¹The Water Smart Farms Project objective for water remaining with irrigators was estimated at 1500 million litres but was later revised to 1100 million litres (depending on the type of works agreed and finally implemented).

²The Hawkesbury–Nepean River Recovery Program total water savings objective of 11,590 million litres included the original estimated 1500 million litres of water savings to remain with irrigators.



Secured water savings

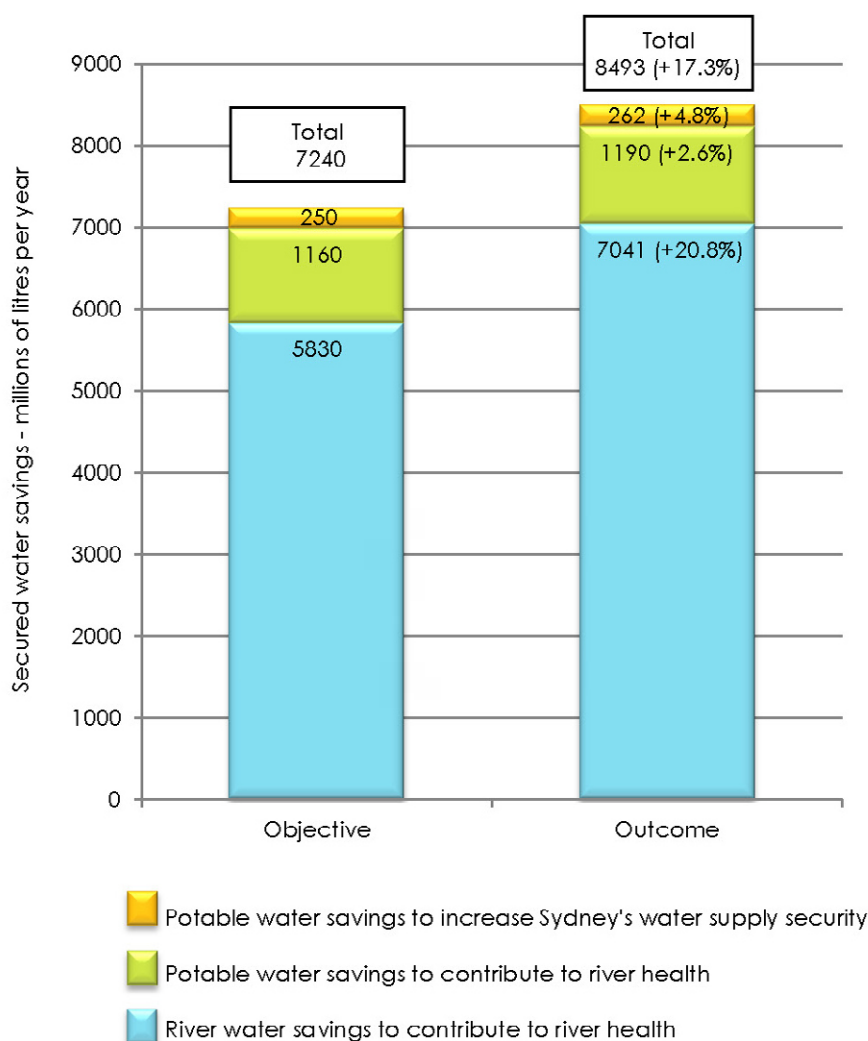
In the Hawkesbury–Nepean, secured savings are water savings that have been legally protected through a water licensing or water accounting mechanism within the catchment's water planning framework, as detailed in the 'Securing and accounting processes for water savings' section on page 16.

The overall program objective for secured water savings was 7240 million litres per year. As shown in Figure 4, the four projects contributing to this saving exceeded the objective by 17.3 per cent, achieving 8493 million litres of water savings per year. The savings comprised:

- 7041 million litres per year of water savings through direct unregulated river licence purchases (Licence Purchase and Water Smart Farms projects) and improved river water-use efficiency (Water Smart Farms Project), which contribute to environmental water
- 1190 million litres per year of potable water savings (from Sydney's water supply) through irrigation and landscape efficiencies (Irrigation and Landscape Efficiency Project) and using recycled water instead of potable water (South Windsor Effluent Reuse Scheme Project), which contribute to environmental water
- 262 million litres per year of additional potable water savings through irrigation efficiency measures (Water Smart Farms Project), which increase Sydney's water supply security.

Of the 8493 million litres of secured water savings, 82.9 per cent were achieved through river water savings and 17.1 per cent through potable water supply savings.

Figure 4. Hawkesbury–Nepean River Recovery Program secured water savings objectives and outcomes



Unsecured water savings

The Improving Hawkesbury–Nepean Water Balance Accounting Project (which installed water meters) was estimated to make 2850 million litres per year of unsecured water savings.

As shown in Table A3, the unsecured water savings outcome of 2830 million litres per year was slightly lower than the original objective (by less than 1 per cent) due to fewer meters installed. These savings will be realised through more accurate measurement of water extraction and the associated water-efficiency improvements amongst irrigators.

The water savings associated with meter installations can be achieved either through system operation improvements or behavioural responses to improved water information availability.

System operation improvements are usually a feature of regulated systems where water is actively released from dams to meet irrigation orders on a daily basis. In these systems, improved real-time metering coverage creates water-use efficiencies as a result of two broad factors. Firstly, there is a reduced requirement for irrigators to over-order water to cover the risks associated with delivery uncertainties. Secondly, there is a reduced requirement for dam operators to create in-river surpluses to cover any additional information uncertainties.

The Hawkesbury–Nepean river system provides both potable water for urban water supply and river water to support a significant irrigation industry and maintain in-stream river health. However, the absence of an irrigation ordering and active water delivery system means that it is in effect an unregulated system. Therefore, savings from system operation improvements are not expected to be created as a result of installing improved metering systems.

Behavioural responses create savings through access to additional information about extracted volumes which in turn can be used to water crops more efficiently, both in terms of timing and quantity. In a peri-urban system such as the Hawkesbury–Nepean which is essentially land constrained with small lot sizes, this more efficient behaviour is expected to result in reduced water extraction for the same level of production. However, accurately quantifying this saving over the long term is more challenging since it requires a thorough understanding of cropping and irrigation practices, and how these would change with more accurate real-time metering.

In summary, while there are clear benefits of improved water metering and savings are expected in the Hawkesbury–Nepean catchment, it would be inappropriate to explicitly secure these water savings by reducing irrigators' access to water through reductions to the long-term average annual extraction limits. These limits are imposed by the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011 (water sharing plan) to prevent water use from exceeding current entitlement levels. Therefore, for the purpose of this project, the savings associated with meter installations are defined as unsecured savings.



The Hawkesbury–Nepean river system provides both potable water for urban water supply and river water to support a significant irrigation industry and maintain in-stream river health



Water to remain with irrigators

As part of the irrigators' contributions to the Water Smart Farms Project, 75 per cent of the total water savings associated with the water-use efficiency activities were transferred under licence to the Water Administration Ministerial Corporation (administered by the Office of Water) to contribute to environmental water and 25 per cent remained with the participating river irrigators.

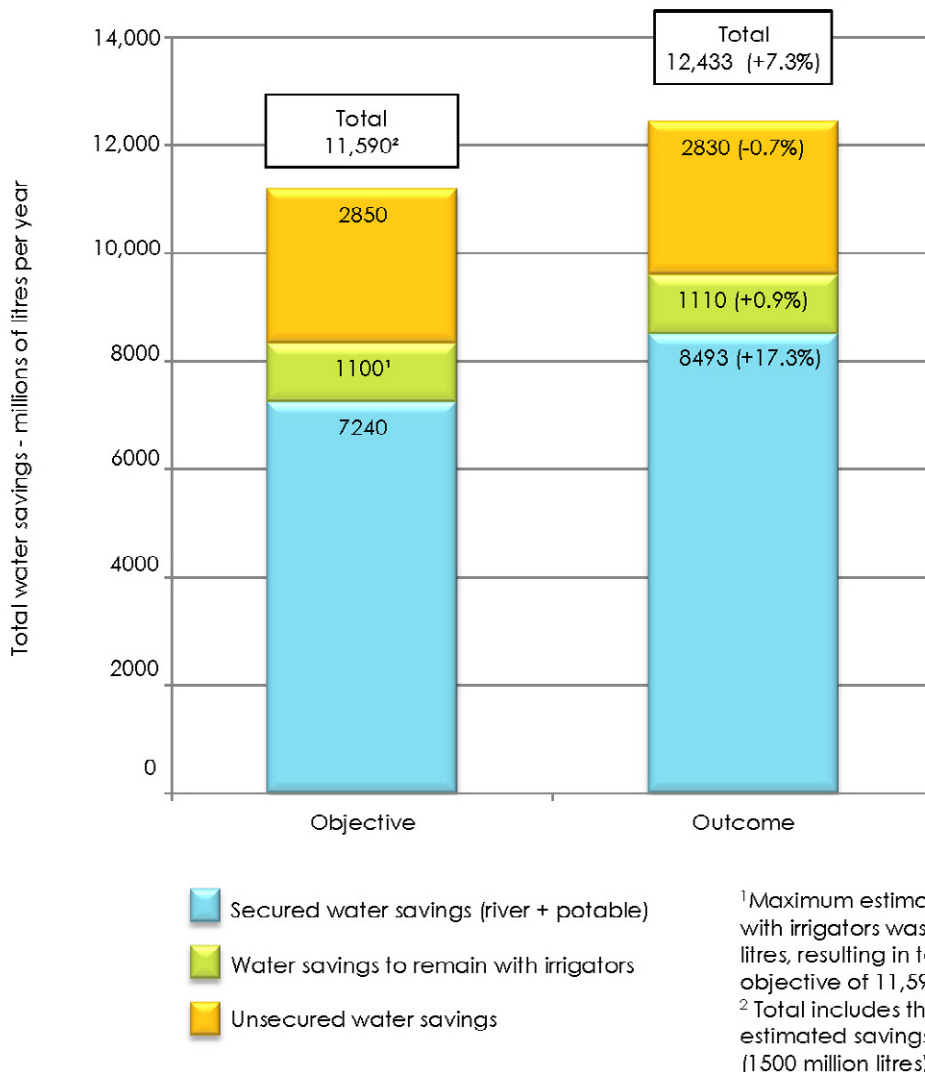
The objective for water remaining with irrigators was estimated at 1100 million litres with a maximum estimated saving of 1500 million litres depending on the type and range of works implemented. During the planning stages to determine the agreed on-ground works projects, the 1100 million-litre objective was confirmed as the more realistic saving. However, achieving this lower value has not affected the total water savings for the overall program as the shortfall has been easily accounted for through exceeding the secured water savings objective.

