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Muswellbrook Shire Council

Integrated Water Cycle Management Strategy Plan

September 2007

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Executive Summary

This report documents the development of the Muswellbrook Shire Council (MSC) Integrated Water Cycle Management (IWCM) Strategy by MSC. This report has been developed in line with the NSW Department of Water and Energy (DWE, formerly the Department of Energy, Utilities and Sustainability, DEUS) *IWCM Guidelines* (2004). It identifies the process in which the preferred scenario for the future management of urban water services in MSC was chosen and provides guidance for its implementation.

Scenario Building Approach and Data

A range of management options was developed to address the catchment, water resource and urban issues identified by the IWCM Concept Study through the review of background studies and stakeholder consultation. In addition, a series of potential management options were investigated through a series of desktop studies, including a demand analysis and a review of alternative water sources such as stormwater harvesting and effluent reuse.

This process eliminated any potential management options which would not be technically feasible for MSC given the prevailing characteristics and issues.

Once the most feasible options for MSC were identified, complementary options were bundled together to form five scenarios. Each of these scenarios considered water supply, sewerage and stormwater aspects of MSC operations. Detailed capital works programs for each of the scenarios were prepared.

Triple Bottom Line Assessment of Scenarios

A set of assessment criteria was developed in order to assess the ability of each scenario to address the identified issues. The criteria developed allowed each scenario to be ranked based on environmental, social and economic aspects i.e. a triple bottom line (TBL) assessment.

The Preferred Scenario

Each scenario was presented to the Project Reference Group (PRG) and a preferred scenario was identified for implementation. The preferred scenario is summarised in the table below.

Table S-1: Preferred Scenario

No.	IWCM Issue	Strategy	Preferred Scenario
1	The water supply and sewerage systems do not have sufficient capacity to service present needs and growth and are not expected to meet future licence conditions. The use of water resources within the shire is also inefficient due to high unaccounted for water, poor demand management and limited use of alternative water sources to minimise town water use.	Demand Management (Shire-wide)	Pricing, WELS, BASIX, UFW, residential audits, education (WSP 2).
		Water sensitive urban design - self-sufficient water supply (shire-wide)	None.
		Stormwater harvesting	Encourage individual developers/ industry to implement stormwater harvesting.
		Muswellbrook (MBK) WTP upgrade	WTP upgrade to 18.2 ML/d. Quality improvement through treatment process as in 12.
		Additional reservoir	No additional storage required.
		Sewer upgrade	Pumping stations and new trunk mains to fully service growth in East and North Muswellbrook.
		MBK STP upgrade	Secondary treatment (capacity 16,500 EP).

No.	IWCM Issue	Strategy	Preferred Scenario
		Denman (DEN) STP	New plant, secondary treatment (capacity 2,500 EP).
		Sandy Hollow (SH) sewerage system	Provide sewerage to SH and municipal effluent reuse (secondary treatment, capacity 150 EP).
2	There is insufficient renewals planning and investment that may cause operational issues, breach of DECC licence conditions and community service level expectations	Renewals planning	Development of condition based asset management plan.
		Renewals investment	Renewal of mains, reticulation, pumps, reservoirs and bores to meet licence requirement and condition based asset management plan.
3	Effluent reuse must be sustainable within the context of overall government and community strategic directions	Effluent management (MBK)	Continue existing mine reuse and golf course reuse until most beneficial reuse option is determined through an effluent management strategy.
		Effluent management (DEN)	Continue existing golf course reuse until most beneficial reuse option is determined through an effluent management strategy.
		Effluent management (SH)	Municipal effluent reuse with provision of reticulated sewerage.
4	Lack of resources to implement plans	Human Resources Provision	Additional resources required for each new project/program proposed are included in the cost of the respective project/program.
5	Lack of education and assistance for demand management measures may result in increased risk of unsuccessful programs	Education	Education program included in demand management (as in 1).
6	Need to ensure long term water supply security and allocation from Hunter River through appropriate provisions in the Water Sharing Plan	Liaison with CMA and DWE	Liaison with CMA, DWE to ensure water supply is secure through Water Sharing Plan.
7	Denman river extraction limited by existing infrastructure	DEN River extraction	Construction of river intake.
8	Poor water supply quality (turbidity and hardness) at Denman	DEN WTP upgrade	New WTP (with future capacity increase)
9	Increase in per capita outdoor water use due to lower occupancy ratios	Development control planning	Taken into account in MSC provided growth projections.
10	Unknown security and saline supply at Sandy Hollow	Security of supply	No change.
		SH WTP upgrade	Upgrade WTP with pressure filter and softening.
11	Lack of groundwater protection protocol for Sandy Hollow	Well protection	Prepare groundwater management plan, monitoring program and well head protection.

No.	IWCM Issue	Strategy	Preferred Scenario
12	Lack of comprehensive algal management protocol	Management plan	Develop comprehensive algal management plan.
		MBK and DEN water treatment	Inclusion of PAC for quality improvement at MBK and membrane filter and softening at DEN.
13	Water supply and environmentally sound sewage treatment processes at risk due to inadequate risk identification and emergency response strategy for water and sewer infrastructure	Contingency plan	Develop comprehensive water supply contingency plan (including human resources and flood impact).
14	Need to improve septic systems management	On site systems	Education program for better on-site septic system management and regular auditing (including increasing licensing of systems).
		Best-practice onsite management systems compliance	New systems to comply with best-practice on-site sewer effluent management policy.
		Sewer new growth (SH)	Provision of reticulated sewerage.
		Sewer new growth (DEN)	Provide sewer service to DEN new growth and core area growth.
		Sewer new growth (MBK)	Provide sewer to MBK new growth and core area growth.
15	Poor catchment management practices, urban stormwater, effluent discharges, over-extraction and salinity have affected water quality in rivers	SMP	Implement Stormwater Management Plan (and update when required) and impose levy.
		Catchment initiative	Implement State of the Environment Report and support CMA to implement catchment initiatives.
		Trade waste plan	Trade waste officer to review, manage and implement trade waste policy.
		Stormwater harvesting	As in 1
		Demand Management	As in 1
		Effluent management	As in 1
16	Insufficient fluoridation to meet NSW Health guidelines	Fluoridation	Meet NSW heath guidelines.

Implementation and Monitoring

Monitoring is an essential part of the IWCM process to ensure that the management strategies which have been identified as part of this study have been successful at addressing the water cycle issues. In addition to this, it is important that any new or changes in severity of individual issues are documented and appropriate changes made to the Strategy document, capital works program and financial plan.

It is recommended that this document be reviewed in 2012 and every fives years afterwards on an ongoing basis.

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Appendices

Glossary

BASIX	A web-based design tool that ensures each new residential dwelling design meets the NSW Government's targets of up to 40% reduction in water consumption and a 25% reduction in greenhouse gas emissions, compared with the average home (Department of Planning, 2006).
Best-practice	An industry standard recognising the most effective management methods of the time.
Capital expenditure	The initial cost of constructing infrastructure assets.
Capital works program	A schedule of planned capital expenditure, normally over a period of thirty years for water supply and sewerage businesses.
Catchment	The area of land drained by a river and its tributaries.
FINMOD	NSW Financial Modelling software package developed by the NSW Government for local water utilities.
Groundwater	Underground water filling the voids in rocks; water in the zone of saturation in the earth's crust. See also aquifer.
Local water utility (LWU)	The water supply and sewerage businesses of a local Council.
Nutrients	A source of nourishment. However, for water quality, it indicates nitrogen and phosphorous.
Potable water	Water that based on current knowledge is safe to drink over a lifetime; that is, it constitutes no significant risk to health.
Rainwater tank (RWT)	Storage tank for collecting rainwater from the roofs of buildings.
Reuse	The use of treated sewage effluent or treated stormwater to replace the use of potable water. Taking water from a waste (effluent) stream or stormwater captured and purified to a level suitable for further use.
Scenarios	Scenarios are a combination of beneficial options used to solve the IWCM issues. The scenarios have the following structure: • A "base" case (also known as "business as usual") which does not include any solutions beyond what MSC is already doing to improve or maintain the water supply and sewerage businesses; • A "traditional" case based on traditional solutions that solve issues in an isolated, non-integrated way; and • Three "integrated" solutions that incorporate combinations of various build and non-build options and an increasing level of integration of water supply, sewerage and stormwater management by including recycled water use and stormwater harvesting, among other options.
Sewage	The used water supply of a community including water-carried waste matter from homes and businesses.
Sewage treatment plant (STP)	A facility to treat sewage to produce treated effluent and biosolids.
Sewerage	Drainage system for taking sewage away from the community to a sewage treatment plant.
Stormwater	Rain that flows over hard surfaces in urban areas and is collected in drainage systems for disposal.

Surface water	Water on the surface of the land, for example in rivers, creeks, lakes and dams.
Typical residential bill (TRB)	The annual bill paid by a residential customer that is not a pensioner or the owner of a vacant block.
Wastewater	See sewage.
Water demand	The water needs of a town including homes, businesses and public organisations.
Water quality	The biological, chemical and physical properties of water.
Water supply	The available water sources, water extraction, storage, transfer and treatment systems to supply town water.
Water treatment plant (WTP)	A facility to treat raw water to a potable water quality.

List of Abbreviations

AD	Average day (demand)
ADWG	Australian Drinking Water Guidelines
B	Base Case Scenario
BIN	Binalong
BOW	Bowning
BPM	Best-Practice Management
CAP	Catchment Action Plan
CMA	Catchment Management Authority
DEC	Former Department of Environment and Conservation, NSW (now DECC)
DECC	NSW Department of Environment and Climate Change
DEUS	Former Department of Energy, Utilities and Sustainability, NSW (now DWE)
DNR	Former Department of Natural Resources, NSW (now part of DWE)
DPI	Department of Primary Industries, NSW
DSS	Decision Support System – DWE computer modelling software for forecasting water demand
DWE	NSW Department of Water and Energy
EP	Equivalent Person
EPA	Former Environment Protection Authority, NSW (now part of DECC)
FINMOD	Financial Modelling software, see also Glossary
GUN	Gundaroo
ICLEI	International Council for Local Environmental Initiatives
IN1, 2, 3	Integrated Scenarios 1, 2, 3
IWCM	Integrated Water Cycle Management
kL	Kilolitre
L	Litre
LGA	Local Government Area
LWU	Local Water Utility
LOS	Level of Service
mg	milligrams
mm	millimetre
ML	megalitre
MBU	Murrumbateman
MSC	Muswellbrook Shire Council
PD	Peak day (demand)

POEO	*Protection of the Environment Operations Act 1997*, NSW
PRG	Project Reference Group
SBP	Strategic Business Plan
SWM Plan	Stormwater Management Plan
STP	Sewage Treatment Plant
SoE	State of the Environment (Report)
T	Traditional Scenario
TBL	Triple Bottom Line
TDS	Total Dissolved Solids
UFW	Unaccounted for Water
WQO	Water Quality Objectives
WSP	Water Savings Program
WTP	Water Treatment Plant

1 Introduction

This report documents the development of the Muswellbrook Shire Council (MSC) Integrated Water Cycle Management (IWCM) Strategy by MSC in line with the NSW Department of Water and Energy (DWE, formerly the Department of Energy, Utilities and Sustainability, DEUS) *IWCM Guidelines* (2004). This report identifies the process in which the preferred scenario for the future management of urban water services was chosen and provides guidance for its implementation.

1.1 The IWCM Process

MSC is continually planning its water, sewerage and stormwater business activities. MSC is committed to developing an IWCM plan for Muswellbrook Shire.

IWCM aims to maximise the benefit derived from available water resources through the efficient and appropriate management of urban water services (water supply, sewerage and stormwater). It also encourages the evaluation of opportunities to minimise the impact of the urban water services on the available water resources through the identification and assessment of potential management solutions (scenarios) to address a range of catchment, water resource and urban issues.

An IWCM Strategy Plan considers issues such as:

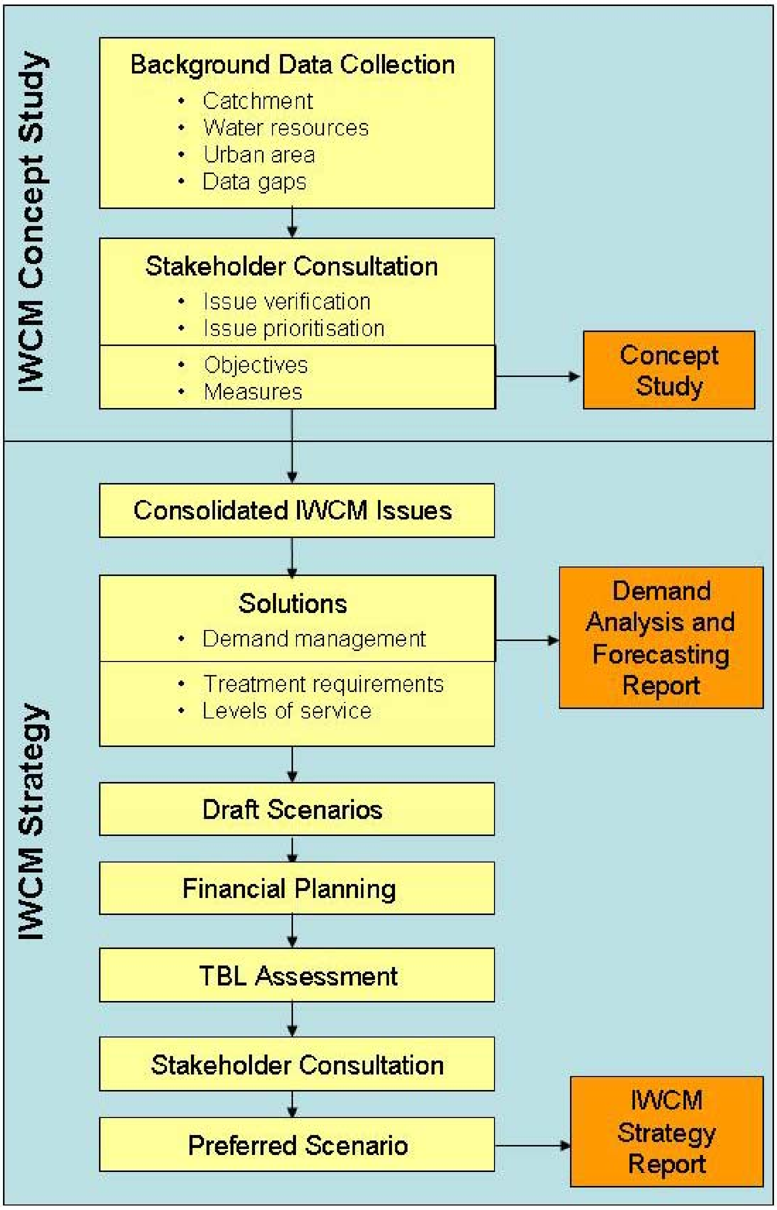
- The future urban water service needs and customer expectations;
- The availability of water including water sources such as rainwater, effluent and stormwater; and
- The impact of town water use on other water users including the environment and future generations.

