



Government of **Western Australia**
Department of **Water**

Water for the Future - Integrated water resource management for the Collie catchment

Final report to the Department of Sustainability,
Environment, Water, Population and Communities

Looking after all our water needs

Department of Water

October 2010

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October 2010

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ISBN 978-1-921789-32-8 (online)

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Acknowledgements

This project was supported with funding assistance from the Australian Government's Water for the Future – Water Smart Australia program.

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1 Introduction

1.1 Background

This report is one of four reports on projects funded under the Australian Government's 'Water for the Future' program (originally 'Water Smart Australia') and designed to improve our knowledge in four priority areas – the Collie catchment, the South West groundwater areas, the Pilbara and the Gngangara mound.

This report, on integrated water resource management for the Collie catchment, represents the final commitment under the Water for the Future funding deed for the Collie catchment project. It describes the work undertaken in this project and compares what was achieved to the original goals. There were five 'project activities' carried out. They are:

- post mining groundwater recovery in mined basins (including surface/groundwater interaction), consisting of:
 - integrated groundwater modelling
 - post mining groundwater recovery
 - innovative use of mine voids
- decision support system for the 'TwoRes' model
- Industry efficiency
 - industry water audit
 - options for industry
- improving river health (stream and water quality management)
- developing a communications and decision-making process

1.2 The Upper Collie surface water and groundwater areas

The Upper Collie surface water and groundwater areas– 'the Upper Collie' – are located around 200 km south of Perth, in the south-west of Western Australia. The water resources of the Upper Collie are significant. Surface water, groundwater and groundwater from mine operations below the watertable (mine dewater) are used.

The Upper Collie surface water area is within the proclaimed Collie River Irrigation District and includes the main stream of the Collie River, the Collie River south and east branches and the Bingham and Harris rivers. The Collie and Harris rivers have been dammed to create the Wellington and Harris reservoirs.

The proclaimed Collie groundwater area covers the groundwater of the Collie Coal Basin which has two distinct subareas, the Cardiff and the Premier, separated by the Stockton Ridge formation. Mine dewater will continue to be abstracted above the groundwater allocation limits within the Premier subarea for the life of the mine. The

surplus dewater is considered to be a resource is reused on an opportunity basis within the licensed entitlement. Extraction of dewater is limited to the minimum needed for safe mining, and groundwater recovery begins once mining is complete.

The area outside the Collie Coal Basin, but within the proclaimed groundwater area, has no significant water resources. Some areas of fractured rock aquifers may exist. The groundwater resources of the Wilga Basin are not included within the proclaimed Collie groundwater area, so they are not covered in this program.

The south-west of Western Australia has experienced a gradual decline in rainfall since 1975, and again since 2001. Groundwater levels have declined as a result, and there is less surface water entering water supply dams. These resources have supplied the local power industry, mining industry, public water suppliers and irrigators for many decades. Demands are increasing as new power stations and industries are proposed for the region. How we manage the modified water resource to meet new demands within the constraints of maintaining a sustainable system is increasingly challenging.

1.3 Projects in the Upper Collie surface water and groundwater areas

To return the water resource system to an environmentally sustainable level of extraction, to maximise the use of existing resources and to respond to the changing water availability, the Department of Water has initiated an integrated water resource management strategy for the Collie catchment. This has involved three major projects:

The Collie salinity recovery project was designed to improve water quality in the Wellington Reservoir and river systems by:

- understanding the source of salinity
- catchment management activities
- diversion of saline water.

The *Upper Collie water allocation plan, 2009* was developed and implemented to:

- implement the first stage of recovery of groundwater
- maximise use of marginal water quality resources by encouraging fit-for-purpose use
- increase water-use efficiency
- increase protection of wetlands and rivers from the direct effects of abstraction.

Water for the Future investment (this project) was used to improve knowledge and refine the strategies of the allocation plan so that a 'second phase Upper Collie water allocation plan' can be prepared. These strategies are:

- Manage the level of abstraction through:

- improving our understanding of the aquifers, including the connectivity between aquifers, to define the hydrogeological boundaries for consumptive pools, to set an environmentally sustainable level of extraction from consumptive pools, and to set an appropriate timeframe for periodic allocations from each consumptive pool
- developing policy and processes to ensure abstraction is at sustainable levels
- developing a better understanding of surface water systems and reservoirs
- to increase water-use efficiency by:
 - increasing the accuracy of current use data, specifically for mining activities, to inform a demand management program
 - maximising the use of fit-for-purpose resources (Wellington Reservoir)
 - reservoir release regimes
- to improve protection of wetlands and waterways from the direct effects of groundwater abstraction by:
 - improving our understanding of the status and susceptibility of wetland systems
 - improving our understanding of the cultural values of wetland systems
- to develop a communication strategy