As shown in Figure 5, the outcome of the Water Smart Farms Project was that 1110 million litres of water savings remained with the participating irrigators, exceeding the 1100 million-litre objective by 1 per cent.

Total water savings

Overall, the Hawkesbury–Nepean River Recovery Program achieved an estimated 12,433 million litres per year of water savings, exceeding the objective of 11,590 million litres by 7.3 per cent, as shown in Figure 5.

Figure 5. Hawkesbury–Nepean River Recovery Program total water savings objectives and outcomes





Securing and accounting processes for water savings

The following section summarises the process for securing and accounting for Hawkesbury–Nepean River Recovery Program water savings achieved through river water purchases and potable water savings from Sydney's water supply.

The Office of Water is the NSW Government's lead agency for managing and protecting the state's water resources. It is responsible for securing and accounting for environmental water savings generated from this program. The Office of Water reports to the Minister for Primary Industries on water policy and is responsible for the administration of key water management legislation, including the *Water Management Act 2000* and the *Water Act 1912*.

Water sharing plans under the *Water Management Act 2000* establish rules for protecting and sharing water between the environmental needs of the river or aquifer and water users, and also between different types of water uses such as town supply, rural domestic supply, stock watering, industry and irrigation.

The Act recognises the need to allocate water or 'environmental flows' for the health of our rivers and groundwater systems. It provides water for the environment in two ways: planned environmental water and adaptive environmental water.

Planned environmental water, such as the Upper Nepean variable environmental flows released by the Sydney Catchment Authority, is water prescribed under the environmental flow rules of a river water sharing plan. These rules are designed to maintain and enhance the health of aquatic plants and animals by generating different types of flow events.

Adaptive environmental water is water that is committed for environmental purposes by conditions of access licences. It can arise from water recovery projects or buying back water licences.

The unique characteristic of the unregulated Hawkesbury–Nepean system means that water savings from this program need to be secured through a combination of planned and adaptive environmental water. For the purpose of this program, environmental flows include both planned and adaptive environmental water savings and are generically referred to as environmental water.

Approaches to secure and account for water savings

For this program, the approach to quantify, secure and account for water savings was dependent on:

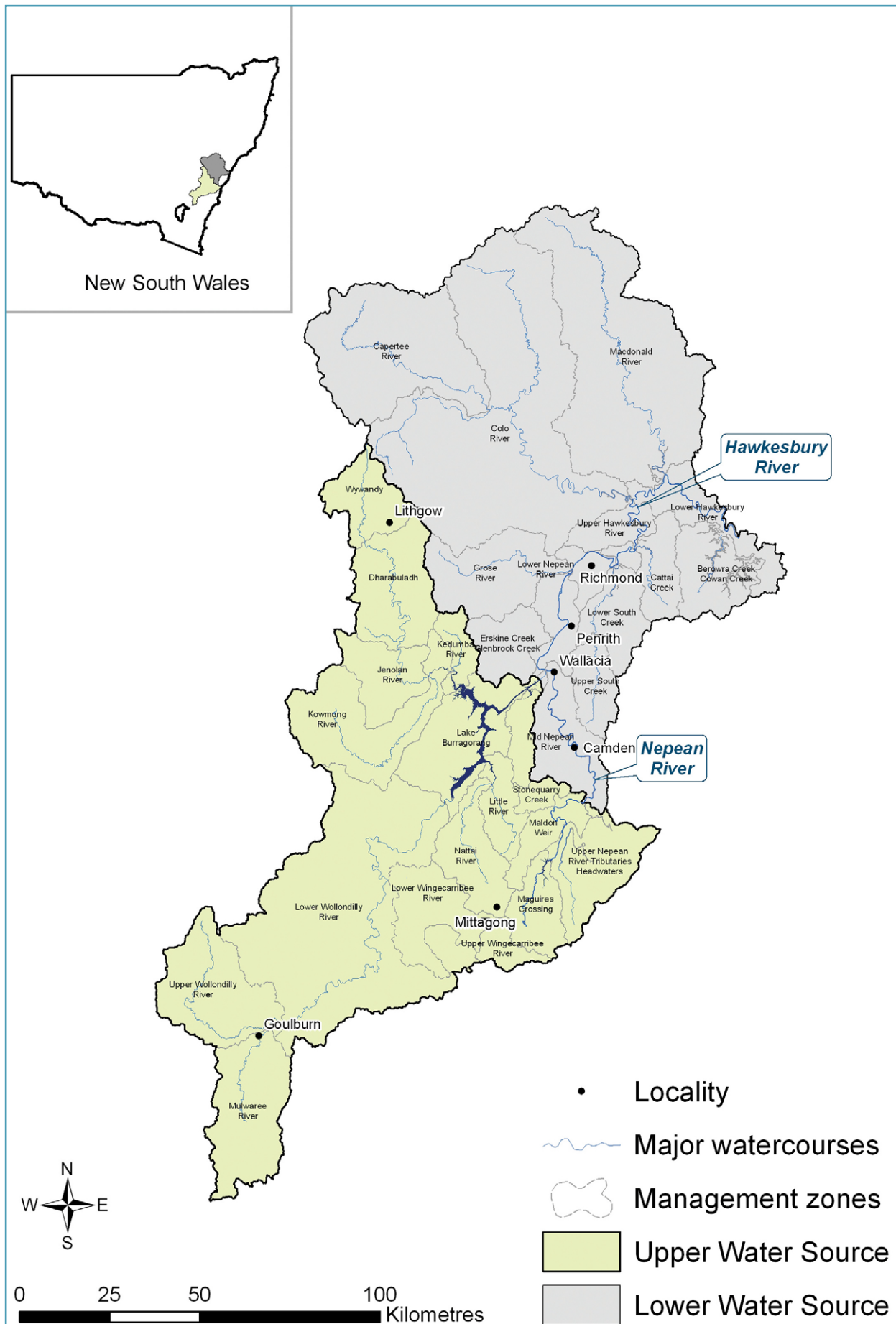
1. the project activity (e.g. purchasing water or improving water-use efficiency)
2. the source from which the savings were derived (either directly from unregulated river licences or potable water from Sydney's water supply, noting that the majority of Sydney's water supply comes from the Hawkesbury–Nepean river system)
3. the geographic location from which the river water savings were derived, as defined by the major water sources in the water sharing plan (see Figure 6):
 - » The Upper Nepean and Upstream Warragamba Water Source (Upper Water Source) – defined as the area upstream of the major water supply dams (Avon, Cataract, Cordeaux, Nepean and Warragamba)
 - » Lower Water Source – defined as the area downstream of the dams
4. calculating the proportion of the saving that will contribute either to environmental water or to increasing Sydney's water supply security. Depending on the project activity, this is calculated by considering either the active component of licences purchased or the gain in water-use efficiency.

The unique characteristic of the unregulated Hawkesbury–Nepean system means that water savings from this program need to be secured through a combination of planned and adaptive environmental water





Figure 6. Hawkesbury–Nepean catchment upper and lower water sources as described in the water sharing plan



Process for securing purchased river water

The key steps in securing river water savings are:

- legally transferring total unregulated river licence entitlements purchased
- determining the average contribution to environmental water.

Legally transferring total unregulated river licence entitlements purchased

Licensed river water users have individual licences with a specified volumetric entitlement or share of water while potable water users are connected to Sydney's water supply and do not have individual entitlements. Therefore, in the case of river water savings, it is possible to account for river water purchased through individual activities by transferring the entitlement purchased under licence to the Water Administration Ministerial Corporation and reducing the individual licence entitlement accordingly.

In total, the Hawkesbury–Nepean River Recovery Program purchased 8232 million litres of river water. This comprised 4912 million litres obtained through licence purchase and 3320 million litres through entitlement reductions as part of the Water Smart Farms Project river water-use efficiency activities. The water was transferred to water access licences and is held by the Water Administration Ministerial Corporation.

Determining the average contribution to environmental water

Of the 8232 million litres legally transferred under licence to the Water Administration Ministerial Corporation as environmental water, an average of 7041 million litres per year of secured water savings will contribute to environmental water.