In 2004, DWE published guidelines to assist LWUs in implementing IWCM, as part of their best-practice approach to LWU strategic planning. These guidelines set out a three step process for developing an IWCM plan:

- **A concept study**: an initial scoping study from which a project brief for a strategy can be developed. During this study, urban, water resource and catchment related water cycle management issues are identified by stakeholders;
- **A strategy**: to assess the ability of proposed urban water management actions to address the issues identified in the concept study. The assessment is made against economic, social and environmental criteria to formulate the most beneficial actions into a long-term business plan;
- **An implementation phase:** to put the strategy plan into place, assess the success of the plan in relation to managing the identified issues over time and revise the plan accordingly.

The IWCM process followed by MSC is illustrated in the following figure and each of these steps is discussed in further detail in the following sections.

Figure 1-1: IWCM Process



1.1.1 IWCM Concept Study

The MSC IWCM Concept Study is attached in Appendix A. This study identified catchment, water resource and urban water cycle management issues relevant to the management and operation of MSC water supply and sewerage businesses. These issues and potential solutions were identified through a stakeholder consultation program and the review of background information.

1.1.2 IWCM Strategy

The IWCM Strategy was developed through the building and assessment of a series of management strategies (scenarios) to address the issues defined in the Concept Study.

Based on the outcomes of the Concept Study and a series of desktop analyses, a number of different management options were developed for each of the water cycle issues identified. Each of the options represents a different level of service to the environment and customers of MSC's urban water services. Similarly, each option is supported by a different asset management plan depending on the type of infrastructure required to deliver the level of service. This in turn means that each option will have different environmental, social and economic outcomes (both positive and negative).

As the number of options can be large, DWE recommends that compatible options covering water supply, sewerage and stormwater services are bundled together as a scenario.

Each of the scenarios must be assessed to identify a preferred scenario for implementation. The different scenarios are assessed on their economic, social and environmental outcomes. The preferred scenario sets out a list of strategic actions to improve the management of the identified water cycle issues over a 30 year planning horizon.

The aim of this Strategy Plan is to detail the development of these scenarios and to document the outcomes of the scenario assessment process as it applies to the issues facing MSC.

1.1.3 Implementation Phase

Once a preferred scenario is identified it must be implemented appropriately to ensure that the management of the water cycle issues identified in the IWCM Concept Study is improved.

Key planning tools for implementation of the IWCM preferred scenario are:

- Strategic Business Planning;
- Financial Planning;
- Best Practice Pricing;
- Development Servicing Plans;
- Demand Management; and
- Drought Management.

This Strategy Plan documents the process of implementation of the preferred scenario for MSC.

2 Developing the IWCM Strategy

This section sets out the approach taken to develop the MSC IWCM Strategy and includes a summary of the input data utilised (including the outcomes of the IWCM Concept Study), stakeholder consultation process, desktop analyses of some of the potential options to manage the water cycle issues and the scenario building process.

2.1 Identifying the Issues

The Concept Study is an essential part of the IWCM process providing a basis to understand the issues faced by MSC in the provision of water, sewerage and stormwater services. These catchment, water resource and urban issues were identified through the review of existing background information as well as discussions with MSC staff and regulatory authorities and stakeholder consultation. The IWCM issues (Core Problems) were confirmed in consultation with DWE and Council (refer Section 2.2).

The Core Problems (IWCM issues) are listed in Table 2-1. In developing solutions to each of the identified issues, a range of strategies were investigated. These are summarised in Table 2-1 and discussed throughout this report. The scenarios developed for MSC incorporate these strategies (refer Table 10-3).

Table 2-1: IWCM Issues and Strategies

IWCM Issues (Core Problems)		Strategies
1	The water supply and sewerage systems do not have sufficient capacity to service present needs and growth and are not expected to meet future licence conditions. The use of water resources within the shire is also inefficient due to high unaccounted for water, poor demand management and limited use of alternative water sources to minimise town water use.	Demand Management (Shire-wide)
		Water sensitive urban design - self-sufficient water supply (shire-wide)
		Stormwater harvesting
		Muswellbrook WTP upgrade
		Additional reservoir
		Sewer upgrade
		Muswellbrook STP upgrade
		Denman STP
		Sandy Hollow sewerage system
2	There is insufficient renewals planning and investment that may cause operational issues, breach of DECC licence conditions and community service level expectations	Renewals planning
		Renewals investment
3	Effluent reuse must be sustainable within the context of overall government and community strategic directions	Effluent management (Muswellbrook)
		Effluent management (Denman)
		Effluent management (Sandy Hollow)
4	Lack of resources to implement plans	Human Resources Provision
5	Lack of education and assistance for demand management measures may result in increased risk of unsuccessful programs	Education

IWCM Issues (Core Problems)		Strategies
6	Need to ensure long term water supply security and allocation from Hunter River through appropriate provisions in the Water Sharing Plan	Liaison with CMA and DWE
7	Denman river extraction limited by existing infrastructure	Denman River extraction
8	Poor water supply quality (turbidity and hardness) at Denman	Denman WTP upgrade
9	Increase in per capita outdoor water use due to lower occupancy ratios	Development control planning
10	Unknown security and saline supply at Sandy Hollow	Increase security of supply
		Sandy Hollow WTP upgrade
11	Lack of groundwater protection protocol for Sandy Hollow	Well protection
12	Lack of comprehensive algal management protocol	Management plan
		Muswellbrook and Denman water treatment
13	Water supply and environmentally sound sewage treatment processes at risk due to inadequate risk identification and emergency response strategy for water and sewer infrastructure	Contingency plan
14	Need to improve septic systems management	On site systems
		Best-practice onsite management systems compliance
		Sewer new growth (Sandy Hollow)
		Sewer new growth (Denman)
		Sewer new growth (Muswellbrook)
15	Poor catchment management practices, urban stormwater, effluent discharges, over-extraction and salinity have affected water quality in rivers	Stormwater Management Plan
		Catchment initiatives
		Trade waste plan
		Stormwater harvesting
		Demand management
		Effluent management
16	Insufficient fluoridation to meet NSW Health guidelines	Fluoridation

2.2 Stakeholder Consultation Program

Stakeholder consultation was undertaken to ensure that stakeholders contributed to the definition of water cycle management issues and the identification of potential solutions. This was achieved through the formation of a Project Reference Group (PRG) which included representatives from MSC, government agencies, local organisations and the community.

Following the drafting of the Concept Study, the PRG assisted in the process of finalising the study. The first meeting of the PRG was held at Muswellbrook Shire Council on 7 June 2006 where the PRG identified a set of issues and set environmental, social and economic objectives for the IWCM strategy.

A second PRG workshop was held on 23 August 2006. The objectives of the second workshop were to:

- Examine draft scenarios developed; and
- Evaluate scenarios to identify preferred solutions through the TBL assessment process.

The PRG Workshop Summary Papers are attached in Appendix B.

During the Strategy phase, the consultation program included a Steering Committee Workshop on 6 February 2007. The workshop reviewed:

- The IWCM issues (core problems);
- Draft scenarios;
- Project elements; and
- TBL analysis.

2.3 Objectives for the Strategy

Draft objectives to set the direction of MSC's IWCM Strategy were formulated as part of the stakeholder consultation process and documented as part of the Concept Study. These objectives set goals for the future management of the identified water cycle issues. The objectives and criteria developed to measure the achievement of the objectives and the scenario assessment process are discussed in Section 10.2.

2.4 Developing Solutions

The purpose of scenario building is to analyse the combinations of water, sewerage and stormwater options available to MSC to sustainably provide these services into the future. Consistent with the DWE methodology, in developing the IWCM Strategy, options to manage water supply, sewerage and stormwater services into the future were assessed in a two part process:

- Identification and assessment of individual management options; and
- Assessment of scenarios (bundles of complementary management options).

The general process applied to MSC is summarised below:

- The process began with the identification of the demand for water. Potable and non-potable end-uses of water were identified as part of the demand analysis. This analysis also examined cost-effective demand management measures that could be put in place to minimise urban water demands. Demand projections were developed to demonstrate the water savings achievable with these demand management measures (refer Section 3);
- Having established water demands, a process of matching demand with the available water sources was undertaken (see Sections 3.3 and 4);
- In addition to the maintenance of existing effluent reuse activities, the potential uses of treated effluent and stormwater/rainwater as alternative sources were identified (refer Section 4.3);
- For each of these uses, the level of treatment required was assessed to ensure the water quality would match the requirements of the intended water use (see Section 7);

- The required capacities of the water and sewage treatment facilities were determined from the water demand and effluent generation forecasts developed (refer Sections 3 and 7 and Appendix C), which took into account savings as a result of demand management activities; and
- Where treated effluent and stormwater could not be utilised as a water source, options for effluent disposal were identified.

To support the process described above, a series of analyses was undertaken. The results of these analyses are set out in the following sections.

2.5 Financial Analysis

In order to compare the financial implications of the draft scenarios, preliminary design and cost estimates were determined for each project/capital works item. These design and cost estimates are provided at a planning level and costs may vary by up to 50%. This achieves the purpose of draft scenario evaluation since similar assumptions, procedures and origins are used for all of the cost estimates.

Cost estimates are based on NSW Reference Rates, information from similar projects and supplier quotes. The costs are adjusted for CPI and construction industry trends as applicable. In most cases, the cost includes engineering, training, manuals, site establishment, project management, land acquisition and contingency.

3 Demand Projections

The historical water demands in Muswellbrook Shire were analysed to develop forecasts of future water demands and wastewater generation. This included an analysis of potential demand management measures to reduce water demands and wastewater contribution. The Demand Analysis and Forecasting Report is attached in Appendix C.

The demand analysis involved:

- Data collection and review: to establish the adequacy of available water production, consumption, restriction and demand management information held by MSC;
- A water demand analysis: to climate-correct MSC's historical water demand records, determine the peak to average day demand ratio, establish the level of unaccounted for water, and establish the categories of existing MSC consumers and the breakdown of their water use activities;
- Water demand and effluent forecasts: to identify the drivers of future demand in the MSC service area in order to establish a baseline forecast of the water demands and effluent flows that would be expected in the service area over the next 30 years; and
- A water efficiency analysis: to propose various water efficiency measures, to determine a preliminary cost-benefit assessment of potential water efficiency measures and assess the impact of a set of two potential water efficiency programs (demand-side management programs) for MSC.

3.1 Demand Analysis

Overall, the analysis identified:

- The climate-corrected productions for Muswellbrook and Denman schemes are 2,115 and 347 ML/annum respectively. Full production data was not available for Sandy Hollow. Climate correction is carried out using the DWE Water Demand Trend Tracking and Climate Correction model to eliminate the impact of unusual climate years on future demand projections. Details are provided in Appendix C.
- The production data did not give good correlation, especially for Denman (refer Appendix C), therefore these results should be used cautiously;
- Metered potable consumption within the MSC service area for 2004/05 was 2,471 ML/a as follows:

  - Muswellbrook system 1,725 ML/a;

  - Denman 254 ML/a;

  - Sandy Hollow 23 ML/a; and

  - Surrounding Area 468 ML/a.

  Metered consumptions are based on MSC meter readings for 2004/05, whereas the climate corrected production is a long term average synthetic production value generated by considering various climate influences. In general, a higher climate corrected value indicates a cooler year.
- The metered consumption data indicates high consumption in Denman. Poor data correlation for Denman (refer Appendix C) suggests that any interpretation of Denman consumption data should be made with caution.
- Average unaccounted for water (UFW) is 22% for Muswellbrook and 25% for Denman against climate corrected production. The industry target for UFW is around 10%. The primary reason for the high UFW is the metering of consumption in the surrounding areas and reconciliation with water production

data. Also, bulk sales are not listed in the consumption database. It is likely that ageing infrastructure is causing some leakage.