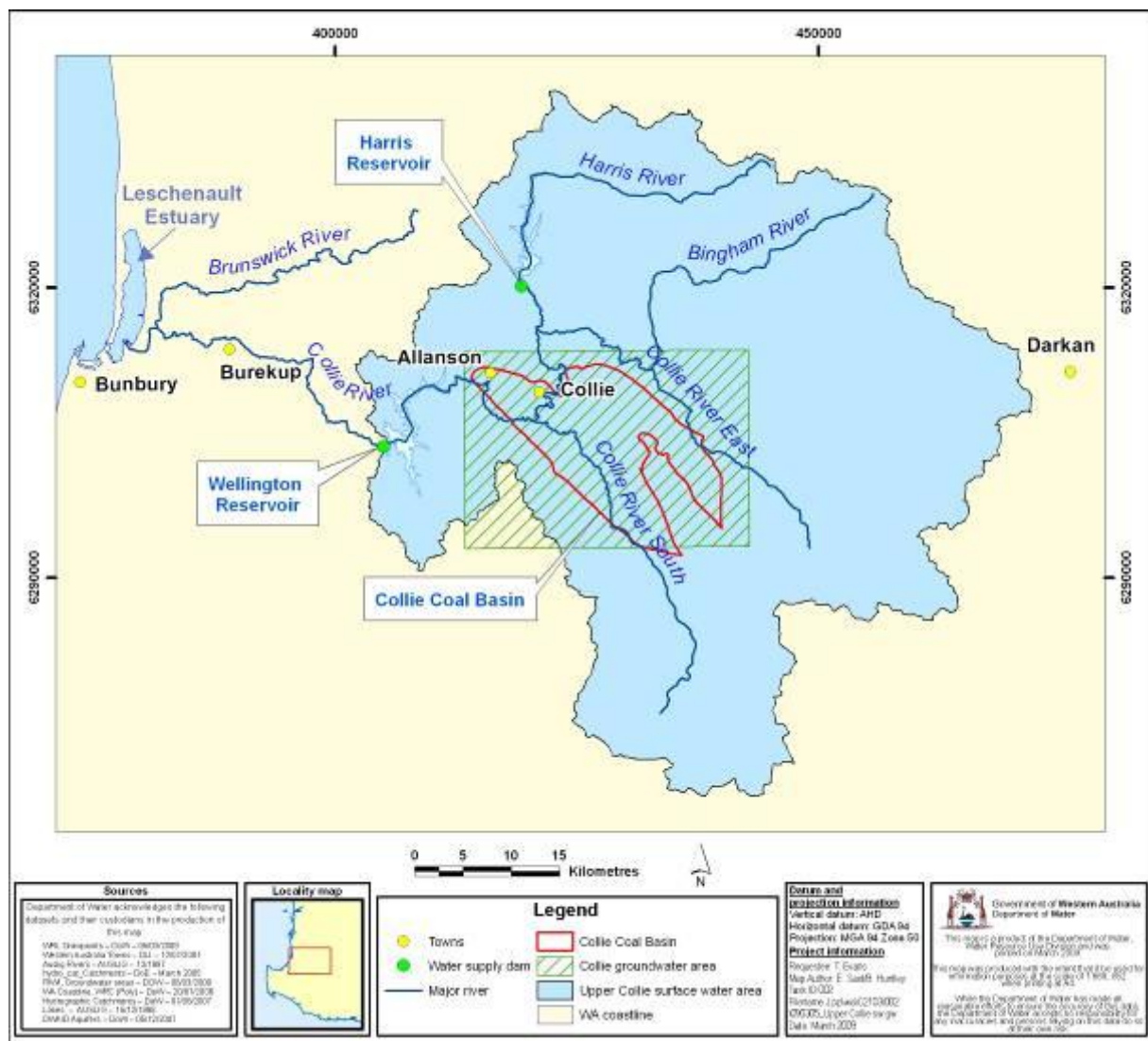


Figure 1 Location of the Upper Collie surface water and groundwater areas

2 How was the WFTF project for Collie catchment areas implemented?

2.1 Mapping WFTF milestones (Schedule A18) to WFTF project activities (A9)

The project was divided into four main components described as project activities in Schedule 9 of the deeds. Each project activity was achieved by completing specific milestones as described in schedule 18 of the deed. The deed specified agreed timelines by which each milestone had to be completed over the three year project. The table below gives details of the project activities and their related milestones.

Table 1 Mapping milestones to project activities

Project activities	Related milestones
Post mining groundwater recovery in mined basin (including surface/groundwater interaction)	<i>Milestone 1 – Post mining recovery in mined basins (including GW/ SW interaction)</i> 1.1 – Integrated groundwater modelling 1.2 – Post-mining GW recovery 1.3 – Innovative use of mine voids
Decision support system and TwoRes model	<i>Milestone 2 – Decision support and TwoRes model</i>
Industry efficiency	<i>Milestone 3 – Optimisation of water use – Study and inventory of industrial water requirements and potential to implement water efficient technologies</i> 3.1 – Complete industry water audit 3.2 – Complete alternative options for industry and water options strategy
Healthy rivers (Stream and water quality management)	<i>Milestone 4 – Healthy rivers (stream and water quality management)</i> 4.1 – Scope project and identify issues 4.2 – Involvement of local community and Indigenous people
Communication and decision making	<i>Milestone 5 – communication and decision making</i> 5.1 – Completion of Stage 1 of community involvement plan 5.2 – Completion of Stage 2 of community involvement plan

2.2 How WFTF project activities relate to the Department of Water allocation planning process

The Collie Water for the Future (WFTF) project has been part of a more comprehensive program of works for the Collie catchment, to integrate ground and surface water management for the Upper Collie and Lower Collie systems.

Over the last 3 years the WFTF project has formed the backbone of Collie work through investigations and the development of surface and groundwater models, providing a better understanding of the system, its health, functioning and values.

Each Water for the Future activity informed different stages of the planning process as shown in Figure 2. With the support of the Water for the Future the department

now has a strong foundation of information and management tools which will now allow further water reform management plans to be developed for the Collie catchment, which will improve the department's integrated approach to water resource management.

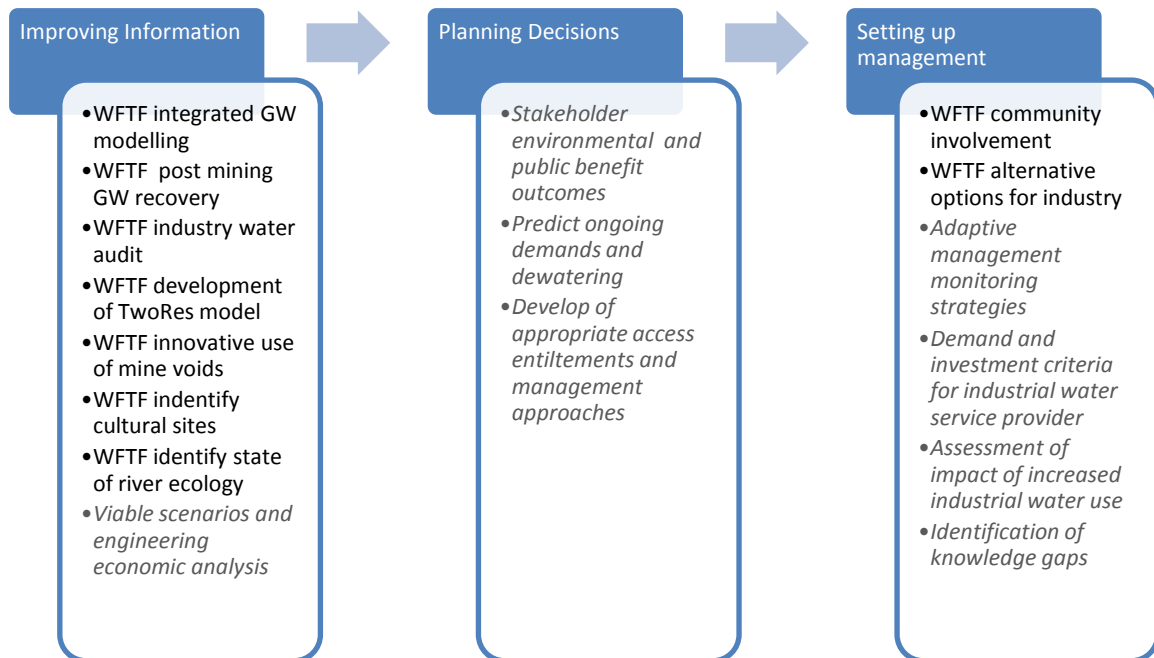


Figure 2 Mapping WFTF project activities to integrated approach to planning process

3 Statement against project activities (Schedule A9)

Activity 1: Post mining groundwater recovery in mined basins (including surface/ groundwater interaction)

Background

This project activity included:

- Integrated groundwater modelling
- Post mining groundwater recovery
- Innovate use of mine voids

The development of an integrated groundwater model has allowed better management decision making that balances the needs of water users with those of the environment. These project activities also considered the economic, social and environmental impacts of mine site dewatering and present real management solutions and case studies for use in addressing future post mining and groundwater management, including the setting of best practice standards for mine void rehabilitation and mine void management.

Work conducted and products developed

Milestone 1 – Post mining groundwater recovery in mined basins (including surface/groundwater interaction)

Milestone 1.1 - Integrated groundwater model

Since the late 1990s a 3-D finite difference groundwater model had been used in the Collie basin for the allocation process. This model took into account the interaction of the river pools and recovery of the Cardiff sub-basin. The model had a number of limitations and assumptions that need to be addressed to enable more precise management of the resource. These included:

- a lack of data relating to water level and deep stratigraphy, particularly in the Premier sub-basin
- incomplete historic abstraction database and water level database
- the shape, pool dimensions and conductance of the south and east branch of the Collie River was estimated
- insufficient recharge processes through the Nakina formation
- river stage input was an estimate

- steep hydraulic gradients induced by large abstraction were not represented in the model.

WFTF funds were used to develop a viable conceptual hydrogeological model of the subregion, outlining important aquifers, quantifying aquifer parameters, a water balance with respect to abstraction, recharge and changes in water levels using the most up to date data. The intent of the modelling work was to serve as a groundwater resource tool by performing the following tasks:

- Advance the understanding of groundwater flows in the Collie Basin.
- Quantify the relative impacts of various abstraction layouts and scenarios.
- Understand the possible effects on groundwater resulting from changed rainfall patterns due to climate changes.