For licence purchase activities, the amount of environmental water created is less than the total entitlement secured because the entitlements purchased are generally not fully activated, meaning licence holders do not take their full entitlement volume every year. This is because the level of activation is dependent on farm development and cropping practices, climatic and soil moisture conditions and availability of flows, including those coming from the dams, downstream tributaries and sewage treatment plants.

Therefore, the real reduction estimates associated with the purchased entitlements are based on the historical level of activation of the unregulated river access licences.

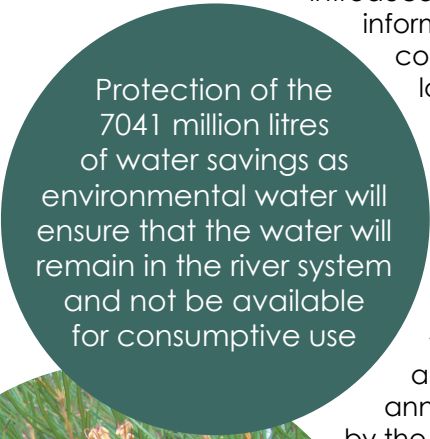
Estimating this level of activation is a complex exercise. Prior to this project and before the implementation of broad-scale meters for licensed river users, historical activation levels were based on a broad-scale surveying process undertaken as part of converting the land-based entitlements to volumetric entitlements. The water sharing plan, introduced during the project, used the information from the volumetric conversion process to establish long-term average annual extraction limits which prevent water use from exceeding current entitlement levels.

Therefore, the formula to convert the purchased entitlements to environmental water savings involved applying a ratio of the long-term average annual extraction limit divided by the sum of the unregulated river licence entitlements. This rule did not apply to the Water Smart Farms on-ground works activities for increased river water-use efficiency as savings were from active water users.

For this program, protection of the 7041 million litres of water savings as environmental water will ensure that the water will remain in the river system and not be available for consumptive use. The water savings are protected at a regional level via the implementation of long-term average annual extraction limits in accordance with the requirements of the water sharing plan. An adaptive environmental water plan is currently under development for the management of the river water savings that will contribute to environmental flows.

Geographic location of river water purchases

Table A4 shows the locations of the river water purchased through the Licence Purchase and Water Smart Farms projects according to the water sources described in the water sharing plan.



Protection of the 7041 million litres of water savings as environmental water will ensure that the water will remain in the river system and not be available for consumptive use

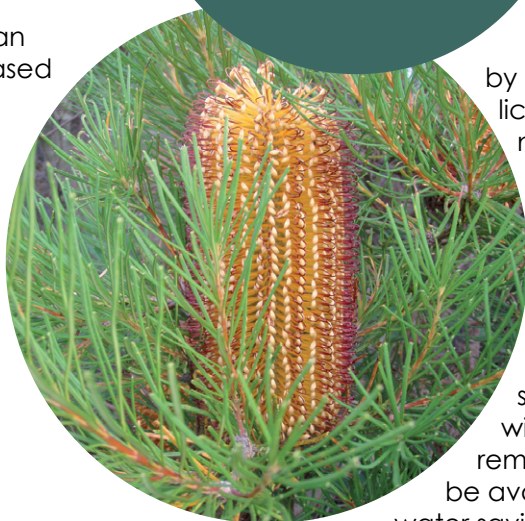




Table A4
Purchased river water by project and location

Water source*	Project			Total unregulated river licence entitlement purchased (million litres)	Geographical representation (%)
	Licence Purchase Project (million litres)	Water Smart Farms Project – licence purchases (million litres)	Water Smart Farms Project – water-use efficiency (million litres)		
Upper Water Source	1035	0	256	1291	15.7
Lower Water Source	2623	1254	3064	6941	84.3
Total	3658	1254	3320	8232	

*As defined in the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011

Of the river water purchased and transferred under licence, 15.7 per cent was from the Upper Water Source and 84.3 per cent was from the Lower Water Source. The Hawkesbury–Nepean catchment water sources are illustrated in Figure 6.

The 8232 million litres of unregulated river licence entitlement purchased represents approximately 7.7 per cent of total available licence shares, excluding major utilities such as Sydney's major water suppliers (e.g. the Sydney Catchment Authority) which are managed and metered under separate licensing arrangements. Given that the water savings are geographically spread, the overall cumulative benefit will result in more water left in the river which will improve its health.

Process for securing potable water savings

Potable water savings from the Hawkesbury–Nepean River Recovery Program, made through effluent reuse and improved water-use efficiency, will contribute to additional environmental water in the Hawkesbury–Nepean river system and increase Sydney's water supply security.

As previously stated, potable water users do not have individual entitlements that can be legally reduced as they are connected to Sydney's water supply. Therefore, the potable savings are based on calculated savings associated with the on-ground works projects and water-efficiency training given to irrigators. The realisation of the estimated potable savings will be reliant on continued optimal operation of the works and practices over time.

Program participants, such as landholders and local councils, will be motivated to maintain the potable water savings, not only by their contractual obligations to do so, but by the water bill reductions associated with water efficiency. Therefore, the mechanisms to account for and protect the savings will vary according to the purpose of the saving.

Potable water savings for additional environmental water

As shown in Figure 7, an estimated 1452 million litres of potable water will be saved per year through increased water-use efficiency or treated reuse. Of this total, 1190 million litres per year (81.9 per cent) will be achieved through the Irrigation and Landscape Efficiency and South Windsor Effluent Reuse Scheme projects (comprising 1090 and 100 million litres respectively). Both projects have met their water savings objectives with the Irrigation and Landscape Efficiency Project exceeding its objective by 2.8 per cent.

The estimated 1190 million litres of potable water savings per year achieved for additional environmental water will be protected under the water sharing plan. Savings made through these two projects will be protected as environmental water by establishing, in the water sharing plan, a proportion of fixed environmental water releases from St Marys Water Recycling Plant. The potable water savings will be protected by increasing the environmental flow protection rule in the water sharing plan by 3.3 million litres per day (to 1190 million litres per year) for the Nepean River.



Potable water savings for increasing Sydney's water supply security

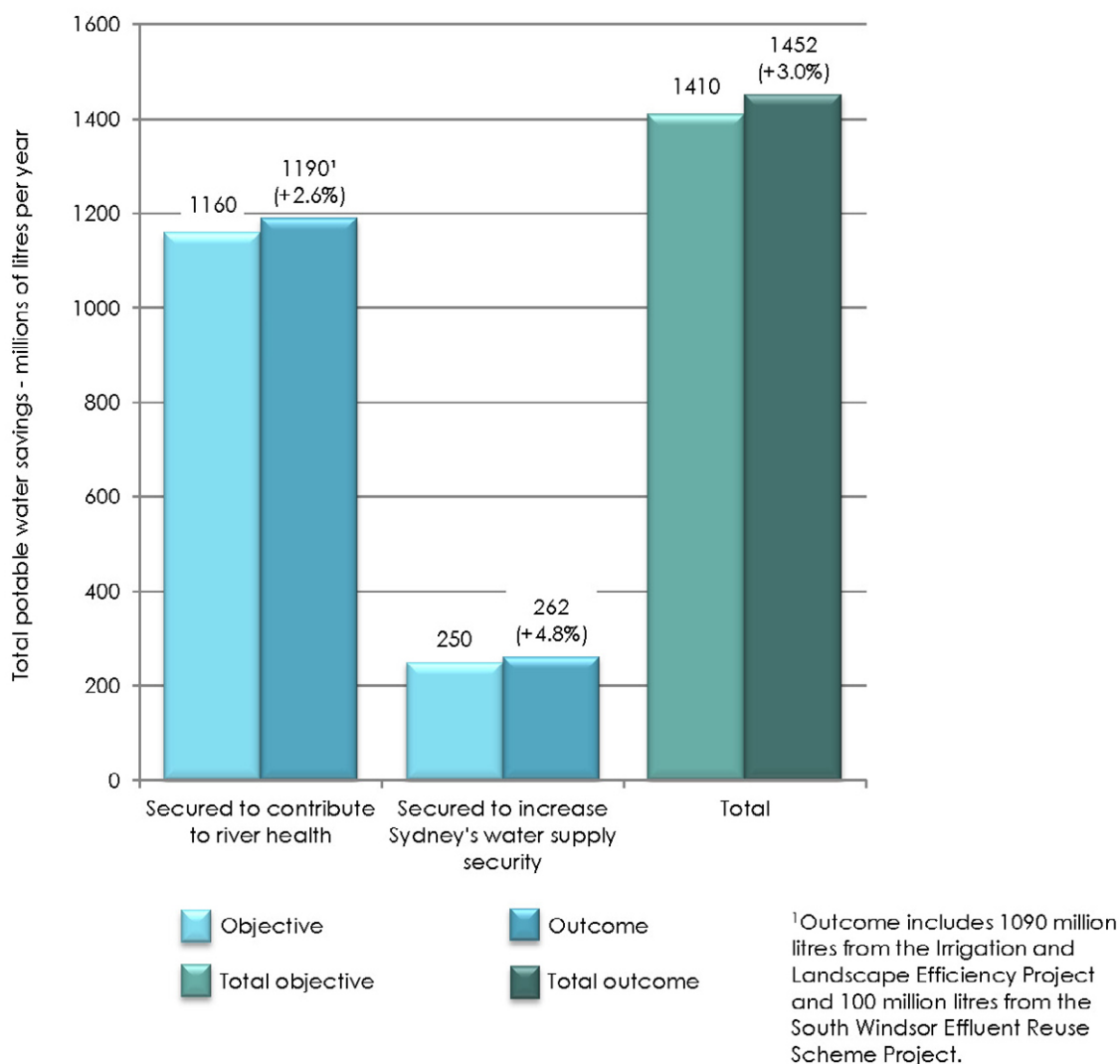
The original potable water savings objective for increasing Sydney's water supply security through reducing demand and increasing reliability of available water (funded by the NSW Climate Change Fund) anticipated savings of up to 1500 million litres per year. However, it was realised during the program that this was not an achievable objective. After consultation with the funding bodies, the objective was revised to 250 million litres per year. It was also agreed that the remainder of the original 1500 million litre objective could be achieved by purchasing unregulated river licence entitlements.