- The above analysis, based on available production and consumption data, suggests that improved meter reading/production data is required.
- Considering unreliable production and consumption data, a current UFW value of 15% has been adopted for this Study. UFW reduction has been addressed by the water savings program (refer Table 3-1) and the renewals program (refer Section 6.1).
- Residential demand accounts for approximately 77% of potable consumption in the Muswellbrook system and around 63% in the Denman system.
- Increasing population within the MSC service area is expected to be the most important driver of demand over the next 30 years. Changes in dwelling type may also be significant.
- Baseline water forecasts predict that annual average demand in the Muswellbrook scheme will increase from 6.0 ML/d in 2005 to 8.8 ML/d in 2035. Peak demand will become 21.7 ML/d from 14.4 ML/d over the next 30 years. These correspond to an increase of approximately 47% in average demand and about 50% in peak demand (refer Figure 3-1, Figure 3-2 and Appendix C).

3.2 Demand Management Measures

By applying a number of individual demand management measures to the baseline forecast and examining the costs and benefits (in terms of both dollars and water saved) the relative merit of each measure was determined. Individual water efficiency measures considered as part of this analysis are set out in Table 3-1.

Table 3-1: Individual water efficiency measures.

Measure	Description
Pricing Measure Model	MSC adopted user pays pricing in 2005. As a result, 76% of residential revenue comes from usage charges and this is fully compliant with the DWE minimum requirement of 75%. The DSS model was prepared with 2004 as year 0 based on data available at the time of model calibration. The previous pricing structure has usage revenue around 12% less than present pricing. The impact of this measure is expected to reduce outdoor use only as the overall level of internal consumption in MSC is inelastic. This is expected to act primarily as reinforcement of the saving gained from the introduction of best practice pricing.
BASIX	Implementation of the mandatory NSW Government BASIX Program. The model developed focused on rainwater tanks for all new single and multi-residential dwellings. It is however, assumed that if other alternative sources of water were used, similar costs and savings would occur.
Rainwater Tank Rebate	This program assumes that MSC will provide a $500 rebate for customers willing to install a rainwater tank. This program is separate from the BASIX program and focuses on existing single residential dwellings.
Education Program for external uses	Education is an important part of the water efficiency program. It is assumed that this program will continue over the next 30 years to maintain water efficient behaviour. An education program for internal use was not considered as this is known to be inelastic.
Unaccounted for Water	This program assumes Council will spend $250,000 over 5 years starting from 2007. This models the likely impact of the replacement program and MSC's focus on reducing UFW from the distribution system. The target UFW level is 10%.

Measure	Description
Water Conservation Order	This measure implements permanent water conservation measures throughout the area focusing on urban irrigation, car washing and other external water uses. This also includes the monitoring, education and passive enforcement of sensible water use.
Dual Flush Toilet Retrofit	This measure aims to replace single high flow cisterns or 9/4.5 dual flush cisterns with 6/3 dual flush cisterns. This is likely to continue for 6 years with a cost of $300 per retrofit to Council.
Showerhead Retrofit	This model assumes this voluntary program will continue, but also recognises the fact that BASIX will over-ride the need for this program in relation to new development. This is likely to continue for 6 years with a cost of $200 per retrofit to Council.
Residential Household Tune-Up	Local residents would be offered the opportunity to have an analysis of their household water using devices and activities focussing on ways to improve water use efficiency.
Business Tune-up	Similar to residential tune up services provided to business accounts.

The best performing individual measures were progressively bundled together as a number of water savings programs (WSP).

- Introduction of BASIX and best-practice pricing are expected to be the most cost-effective measures for reducing water demand over the planning horizon. These measures are also mandatory requirements.
- WELS is also a mandatory requirement for new water appliances. This helps educate people to use more water efficient appliances. As the water demand reduction from WELS is difficult to quantify, it has not been separately modelled.
- Another significant cost-effective measure is UFW reduction. The target UFW is assumed to be 10%.
- Education is a complementary measure and irrespective of its cost effectiveness, it is recommended in order to maximise the benefit from other programs.
- The residential audit is included in the water savings program proposed as this can indirectly also promote showerhead and dual flush toilet retrofits.

As part of the demand analysis, two WSPs were developed. Each program contains progressively more water efficiency measures based on a benefit-cost analysis of the individual measures as illustrated in Table 3-2. Further information is provided in Appendix C.

Table 3-2: Potential water saving programs for MSC.

Program	Pricing	BASIX	WELS	Education	UFW	Residential Audit
WSP 1	✓	✓	✓			
WSP 2	✓	✓	✓	✓	✓	✓

The demand management measures apply to both urban and non-urban customers. Most parts of the education program can successfully capture both the rural and urban audiences.

WSP2 is expected to reduce the baseline annual peak demand of Muswellbrook Scheme to 18.2 ML/d (a reduction of 16%) and the baseline average demand to 7.5 ML/d (a reduction of up to 15%) by 2035 (refer Section 3.3).

Further review of costing for each water efficiency measure is required to finalise the cost benefit analysis used to develop these water efficiency programs. A Demand Management

Plan is required to identify and assess the potential for demand management measures to deliver water savings in the MSC service area over the next thirty years. This would include an investment program for the implementation of effective demand management measures.

3.3 Demand Forecasts

The estimated impact of the WSPs on the average day water demand, the peak day water demand and dry weather effluent flows for the Muswellbrook, Denman and Sandy Hollow systems are set out in the following figures.

Figure 3-1, Figure 3-4 and Figure 3-7 show that the water supply sources for Muswellbrook, Denman and Sandy Hollow are secure as the average demand is below the existing licence allocations of 3,250 ML/a (8.9 ML/d), 550 ML/a (1.5 ML/d) and 50 ML/a (0.14 ML/d) respectively under the water savings programs.

The capacities of Muswellbrook and Denman WTPs (14.5 ML/d and 2.4 ML/d) are insufficient for projected demands as shown in Figure 3-2 and Figure 3-5. The target PDD (2035) of the Muswellbrook system varies between 18 and 22 ML/d depending on the demand management scenario adopted and an increase in plant capacity is essential to meet these demands. However, the consumption figures in Denman are very unreliable, and the treatment plant capacity has been decided based on a combination of historical and theoretical figures. A significant future investigation will be required to correct any anomalies either in the records or the system.

The forecast effluent production for Muswellbrook and Denman as shown in Figure 3-3 and Figure 3-6 exceeds the hydraulic capacity of the existing STPs (3.2 ML/d and 0.56 ML/d respectively). An increase in STP plant capacity is required to meet the demand. However, the STP sizing does not relate to the effluent generated out of the town water use only, and the amount of water used from alternate sources such as rainwater tanks and the level of sewer infiltration must also be considered.

Figure 3-1: WSP influenced average day demand forecast (ML/d) – Muswellbrook.

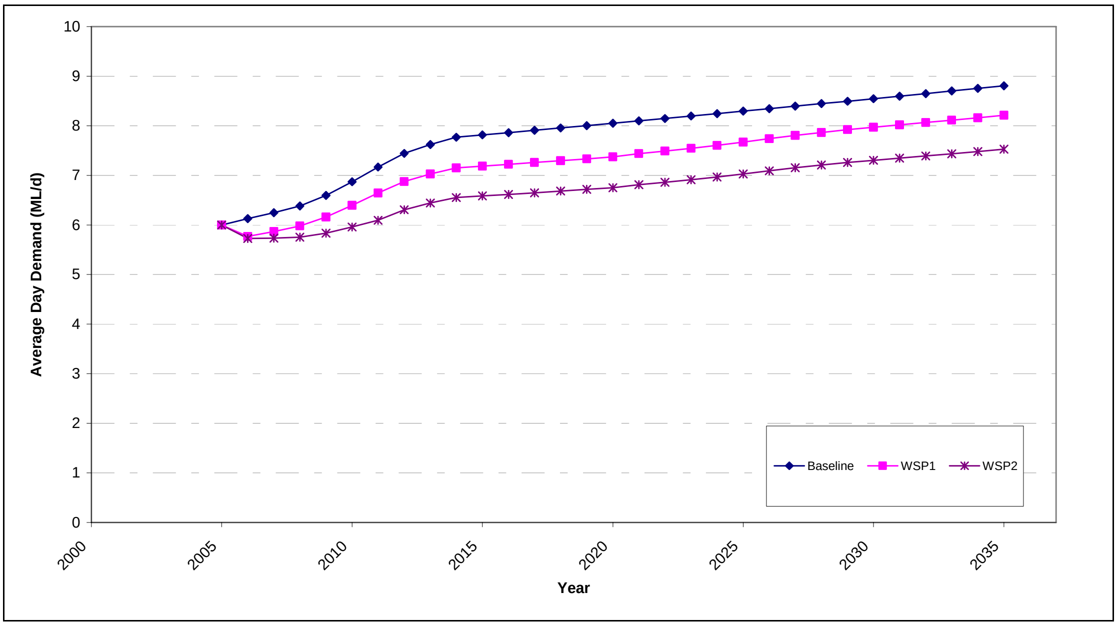


Figure 3-2: WSP influenced peak day demand forecast (ML/d) – Muswellbrook.

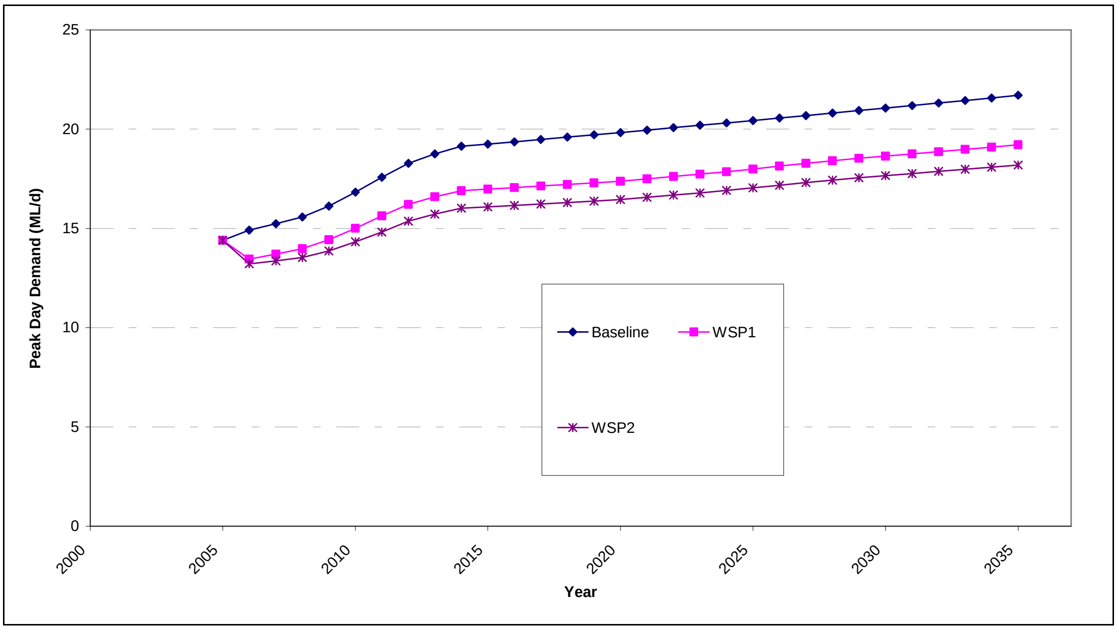


Figure 3-3: WSP influenced dry weather effluent forecast (ML/d) – Muswellbrook.

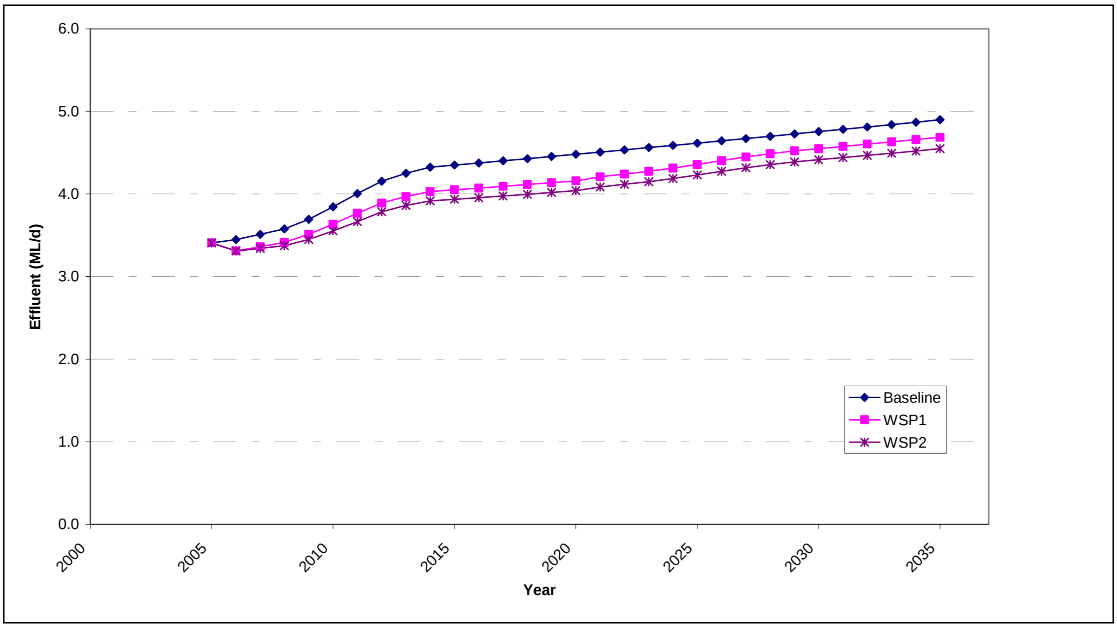


Figure 3-4: WSP influenced average day demand forecast (ML/d) – Denman.