The model was developed using the finite element groundwater modelling package FEFLOW, developed by DHI-WASY. FEFLOW is the industry standard finite element modelling package for flow, mass and heat transport in porous media. This modelling environment was selected because it had these features:

- the ability to represent steeply dipping strata
- spatial delineation of complex geometries
- localised mesh refinement
- ability to present faulting
- powerful surface flux interface (recharge/ET)

A series of predictive scenarios were run to determine the likely future groundwater response to assumed stresses. A total of four predictive scenarios were run as follows:

- Current levels of abstraction continued into the future with historic climate.
- Increased extractions up to currently licensed rates continued into the future.
- Increased extractions corresponding to increased groundwater allocations in the future.
- Current levels of abstraction with an assumed 5% decrease in future rainfall.
- Current levels of abstraction with an assumed 10% decrease in future rainfall.

Milestone 1.2 - Post-mining groundwater recovery

This milestone focuses on the implications of groundwater level recovery in areas where mining has ceased.

Underground and open cut coal mining has taken place in the Collie Basin since 1898. Until the mid 1990s coal mining was predominantly in the Cardiff sub-basin. In

1997 mining in the Cardiff sub-basin ceased and since then mining has taken place in the Premier sub-basin at the Muja, Ewington and Premier mines.

The groundwater table has been significantly altered by dewatering in mined areas as required to maintain safe mining conditions. In the Cardiff sub-basin where mining has ceased groundwater levels are recovering. This may flood underground and open cut mine voids where sulfide rich coal seams occur and has the potential to degrade water quality within the basin.

The upper Collie River flows through the Collie Coal Basin. There are numerous river pools along the east and south branches that are used by local communities for recreation and support ecological communities. Water levels in the river pools have dropped and many have been artificially supplemented with water by Verve Energy, Griffin Coal or Premier Coal. Management issues for the pools include the sustainability of supplementation in a drying climate and possible impacts on water quality due to groundwater recovery.

A robust monitoring network is critical to understanding groundwater recovery in the basin. A shallow aquifer monitoring network was established in 1998. These bores were *installed to address a lack of regional scale monitoring data in this aquifer and identify* areas of recharge and discharge. Monitoring of these bores has improved the understanding of surface water and groundwater interactions and regional and local impacts of dewatering related to mining. Deeper aquifers in the Collie Basin are numerous, variably confined and localised due to extensive faulting. Combined these factors complicate the monitoring of water levels in individual aquifers in the deeper basin sediments. Monitoring bores in these aquifers are located within and near open cut mines.

WFTF funds were used to develop a water quality sampling programme of selected Department of Water monitoring bores and to prepare a report interpreting the data and discussing results. Subsequent to this a risk assessment of changes in groundwater and surface water quality in response to underground and open cut coal mining in the Collie Basin was carried out. A strategy and methodology to sample water quality in the underground mine workings has also been prepared. A 'State of the Basin' report summarising the trends in groundwater levels and quality in major aquifers in the Collie Basin highlighting major issues and making recommendations for monitoring and management has been completed.

Milestone 1.3 - Innovative use of mine-voids

This project focuses on the management and use of pit lakes that have formed within closed mine voids within the Collie Basin. The groundwater table has been significantly altered by dewatering in mined areas. In the Cardiff sub-basin where mining has ceased groundwater levels are recovering.

There are currently a number of closed mine voids within the Collie Basin that contain water, forming pit lakes. These pit lakes have the potential to alter the groundwater balance and affect water quality. Some of these are currently used for

recreation. Others may be used in the future for public recreation or as water resources.

WFTF funds were used to:

Develop an inventory of pit lake data within the Collie Basin including void history, storage, hydrology, water quality, water source and ecology

A preliminary assessment of end-use options for each pit lake and gaps in existing data sets were determined. This task required the compilation and review of existing data sets related to pit lakes within the Collie Basin. Existing data were collected from all stakeholders including mining companies, consultants and government agencies. The data included lake history and water storage, hydrology (including degree of connection to groundwater and surface water systems), water quality, water source and ecology). A summary report addresses the major trends and issues, along with preliminary assessments of end-use options for each pit lake. Any gaps in existing data were highlighted in the report.

Conduct an assessment of the effects of pit lakes on human health

This assessment examined possible impacts of human interaction with pit lakes. A literature review captured relevant existing research and overseas experiences with the use of pit lakes and potential impacts on human health. Any existing relevant trigger values for environmental variables were included in this review. The assessment of health impacts used screening health risk assessment methods and/or an exposure studies. A summary report identifies relevant trigger values for human interactions with pit lakes as well as down-stream users of groundwater and surface water.

Develop an ongoing monitoring strategy for pit lakes and connected waters

A monitoring strategy has been designed that incorporates all measurements necessary to formulate robust management plans for pit lake resources. Detailed sampling regimes including parameters to be measured at specific temporal and spatial sampling intervals are included meeting the complex bio-geo-chemical modelling of pit lake water chemistry. The work includes a detailed justification of the monitoring strategy and an approximate cost of implementation. Data gaps that must be filled in order to complete bio-geo-chemical modelling of pit lakes were highlighted.

Develop conceptual models of individual pit lakes

Conceptual models have been drafted that incorporate pit lake hydrology (including water flow paths and water quality), ecology and possible health impacts. This study incorporates the results from groundwater flow and solute transport modelling from Milestone 1.1. The conceptual models provide the basis for bio-geo-chemical modelling of pit lake chemistry.

Undertake bio-geo-chemical modelling of pit lake water chemistry to support management decisions

This task was integrated with the groundwater flow-solute transport model prepared as part of Milestone 1.1. A range of modelling scenarios were developed enabling an assessment of end-use options for each pit lake resource.

The above studies resulted in tools that provide the strategies to better manage dewatering, groundwater recovery, use of mine voids and water quality issues.

Milestone 1 findings

The groundwater model will be used to predict the ongoing license applications and future dewatering demand.

The groundwater recovery project will be used to develop monitoring strategies for the basin particularly the river pools. Loggers have been purchased to answer the Surface water – groundwater interactions and river discharge areas. These areas are and more importantly will be areas for water contamination.

The innovative use of mine void milestone will be used to determine the water quality of mine voids if dewatering activities occur or surface water inflows are encountered. This will allow a quantitative measure of the exported waters. They will also be used for various activities both commercial and recreational.

Milestone 1 Products

Milestone number	Milestone detail	Product status	Products
1	1.1 – Integrated ground water modelling	Completed	<ul style="list-style-type: none"> Collie Basin Groundwater Modelling –, June 2010
	1.2 – Post Mining groundwater recovery	Completed	<ul style="list-style-type: none"> Collie Basin Groundwater Assessment of State of the Basin, May 2010
	1.3 – Innovative use of mine voids	Completed	<ul style="list-style-type: none"> Mine Voids Management Strategy Parts 1 to 5 (ECU)

Activity 2: Decision support system and TwoRes model

Background

This project activity has provided an innovative solution for reservoir management by coordinating the management of multiple reservoirs to optimise water use and transfer efficiency.

Work conducted and products developed

Milestone 2 – Decision support system and TwoRes model

The TwoRes model has been developed for both the Wellington and Harris reservoirs. It has the capacity to support surface water modelling as an innovative

solution by coordinating the management of multiple reservoirs to optimise water use and transfer efficiency.

The Department of Water previously operated a spreadsheet model for the Wellington Reservoir to assess the impact of catchment management options on yield reliabilities and water quality (salinity). The Excel spreadsheet model was a semi-empirical daily flow and salinity balance model which represented Wellington Reservoir as a two layer system; a dense 'salty' bottom layer and a 'fresh' surface layer. Inflows from May through to September were added to the bottom layer, while inflows from October through to April were added to the top layer. On 1 May each year, the two layers are combined to form a single fully mixed layer.