As shown in Figure 7, the program achieved 262 million litres of potable water savings for increasing Sydney's water supply security, exceeding the revised objective by 12 million litres or 4.8 per cent.

In the case of the 262 million litres of potable water savings funded under the NSW Climate Change Fund, the total savings volume will be added to the Sydney Catchment Authority's long-term average annual extraction limit. This will be accounted for as part of the management of the water sharing plan. These potable savings will also be accounted for as contributing to Sydney's water supply as part of the ongoing review of the Metropolitan Water Plan, the overarching plan responsible for securing water through recycling and water-use efficiency for greater Sydney.

In summary, 81.9 per cent of the 1452 million litres per year of total potable water savings will contribute to additional environmental water and 18.1 per cent will contribute to increasing Sydney's water supply security.

Figure 7. Hawkesbury–Nepean River Recovery Program potable water savings





Complying with national standards for securing and accounting for water savings

While achieving the overall water savings objectives, the program was also required to comply with relevant national and state standards for securing and accounting for water, specifically ensuring:

- saved/recovered adaptive environmental water is registered and monitored according to National Water Initiative environmental water accounting principles
- that information and data from the program are freely and openly available to the Australian Government for management by the Australian Bureau of Meteorology consistent with the National Plan for Water Security, which is now covered by the *Commonwealth Water Act 2007*
- the collection, management and dissemination of water information and data meets the nationally agreed standards and protocols, as these standards and protocols are developed by the Bureau of Meteorology.

As required under the National Water Initiative, the Office of Water has established an environmental water register of all water purchases to provide accessible information for water users and the general public. The register holds reports on water committed to the environment. An annual review of environmental water use and shares will be reported by the Office of Water in accordance with water accounting reporting under the water sharing plan. The public registers and the water accounting framework currently in place are consistent with the National Water Initiative intergovernmental agreement for a standardised approach to water resource accounting and information management.

Additionally, the Office of Water regularly reports on the state's water use to the Bureau of Meteorology as part of its business requirements. The Improving Hawkesbury–Nepean Water Balance Accounting Project has enabled the collection of more reliable, real-time water-use data for the Hawkesbury–Nepean catchment which will also be provided to the Bureau of Meteorology.

The Bureau of Meteorology developed the exposure draft of the Australian Water Accounting Standards to define the structure for a general-purpose water accounting report. The Office of Water is progressing with the development of general-purpose water accounting reports and continues to contribute to the delivery of the National Water Account in accordance with the nationally agreed standards and protocols, as these standards and protocols are developed by the Bureau of Meteorology.

The Office of Water installed 799 electro-magnetic water meters with telemetry equipment for licensed river water users in the Hawkesbury–Nepean catchment. The meters installed now cover 97 per cent of the active licensed entitlements for unregulated river access licences in the catchment, excluding major utilities such as Sydney's major water suppliers (e.g. the Sydney Catchment Authority) as they are managed and metered under separate licensing arrangements.

The meters comply with the NSW Interim Water Meter Standards and the Australian Technical Standard 4747. Metering systems provide the data to ensure transparent recording, management, compliance and reporting of water extraction in the Hawkesbury–Nepean river system under licensing and water sharing plan requirements. This information is now more individualised and more freely available, giving the irrigating community more confidence in the benefits of water reform. A virtual private network was implemented to reduce long-term operational costs and provide more security for diagnostic data transfers. More detailed information about the Improving Hawkesbury–Nepean Water Balance Accounting Project can be found on pages 38-55 of this report.

Conclusion

Overall, the Hawkesbury–Nepean River Recovery Program achieved an estimated 12,433 million litres per year of secured and unsecured water savings and water to remain with irrigators, exceeding the objective of 11,590 million litres by 7.3 per cent.

The program secured 8,493 million litres of water savings per year, exceeding the secured water savings objective by 17.3 per cent. Of the secured water savings, 82.9 per cent were achieved through the purchase and legal transfer of river water and will contribute to additional environmental flows. The remaining 17.1 per cent were achieved through potable water savings, of which 1 190 million litres will contribute to additional environmental flows and 262 million litres will contribute to increasing Sydney's water supply security.

The annual review of environmental water use and shares will be reported by the Office of Water in accordance with water accounting reporting under the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011. The water accounting framework currently in place is consistent with the National Water Initiative intergovernmental agreement and the Office of Water regularly reports on the state's water use to the Australian Bureau of Meteorology as part of its business requirements.

Reducing nutrient exports to the river system

Evaluation of Hawkesbury–Nepean River Recovery Program nutrient savings

The following section identifies the reductions in nutrient exports to the Hawkesbury–Nepean river system achieved by the Hawkesbury–Nepean River Recovery Program. As indicated in Table A5, nutrient export reduction objectives were adopted for five of the program's seven projects, with the majority of the expected reductions being achieved by the Water Smart Farms and Nutrient Smart Management projects. Collectively, the projects aimed to reduce nutrient exports to the river system by at least 48.2 tonnes per year (40.9 tonnes of nitrogen and 7.3 tonnes of phosphorus).



Collectively, the projects aimed to reduce nutrient exports to the river system by at least 48.2 tonnes per year

Table A5 Nutrient reduction objectives for each project of the Hawkesbury–Nepean River Recovery Program		
Project	Nutrient reduction objective (tonnes per year)	
	Total nitrogen	Total phosphorus
Improving Hawkesbury–Nepean Water Balance Accounting	1.4	0.1
Licence Purchase	0.3	0
Water Smart Farms	11.8	1.2
Nutrient Smart Management	27	6
Nutrient Export Monitoring	0	0
Irrigation and Landscape Efficiency	0	0
South Windsor Effluent Reuse Scheme	0.4	0
Overall program	40.9	7.3
Total	48.2	

The following sections summarise the work undertaken and nutrient reductions achieved by each of the five contributing projects, and the rationale for the evaluation of those reductions.

Improving Hawkesbury–Nepean Water Balance Accounting

The Improving Hawkesbury–Nepean Water Balance Accounting Project was expected to reduce nutrient exports to the Hawkesbury–Nepean river system by approximately 1.4 tonnes of total nitrogen and 0.1 tonnes of total phosphorus per year. These nutrient reduction estimates were based on the understanding that over irrigation on farms results in nitrogen and phosphorus moving to the wider environment via run-off and leaching, and that metering would facilitate more efficient irrigation practices that would reduce such over-irrigation and consequent discharges to the environment. Specifically, the nutrient reduction objectives for this project were derived on the basis of:

- the volume of water that the project aimed to save through more efficient irrigation practices (2850 million litres per year)
- an estimate of the reduction in nitrogen and phosphorus exports discharged from the site, per million litres of water saved through more efficient irrigation
- a reduction factor of 25 per cent to account for the considerable uncertainties relating to the degree to which metering irrigation activities will reduce run-off volumes and associated nutrient exports.

The evaluation of this project's actual performance in achieving the nutrient reduction objectives relies on a similar approach but is also able to draw on actual pollutant concentrations measured in run-off from relevant agricultural land uses, as measured by the Nutrient Export Monitoring Project. As water savings have been secured through irrigation metering on a diverse range of farm types, conservative estimates of nutrient levels in farm run-off have been adopted when assessing project benefits.

The procedure for deriving nutrient discharge reduction estimates for this project is presented in Table A6. It can be seen that the nutrient objectives for this project have been easily exceeded. This high level of exceedance is the result of the adoption of highly conservative assumptions in the development of the objectives at the project inception stage.



Over irrigation on farms results in nitrogen and phosphorus moving to the wider environment via run-off and leaching

Table A6
Improving Hawkesbury–Nepean Water Balance Accounting
estimated nutrient export reductions

	Total nitrogen	Total phosphorus
Nutrient export reduction objectives (tonnes per year)	1.4	0.1
Reduction in water use resulting from improved irrigation practices (million litres per year)	2830	
Conservative estimates of nutrient concentrations in run-off from relevant agricultural land uses (milligrams per litre)	4.7	1.1
Potential nutrient export reductions (tonnes per year)	13.3	3.1
Reduction factor*	-75%	
Estimated nutrient export reductions (tonnes per year)	3.3	0.8

*The nutrient reduction factor of 75 per cent was adopted at project initiation to account for uncertainties about the relationship between improved irrigation efficiency and reductions in nutrient exports.



Licence Purchase

The Licence Purchase Project was expected to reduce nutrient exports to the Hawkesbury–Nepean river system by 0.3 tonnes of nitrogen per year. Lower nutrient export rates are expected over the long term as the market responds to reduced water availability (resulting from licence purchases) through a long-term change in land use from irrigated agricultural cropping to a less intensive (non-irrigated) form of rural or peri-urban land use.