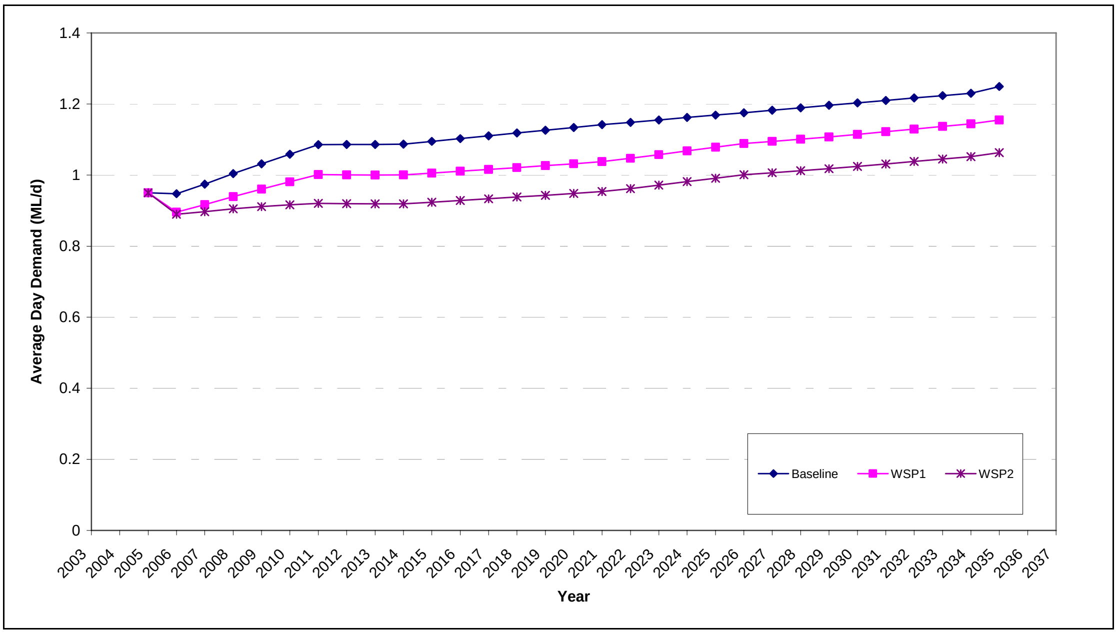


Figure 3-5: WSP influenced peak day demand forecast (ML/d) – Denman.

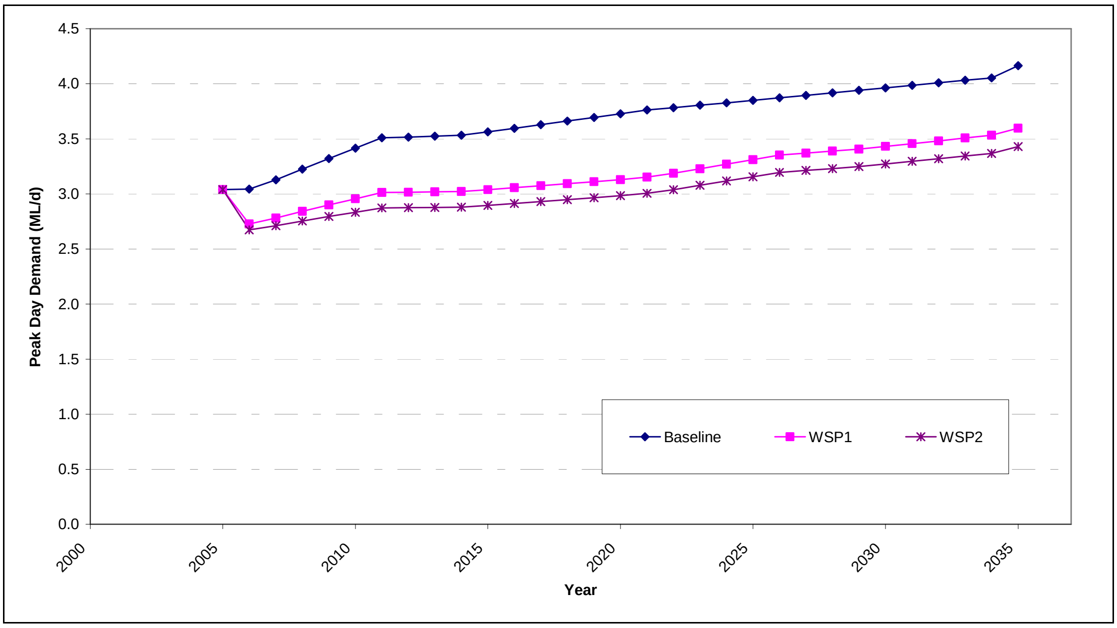


Figure 3-6: WSP influenced dry weather effluent forecast (ML/d) – Denman.

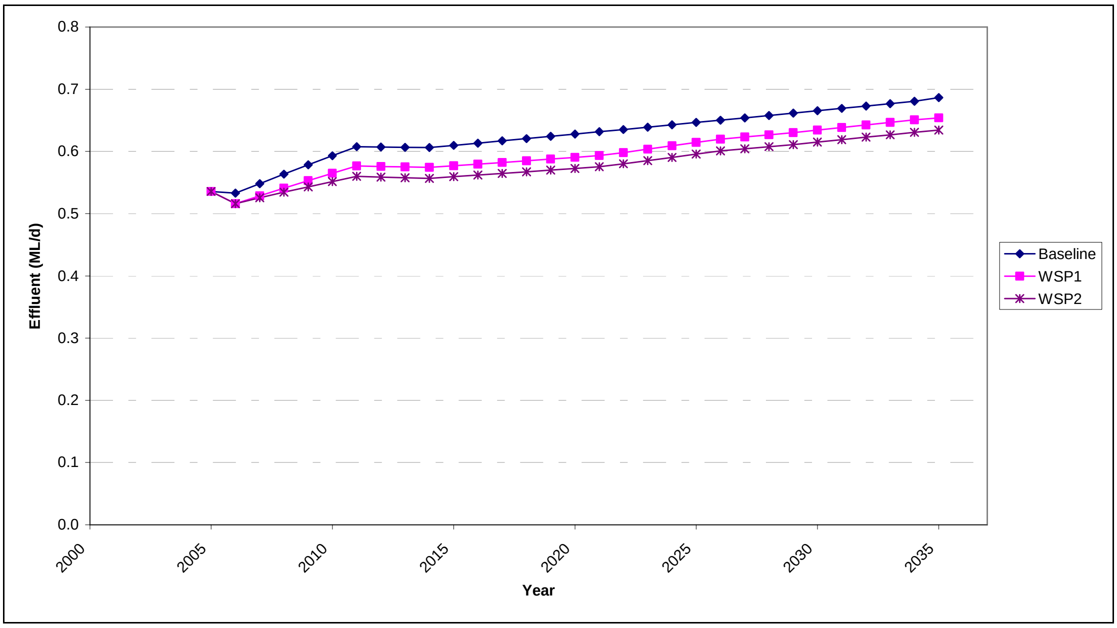


Figure 3-7: WSP influenced average day demand forecast (ML/d) – Sandy Hollow.

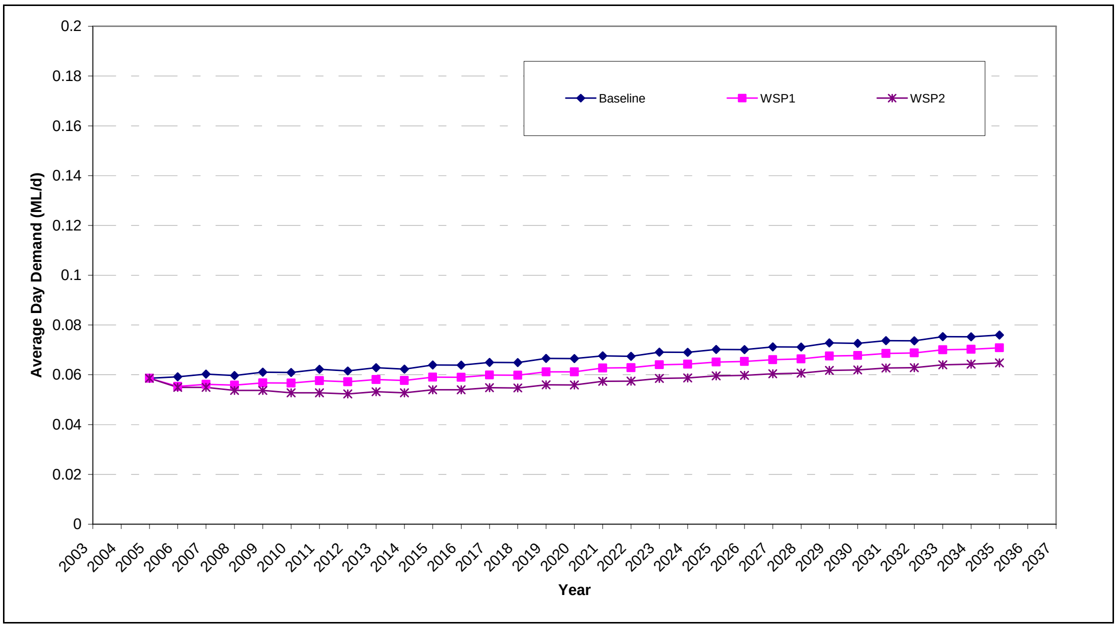


Figure 3-8: WSP influenced peak day demand forecast (ML/d) – Sandy Hollow.

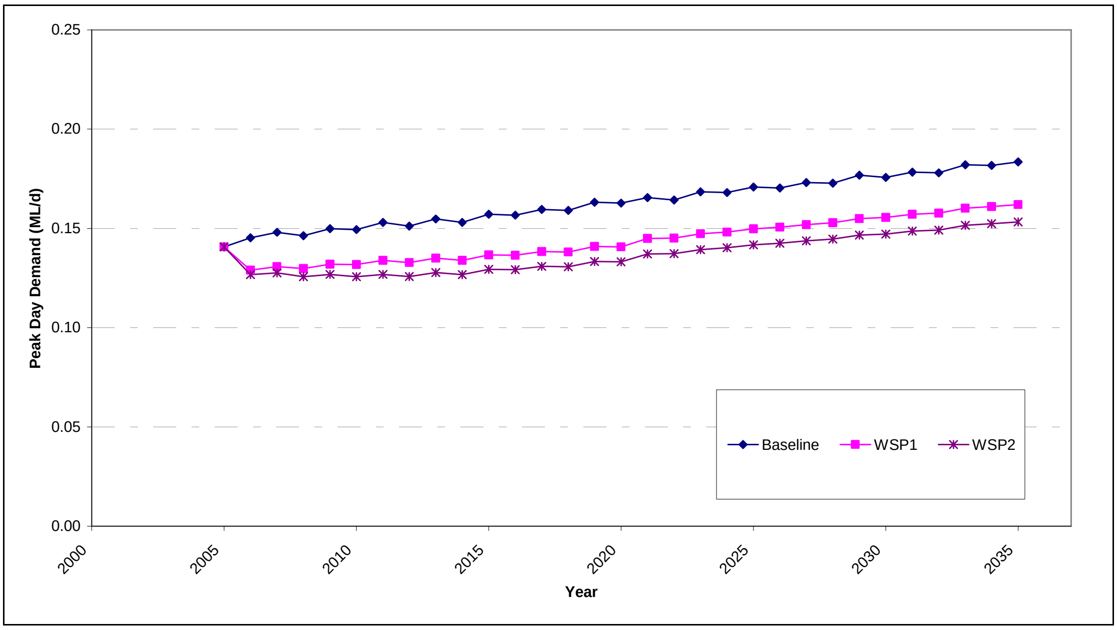
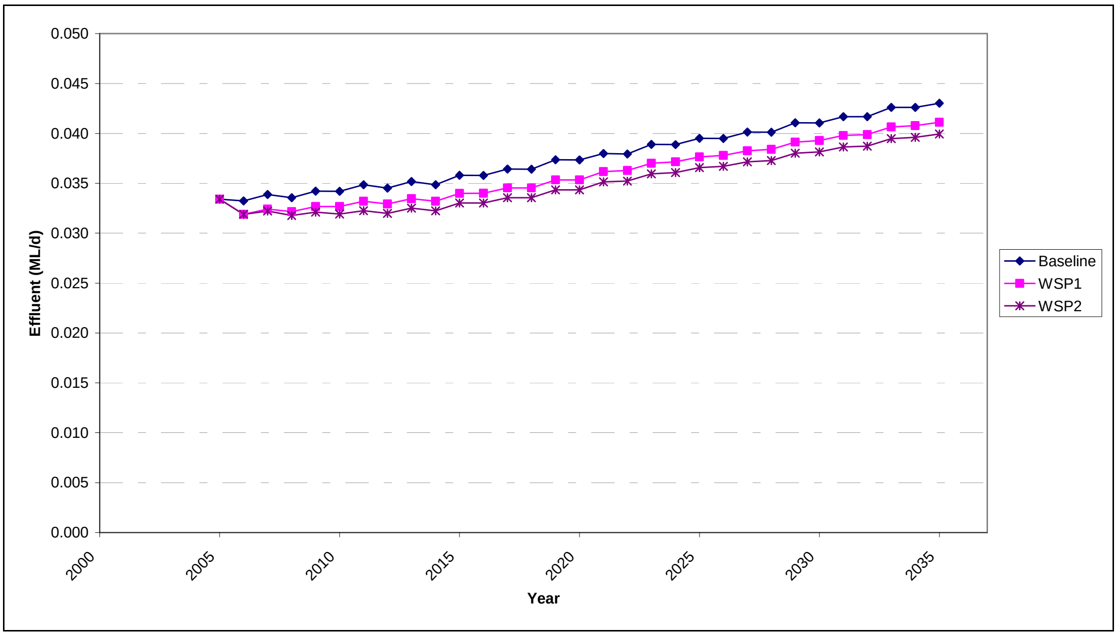


Figure 3-9: WSP influenced dry weather effluent forecast (ML/d) – Sandy Hollow.