The spreadsheet model incorporated two inflow sources (Collie River inflows and local inflows), up to three draws from the reservoir (irrigation draw, Western Power draw and an additional draw) plus scour and spill releases. The model ran over the period from 1 April 1974 to 31 December 2001.

The existing spreadsheet model produced satisfactory results. However due to the processing capability limitations of Excel it was time consuming to run and there was a limit to the number of years that could be modelled in a single spreadsheet. Additionally, the Harris Reservoir system, which contributes inflows and salinity mitigation releases to Wellington Reservoir was not included in the model.

To enable longer assessment periods and the incorporation of the Harris Reservoir system, a daily time-step REALM model of the Wellington Reservoir system was developed and has replaced the existing spreadsheet. The REALM modelling platform was selected as it has the capability to model flow and salinity on a daily time-step and has been extensively used and tested on many major water resource systems across Australia.

REALM (REsource ALlocation Model) is a water supply system simulation package. It is general in that any water supply system can be configured as a network of nodes and carriers representing reservoirs, demand centres, waterways, pipes, etc. It is flexible in that it can be used as a 'what if' tool to address various options (i.e. new operating rules, physical system modifications, etc.). System changes can be quickly and easily configured and investigated.

A wide range of operating rules can be modelled either directly or indirectly by exploiting the basic set of node and carrier types and their corresponding attributes. It uses a network linear programming algorithm to optimise the water allocation within the network for each time step of the simulation period, in accordance with user-defined operating rules.

The user can specify the desired level of detail of output from the model. Output can be presented graphically, either in raw form or after post-processing using a suite of utility programs separate from the simulation model. Input and output data (ASCII) files have the same format and can easily be transferred to commercially available word processing and spreadsheet packages such as Microsoft Office to improve presentation and/or to perform more detailed statistical analyses.

The TwoRes model is a management tool that provides the department with the ability to quickly assess any future licence applications or changes in operating strategies for Wellington or Harris reservoirs. The TwoRes model is currently being used to assess the impact of increased industrial water use from Wellington Reservoir on irrigation supply.

Milestone 2 Findings

The TwoRes model is a management tool that provides the department with the ability to quickly assess any future licence applications or changes in operating strategies for Wellington or Harris reservoirs. The TwoRes model is currently being used to assess the impact of increased industrial water use from Wellington Reservoir on irrigation supply.

Milestone 2 products

Milestone number	Milestone detail	Product status	Products
2	Decision support and TwoRes model	Completed	<ul style="list-style-type: none"> Development of a daily water balance REALM Model for Wellington reservoir, Aug 2009 Wellington and Harris reservoirs, REALM Model, Mar 2010 (operating manual)

Activity 3: Industry efficiency

Background

Project activities have identified more cost effective methods of using appropriate quality water and has increased the potential to invest in innovative infrastructure in heavy industry to allow poorer quality water to be used. This in turn will lead to greater availability of good quality water for potable water supplies and higher value uses.

Work conducted and products delivered

Milestone 3 – Optimisation of water use – *study and inventory of industrial water requirements and potential to implement water efficiencies*

Milestone 3.1 - Complete industry water audit completion assessment of industrial water requirements and identification of potential new sources

Water audits Verve (MPS & CPS) and BW 1/2

The original intent of this task was to undertake water audits of key industries. Scoping for the work was commenced. This indicated there were a number of higher level factors which meant that it this task could not be completed. These include:

- The Griffin Group is in administration and this issue is not a priority for them at the moment.
- Verve Energy has a very good understanding of their water use and opportunities for efficiency gains. Verve has offered to work with the department in preparing a water efficiency strategy for power industry in preparation of the plan.
- The state is developing a strategic energy initiative which will also provide direction for water demand and efficiency in the Collie Area.

Metering and accounting review of industry and users; metering and accounting strategy

The original intent of this task was to undertake metering review of key industries and prepare a metering and accounting strategy. Scoping for the work was commenced. This indicated there were a number of higher level factors which meant that it this task could not be completed. These include:

- The state is currently developing a water accounting procedure in line with national standards. This made it difficult to define the policy require and scoping of work for this task.

Interim framework for Collie Utility

An industrial water supply utility had been mooted for the Collie area as an instrument to manage limited water supplies in response to a growing water demand. This conceptual study project considered the legal and governance framework and incentives to encourage private participation.

The initial concept of an industrial water supply utility considered the following:

- provide transparent supply arrangements which promote equity and fairness of pricing and service between competing users for industrial water
- provide a supplier to build, own and maintain assets required to access, distribute and sell water to local and regional industry

- provide a supplier who can administer an allocation or assignment of water (e.g. surface water and groundwater) to manage and preserve the consumptive pool of available water over the long term
- ensure that the highest value use of water is promoted
- provide an arrangement which enables industry to secure its water through a water service provider rather than individual agreements made with mining companies who are dewatering for the purpose of the safe mining of coal
- introduce competition into industrial water supply.

The project report provided the constraints and criteria to be considered in developing a policy framework for an industrial water service provider.

This preliminary work was used to scope a more detailed study into an industrial water service provider – the water service provider policy framework stage 1 is described in the following.

Business case for Collie salinity diversion phase B

This report and product was 50 per cent funded by WFTF. The state government contributed the other 50 per cent recognising the salinity recovery and water resource management components.

The Department of Water, and its predecessors in partnership with the Australian Government, has been working to develop sustainable salinity recovery solutions for the Collie-Wellington river basin. Considerable progress has been made, but further work is required to bring the water quality of the Wellington Reservoir back to levels that will allow the Government to meet its environmental and industry development objectives.

The benefits of the project are improved salinity in Wellington Reservoir and making available 3.7 GL of high quality water to the Collie Basin. These benefits will lead to a more sustainable irrigation industry on the Swan Coastal Plain, more sustainable water resource management, and provide fit-for-purpose water supply for new industrial development in the Collie-Bunbury region.

This project assists the South West region of Western Australia to achieve longer-term sustainable development and growth, whilst creating a strong and vibrant Bunbury-Wellington community. This is in line with state government initiatives for regional Western Australia.

This project was a study to determine the costs-benefits, the beneficiaries and to consider the business settings for continuing with state government investment in infrastructure and further consider the feasibility of an industrial water service provider. A preliminary financial analysis was also included with respect to how an industrial water supply could operate.

The Phase B business case informs and is complemented by the financial base case analysis and the water service provider policy framework.

Water service provider policy framework - options and criteria

Due to the socio-economic value of the water resources of the Upper Collie area, there is widespread stakeholder support to address salinity in Wellington Reservoir in order to improve water resources management and to produce benefits for irrigation and the environment.

There is also interest from industry, public and private, for increased water supplies to meet industrial demands in the short and long term, and to provide increased security of water supply. There is awareness by industry that there may be a shortage of water available to industry in the area in the long term. Also, new industrial developments are often highly dependent on obtaining access to secure water supplies. There is therefore significant interest by industry in industrial water supplies, whether connected with salinity reduction measures or otherwise.

Given the above policy for water allocation in the Upper Collie area, the Department of Water has been examining the concept of a water supply utility or other similar supplier arrangement. Such a supplier could have entitlements to water in the area and have the responsibility and rights to supply water to industrial customers (and possibly the Integrated Water Supply System (public drinking water) also).

The desire for such an approach is based on the concept of:

- providing transparent supply arrangements which, with appropriate regulation, promote equity and fairness of pricing and service between competing users for industrial water
- having a supplier which could build, own and maintain assets (such as pipes and pumps) required to access, distribute and sell water to local and regional industry
- having a supplier who could administer an allocation or assignment of water (e.g. surface water and groundwater) to efficiently manage and preserve the consumptive pool of available water over the long term
- ensuring that the highest value use of water is promoted
- having a supplier which would enable industry, including miners and energy companies, private and public, to secure their water through a water service provider rather than have individual agreements made with mining companies who are dewatering only for the purpose of the safe mining of coal
- taking the opportunity to introduce competition into industrial water supply.