An estimate of long-term land use changes resulting from licence purchase has been made assuming that all other influences on land use are constant. Conversion of irrigated pasture/ lucerne to dryland pasture following licence purchase is conservatively expected to reduce nitrogen by 0.001 tonne per hectare per year. The project's secured water saving of 2755 million litres per year thus equates to the conversion of approximately 460 hectares of irrigated pasture or lucerne to dryland pasture, assuming an average annual water use of 6 million litres per hectare. A conservative estimated nitrogen export reduction of 0.001 tonne per hectare per year leads to an estimated 0.46 tonnes per year of reduced nitrogen discharges from these licence purchases over the long term.

Water Smart Farms


The primary objective of the Water Smart Farms Project was to obtain water savings on irrigated farms in the Hawkesbury–Nepean catchment in order to improve Sydney's water security and increase environmental water in the Hawkesbury–Nepean river system. This project also sought to reduce nutrient-rich run-off from irrigated farms through more efficient water use and run-off capture and reuse.

An extensive and diverse range of activities was undertaken by the Water Smart Farms Project. Activities included infrastructure projects that led to water savings and, in turn, reductions in nutrient exports discharged via run-off from irrigated agriculture. These infrastructure works included:

- irrigation systems conversions and upgrades
- nutrient/water capture and reuse ponds
- soil aeration
- automated irrigation control systems
- soil moisture monitoring systems.

The performance of the Water Smart Farms Project in achieving its nutrient reduction objectives was assessed as part of the Nutrient Export Monitoring Project. This assessment was based on the selection and analysis of the four main types of nutrient mitigation measures: irrigation upgrades, leachate recycling, soil aerators and nutrient retention ponds.

A representative subset of 15 of the 95 irrigation infrastructure upgrade projects was assessed. A run-off and nutrient calculator, developed as part of the Water Smart Farms Project, was used to estimate reductions in irrigation usage, which provided a basis for estimating nutrient export reductions from each site, based on land use and area. Estimates derived for the 15 assessed sites were then extrapolated to estimate the total reductions in nutrient exports achieved through irrigation upgrades.



The Licence Purchase Project was expected to reduce nutrient exports to the Hawkesbury–Nepean river system by 0.3 tonnes of nitrogen per year



The performance of other types of nutrient reduction on-ground works projects was estimated on the basis of applicable nutrient export rates and mitigation efficiencies, in the same manner as that for the Nutrient Smart Management on-ground works projects. Nutrient export rates were determined through a combination of local field monitoring undertaken by the Nutrient Export Monitoring Project and values derived from other investigations reported in technical literature. Mitigation efficiencies were determined from a review of relevant technical literature.

The Nutrient Export Monitoring Project's assessment estimated the nutrient export reductions achieved by Water Smart Farms on-ground works projects to be 15 tonnes of nitrogen and 3.5 tonnes of phosphorus per year. As shown in Figure 8, these reductions are well in excess of the project objectives of 11.8 tonnes of nitrogen and 1.2 tonnes of phosphorus per year. Figure 9 illustrates the contribution of different types of activities and works to the total nutrient reduction achieved by the Water Smart Farms Project.

An internal project performance evaluation estimated annual nutrient export reductions achieved are 20 tonnes of nitrogen (including reductions expected through licence purchase activities) and 7.9 tonnes of phosphorus per year, higher than those determined by the Nutrient Export Monitoring Project. These differences highlight the complexity of cost-effectively evaluating the performance of diffuse source pollution control techniques. Each assessment, however, has found that the project significantly exceeded its nutrient export reduction objectives.

Figure 8. Nutrient reduction performance of the Water Smart Farms Project

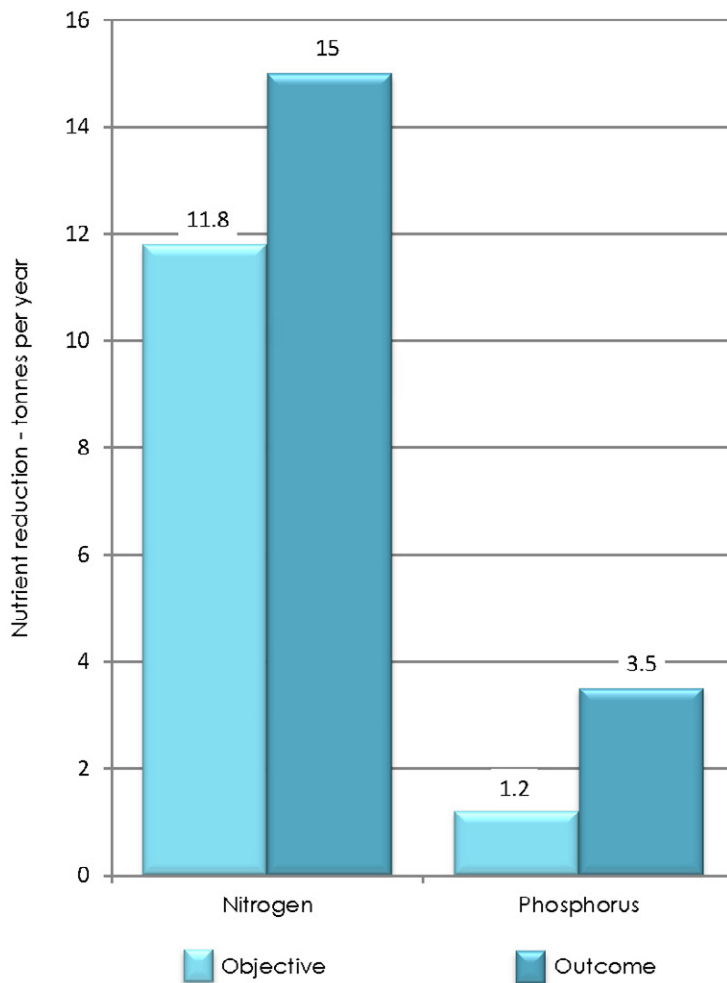
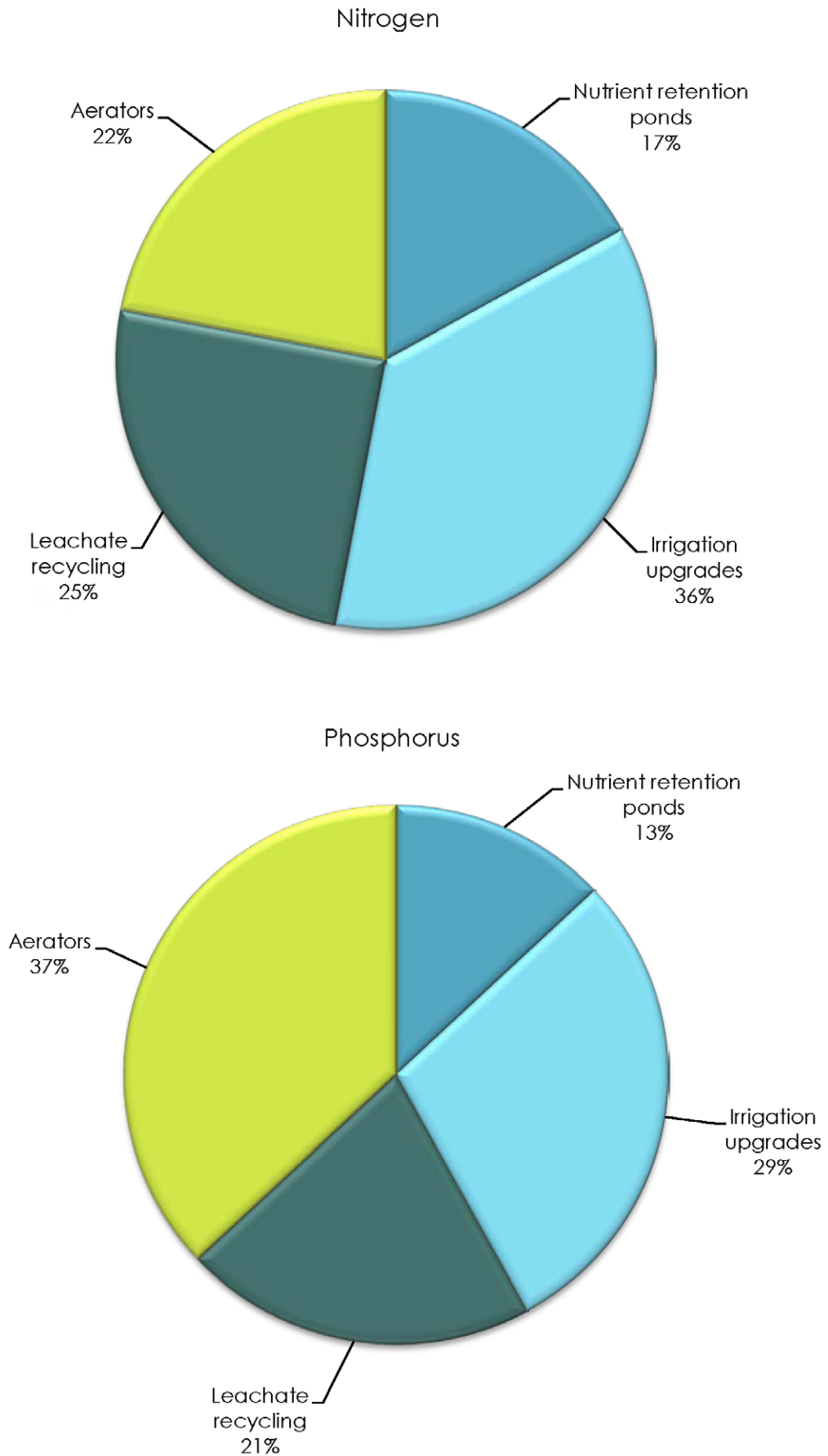