Implementation of the preferred water savings program and the cost implications over the planning period will be included in a demand management plan to be prepared by MSC.

4 Water Availability Analysis

The water availability analysis aims to identify water sources currently utilised in the provision of water to each of the main towns within MSC and to also assess the ability for these resources to meet future demands. Once this is established, alternative water sources such as stormwater harvesting and effluent reuse were considered to supplement or replace non-potable demands on the town water supplies.

4.1 Existing Water Supply

The source of water for the towns of Muswellbrook and Denman is the Hunter River. The Hunter River is a regulated river supplied from Glenbawn Dam and provides a reliable source for both Muswellbrook and Denman. The flow released from Glenbawn Dam averages 124,500 ML/a. Town water licensed extraction is 3,250 ML/a and 550 ML/a for Muswellbrook and Denman respectively.

The previously used alternate bore field for Denman water supply commissioned in 1982 near the river is now obsolete due to quality and quantity limitations. The present source of water for this scheme is the Hunter River. Because of the inadequate bore capacity, a temporary river pump was installed in 2002 with a supply capacity of 2.4 ML/day. The water is drawn through a pressure sand filter to reduce turbidity then receives chlorination before being pumped to the high level reservoir. The capacity of the river pumping is also restricted because of the extended periods of time the river water is turbid and therefore unsatisfactory to pump.

In spite of the considerable efforts of Council to provide an acceptable water supply to the people of Denman, there has still been the need for extended periods of water restrictions. A new river intake and water treatment plant were constructed at Denman (completed in 2007).

Under the *Water Sharing Plan for the Hunter Regulated River Water Source* (2003), MSC entitlements are to be maintained even through a repeat of the worst period of low inflows to the Hunter River. As projected demand is below the licence entitlement, the supply is considered secure (refer Section 3.3). MSC will review licence entitlements and water supply security following the five year review of the Water Sharing Plan (due in 2009).

MSC is currently preparing a Drought Management Plan with water restrictions based on DWE's available water determination (AWD) announcements made under the Water Sharing Plan for high security water licences. In this way, town water trigger levels will be set in parallel with restrictions affecting other users.

Sandy Hollow relies on the unregulated Goulburn River. The source of water for Sandy Hollow is a bore field (supply capacity 5.0 L/s) close to the Goulburn River. The main source of water is a gallery bore that has been laid horizontally in the river bed at a depth of approximately 5 metres. The second bore is drilled vertically to a depth of approximately 18 metres. Water availability will be controlled by the yield of the bores. Experience in recent dry summer periods demonstrates that the yield of the gallery bore is not sufficient for the summer peak but there was sufficient quantity in the other bore. Whilst the bore field has a reliable supply, its water is generally of poorer quality than water extracted from the gallery bore, so the latter is preferred when the river flows are not highly turbid. Further growth in Sandy Hollow may be limited by the availability of water from either of these sources.

A DWE (formerly the Department of Natural Resources, DNR) licence for 50ML per annum is held for Sandy Hollow. The licence conditions allow the extraction of "up to twice the licensed volume in any one year provided the aggregate does not exceed three times the licensed volume in any three years." From the demand and supply analysis (refer Section 3.3), the quantity of water for Sandy Hollow is sufficient.

MSC plans to provide additional storage reservoirs for Denman and Sandy Hollow. These would not be required with high level demand management measures (WSP 2).

Other villages and rural residences within the LGA rely on non-reticulated water sources such as groundwater.

4.2 Existing Sewerage Systems

Muswellbrook Shire has two sewerage schemes in Muswellbrook and Denman.

Muswellbrook is served by a Sewage Treatment Plant (STP) with primary, secondary and tertiary treatment of effluent. Catchments gravitate to the nine pumping stations located throughout Muswellbrook and the sewage is then pumped to the other pumping stations or the treatment works. The four major pumping stations (PS 1, 2, 3 and 5) are connected by a telemetry system which controls the sequence of flows to the treatment works, records operational data and sets off the alarm when a malfunction occurs. The excessive lengths of the rising main from the northern side of town make it necessary for chemical dosing at PS 3 to be installed to control sulphides in the sewage.

The sewage is pumped to the treatment works located on the south-western edge of the town. Preliminary treatment occurs with flow measurement, basic odour control, the removal of grit and solids at the inlet works followed by some flow control through a detention basin. The sewage then undergoes primary treatment in four sedimentation tanks followed by secondary biological treatment using 3 trickling filters and 2 humus tanks. The treated sewage is then directed into the tertiary ponds. A pasveer ditch with 2,000 EP capacity can be operated in parallel but at present, this has been decommissioned because of its high energy consumption and its ability to only treat slug doses.

Sludge is treated separately in 3 digesters and 2 sludge lagoons. Some sludge is periodically combined with chipped green waste during the production of compost. It is Council's intention to sell this commercially as an 'A' grade compost.

The treated effluent is chlorinated before being reused. No river discharge occurs.

The last augmentation of the treatment capacity occurred in 1980 with the addition of the 2,000 EP Pasveer Channel. The capacity of the Muswellbrook STP is currently 11,500 EP.

The Denman STP consists of primary, secondary and tertiary treatment of effluent. Two pumping stations are necessary to lift sewage to the STP located to the south of the town. The northern part of Denman gravitates to a pumping station near Crinoline/Palace Street intersection where it is lifted to another main which in turn gravitates to a second pumping station. This pumping station located in Babington Street pumps sewage to the STP.

The main treatment of sewage occurs in the Extended Aeration Tank where effluent is drawn off and directed to the tertiary pond. Treated effluent is disinfected before being reused. Discharge to the Hunter River only occurs during extremely high rain events. The current capacity of the Denman STP is 2,000 EP.

Sludge is pumped to a sludge lagoon where it is dried and either used on the adjacent tree lot or transported to Muswellbrook Waste Depot.

There is no municipal sewerage system in Sandy Hollow. This causes problems, as identified in the Concept Study, with septic tank effluent discharges creating a public nuisance and potential public health problems.

The option of constructing a sewerage system in Sandy Hollow will increase the pressure for future development growth in the village, which will put major strain on the ability to supply water to the community, especially in terms of available quantities of raw water. The overall sustainability of growth of this community, especially in terms of provision of services, needs to be carefully examined as part of the process of assessing the need for upgrading services to the existing population.

4.3 Alternative Water Sources

4.3.1 Recycled Water

At present, 100% of the treated effluent from Muswellbrook and Denman is reclaimed.

At Muswellbrook, an informal agreement with the Golf Club allows them to take up to 150 ML/a for irrigation purposes. The rest (which was 85% in 2004/5) of the treated effluent from Muswellbrook is piped to the Mt. Arthur mine located on the southern side of town where it is used for mine production purposes. This has prevented treated effluent from being discharged in the Hunter River and reduced the need for the mine to pump water from the river to meet water needs. Council has an agreement with the mine to take a maximum amount of 850 ML/a of treated effluent. This agreement applies until 2009.

At Denman 100% of the treated effluent is pumped to holding dams adjacent to the golf course where it is used to irrigate the course and Denman Oval.

The predicted volume of effluent available for reuse from Muswellbrook and Denman STPs over the next thirty years is show in Figure 3-3 and Figure 3-6 respectively. The current volume of effluent available for reuse was estimated to be approximately 3.4 ML/d and 0.5 ML/d respectively.

The following alternative effluent reuse opportunities were investigated in the development of the IWCM Strategy:

- Dual reticulation as part of the provision of sewerage to Sandy Hollow;
- Recycling of water from Muswellbrook STP to various mines, power station, vineyards, irrigation and municipal uses;
- Recycling of water from Denman STP to irrigation and municipal uses;
- Recycling of water from Sandy Hollow STP for irrigation (as part of the provision of sewerage);
- Indirect potable reuse from Muswellbrook STP to the Hunter River at a point upstream of the water supply intake;
- Indirect potable reuse from Denman STP to the Hunter River at a point upstream of the water supply intake; and
- Indirect potable reuse from Sandy Hollow as groundwater recharge (as part of the provision of sewerage).

The effluent reuse opportunities and the estimate of capital, operational and lifecycle costs are presented in Table 4-1. These estimates do not include treatment requirements which are discussed in Section 7.

Table 4-1: Cost Estimates of Effluent Reuse Options.

System	Option	Capital ($'000)	Operating ($'000/a)	NPV ($'000 @ 7% discount)
Muswellbrook	Mines and Power Stations - Mt Arthur Open Cut Mine, Bengalla Open Cut Mine, Dartbrook Underground Mine, Bayswater Open Cut No. 2 Mine, Drayton Open Cut Mine, Bayswater Open Cut No. 3 Mine, Saddlers CK Open Cut Mine or Liddell Power Station.	6,991 [1]	238	9,294
	Irrigation - West of River, South of Bengalla, East of River, South of STP, West of River, East of Bengalla, West of River, North of Muswellbrook, East of River, North of Muswellbrook or Golf course.	7,047 [1]	171	8,569

System	Option	Capital ($'000)	Operating ($'000/a)	NPV ($'000 @ 7% discount)
	Vineyards	4,939	96	5,729
	Indirect potable reuse	2,479	310	5,912
Denman	Irrigation east and south of Denman	1,643	64	2,278
	Municipal uses	828	41	1,249
	Indirect potable reuse	1,960	64	2,574
Sandy Hollow	Irrigation	656	10	729
	Municipal uses	358	5	393
	Dual reticulation	949	14	1,049
	Indirect potable reuse (aquifer storage and recovery)	2,153	30	2,360

1. Capital cost estimates used in the IWCM Strategy are an average of the estimated additional costs to provide recycled water to the various end users listed. This gives MSC flexibility in the funding of various effluent reuse alternatives.

It is recommended that MSC undertake an effluent management study to determine the most beneficial uses of recycled water while considering the water needs of all water users. This would require analysis of the requirements of the potential end users including reuse volumes, treatment level, irrigation conditions and transfer systems.

Existing users of recycled water, particularly Mt. Arthur Mine and the Muswellbrook and Denman golf courses will require a continuing source of water for their operations.

Implementation of dual reticulation and/or indirect potable reuse options requires considerable investigation in the planning stages involving not only technical feasibility and financial viability but also risk management and social acceptability analysis. Similarly, the aquifer storage and recovery option will require further feasibility assessment.

4.3.2 Rainwater Tanks

Analysis of the potential opportunity for stormwater harvesting via rainwater tanks in MSC LGA involved a simple spreadsheet model (adapted from a daily water balance model developed by DWE for the Kempsey IWCM Strategy). The analysis (refer Appendix H) indicated that the optimum tank size for Muswellbrook is between 5,000 L and 10,000 L for external use only and between 10,000 L and 12,500 L for external and toilet use. However, there was limited additional benefit for tanks over 12,500 L. The model also indicates that:

- With a 7,500 L tank, harvesting of the rainwater for outdoor use would result in 72% reduction of corresponding (outdoor) water needs (which are currently supplied from town water);
- The reduction would be 56% of the corresponding water needs if the water is used for both outdoor and toilet flushing; and
- The rainfall runoff can be reduced by up to 81% preventing stormwater flowing from the house when used for outdoor and toilet flushing.

The contribution of a rainwater tank to water savings for a dwelling in the LGA is significant. This analysis highlights the need to include rainwater tanks in new developments as a complementary way to save water (as part of the BASIX scheme).

4.3.3 Stormwater Harvesting

Harvesting of stormwater for new development areas in Muswellbrook (Webber, Eastbrook, Northview and Highbrook) was considered for the IWCM Strategy where the areas could rely on rainwater and stormwater harvesting and not need to connect to the town water supply. It is assumed that costs for such water sensitive urban design (WSUD) components of new developments will be borne by developers.

A preliminary desk top water balance investigation shows that it is possible to satisfy total water needs of these new development areas from stormwater harvesting supported by grey water reuse and BASIX water savings based on typical building sizes and impermeable surfaces.

The principal assumptions used for the analysis include 40% demand reduction under BASIX, typical roof area of 150m^2, roof runoff coefficient of 0.8, average lot size of 890m^2, 10% harvestable hard surface and communal use and maximum 50% grey water reuse. These are based on current typical trends. A summary of the results is given in the following table.

Table 4-2: Potential Stormwater Harvesting.

Analysis	2008/09	2011/12	2013/14	2016/17
Cumulative Total Tenements*	214	735	1216	1557
Water saved/required (ML/a)	35	121	200	256
Stormwater generated from homes (ML/a)	16	54	90	115
Stormwater generated from other surfaces (ML/a)	12	40	67	85
Total stormwater (ML/a)	28	95	157	200
Stormwater as % of required water	78%	78%	78%	78%
Effluent Produced (ML/a)	8	27	45	58
Total Available Water Resource (ML/a)	35	122	201	258
Available resource as % of water required	101%	101%	101%	101%

*Webber, Eastbrook, Northview and Highbrook.

This analysis suggests that these new areas can be self sufficient for water requirements with stormwater harvesting, eliminating the need to provide town water supply. All developments would be required to comply with the relevant fire fighting requirements. Before implementing a WSUD strategy such as this, a comprehensive investigation including risk assessment must be carried out to assess issues such as drought, system failure, fire fighting requirements and contingency plans.

It may also be beneficial to encourage individual developers or industry to implement stormwater harvesting. There are potential benefits of implementing WSUD at the design stage for both individual lots and whole subdivisions. This can reduce the impacts of stormwater as well as reduce potable water use. The IWCM Strategy proposes to encourage developers to consider WSUD. This can be undertaken in the form of a DCP.