This study considered whole of government objectives, policy, supply/demand and service delivery options.

The water service provision policy framework was delayed for several months awaiting direction from the minister regarding the independent review into salinity reduction options for Collie. Because of the primary dependency between the review and the policy framework unplanned effort has gone into considering the review and advising the minister on his response.

The policy framework will proceed within the time available in scoping the whole of government objectives, evaluating options against criteria and shortlisting the most likely options. A strategy will be developed for water service provision for Collie as an input to the review of the plan.

Detailed evaluation of likely scenarios will be carried out over the next 12 months as required.

A final report will be produced on the Water Service Provision Policy Framework (June 2010) and the final position and strategy will be developed over the next two years as the plan is developed. Detailed business evaluation may also be carried out sooner if a private sector participation (PSP) or private proposal is presented to Government before.

Financial base case for viability of future water supply

Complementary to the Phase B business case and the water service provider policy framework, feasibility and governance constraints were also tested with a business. Previous studies identified that assumptions in capital costs, operating cost and benefits were unclear as to the viability of salinity intervention infrastructure as a basis of an industrial water supply and a financial analysis was carried out recognising the more advanced stage of design, the policy framework and feedback from stakeholders.

KPMG Australia completed the business case and the Water Corporation was engaged to carry out a financial analysis to benchmark the current project work and to consider adaptability for future water supplies.

Milestone 3.2 - Complete alternative options for industry and water options

Water service provider policy framework

This work is a continuation of the initial work completed as described above. The final report covers the short listing of options, descriptions of shortlisted options, identification and description of options of water sources to meet industrial demand, evaluation of sources against criteria and the context for scenarios.

Independent review into options for Collie Basin

This report is before state Cabinet and will be released in accordance with Cabinet protocol. This was a state government initiative and was completely funded by the state government. This review informs the direction for irrigated agriculture and industrial water supplies and provides a government policy platform for water management in the Collie area. The scope of the proposal was to:

- 1 Assess the options to recover salinity in Wellington Dam and the Collie River Basin.
- 2 Assess the requirements of water quality in Wellington reservoir to ensure sustainability and viability of the Collie Irrigation district.

- 3 Assess the potential to deliver potable water from the Collie River Basin into the Integrated Water Supply Scheme.
- 4 Assess the potential for developing an industrial water supply in the Collie River basin.
- 5 Provide a cost-benefit analysis of the options and opportunities.
- 6 Make recommendations in regard to salinity recovery in the Collie River Basin.

Evaluation of air cooling - Evaluation of alternatives

The original intent of this task was to undertake an evaluation of air cooling for the energy sector, develop a policy position on air cooling and undertake an evaluation of alternatives. Scoping for the work was commenced which identified the considerable and detailed work that had been conducted by the National Water Commission.

The NWC conducted research into the water demands of the electricity industry across Australia (Managing water supply risk in the electricity industry) and Verve Energy contributed to this research. Verve has indicated that they support the conclusions of this paper and will work with the department to develop the policy settings for Western Australia. The NWC paper has done the research that this project was originally going to attempt for Western Australian settings. The scale of the energy market in the state compared to the rest of Australia is still an area of concern and is poorly defined.

In addition the state is developing a strategic energy initiative which will also provide direction for the energy sector.

Scenario evaluation

The original intent of this task was to develop scenarios for a water service provider in the Collie Basin. Scenario evaluation will be completed by the department and the final strategy will be developed as a position for the plan.

Milestone 3 Findings

Water Service Provision Policy Framework - Industrial water service provider

This work will be further developed to consider viable scenarios and engineering and economic analysis over the next two years as the position and policy is developed with the plan. Emerging drivers include existing electricity generators who are considering resource security, new industry and a revitalised/restructured irrigated agriculture industry who are all exceeding current water sources and are demanding improved or best fit-for-purpose water supplies. The new state energy initiative will further describe the future of water security and demand for alternatives in the Collie area. Demand and investment criteria for an industrial water service provider in the Collie area will be developed.

Water accounting and measurement

The department will work with industry and stakeholders once the national and Western Australian standard is finalised and consider the local accounts for Wellington Reservoir and Collie groundwater as the next generation plan is developed over the next two years.

Alternative water supplies - air cooling for power stations and new industry

A water strategy will be considered for the Collie basin once the financial position of the Griffin Group has been stabilised and the expected state energy initiative is released. The Griffin Group are currently operating two coal fired power stations with another two receiving environmental recommendation from the EPA.

At this time the findings of the NWC research have been generally accepted by Western Australia and Verve Energy has agreed to work with the department to develop a position/policy based on the NWC paper for the Collie electricity sector. Further modelling and financial analysis will be required to adapt the findings to local scale conditions and consider any carbon pollution charges and impacts on water demand. The scale constraints relate to the minimum size of air cooled generator systems and Western Australia’s supply/demand requirements for incremental electricity supply

Milestone 3 products delivered

Milestone number	Milestone detail	Product STATUS	Products
3	3.1 - Complete industry water audit completion assessment of industrial water requirements and identification of potential new sources	Completed	<ul style="list-style-type: none"> • Business case for phase B – Salinity treatment and Disposal project, Jul 2009 • Collie – Wellington salinity recovery scheme, Mar 2010 • Investigation of management framework and options for the proposed Collie water utility, Oct 2008
	3.2 - Complete alternative options for industry and water options	Completed	<ul style="list-style-type: none"> • Industrial waterservice provision for the Upper Collie area, May 2010; •

Activity 4: Healthy rivers (stream and water quality management)

Background

These project activities have identified the scope of works required on riverbanks, in terms of drainage configuration, to improve the quality of water entering the river system. Data concerning seasonal flow has been obtained which identifies the flow required to maintain desired ecosystem functions. Details of the current state of the

river ecosystems has been obtained and targeted strategies developed to improve river health.

Work conducted and products delivered

Milestone 4 – Healthy rivers (stream and water quality management)

This project seeks to reinstate ecosystem processes in degraded stream channels, in order to improve stream water quality. This will entail detailing the current state of the river ecosystems and implementing targeted strategies to improve river health.

Milestone 4.1 - Scope project and identify issues - completion of contract to identify state of river ecosystems

Two documents were produced under this Milestone:

- Upper Collie River Action Plan completed April 2010.
- *Collie River Ecological Values Assessment* report completed April 2009. This report was used as the basis for Ecological Water Requirement (EWR) reviews on several reaches of the Collie river system undertaken by the Department of Water to support the Water for the Future deliverables. Reports arising through this process include;
 - *Environmental Flow Regime for the lower Collie River* – Shenton's Elbow Reach (Draft completed April 2010)
 - *Ecological flows of the Collie River* – Wellington reach (Draft completed April 2010)
 - *Ecological flows of the Collie River* – Harris reach (Draft completed April 2010)

The above products provide a solid review of the state of existing biological and physical aspects of the riverine ecosystems and associated foreshore, including prioritisation and recommendation for restoration and management. Complementary environmental water studies define the necessary flow regimes required to support the biological values at a low level of risk.

Milestone 4.2a - Involvement of local community and Indigenous people - completion of stage 1 of identifying cultural sites of significance and identifying water requirements to meet values

Four studies were completed as part of this Milestone:

- Lower Collie River Social Values Survey completed November 2008.
- Nyungar Values of the Collie River completed March 2009.
- Brunswick River Catchment Social Values Study completed April 2010.
- Lower Collie River Water Use Survey completed April 2010.