Figure 9. Proportion of nutrient reductions achieved by management activities undertaken as part of the Water Smart Farms Project





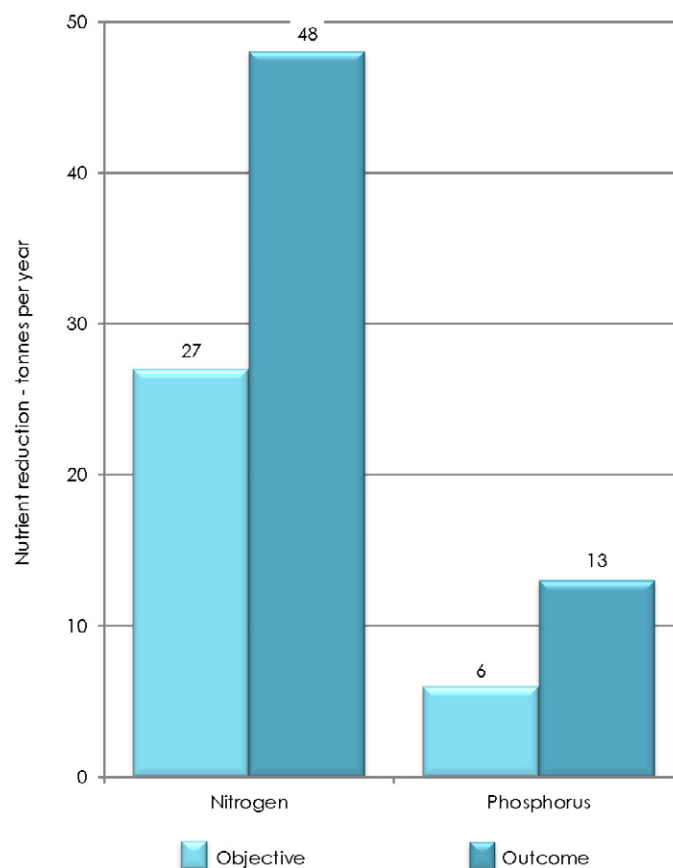
Nutrient Smart Management

A broad range of nutrient mitigation activities were undertaken on agricultural lands through the Nutrient Smart Management Project. The range of activities included:

- a. nutrient retention ponds
- b. riparian stock exclusion fencing and riparian buffers
- c. leachate and wastewater recycling
- d. compost amendments
- e. effluent and waste management
- f. mechanical soil aerators
- g. erosion control
- h. dam repairs
- i. in-stream works
- j. manure and waste stockpile management
- k. fertiliser management
- l. management of run-off from laneways and crossings.

The Nutrient Smart Management Project's nutrient export reductions were evaluated by the Nutrient Export Monitoring Project. This evaluation found that more than 48 tonnes of nitrogen and 13 tonnes of phosphorus per year will be prevented from entering the Hawkesbury–Nepean river system. As indicated in Figure 10, these reductions are well in excess of the project objectives of 27 tonnes of nitrogen and 6 tonnes of phosphorus per year.

Figure 10. Nutrient reduction performance of the Nutrient Smart Management Project



The performance of projects of types (a) to (f) were estimated on the basis of nutrient export information for each land use, and the capture or mitigation efficiencies of relevant nutrient reduction activities. Nutrient export rates were determined through a combination of reported farm management field monitoring undertaken by the Nutrient Export Monitoring Project and values derived from other investigations reported in technical literature. Mitigation efficiencies were determined from site analysis and a review of relevant technical literature.

The achievements of projects of types (g) to (j) were based on estimates of current annual nutrient losses, nutrient content analysis of soil or waste, and the estimated effectiveness of control measures. Estimates of reductions through improved fertiliser management were made on the basis of the proportional reduction in fertiliser use and the relevant land use and area of each on-ground works project.

Figure 11 illustrates the contributions of different types of activities and on-ground works to the total nutrient export reduction achieved by the Nutrient Smart Management Project. These diagrams indicate that approximately half of the nutrient reduction is secured through three categories of activities – nutrient retention ponds, leachate recycling and improved waste management at dairy farms.

The performance of the Nutrient Smart Management Project was also internally evaluated. Nutrient export reductions estimated by this self-evaluation varied for individual works or activities, with some estimates being greater and some being less than those calculated through the Nutrient Export Monitoring Project. In aggregate terms, the Nutrient Smart Management Project's evaluation yielded nutrient export reduction estimates of 76.1 tonnes of nitrogen and 17.4 tonnes of phosphorus per year, which are higher than those determined by the Nutrient Export Monitoring Project.

Again, these differences highlight the difficulty of accurately and cost-effectively evaluating the performance of diffuse source pollution control techniques. The important point is that two separate approaches to estimating the performance of the Nutrient Smart Management Project have both found that it significantly exceeded its nutrient reduction objectives.

The evaluation of the nutrient export reduction performance of specific activities undertaken by the Nutrient Smart Management and Nutrient Export Monitoring projects provides a basis to assess the relative cost-effectiveness of different types of nutrient control interventions. Figure 12 illustrates the broad range of cost-effectiveness estimated for different nutrient control activities undertaken on agricultural lands through this project. As indicated in Figure 12, cost-effectiveness has been calculated simply on the basis of the estimated nutrient reduction achieved by specific activities adopted at project sites, and the 'up-front' costs of that implementation (the Hawkesbury–Nepean River Recovery Program grant plus landholders' financial and in-kind contributions). Costs of ongoing maintenance of nutrient reduction works have not been included in this analysis.

It is evident that cost-effectiveness is influenced by both the nature of the nutrient management activity, and the land use on which it is practised. This is due to the varying nutrient exports emanating from different agricultural land uses (e.g. improved fertiliser management is much more cost effective on vegetable farms than on orchards).



A dam spillway at Wallacia was constructed under the Nutrient Smart Management Project

Figure 11. Proportion of nutrient reductions achieved by management activities undertaken as part of the Nutrient Smart Management Project