5 Service Extension

The options to extend MSC's water and sewerage service areas to address the issue of insufficient capacity to service present needs and growth (Issue 1 in Table 2-1) are discussed below. It is considered that expenditure for growth works should be recovered through developer charges. Reticulation is usually paid for by the developers. The Muswellbrook DSP needs to be updated to reflect any changes to the capital works program.

5.1 Water

MSC provides water treatment and reticulated water supply services to the urban areas of Muswellbrook, Denman and Sandy Hollow.

Water main extensions are planned for Muswellbrook, Denman and Sandy Hollow systems to service growth of 2,449, 262 and 15 assessments respectively (based on MSC population projections (MSC, 2006c) and the draft DSP (MSC, 2006b).

Based on the demand and supply analysis, new reservoirs are not required to service growth if an integrated scenario (with high level demand management measures) is adopted. However, for operational reasons, a new reservoir might be needed and this must be investigated separately as part of Council's normal asset planning.

Options for these water main extensions and the estimate of capital, operational and lifecycle costs are presented in Table 5-1.

Table 5-1: Cost Estimate of Service Extension Options (Water Supply)

Location	Option	Capital ($'000)	Operating ($'000/a)[1]	NPV* ($'000 @ 7% discount)
Muswellbrook	Extensions for growth (as in DSP)	3,790	379	7,937
	Extensions for growth with demand management measures (no new reservoir)	992	99	2,075
Denman	Service reservoir [2]	100	10	209
Sandy Hollow	Service reservoir	100	10	209

1. Approximate value for OMA (10% of capital cost). Recurrent costs were included in the OMA schedule used in MSC's DSP (MSC. 2006b).
2. Service reservoir is not required with demand management measures.

5.2 Sewerage

MSC provides sewerage reticulation and treatment to the urban areas of Muswellbrook and Denman although not all precincts are sewered. Other towns, villages and rural areas within the LGA are currently served with on-site wastewater management systems.

Approximately 3,500 people in the Shire rely on on-site wastewater management systems for wastewater treatment. MSC has a total of 1,329 systems registered but estimates that up to 1,800 systems could exist in the Shire, many of which have been installed many years ago without Council approval.

Council has in place an auditing program which is detailed in the MSC On-Site Sewerage Management Strategy (MSC, 2005 DCP18). Throughout 2003/04, 185 systems were inspected, of which 130 systems were found to be non-compliant. Overloading of on-site systems with wastewater is particularly problematic when there is increased domestic water use due to a connection to town water.

Sewer extensions are planned for all new assessments as for water supply. In Muswellbrook and Denman, this will serve 5,830 and 540 new EP respectively. In addition, in the existing areas, infill growth of 25% is assumed.

A reticulated sewerage system is proposed for Sandy Hollow (in 2015/16) to address the need for improved sewerage management in areas which are currently not served with reticulated sewerage. It is recommended that a feasibility study be undertaken by Council to confirm the best approach for provision of sewerage services in Sandy Hollow. Extensive community consultation should also be undertaken to adequately consider social issues.

Options to extend the sewerage service and the estimate of capital, operational and lifecycle costs are presented in Table 5-2. A cost of $1,500 is estimated for each new service connection.

Table 5-2: Cost Estimate of Service Extension Options (Sewerage)

Location	Option	Capital ($'000)	Operating ($'000/a)	NPV* ($'000 @ 7% discount)
Muswellbrook	Extensions for growth in core areas (Thomas Mitchell Drive and Racecourse Road) (as in DSP)	4,640	282	7,607
	Extensions for growth in core areas (modified cost estimate including upgrade of collection system for infiltration reduction)	16,054	282	18,274
	Infill only, no service to new growth areas but including infiltration reduction	7,716	147	8,916
Denman	Extensions for growth in West Denman (as in DSP)	466	34	1,537
	Extensions for growth in West Denman (modified cost estimate including infiltration reduction)	6,587	34	6,550
	Infill only, no service to new growth areas but including infiltration reduction	2,049	34	2,309
Sandy Hollow	Reticulated sewerage system (not including treatment)*	1,449	21	1,598

* SH treatment cost is discussed in Section 7.2.

6 Asset Management

An Asset Management Plan contains information that Council will use to manage its assets throughout their whole life cycle including asset creation, operation, maintenance, replacement and disposal. The Plan identifies current and projected capital works to satisfy future demands in terms of growth, improved level of service and replacement of existing assets.

6.1 Renewal Program

MSC's renewals planning and investment in asset replacement has historically been insufficient. The 2005/06 Strategic Business Plans (MSC, 2005a, 2005b) identify projected renewals investment of $300,000 p.a. for water supply (with the estimated current replacement cost in 2005 of $38.5 million) and $450,000 p.a. for sewerage (with the estimated current replacement cost in 2005 of $47.1 million). This is proposed to address mains renewal only.

The IWCM Strategy considers the development of a condition based asset management plan and renewals expenditure based on asset condition, remaining asset life and depreciation considering written down current cost and current replacement cost.

Information from the MSC asset register was used to determine the depreciation of each asset. Assets included raw water pumping stations, bores, reservoirs, reticulation, trunk mains, WTPs, sewerage pumping stations, gravity mains, rising mains and STPs. The average life of water and sewer assets was assumed to be 70 years. No renewal cost is considered until an asset reaches 50% of its design life.

The options for renewal expenditure are detailed in Table 6-1.

Table 6-1: Renewals Expenditure.

System	30 year Expenditure ($'000) - MSC SBP	30 year Expenditure ($'000) – asset based
Water Supply	9,000	11,166
Sewerage	10,350	18,660
Total	19,350	29,826

Capital works programs (including renewals schedules) for each IWCM scenario are attached in Appendix D. Appropriate operation, maintenance and administration (OMA) expenditure has also been identified to suit the required level of service delivery in each scenario.

6.2 Infiltration reduction

Infiltration of groundwater into the sewer pipes can lead to inefficient operation or overloading of the treatment plants and pumping stations. This can also result in constraints on growth and expansion of services.

Inlet flows are recorded daily at both Muswellbrook and Denman STPs. Rainfall is recorded at the Muswellbrook STP only. Comparison of the daily rainfall data from the Muswellbrook STP with flows into the treatment works shows that inflows increase after rain events and quite substantially after several consecutive days of rain. Inflows are not presently recorded at pump stations and thus it is not possible to isolate points of inflow within the town. However, large inflow to the sewerage system has been identified.

An infiltration and inflow (I/I) reduction program, combined with the renewal program, is proposed. It is assumed that this program will reduce total sewage flows by 20%. For the recent sewerage augmentation, the hydraulic load was estimated as 280 L/ET/d. With implementation of the I/I reduction program, the design hydraulic load is expected to be 224 L/ET/d. This will result in a reduction of the required STP capacity (refer Table 7-2).

The cost of I/I reduction is estimated at 5% of the current replacement cost which is around $2 million. However, further investigation is required to confirm the details of the program.

7 Treatment Analysis

The treatment analysis aims to match the type of treatment required for the water sources identified in Section 4 with the potential needs of the various customers to be supplied with each source. This considered not only the required quality and treatment of potable water supplies, but also of potential recycled effluent and stormwater harvesting opportunities.

7.1 Water Supply Treatment

Water is drawn from the Hunter River and treated in a water softening and filtration plant at Muswellbrook that has been progressively modernised. The present capacity of the water treatment plant is 14.5 ML/day (PDWD). Hydraulically, the plant could process up to 18 ML/day but at a lower performance, limited by the capacity of the existing sand filters. Records show that the average peak day demand for the period 2004/05 was 14.4 ML/d which highlights that the existing plant is operating at capacity for the current demand (refer Section 3). The treated water is fluoridated, chlorinated and then distributed throughout Muswellbrook via a network of trunk mains, pumping stations and service reservoirs (these reservoirs store the equivalent of approximately 3 days of ADWD).

In Denman scheme, the water is drawn through a pressure sand filter to reduce turbidity then receives chlorination before being pumped to the high level reservoir. To improve the supply water quality, a new membrane filtration plant was constructed in 2007.

Water from the Sandy Hollow bores is treated to remove most of the manganese and iron, (but not hardness), then chlorinated and pumped to two reservoirs that supply consumers. Council is trialling an ozone treatment plant to improve the management, performance and operation of the existing plant and to ensure consistent and higher water quality.

Fluoride dosing currently undertaken at MSC WTPs is insufficient to meet NSW Health guidelines. Additional dosing will be undertaken to ensure compliance with fluoridation requirements.

The potential water treatment options are listed in Table 7-1. Before implementing any of the options, detail investigation should be carried out to confirm plant size, process, design, cost and staging.

Capacity requirements will vary with the peak demand established for each scenario depending on the adopted water savings program (refer Section 3). Also, within Muswellbrook system, stormwater harvesting is proposed for two new development areas where town water supply will not be required (refer Section 4.3.3). The demand reduction due to this self-sufficient development is approximately 2 ML/d.

For all scenarios (except the base case), advanced treatment is proposed to address IWCM issues 1, 8 and 12 (refer Table 2-1). A Powdered Activated Carbon (PAC) process is proposed for Muswellbrook WTP and membrane filtration and softening is provided at the new Denman WTP.

Table 7-1: Water Treatment Options.

Location	Option	Issue Addressed	Capital Cost ($'000)	Operating Cost ($'000 p.a.)	NPV* ($'000 @ 7% discount)
Muswellbrook	Water treatment plant augmentation proposed in DSP – 22 ML/d	Capacity upgrade	10,600	1,060 [1]	22,200

Location	Option	Issue Addressed	Capital Cost ($'000)	Operating Cost ($'000 p.a.)	NPV* ($'000 @ 7% discount)
	Conventional water treatment (including sand filter) and PAC dosing – 19 ML/d (demand corresponds to WSP 1)	Capacity (reduced due to demand management) and process upgrade including algae treatment.	13,929	1,610	31,689
	Conventional water treatment (including sand filter) and PAC dosing – 18 ML/d (demand corresponds to WSP 2)	Capacity (further reduced due to demand management) and process upgrade including algae treatment.	13,483	1,403	28,872
	Conventional water treatment (including sand filter) and PAC dosing – 16 ML/d (demand corresponds to WSP 2 and new development areas are not served with town water)	Capacity (further reduced due to development control) and process upgrade including algae treatment.	12,590	1,265	26,437
Denman	Conventional filter – 4.2 ML/d (proposed in DSP)	Hardness and turbidity	3,352	335 [1]	7,020
	New plant of 2.7 ML/d, membrane filtration (MSC data)	Hardness and turbidity	3,715	190	5,675
	New plant of 2.7 ML/d, membrane filtration (MSC data), then future upgrade to 3.5 ML/d	Hardness and turbidity	5,738	190	7,566
	New plant, conventional filter – 3.5 ML/d	Hardness and turbidity	6,714	283	9,557
	New plant, pressure filter – 3.5 ML/d	Hardness, turbidity and algae	6,963	290	9,871
	New plant, membrane filter – 3.5 ML/d	Hardness, turbidity and algae	11,544	428	15,752
Sandy Hollow	Conventional filter with softening (as in DSP)	Hardness	630	63 [1]	1,319
	Pressure filter with softening – 0.2 ML/d	Hardness	1,021	106	2,184

Location	Option	Issue Addressed	Capital Cost ($'000)	Operating Cost ($'000 p.a.)	NPV* ($'000 @ 7% discount)
	Membrane microfilter and reverse osmosis with softening – 0.2 ML/d	Salinity and hardness	1,718	170	3,577

1. Approximate value for OMA (10% of capital cost). Recurrent costs were included in the OMA schedule used in MSC's DSP (MSC, 2006b).

7.2 Sewage Treatment

The existing sewage treatment systems are discussed in Section 4.2.

Each of the potential sewage treatment and reuse options are listed in Table 7-2 along with estimates of their capital, operational and lifecycle costs. Capacity requirements will vary with the effluent forecasts established for each scenario (refer Sections 3 and 4.3.1).

The infiltration reduction program proposed in Section 6.2 can reduce the required STP size, which is reflected in the capacities in the following table. It is assumed that the STP inflow will be reduced by 20% after the implementation of the I/I reduction program. Further investigation is required to confirm the details of the program.

Table 7-2: Cost Estimates of Sewage Treatment Options.

Location	Option	Issue Addressed	Capital ($'000)	Operating ($'000/a)	NPV ($'000 @ 7% disc.)
Muswellbrook	20,500 EP secondary treatment (cost allocated in DSP).	Capacity increase.	11,600	1,160 [1]	24,294
	Refurbish existing 11,500 EP STP	Improve STP operations.	6,148	475	11,254
	20,500 EP secondary treatment.	Capacity increase, (revised cost estimate).	19,452	808	27,550
	20,500 EP tertiary treatment	Capacity and treatment level increase.	28,572	1,117	39,657
	16,500 EP secondary treatment (size reduced due to infiltration reduction)	Capacity increase with I/I reduction.	17,100	699	24,088
	16,500 EP tertiary treatment (size reduced due to infiltration reduction)	Capacity and treatment level increase with I/I reduction.	24,397	882	33,030
	15,000 EP tertiary treatment (size reduced due to infiltration reduction and new development area not served)	Reduced capacity due to WSUD, advanced treatment for indirect potable reuse.	22,860	824	30,921
Denman	Refurbish existing 2,000 EP STP	Improve STP operations	1,401	98	2,446
	3,000 EP secondary treatment.	Capacity increase.	4,346	151	5,813
	3,000 EP tertiary treatment.	Capacity and treatment level increase.	5,986	192	7,821
	2,500 EP secondary treatment (size reduced due to infiltration reduction)	Capacity increase with I/I reduction.	4,074	140	5,431
	2,500 EP tertiary treatment (size reduced due to infiltration reduction)	Capacity increase with infiltration reduction, advanced treatment for indirect potable reuse.	5,395	164	6,944
Sandy Hollow [2]	150 EP secondary treatment	Provision of sewerage.	959	101	2,068
	150 EP tertiary treatment	Provision of sewerage, advanced treatment for dual reticulation or indirect potable reuse.	1,174	118	2,466

1. Approximate value for OMA (10% of capital cost). Recurrent costs were included in the OMA schedule used in MSC's DSP (MSC. 2006b).
2. The location of the new STP is to be confirmed during the feasibility study.