The above documents supported existing social and cultural values assessments into social and cultural values previously undertaken by the Department of Water.

The studies provided an opportunity for the Collie River catchment community to be empowered and engaged and drive some ownership and awareness over the catchment and its values. The social and cultural values can be linked with the EWR reviews towards driving Environmental Water Provisions (EWPs) and the identification and prioritisation of sites has strong synergistic linkages with the outcomes of the River Action Plan.

Milestone 4.2b - Involvement of local community and indigenous people - completion of stage 2 of identifying cultural sites of significance and identifying water requirements to meet values

Identification and Mapping of Groundwater-Dependent Ecosystems associated with the Collie River completed April 2010.

This product further consolidates outcomes from the previous studies in both identifying ecological values and recognising the dependency of these systems on groundwater in areas where there is significant competition for groundwater resources. The outcomes display high correlation to values identified through the other project products making decision-making regarding these values more robust.

Milestone 4 Findings

The products delivered by this component have provided a consolidated review and conceptual framework around understanding the Collie River system, its:

- ecological values
- prioritisation of reaches under a value/threat assessment
- understanding of surface water flow requirements to support both ecological, as well as social and cultural values
- conceptual dependency of ecosystems on groundwater.

Implicitly, these studies have identified knowledge gaps on which further investigation can be undertaken or refined. However, the outcomes of these studies have provided tools to assist the Department of Water in developing appropriate licensing conditions and management approaches to assist in future assessments or applications, particularly for groundwater use.

The department can apply a regulatory framework approach which can support continued state development of the Collie water resources within a minimal risk approach, recognising that some refinement of the current studies may be borne by the applicant where a potential impact has been identified at the conceptual level through these studies.

Milestone 4 products

Milestone number	Milestone detail	Product status	Products
4	4.1 - Scope project and identify issues - completion of contract to identify state of river ecosystems	Completed	<ul style="list-style-type: none"> • River Action Plan for the Upper Collie Catchment, April 2010 • Collie River Ecological Values Assessment, April 2009
	4.2 - Involvement of local community and Indigenous people - completion of stage 1 of identifying cultural sites of significance and identifying water requirements to meet values	Completed	<ul style="list-style-type: none"> • Nyungar Values of the Collie River; Mar 2009 • Lower Collie River Social Values Survey, Nov 2008 • Brunswick River Catchment Social Values Survey, April 2010
	4.3 - Involvement of local community and Indigenous people - completion of Stage 2 of identifying cultural sites of significance and identifying water requirements to meet values	Completed	<ul style="list-style-type: none"> • Identification and mapping of Groundwater Dependent Ecosystems Association with the Collie River, April 2010

Activity 5: Communication and decision making

Background

This project activity has provided a transparent consultation and engagement strategy which can assist the community and water resource user's in accepting the next phase of statutory planning.

Work conducted and products delivered

Milestone 5 – Communication and decision making

Milestone 5.1 - Completion of stage 1 of community involvement plan

The Upper Collie catchment supports an environment that is highly regarded by local people for its cultural values and recreational use. It also supports two major industrial areas, and provides a substantial portion of the base load power to the south-west of Western Australia (through coal mining and coal power plants).

The area is critically important from an industry and water management view. The population and industry it supports are very politically astute. Effective engagement is crucial if long term management (such as the preparation and approval of a statutory Water Management Plan) are to be successful.

Water management is complex focusing on both water quality recovery and allocation. To realise full allocation potential requires recovery of water quality of the Wellington reservoir, mine voids, river systems. There have been significant advances in managing these aspects. Clarity in communicating this progress and the

outcomes of WFTF projects in preparation for a water reform plan in 2011/2012 is critical to gain community and key industry stakeholder support.

The major themes of the community engagement work undertaken over the course of the WFTF project were:

Gnaala Karla Booja Claimant Group / Ngalang Boodja Council

The Collie catchment is subject to a registered native title claim by the Gnaala Karla Booja claimant group (WC98/058). Most of the Collie River and its tributaries are also registered Aboriginal heritage sites under the Aboriginal Heritage Act 1972. The spiritual and cultural connections this active group has with the landscape are very strong and are maintained through the local Ngalang Boodja Council.

A major focus of our work has been to develop an understanding of the Council's concerns, their desired outcomes and to develop an effective working relationship.

Local government

Local Government will continue to be a critical stakeholder in this area. Management of local waterways is a key interest to the local government. The department is providing support to local government to assist with managing the riverine water resources.

In June 2009 the Department of Water sponsored a briefing session for people wanting more information about filling the W5H mine void as part of the salinity management projects being undertaken in the catchment. Information sharing activities have helped engender the necessary support for the project.

Community and projects

The department has been involved in many projects requiring broader community engagement. Departmental officers also maintain close ties with the community through a range of forums. Local interest groups and committees include:

- Cardiff Progress Association, who hold a close association with the Collie River South.
- Personal meetings and conversations with community members
- South West Development Commission and Lake Kepwari Assessment: This disused mine void was filled with 27 GL to create a 100 ha water recreational area. There are considerable issues to be overcome to allow the proposal to proceed. These projects cross link to Milestone 1.3 – innovative use of mine voids. As a second part of this project, the feasibility of redirecting the south branch of the Collie River back to its original (pre mining) course, through the Lake Kepwari is being investigated.
- The Collie River Revitalisation Project is another project where the department is engaged with broader community interests to progress a project to install riffles in 8 km of the Collie River through high profile areas of the Collie townsite. This project builds on a major report prepared by

Professor Peter Davies for the Shire of Collie with significant input from the Department of Water.

It is imperative to inform, motivate and enthuse key stakeholders to participate where appropriate in the management of the catchment, which includes the implementation of the Collie Salinity Recovery Program. This project was designed to ensure appropriate levels of communication to relevant stakeholders at the appropriate times in the best interests of a collective management effort.

Cross link to milestone 3 - industry efficiency

Many meetings have been undertaken as part of the deliverables for 3.1 and 3.2. This has involved both existing and new industry stakeholders and potential utility service providers.

Cross link to milestone 4

Significant meetings and stakeholder visits have been undertaken as part of the Milestone 4 deliverables particularly associated with Indigenous consultation and also river action planning. Consultants for both projects have met with groups and individuals to understand river health issues and identify solutions.

Cross link to salinity recovery

The work undertaken in the Collie catchment has considerable demonstrative value. The Department of Water frequently assists professionals from across Australia, explaining and showing the work that has been done. The department has supported at least 12 tours of the catchment have been since the WSA project began.

Milestone 5.2 - Completion of stage 2 of community involvement plan

In November 2009 a consultancy scoping document was developed with the following requirements:

- 1 Develop a comprehensive communications and community engagement strategy to guide the Department of Water's interaction with stakeholders and the broader community during the development phase of the RiWI¹/statutory management plan for the Upper Collie catchment, due for release in 2012. (Note the date was later amended to 2013)

Specific objectives were to:

- Highlight the Water Smart Australia funded projects and outcomes and how they form the foundation for the development of the next planning phase.
- Assist with the development and maintenance of positive working relationships between the department and industry, community and other

¹ Currently water resource management is guided by the Rights in Water Irrigation Act (1914). The department has been working on the introduction of new legislation, Water Resources Management Bill which will update and simplify the current, outmoded and cumbersome legislation. If the new legislation is passed statutory management plans will be introduced, if not the plan will be based on the current RiWI Act.

stakeholders, to secure widespread acceptance for the department's management of the Upper Collie catchment.