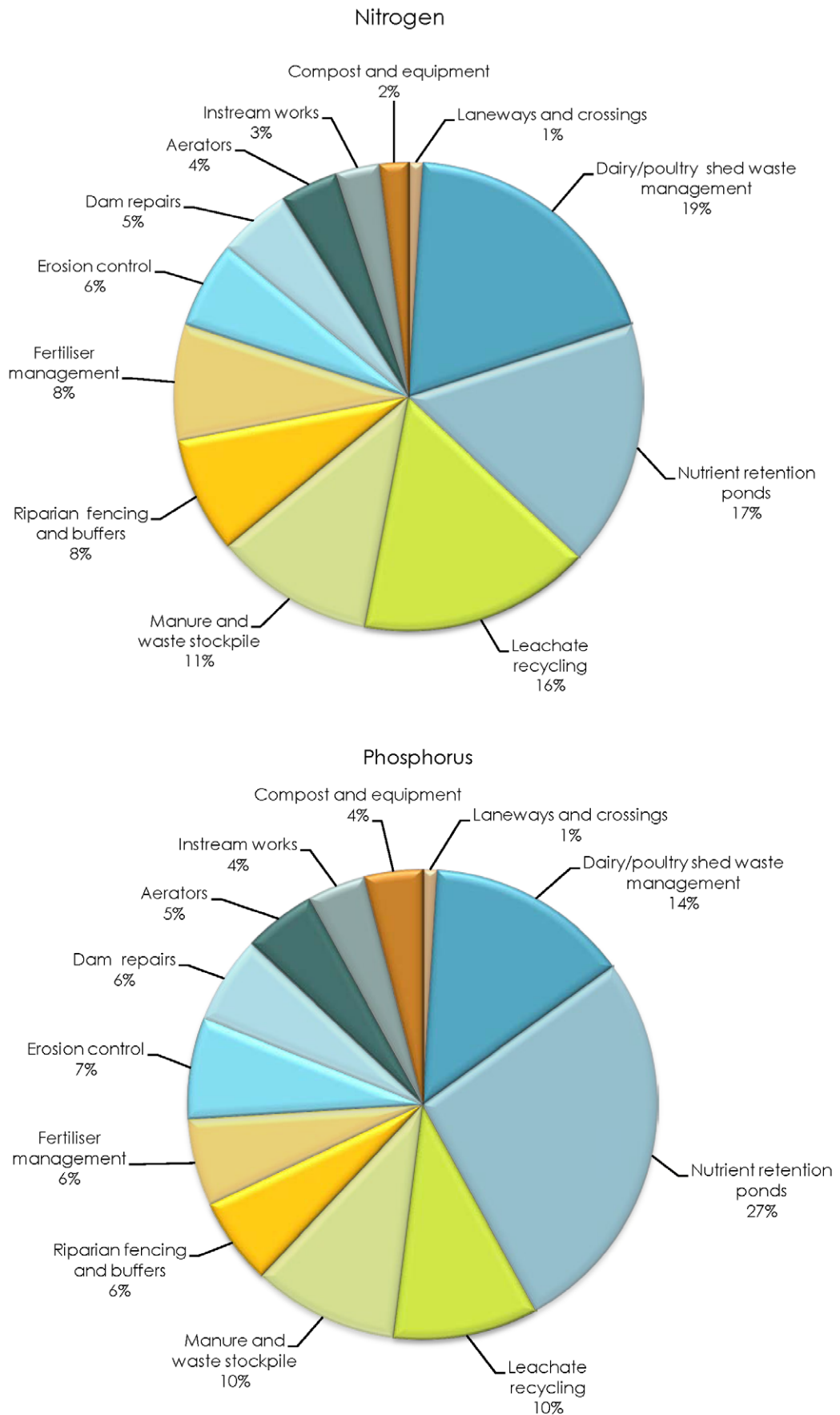
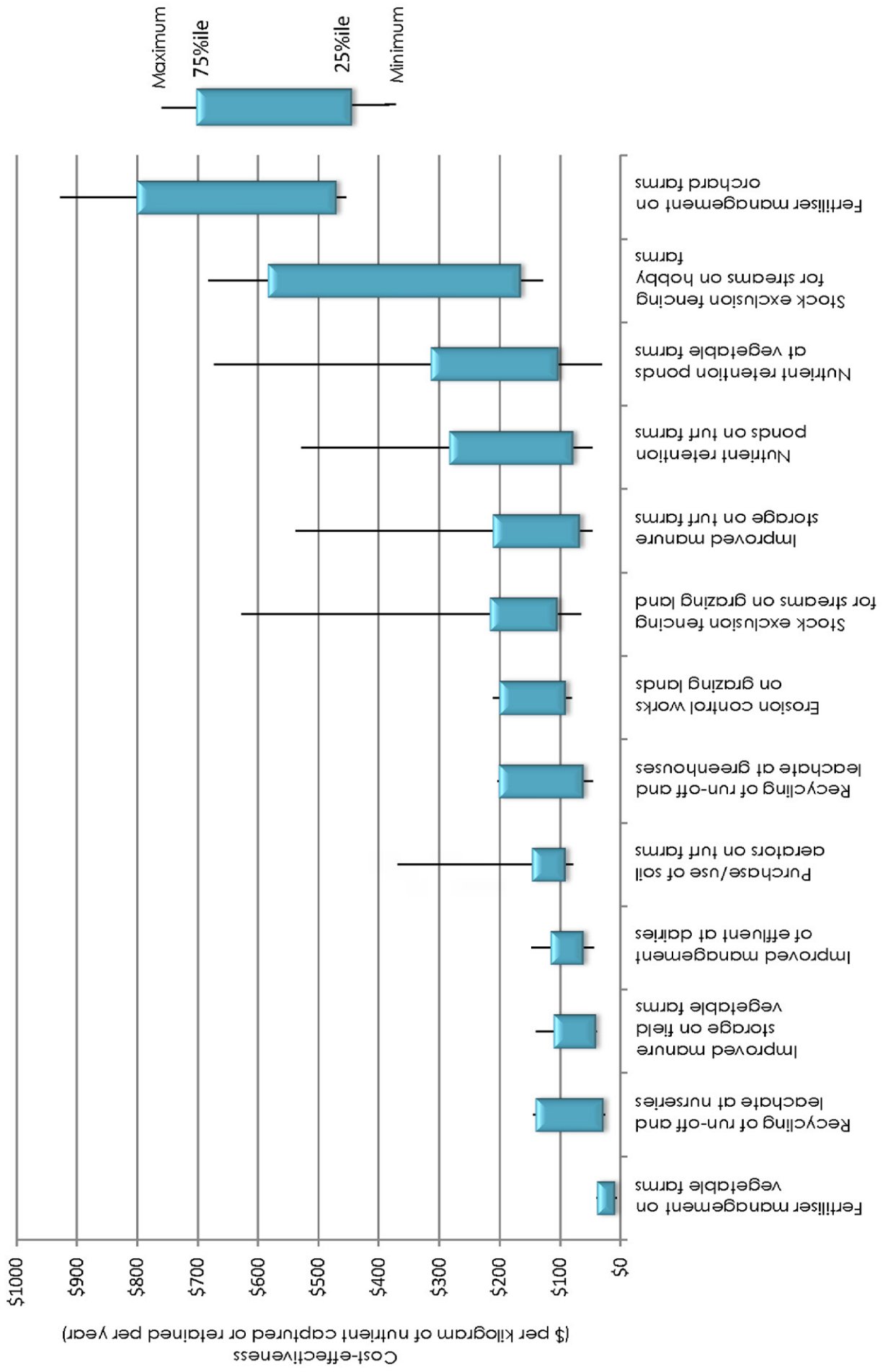


Figure 12. Relative cost-effectiveness of nutrient management activities undertaken through the Nutrient Smart Management Project



Irrigation and Landscape Efficiency

The Irrigation and Landscape Efficiency Project's primary objective was to achieve around 1060 million litres of water savings from potable water irrigation activities on park landscapes and sports fields throughout the Greater Sydney region, only a portion of which lies within the Hawkesbury–Nepean catchment.

The participating urban and park irrigation areas were widely dispersed throughout the Sydney basin and not directly connected to the river system. Therefore, while there are likely to be small nutrient reductions at locations throughout Sydney through improved irrigation and landscape efficiency practices, no significant nutrient export reductions to the Hawkesbury–Nepean river system were expected and no associated objectives were developed.

South Windsor Effluent Reuse Scheme

The South Windsor Effluent Reuse Scheme Project aimed to reduce total nitrogen exports to the Hawkesbury–Nepean river system from the South Windsor sewage treatment plant by 0.44 tonnes per year.

The objective was based on estimated nutrient savings achieved by ceasing the discharge of nutrient-rich water directly into South Creek, by treating it and using it for surface irrigation. Actual nutrient reductions achieved will be determined on the basis of the volume of water re-used and the concentration of nutrients (both nitrogen and phosphorus) measured in that treated effluent.

The effluent reuse plant was operational at the completion of the project. The project has been designed to meet the requirements of the Guidelines for Urban and Residential Use of Reclaimed Water 1993 and the Australian Guidelines for Water Recycling 2006 and operation and maintenance plans are in place to ensure ongoing compliance with those guidelines. It is assumed that with the successful completion of the project, the objective of 0.44 tonnes of nutrients per year will be met.

Conclusion

The Hawkesbury–Nepean River Recovery Program achieved nutrient export reductions of 84.1 tonnes per year, exceeding the program objective of 47.8 tonnes per year by 76 per cent.

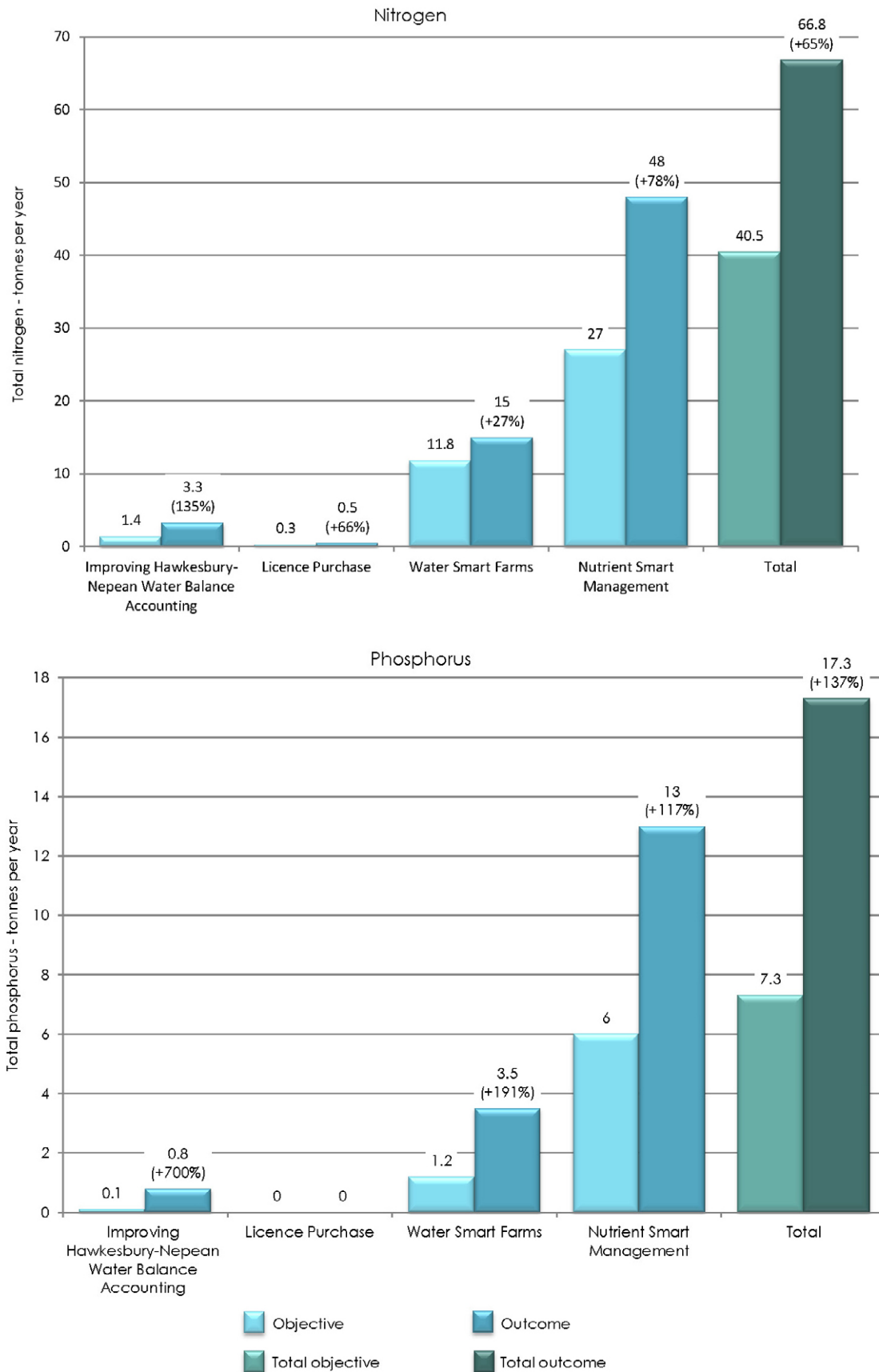
The overall success of the program in reducing nutrient exports to the Hawkesbury–Nepean river system is illustrated in Figure 13. These graphs indicate that, excluding the outcomes of the South Windsor Effluent Reuse Scheme Project for which performance data is not yet available, the combined nitrogen and phosphorus export reduction objectives have been exceeded by 65 per cent and 137 per cent respectively.