7.3 Stormwater

Drainage from the towns of Muswellbrook and Denman are the major sources of urban stormwater entering the Hunter River from within the IWCM study area. The quality of the stormwater leaving these urban areas not only affects the waterways within the urban areas, but also the quality of the water in the Hunter River which is the shire's major source of water. Poor stormwater quality also affects the fauna and flora, which inhabit the water of the Hunter River and depend upon its quality to live, develop and reproduce. The Muswellbrook Stormwater Management Plan was adopted in 2000 with the purpose to develop and implement strategies that will improve the quality of stormwater runoff from urban areas.

Currently, there are limited measures to treat stormwater in MSC as the existing stormwater management plan for the shire has remained largely unimplemented due to a lack of human and financial resources.

Cost estimates in the Stormwater Management Plan were used to develop the stormwater capital works programs (Appendix F).

8 Other IWCM Initiatives

An integrated approach to water supply and sewerage services includes consideration of stormwater quantity and quality, catchment health, water sharing and the resulting interactions with the town water supply and sewerage systems. For some issues, water supply and sewerage solutions do not completely solve the identified problem and a total catchment management approach is required. The resulting solutions are not traditionally part of the water and sewerage businesses of NSW LWUs and funding for these initiatives must come from other areas (e.g. Council's General Fund, stormwater and catchment levies, the Catchment Management Authority (CMA) or other State Government departments).

This section addresses the IWCM initiatives which are complementary to those to be implemented by the MSC water and sewerage businesses or which are not addressed in other sections of this IWCM Strategy Plan. These initiatives are required in the IWCM scenarios to provide a complete set of solutions to the identified IWCM issues.

8.1 Complementary Initiatives

As discussed in Table 2-1, the strategies investigated to solve some of the IWCM issues include the following initiatives:

- Provision of additional human resources to implement the proposed projects. The additional resources required for each new project/program are included in the operating cost of the project/program (Issue 4);
- Liaison with DWE and the CMA to monitor the water sharing process and ensure all users have sufficient water (Issue 6);
- Development controls to ensure new developments are sustainable (Issue 9);
- Groundwater monitoring, well head protection, aquifer assessment and preparation of groundwater management strategies to protect groundwater supplies for Sandy Hollow in association with DWE and the CMA (Issue 11);
- Development of a comprehensive algal management plan (Issue 12);
- Development of a comprehensive water supply and sewerage contingency plan including human resources requirements, impacts of flooding, risk management and emergency response strategies (Issue 13);
- Stormwater quality control and catchment initiatives to address poor water quality in rivers and improve the quality of raw water for drinking water supplies through implementation of the stormwater management plan (refer Section 7.3) (Issue 15);
- Incentives to improve catchment management practices to increase soil fertility, reduce soil erosion, acidity and dryland salinity (Issue 15);
- Groundwater management strategies to reduce over-extraction (Issue 11); and
- Implementation of trade waste policy (Issue 15).

These initiatives will be implemented by Council in consultation with the relevant regulatory authorities.

Stormwater and catchment management capital works programs and OMA schedules are included in Appendix F. Approximate stormwater and catchment levies required to fund the related initiatives are listed in Table 8-1 as an indication of the cost of these initiatives. Council may choose to assist the CMA to fund catchment management projects through a levy implemented from the General Fund. Similarly, stormwater projects can be funded in this way. The level of funding and catchment/stormwater projects supported is to be determined by the Environment and Heritage and Transport and Drainage divisions of Council respectively. MSC needs to specify how this money would be allocated.

Table 8-1: Cost Estimates for Stormwater and Catchment Management Initiatives.

Initiative	30 year Capital ($'000)	30 year Operating ($'000)	Average Cost ($'000 p.a.)	Levy (per assessment) [2]
Stormwater	2,919	1,575	150	20
Catchment Management	7,617	762	279[1]	37

1. In 2006/07, MSC contributed $59,300 to the Catchment management authority.
2. Based on ultimate (year 2035) number of water and sewer residential assessments.

8.2 ICLEI Water Campaign™

MSC is participating in the International Council for Local Environmental Initiatives (ICLEI) Water Campaign™ which is an international freshwater management program which aims to build the capacity of local government to reduce water consumption and improve local water quality. This is one of the programs of "ICLEI Local Governments for Sustainability", which is an international association of local governments and national and regional local government organisations that have made a commitment to sustainable development.

The IWCM Strategy Plan acknowledges Council's commitment to the Water Campaign™ and will support this commitment by providing strategic backing for:

- the completion of Milestone 2 (refer below) that involves the setting of Water Campaign™ goals; and
- the completion of Milestone 3 through recommending that the Water Campaign™ requirements are included in a Water Management Plan that draws together information from existing Council documents that would be complementary to the aims of the campaign such as the Demand Management Plan, Stormwater Management plan and the Council Development Control Plan (DCP).

Thus the IWCM strategy will provide strategic support in particular for the completion of Milestone 2 (goal setting) and Milestone 3 (Local Action Plan).

To achieve the milestones, the Water Campaign™ provides a framework to address the management of water resources on two levels - Water Quality and Water Conservation. MSC will address each of these modules on a further two levels:

1. Corporate: Improving water management within Council's own operations; and
2. Community: Improving water management in both residential and non-residential water use in the community.

A third module called the "Catchment Module" is currently being developed and piloted. This will be a framework for Councils to work with other Councils and stakeholders to address water management at the catchment level. Currently Muswellbrook Council is focusing on the Corporate and Community modules.

Each of the modules is addressed using a five step project management structure called the "milestone framework". This involves:

- Milestone 1 – the collation and analysis of water consumption data and undertaking an assessment of practices that influence water quality;
- Milestone 2 – the setting of water conservation and water quality improvement goals. These goals are endorsed by Council;

- Milestone 3 – the creation of a local action plan that sets out the strategies and outlines the detailed actions Council will take to achieve the goals. The plan is endorsed by Council;
- Milestone 4 – implementation of the action plan, including a quantitative and qualitative assessment and reporting of the implemented actions; and
- Milestone 5 – conducting a re-inventory to assess Council progress and ensure continuous improvement in water management practices.

These five milestones each have a set of requirements set by ICLEI to ensure that the work completed through them is to a certain standard and to allow ICLEI to aggregate the data on a state and national scale. MSC has achieved one milestone and is now working on milestones 2 and 3. Milestone 2 involves setting corporate and community reduction goals expressed as a percentage reduction compared with base year and sets a target year of achievement. Milestone 3 is the action plan to achieve the goal. The Local Action Plan will be a strategic document that provides context for the management of water both within Council operations and those of the community that draws together existing Council plans.

This IWCM Strategy Plan will contribute to the achievement of the Water Campaign™ goals.

9 Identified Data Gaps

As part of the IWCM Concept Study (refer Appendix A) a data audit involving the collection of background data and the identification of data gaps was undertaken. In order to progress the IWCM Strategy, measures were identified to address these gaps that would be undertaken prior to the first review of the IWCM strategy, which is due within 5 years of the Strategy Plan being completed.

A review of the status of these data gaps has been undertaken. A summary of this review and the original recommendations for addressing these gaps are presented in Table 9-1. Where the data gap has been resolved in the IWCM Strategy, this is discussed in Sections 10 and 11.

Table 9-1: Data gap review and summary.

Data Gap	Measures to Remedy Gap	Status of data gap
Limited data on distribution of soil type in the catchment.	CMA to undertake landscape investigation.	The IWCM Strategy Plan includes provision for assistance to the CMA for catchment management activities (refer Section 8.1). Council may choose to assist the CMA to fund catchment management projects through a levy implemented from the General Fund.
Limited groundwater quality data.	Set up a groundwater quality monitoring program with the assistance of the CMA and DWE.	
Limited data on soil degradation.	Collaborate with CMA to evaluate drivers and impacts.	
Details of pollution discharge status from industrial and agricultural activities and urban centres.	CMA to design and implement catchment quality management program.	
Limited information on acid soils.	Collaborate with CMA and DWE to evaluate drivers and impacts.	
Limited data for water quality assessment particularly, drinking water, aquatic food and secondary contact recreation.	CMA to develop and implement a water monitoring program.	
Inadequate consumption database customer categories. Current records divide customers into business, farmland, mining, residential, rural residential, strata plan and non rateable, limiting end use analysis.)	MSC to review the customer database and include a more detailed breakdown of customer categories including: industrial, motels, caravan facilities, schools, nursing homes and hospitals.	This will be considered during the preparation of the Demand Management Plan and the customer database will be modified accordingly.
Limited data on on-site sewerage management (location, condition, pump out, etc.)	MSC to review the audit conducted in 2003/04.	The IWCM Strategy Plan has considered measures to improve on-site system management including education programs, auditing and incentives to upgrade high risk systems.

Data Gap	Measures to Remedy Gap	Status of data gap
Stormwater quality data.	MSC to implement existing stormwater management plan including tracking stormwater data.	The IWCM Strategy Plan considers the implementation, review and update of the stormwater management plan as well as a levy to fund stormwater improvement works (refer Section 8.1).

10 IWCM Scenarios

10.1 Draft Scenarios

Having identified and evaluated a range of opportunities to manage each of the verified issues (Table 2-1) developed as part of the Concept Study, five draft scenarios were established.

These scenarios include:

- A "base" case (also known as "business as usual") which does not include any solutions beyond what MSC is already doing to improve or maintain the water supply and sewerage businesses;
- A "traditional" case based on traditional solutions that solve issues in an isolated, non-integrated way; and
- Three "integrated" solutions that incorporate combinations of various build and non-build options and an increasing level of integration of water supply, sewerage and stormwater management by including recycled water use and stormwater harvesting, among other options.

Tailoring the IWCM process in this way ensured that that a high number of potential options were investigated and assessed at the preliminary stage without compromising the ability of the final outcome to provide effective management solutions.

The previous chapters present various potential options to solve the issues. The potential options are summarised in Table 10-1. The options showing poor benefit:cost were not included in the draft scenarios. The draft scenarios are listed in Table 10-3.

Table 10-1: Potential Options.

Category	Options	Included in Scenarios [1]	Note
Demand Management	No demand management	B	
	DWE best practice two part pricing	T, 1, 2, 3	Mandatory
	Rainwater tanks under BASIX (for new development)	T, 1, 2, 3	Mandatory
	WELS (Water Efficiency Labelling and Standards)	T, 1, 2, 3	Mandatory
	Residential audit	1, 2, 3	
	Educational program for external use	1, 2, 3	
	Reduction in unaccounted for water (UFW)	1, 2, 3	
	Rainwater tank retrofit (for existing development)	No	Poor benefit:cost
	Shower head retrofit	No	Poor benefit:cost
	Dual flush toilet retrofit	No	Poor benefit:cost
	Water Conservation Order	No	Poor benefit:cost
	Business Audit	No	Poor benefit:cost

Category	Options	Included in Scenarios [1]	Note
Stormwater harvesting	Stormwater harvesting for all new development (Webber, Eastbrook, Northview, Highbrook)	3	
	Encourage individual developers/industry to implement stormwater harvesting	T, 1, 2	
Water Treatment Plant	MBK: as DSP (requirement 22 ML/d)	B	
	MBK: 19 ML/d, PAC	T	
	MBK: 18 ML/d, PAC	1, 2	
	MBK: 16 ML/d, PAC	3	
	DEN: as in DSP (requirement 4.2 ML/d)	No	Can not solve hardness and turbidity issue
	DEN: 3.5 ML/d, conventional filter, new plant	No	Capacity reduction due to demand management, alternative process not adopted by MSC.
	DEN: 3.5 ML/d, pressure filter, new plant	No	Capacity reduction due to demand management, alternative process not adopted by MSC.
	DEN: 3.5 ML/d membrane filter, new plant	No	Capacity reduction due to demand management, new plant alternative not adopted by MSC.
	DEN: 2.7 ML/d membrane filter, new plant	All	Phase 1 constructed in 2007.
	DEN: Future upgrade from 2.7 ML/d to 3.5 ML/d	T, 1, 2, 3	
	SH: as in DSP (Conventional filter and softening)	B, T	
	SH: 0.2 ML/d, pressure filter	1	
	SH: 0.2 ML/d, membrane micro filter	2, 3	
	SH: Groundwater well head protection	T, 1, 2, 3	
Water Storage	As in DSP (15 ML)	B, T	
	No additional storage required	1, 2, 3	Demand is reduced.