- Ensure proactive risk management response to any negative media coverage of Upper Collie specific water issues.
 - Raise community and industry awareness about the need for innovative methods to secure the long term future availability of the water resources of the catchment and the cost of doing nothing.
 - Through a variety of community engagement methods, ensure that the community, industry and other stakeholders are kept informed of the development of the RiWI/statutory management plan and that they have a voice in the long term future planning of the Upper Collie catchment.
 - Achieve positive media coverage to raise awareness of the department's broader planning framework as a facet of the department's on-going commitment to good water resource management in the region.
- 2 Develop a suite of targeted products to assist in the implementation of the strategy. e.g. brochure, posters, e-bulletin templates, branding. etc.

The communications consultancy, 'Mills Wilson' successfully tendered for the project and delivered the final *Communications and Community Engagement Strategy* and the required suite of targeted products by the end of April 2010.

Outcomes of communications strategy

The community of the Upper Collie catchment is close knit and has a long history with the mining industry with coal being discovered in the late 19th century. The Collie Basin is the only producing coalfield in Western Australia, and 80% of coal mined in Collie is used to generate about 42% of Western Australia's power. There is also a strong Indigenous community in the Collie region, being 2.9% of the total population.

Even though the Collie community is relatively small in number, it is high in involvement and complex in nature and therefore required a targeted approach specifically tailored to the stakeholder interests and outcomes sought by the department.

The key element of the strategy has provided readily accessible information for the broader community and stakeholders to ensure their support and participation as the department continues to work towards the development of a management plan for the catchment. It provides a balanced level of engagement and has the capacity to engage the community in a meaningful and effective manner that can result in a positive outcome for all participants.

Milestone 5 Findings

The products of this milestone have provided a sound foundation for future community engagement as the department develops the second stage of planning for the Upper Collie catchment. It also enables a smooth integration of the outcomes

of all the milestones to be communicated in a cohesive and user friendly manner to not only the Collie community but the broader community of Western Australia.

The next step is to build on this work to improve allocation planning and associated management regime under new legislation. Through the allocation planning process, work under the Water for the Future project will ultimately lead to more sustainable water use, improved environmental outcomes and greater water security for the community and industry stakeholders in the Collie catchment.

Milestone 5 products

Milestone number	Milestone detail	Product status	Products
5	5.1 - Completion of Stage 1 of community involvement plan	Completed	<ul style="list-style-type: none"> Completion for Stage 1 community involvement, Nov 2009- summary report
	5.2 - Completion of Stage 2 of community involvement plan	Completed	<ul style="list-style-type: none"> Communications and community engagement strategy – Integrated water resources management for Upper Collie catchment, Apr 2010

4 Statement against project objectives (Schedule A7)

OBJECTIVE A

To accelerate the development and implementation of a statutory management plan for the water resources of the Collie River Catchment in line with NWI timelines

(see Milestones 1 – 5)

(Objectives A and I provide a planning approach to water allocation management)

This objective has been approached in two stages.

The first stage was: Departmental funding (matching funding) for this project has been used to develop, release and implement the Upper Collie water allocation plan (surface water and groundwater).

The allocation plan, released in July 2009, controls individual water licences (entitlements) issued under the legislation. Management objectives in the plan are to protect security of supply, ensure efficient water use, issue water only up to the allocation limit, achieve highest value use and to increase accountability. Resource objectives set in the plan are to recover over-abstracted resources, maintain health of river pools and align allocation management with water quality targets. This allocation plan forms the basis for the transition to the second phase, statutory management plans. An annual evaluation statement is being prepared to evaluate performance against the plan for its first year of operation.

The second stage was to use Water for the Future funding to address specific water resource management knowledge, policy and mechanisms to enable transition to water reform plans further to enabling legislation.

Water for the Future funded projects have increased the information on the water resource and considered options for transition to reform mechanisms to improve management and develop policy. This has enabled more precise management to achieve the intent of the reform agenda for the Collie catchment. Section 3 above summarises the implications for water resource management of each milestone and deliverable. Section 6 summarises the findings from the work.

OBJECTIVE B

To provide a robust foundation to guide and facilitate the development of innovative approaches to water management

(See Milestone 3)

Power generation, irrigation and public water supplies are competing for the surface and groundwater resources of the Collie catchment. Water for the Future funding has allowed investigations to be made into the use of mine void water sources and

the establishment of a water utility to make best use of dewater and brackish sources, and so reduce demand for freshwater abstraction.

In particular, the funding has allowed faster progress to be made on:

- a policy position for a water service provider for Collie
- a water efficiency strategy for industry
- a water supply strategy for future industry development
- a policy position on priority use of water and alternative options.

The policy position for a water service provider is directly transferable to the rest of the state and will be fundamental to how the department and state consider water options in the future.

OBJECTIVE C

To improve community understanding and management adoption through social marketing and collaboration

(See Milestone 5)

The development, release and implementation of the Upper Collie water allocation plan (surface water and groundwater) in 2009 are providing a strong foundation for understanding of the state of the Collie water resources. Industry and local government in particular recognise the need for change and more effective water management in the future, including collaborative use and reuse of ground and surface water sources. Newspaper articles regularly quote these on the issue of water management.

We developed a communication strategy and communication tools by completing Milestone 5 of this project. The strategy outlines the outcomes of other milestones and the implications for future water management.

OBJECTIVE D

To improve groundwater management through enhanced dynamic groundwater management and early identification of post mining recovery options

(See Milestone 1)

Pit lakes (mine voids) have the potential to alter the groundwater balance and affect water quality. Some of these are currently used for recreation and others may have the potential for future recreation or as a water resource. WFTF funds have been used to update and refine a groundwater model for the catchment and highlight risks associated with post- mining groundwater recovery. A database of pit lake resources has been completed which addresses water levels, water quality, ecology and potential end uses. These tools provide the strategies to better manage mine voids in the future. Conceptual and numerical models, where suitable data is available, have been developed.

OBJECTIVE E

To increase efficiency of water use through quantifying industry demands and identifying potential risk management strategies for resource protection

(See Milestone 3)

The Upper Collie water allocation plan 2009 controls individual water licences (entitlements) issued under the legislation. Licence conditions are being revised to ensure optimised efficient water use. WFTF funds have accelerated this process through the development of an inventory of industrial water requirements and identifying potential water efficient technologies. Salinity recovery options for Wellington Reservoir are being explored to maximise water use options and resource protection.

OBJECTIVE F

To optimise the performance of major surface water reservoirs in the catchment

(See Milestone 2)

A new two-reservoir daily water balance model has been completed. This model simulates the combined operation of the Harris and Wellington reservoirs. The TwoRes model is a management tool that provides the department with the ability to quickly assess any future licence applications or changes in operating strategies for Wellington or Harris reservoirs. The TwoRes model is currently being used to assess the impact of increased industrial water use from Wellington Reservoir on irrigation supply.

OBJECTIVE G

To maximise the efficiency of the supply of water for industrial and irrigation use

(See Milestone 3)

WFTF funds have been used to review industry and irrigation water quality requirements. This has been combined with a review of state, national and internal best practice in achieving water efficiency in the power and irrigation industries. Efficiency strategies have been developed for each industry, including measurable targets and milestones.

OBJECTIVE H

To improve water quality in degraded stream channels and drains

(See Milestone 4)

Significant work has been completed to identify the health and functioning of waterways in the catchment. River action plans have been completed for the Upper Collie River. This has involved stakeholder consultation (Indigenous and non-

Indigenous), mapping of the foreshores and recommendations for management. The department is continuing to work with the Collie Weed Management Group and the Leschenault Catchment Council to facilitate future on ground works.