The program steering committee visiting the South Windsor Effluent Reuse Scheme Project site during construction of the storage tank, June 2011





Figure 13. Performance of the Hawkesbury–Nepean River Recovery Program in reducing nutrient loads to the Hawkesbury–Nepean river system



Note: Nutrient reductions achieved by the South Windsor Effluent Reuse Scheme Project have not yet been assessed and have therefore not been included



Stakeholder engagement

The Hawkesbury–Nepean River Recovery Program was required to achieve its water and nutrient savings by engaging with relevant state agencies, local government and landholders across the Hawkesbury–Nepean catchment.

Stakeholder engagement across the program was successful, with excellent inter-agency links and cooperation established and a high level of landholder, local government and community engagement achieved.

A cohesive network with effective and efficient communication between the individuals and organisations involved was developed. As the agency responsible for overall program management, the Office of the Hawkesbury–Nepean was fundamental in linking projects and facilitating communication and engagement across the program and acting as a broker between its projects and partner organisations.

Effective direct links were also established between the project agencies and their target audiences. For example, the Irrigation and Landscape Efficiency Project, managed by Sydney Water Corporation, had identifiable links to its participating organisations. Similarly, councils, schools, industry representative organisations and irrigation specialists were all effectively linked to their relevant project agencies.

Interagency relationships were developed during the life of the program and knowledge sharing between departments and staff was extremely beneficial. Stakeholder engagement across the projects was successful at both state agency and local government levels, with interagency links between key individuals active and reciprocated.

The projects engaged with a large and diverse range of stakeholders during the program period:

- 799 licensed water users had meters installed by the Improving Water Balance Accounting Project.
- 114 licence holders were engaged in the Licence Purchase Project.
- 3899 attendees participated in the Nutrient Smart Management, Water Smart Farms and Nutrient Export Monitoring capability-building activities.
- 23 organisations were involved with the Irrigation and Landscape Efficiency Project.
- Hawkesbury City Council engaged a large part of its community and directly benefited eight schools and sporting groups in the roll out of the South Windsor Effluent Reuse Scheme Project.

The projects were required to achieve a substantial amount of work in a short period of time. This limited the amount of time available to further engage stakeholders in the implementation of the program works. Because of this the projects that received the most positive feedback from stakeholders and had the most successful engagement were those with pre-existing relationships with their target audience. Strong relationships with and trust in the people delivering the projects positively influenced stakeholder involvement in and acceptance of the project activities. Working with stakeholders who were 'early adopters' and open to new ideas also made for a positive stakeholder experience.

The program steering committee visiting Water Smart Farms works at Westwood Farm on the Sydney University Camden Campus, September 2010



The Office of the Hawkesbury–Nepean was fundamental in facilitating communication and engagement across the program and acting as a broker between projects and partner organisations



It is evident that successful stakeholder engagement is strongly correlated with the engagement approach. For example, the Nutrient Smart Management, Water Smart Farms and Irrigation and Landscape Efficiency projects offered free on-site water and nutrient audits to stakeholders who were willing to get involved. The audits were organised by the relevant project team, but undertaken by an independent party. Stakeholders placed a high value on the results of the assessments. In the case of the Irrigation and Landscape Efficiency Project, the free independent audit process resulted in ongoing participation from almost 100 per cent of the councils involved.

In the Nutrient Smart Management and Water Smart Farms projects, financial incentives assisted stakeholder engagement and encouraged participation. As one landholder said '...it makes it a lot easier if we are getting grants and funding or have a bit of a help along with it and the improvement to just our farm practice alone with nutrient is unbelievable.' These people are now advocates for the work that has been achieved.

Projects utilised multiple forms of engagement consistent with program objectives. Each project used one-to-one contact between staff and stakeholders to some extent. The Nutrient Smart Management, Water Smart Farms, Improving Hawkesbury–Nepean Water Balance Accounting, Irrigation Landscape Efficiency and Nutrient Export Monitoring projects found this type of engagement extremely beneficial as it fostered greater trust and enabled open lines of communication with stakeholders.

A significant amount of time was spent on the telephone talking to stakeholders directly. This was particularly important for both the Improving Hawkesbury–Nepean Water Balance Accounting and Licence Purchase projects as many stakeholders required individual attention.

Another contributor to success was ensuring stakeholders from culturally and linguistically diverse backgrounds were accounted for in all communications and engagement activities. Department of Primary Industries bilingual extension officers carried out extensive effective communications for the Nutrient Smart Management and Water Smart Farms projects. They also assisted a number of other projects with one-to-one and telephone communications, as well as providing assistance with written promotional materials. The Improving Hawkesbury–Nepean Water Balance Accounting Project engaged Office of Water bilingual staff to communicate over the telephone with non-English-speaking licence holders. The project also set up a multilingual telephone line in partnership with the Licence Purchase Project.

All projects produced brochures, information sheets and webpages to communicate broadly with stakeholders. Newspaper advertisements, press coverage and direct mail-outs were also used by most projects. Of these forms of communication, direct mail-outs were considered the most successful means of engaging stakeholders as information could be targeted to key groups, including landholders from culturally and linguistically diverse backgrounds.

These specific and targeted forms of communication enabled the Hawkesbury–Nepean River Recovery Program to successfully engage relevant state agencies, local government and landholders across the Hawkesbury–Nepean catchment. The Office of the Hawkesbury–Nepean was fundamental in linking the projects and building a collaborative network to ensure the overall water and nutrient savings were achieved.

One-to-one contact between staff and stakeholders fostered greater trust and enabled open lines of communication with stakeholders



AWARDS AND ACCOLADES

The program's achievements were formally recognised when it was named winner of the government category at the 2012 savewater! awards® and winner of the program innovation category at the 2012 Australian Water Association NSW Branch Awards.

The savewater! awards® are considered Australia's leading awards for water sustainability. The 2012 awards received 1000 entries from 54 countries with winners chosen by an independent judging panel consisting of 40 industry experts from 28 organisations around the world.

The Australian Water Association NSW Branch Awards provide the highest accolade that currently exists in the NSW water industry. The NSW awards acknowledge the best of the best in the NSW water sector as well as recognising exceptional achievements in a range of project and individual categories. Following its success at the NSW Branch awards (and as this report goes to print), the Hawkesbury–Nepean River Recovery Program has also been named a finalist in the program innovation category at the Australian Water Association National Awards, announced at the Ozwater conference in May 2013.

Initiatives developed through the program's seven projects also received esteemed recognition:

- Cameron's Nursery, who received funding through the Water Smart Farms Project, won the Business Award (small) category at the 2012 savewater! awards® and was named a finalist for the 2012 Prime Minister's Water Wise Award. The nursery designed and implemented a state-of-the-art, computer-operated water and drainage system, incorporating drip irrigation lines that release water slowly for economical absorption by plants. It also installed water-efficient sprinklers and constructed a 2.3 million litre storage tank to help capture, store and re-use irrigation run-off and rainwater from building roofs. In the 12 months to March 2012, the nursery saved 37 per cent in overall water use and 80 per cent in potable water use.
- The Nutrient Smart Management Compost Project won the Leadership Award for the most innovative recycled organics product design for a specific application at the Compost Australia national awards ceremony held in August 2011. The project spread fully subsidised compost over 252 hectares of farmland to improve soil structure and moisture retention and ultimately reduce nutrient exports to the Hawkesbury–Nepean river system.
- Strathfield Council, who received funding through the Irrigation and Landscape Efficiency Project, received a Highly Commended award in the water conservation category at the 2012 Local Government Excellence in the Environment Awards for their Hudson Park Golf Course Sustainability Project. The project implemented major upgrades, including installing revolutionary new turf expected to deliver savings of up to 12 million litres of water and \$40,000 per year.



Maree Abood, Director, (former) Office of the Hawkesbury–Nepean (centre) accepts the Australian Water Association NSW Branch Award with program management team members Nicola Cammell and Beatrice Valter (top); The 2012 savewater! award® winners (bottom)