OBJECTIVE I

To return over-allocated water resources to sustainable levels

(see Milestones 1 – 5)

(Objectives 1 and 9 provide a planning approach to water allocation management)

The Upper Collie Water Allocation plan, released July 2009, sets new, reduced, allocation limits aimed at recovering groundwater to sustainable levels of use post mining. The allocation limit, supported by water access and use policies drives optimisation of water for consumptive using, including fit for purpose use in order to make best use of dewater and brackish sources, and so reduce demand for freshwater abstraction. The plan is now used to guide decision making on new industrial development in the Collie Basin to ensure water objectives are complemented. Water licences (entitlements) have been reviewed on a priority basis and license conditions rationalised to meet NWI requirements for metering.

5 Findings and management implications

The Water for the Future integrated water resource management for the Collie catchment project has significantly improved the quality of information that will underpin the next water allocation plan. The detailed investigation and assessment of the surface and groundwater areas has led to a higher level of understanding of how the total system works and how it responds to abstraction and stresses.

When the project began there were significant gaps in our knowledge and understanding of how the groundwater system functioned, how it responded to abstraction and recharge and how ground and surface water systems interacted.

The coal, irrigation and power industries had expressed concerns about the amount of water that could be safely abstracted, particularly in relation to climate change. The community was concerned that the department had set its allocation limits using information collected by the Water Corporation in support of its proposal 45 GL abstraction proposal. Fundamentally the community questioned the independence of the information and its accuracy.

Through this project and the expenditure of Water for the Future funds we have:

- upgraded the groundwater models
- developed tools to assess and manage the risks and water assets associated with mine voids
- developed a TwoRes model for managing our reservoirs
- developed a 'Collie service provider policy framework'
- undertaken river surveys
- undertaken social and cultural values surveys.

The three most significant findings and management implications from this project are:

- Salinity recovery and mine void management are part of the solution to meet future water needs in the Collie catchment
- Industry needs to work together to collectively secure their water needs for future expansion
- The community and industry have increased confidence in our allocation planning decisions due to better data, models and a greater understanding of our environmental, social and cultural values.

The results of the Water for the Future project will ultimately lead, through the allocation planning process, to more sustainable water use and improved environmental outcomes.

The Department of Water milestones aligned with the WFTF milestones for the updated Collie allocation plan are shown in Figure 2. Please refer to section 2 of this report.

Appendices

Appendix A – List of products completed through the project

Milestone No.	Milestones details	Products
1	Post mining Groundwater recovery in mined basins (including GW & SW interactions) <i>Integrated groundwater modelling</i>	1 Collie Basin Groundwater model, June 2010
1.2	<i>Post mining Groundwater recovery</i>	1 Collie Basin Groundwater Assessment State of the Basin, May 2010
1.3	<i>Innovative use of mine voids</i>	<ul style="list-style-type: none"> 1 Mine voids Management Strategy (I) – Pit Lake Resources of the Collie Basin; 2 Mine voids Management Strategy (II) – Review of potential health risks associated with Collie pit lakes; 3 Mine voids Management Strategy (III) – A monitoring strategy for pit Lakes and Connected Waters; 4 Mine Voids Management Strategy (IV) - Conceptual Models of Collie Basin Pit Lakes 5 Mine Voids Management Strategy (V) – Water quality modelling of Collie Basin Pit Lakes
2	Decision Support and Two Res Model	<ul style="list-style-type: none"> 1 Development of a daily water balance REALM Model for Wellington reservoir, Aug 2009 2 Wellington and Harris reservoirs REALM Model -Operating manual, Mar 2010
3	Optimising of water use Study and inventory of industrial water requirements and potential to implement water efficient technologies <i>Complete industry water audit</i>	<ul style="list-style-type: none"> 1 Business Case for Phase B – Salinity treatment and Disposal project, July 2009 2 Collie – Wellington Salinity recovery scheme, Mar 2010 3 Investigation of management framework and options for the proposed collie water utility, Oct 2008
3.2	<i>Complete alternative options for industry and water options strategy</i>	1 Industrial water service provision for the Upper Collie area, May 2010
4	Healthy rivers (stream and water quality management) <i>Scope of project and identification of issues</i>	<ul style="list-style-type: none"> 1 River Action Plan for the Upper Collie Catchment, April 2010 2 Collie River Ecological Values and Assessment , April 2009

Milestone No.	Milestones details	Products
4.2	<i>Involvement of local community and Indigenous people</i>	<ol style="list-style-type: none"> 1 Nyungar values of the Collie River; 2 Lower Collie River Social Values Survey, Mar 2009 3 Brunswick River Catchment Social Values Survey, Apr 2010 4 Identification and mapping of groundwater dependent ecosystems associated with the Collie River, Apr 2010
5	Communications and decision making	<ol style="list-style-type: none"> 1 Completion of stage 1 community involvement, Nov 2009 2 Communications and community engagement strategy – Integrated water resources management for Upper Collie catchment, Apr 2010

Appendix B – List of products submitted as evidence for completion of May10 milestones

Milestone No.	Milestones details	Products delivered
1.1	<i>Integrated groundwater modelling</i> Completion of Collie model upgrade and scenario runs	1 Collie Basin Groundwater modelling, June 2010
1.2 1.2 a 1.2b	<i>Post mining Groundwater recovery</i> Complete project scope and identify issues Agree monitoring and recovery strategy	1 Collie Basin Groundwater Assessment State of the Basin, May 2010
1.3 1.3a 1.3b	<i>Innovative use of mine voids</i> Complete inventory of mine voids Compete mine void management strategy	1 Mine voids Management Strategy (I) – Pit Lake Resources of the Collie Basin 2 Mine voids Management Strategy (II) – Review of potential health risks associated with Collie pit lakes 3 Mine voids Management Strategy (III) – A monitoring strategy for pit Lakes and Connected Waters 4 Mine Voids Management Strategy (IV) - Conceptual Models of Collie Basin Pit Lakes 5 Mine Voids Management Strategy (V) – Water quality modelling of Collie Basin Pit Lakes
2	Decision Support and Two Res Model Completion of preliminary work into decision support tool	1 Wellington and Harris reservoirs REALM Model, Mar 2010 - Operating manual ²
3 3.1	<i>Complete industry water audit</i> Completion assessment of industrial water requirements and identification of potential new sources.	1 Business case study for phase B – Salinity treatment and Disposal project, Jul 2009 2 Collie – Wellington Salinity recovery scheme, Mar 2010 3 Investigation of management framework and options for the proposed Collie water utility, Oct 2008
3.2	<i>Complete alternative options for industry and water options strategy</i>	1 Industrial water service provision for the Upper Collie area, May 2010
4.1	<i>Scope of project and identification of issues</i> Completion of contract to identify state of river ecosystems	1 River Action Plan for the Upper Collie Catchment; April 2010 2 Collie River Ecological Values and Assessment, April 2009

² This milestone was completed in November 2009. This document was included as supporting material provided in November 2009.

Milestone No.	Milestones details	Products delivered
<p>4.2 4.2a</p>	<p><i>Involvement of local community and Indigenous people</i> Completion of Stage 1 of identifying cultural sites of significance and identifying water requirement to meet values</p>	<p>1 Nyungar values of the Collie River, Mar 2009 2 Lower Collie River Social Values Survey, Nov 2008 3 Brunswick River Catchment Social Values Survey, Apr 2010</p>
<p>4.2b</p>	<p>Completion of Stage 2 of identifying cultural sites of significance and identifying water requirements to meet values</p>	<p>1 Identification and mapping of groundwater dependent ecosystems associated with the Collie River, Apr 2010</p>
<p>5.2</p>	<p>Communications and decision making – completion of Stage 2 of community involvement plan</p>	<p>1 Communication and community engagement strategy; Integrated water resources management for Upper Collie catchment, April 2010</p>