Category	Options	Included in Scenarios [1]	Note
Sewage Treatment Plant	MBK: DSP (secondary treatment 20,500 EP)	B	Can not solve issue
	MBK: 20,500 EP, secondary, refurbish old plant	No	No infiltration control
	MBK: 20,500 EP, new plant, secondary	No	No infiltration control
	MBK: 20,500 EP, new plant, tertiary	No	No infiltration control
	MBK: 16,500 EP, new plant, secondary treatment, infiltration control	T, 1, 2	
	MBK: 16,500 EP, new plant, tertiary treatment, infiltration control	No	Includes servicing new development areas.
	MBK: 15,000 EP, new plant, tertiary treatment, infiltration control, not servicing new development areas.	3	
	DEN: do nothing	B	Can not solve issue 1.
	DEN: plant refurbishment	No	No infiltration control
	DEN: new plant, 3,000 EP, secondary	No	No infiltration control
	DEN: new plant, 3,000 EP, tertiary	No	No infiltration control
	DEN: new plant, 2,500 EP, secondary, infiltration control	T, 1, 2	
	DEN: new plant, 2,500 EP, tertiary, infiltration control	3	
	SH: No sewer	B	
	SH: 150 EP, secondary treatment	T, 1	
	SH: 150 EP, tertiary treatment	2, 3	
Effluent management	MBK: Mine: to Mt Arthur Open Cut	B, T, 1	
	MBK: Golf course	B, T, 1	
	MBK: Mine: to Bengalla Open Cut	No	Final end user is not determined, so average cost is included.
	MBK: Mine: to Dartbrook Underground	No	
	MBK: Mine: to Bayswater Open Cut No. 2	No	
	MBK: Mine: to Drayton Open Cut	No	
	MBK: Mine: to Bayswater Open Cut No. 3	No	
	MBK: Mine: to Saddlers CK Open Cut	No	

Category	Options	Included in Scenarios [1]	Note
	MBK: Power: to Liddell Power Station	No	
	MBK: Average of all mines and power stations	2	
	MBK: Irrigation: to East of River, South of STP	No	Poor benefit cost
	MBK: Irrigation: to West of River, East of Bengalla	No	
	MBK: Irrigation: to West of River, North of Muswellbrook	No	
	MBK: Irrigation: to East of River, North of Muswellbrook	No	
	MBK: Vineyard	No	
	MBK: Municipal use	No	
	DEN: Golf course	B, T, 1, 2	
	DEN: Irrigation: East of Denman	No	Alternative end user, poor benefit:cost
	DEN: Irrigation: South of Denman	No	Alternative end user poor benefit:cost
	DEN: Municipal	No	Alternative end user poor benefit:cost
	SH: Municipal effluent reuse	T, 1	
	SH: Irrigation: North of River	No	Alternative end user poor benefit:cost
	Effluent Management Study	T, 1, 2, 3	
Dual reticulation	SH: Dual reticulation	2	
Indirect potable use	MBK: STP to river upstream of water supply intake	3	
	DEN: STP to river upstream of water supply intake	3	
	SH: STP to aquifer storage and recovery	3	
New mains extension (water)	As in DSP	All	
	MBK: to Milperra Rd	No	Council advised development not to be served
New mains extension (sewer)	MBK: As in DSP (growth in core area)	B	
	MBK: Modified cost for growth in core area (including infiltration reduction)	T, 1, 2, 3	
	MBK: Thomas Mitchell Drive	T, 1, 2	

Category	Options	Included in Scenarios [1]	Note
	MBK: Woodlands	No	Council advised too far from STP
	MBK: Racecourse Road	T, 1, 2	
	MBK: Do not provide town water service to new development areas	3	
	DEN: As in DSP (growth in core area)	B	Inadequate cost
	DEN: Modified cost for growth in core area	T, 1, 2, 3	
	DEN: West Denman	T, 1, 2	
	DEN: Do not provide town water service to new development areas	3	
	Sandy Hollow	T, 1, 2, 3	
Transmission (Water Supply)	From Denman to Sandy Hollow	No	Poor benefit:cost
Asset renewal	Renewals as SBP	B	Inadequate expenditure
	Modified mains renewal cost	T, 1, 2, 3	
	Renewal for pumps, bores, reservoirs and reticulation	T, 1, 2, 3	
Stormwater management	Do nothing	B	
	Implement stormwater management plan	T, 1, 2, 3	
Catchment initiatives	Do nothing	B	
	Implement SoE catchment initiatives	T, 1, 2, 3	
	Implement CMA catchment initiatives	1, 2, 3	
OMA costs	SBP OMA cost	B	Inadequate expenditure
	SBP OMA cost modified	T, 1, 2, 3	
	IWCM and SBP review	T, 1, 2, 3	
	Financial plan review	T, 1, 2, 3	
	Best practice audit	T, 1, 2, 3	
	Demand management plan	T, 1, 2, 3	
	Drought management plan	T, 1, 2, 3	
	Pricing review	T, 1, 2, 3	
	DSP review	T, 1, 2, 3	
	BASIX administration	T, 1, 2, 3	

Category	Options	Included in Scenarios [1]	Note
	Ongoing update of asset register	All	
	Residential audit program	1, 2, 3	
	Outdoor water use education program	1, 2, 3	
	Comprehensive algal management plan	1, 2, 3	
	Water supply contingency plan	1, 2, 3	
	Switch to Green Power	T, 1, 2, 3	
	Development of asset register	All	
	Water and wastewater training operator courses	All	
	Water meter replacement program	All	
	System metering	All	
	Asset condition review and evaluation	All	
	Denman water main flushing project	All	
	Improve mechanical maintenance program	All	
	Cleaning and painting reservoirs	All	
	Adjust accounting system to suit new pricing structure	T, 1, 2, 3	
	Employ Trade Waste Officer	T, 1, 2, 3	
	Education Program for On-site Sewage management	T, 1, 2, 3	
	HR management	T, 1, 2, 3	
	Education program for WSUD and indirect potable reuse	3	
	Liaison with CMA, DWE	1, 2, 3	
	Best-practice onsite management systems compliance	T, 1, 2, 3	
	Incentive for better on-site systems	2, 3	
	Groundwater monitoring (Sandy Hollow)	T, 1, 2, 3	
	Groundwater management plan (Sandy Hollow)	T, 1, 2, 3	
	Meet NSW heath guidelines for fluoridation	T, 1, 2, 3	

1. B - Base case, T – Traditional scenario, 1 (IN1) – Integrated 1 scenario, 2 (IN2) – Integrated 2 scenario, 3 (IN3) – Integrated 3 scenario.

The basis of the draft scenarios is listed in Table 10-2.

Table 10-2: Main components of Draft Scenarios.

Scenario	Demand Management	Stormwater Management	Effluent Management
Base Case	None.	None.	Continue mine reuse and golf course irrigation.
Traditional	Low level (WSP 1).	Implement stormwater management plan and encourage stormwater harvesting for existing industry and new developments.	Continue mine reuse and golf course irrigation. Effluent management study to determine most beneficial reuse option.
Integrated 1	High level (WSP 2).	Implement stormwater management plan and encourage stormwater harvesting for existing industry and new developments.	Continue mine reuse and golf course irrigation. Effluent management study to determine most beneficial reuse option.
Integrated 2	High level (WSP 2).	Implement stormwater management plan and encourage stormwater harvesting for existing industry and new developments.	Alternative reuse option for Muswellbrook (to be identified in effluent management study), continue golf course irrigation for Denman, dual reticulation for Sandy Hollow.
Integrated 3	High level (WSP 2).	Implement stormwater management plan and stormwater harvesting for new developments.	Indirect potable reuse from Muswellbrook and Denman STPs to river upstream of water supply intake and from Sandy Hollow to aquifer for recharge and recovery.

Each of the draft scenarios combines complementary management options to provide MSC with solutions to the water cycle management issues. The draft scenarios are summarised in Table 10-3.

Table 10-3: MSC Draft Scenarios.

Core Problem	Strategy	Base case (B) (04/05)	Traditional (T)	Integrated 1 (IN 1)	Integrated 2 (IN 2)	Integrated 3 (IN 3)
Demand and capacity requirements under each scenario *	Existing WTP Capacity (ML/d)	Muswellbrook (MBK) = 14.5, Denman (DEN) = 2.4, Sand Hollow (SH) = 0.2				
	Present peak demand (ML/d)	MBK = 14.4, DEN = 3.0, SH = 0.1				
	Ultimate (2035) projected peak demand (ML/d)	MBK = 21.7, DEN = 4.2, SH = 0.2	MBK = 19.2, DNM = 3.6, SH = 0.2	MBK = 18.2, DNM = 3.4, SH = 0.2	MBK = 18.2, DNM = 3.4, SH = 0.2	MBK = 16, DNM = 3.4, SH = 0.2
	Existing STP Capacity (EP)	MBK = 11,500, DEN = 2000, SH = 0				
	Ultimate (2035) projected STP Capacity required (EP)	MBK = 20.500, DEN = 3,000, SH = 0	MBK = 16,500, DNM = 2,500, SH = 0	MBK = 16,500, DNM = 2,500, SH = 150	MBK = 16,500, DNM = 2,500, SH = 150	MBK = 15,000, DNM = 2,500, SH = 150
1 The water supply and sewerage systems do not have sufficient capacity to service present needs and growth and are not expected to meet future licence conditions. The use of water resources within the shire is also inefficient due to high unaccounted for water, poor demand management and limited use of alternative water sources to minimise town water use.	Demand Management (Shire-wide)	MSC 2003 Demand Plan is not implemented	Pricing, WELS and BASIX (WSP 1)	Pricing, WELS, BASIX, UFW, residential audits, education (WSP 2)	Same as IN 1	Same as IN 1
	Water sensitive urban design - self-sufficient water supply (shire-wide)	None	Same as B	Same as B	Same as B	IWCM Development Control Policy (DCP) for all new development area to be self sufficient for water (except fire), sewerage and (some) stormwater management. (requiring NOT to connect to town water supply) Reduced peak demand 16 ML/d for MBK
	Stormwater harvesting	No change	Encourage individual developer / industry for stormwater harvesting (no cost to Council)	Encourage individual developer / industry for stormwater harvesting (no cost to Council)	Encourage individual developer / industry for stormwater harvesting (no cost to Council)	Stormwater harvesting for new developments (no water from town water supply under IWCM DCP)
	MBK WTP upgrade	WTP upgrade as DSP	WTP upgrade (capacity reduction due to demand management as in 1) Quality improvement through treatment process as in 12	WTP upgrade (further capacity reduction due to demand management) Quality improvement through treatment process as in 12	Same as IN 1	WTP upgrade (further capacity reduction due to IWCM DCP) Quality improvement through treatment process as in 12
	Additional reservoir	As SBP (15 ML)	Same as B	No additional storage required	Same as IN 1	Same as IN 1
	Sewer upgrade	As in DSP (Pumping Stations and new trunk mains to service growth in East and North MBK)	B (modified expenditure) + additional mains to service growth areas	Same as T	Same as T	Partial upgrade as new development areas not to be served
	MBK STP upgrade	Secondary only (as in DSP)	Secondary only (capacity reduction due to infiltration control as in 2)	Same as T	Same as T	tertiary treatment (additional capacity reduction IWCM DCP) (Advanced treatment for indirect potable reuse as effluent management of 3)
	DEN STP	Do nothing	New plant, secondary only (reduction due to infiltration control as in 2)	Same as T	Same as T	tertiary treatement (Advanced treatment for indirect potable reuse as effluent management of 3)
	SH sewerage system	No plans to provide SH with sewerage services	Provide sewerage to SH and municipal effluent reuse (secondary treatment only)	Same as T	Provide sewerage and dual reticulation (advanced treatment)	Provide sewerage and indirect potable reuse (through aquifer storage and recovery) (advanced treatment)

Core Problem		Strategy	Base case (B) (04/05)	Traditional (T)	Integrated 1 (IN 1)	Integrated 2 (IN 2)	Integrated 3 (IN 3)
2	There is insufficient renewals planning and investment that may cause operational issues, breach of DECC licence conditions and community service level expectations	Renewals planning	As in SBP	Development of condition based asset management plan (modified cost reflected in renewals investment)	Same as T	Same as T	Same as T
		Renewals investment	Renewal of mains only (as shown on the DSP)	Renewal of mains (modified expenditure to meet licence requirement and condition based asset management plan) + renewal of reticulation, pumps, reservoirs and bores	Same as T	Same as T	Same as T
3	Effluent reuse must be sustainable within the context of overall government and community strategic directions	Effluent management (MBK)	Continue existing Mine reuse and Golf Course	Effluent management study + Continue existing mine reuse and golf course reuse until most beneficial reuse option is determined through an effluent management strategy	Same as T	Alternative effluent reuse (at similar effluent quality)	Indirect potable reuse (highly treated effluent return to Hunter River upstream of the intake for MBK WTP)
		Effluent management (DEN)	Continue existing Golf Course	B + effluent management study	Same as T	Same as T	Indirect potable reuse (highly treated effluent return to Hunter River upstream of the intake for DEN WTPs)
		Effluent management (SH)	No sewerage	Municipal effluent reuse + effluent management study	Same as T	Dual reticulation	Indirect potable reuse (through aquifer storage and recovery)
4	Lack of resources to implement plans	Human Resources Provision	Insufficient resources to implement required projects and tasks.	Additional resources required for each new project / program proposed under the scenarios are included in the cost of the respective project / program.	T + additional project / program resources included as required.	IN 1 + additional project / program resources included as required.	IN 2 + additional project / program resources included as required.
5	Lack of education and assistance for demand management measures may result in increased risk of unsuccessful programs	Education	Minimal	Same as B	Education program included in demand management (as in 1)	Same as IN 1	IN 1 + education on water sensitive urban design and indirect potable reuse (cost included in OMA)
6	Need to ensure long term water supply security and allocation from Hunter River through appropriate provisions in the Water Sharing Plan	Liaison with CMA and DWE	None	Same as B	Liaison with CMA, DWE to ensure water supply is secure through Water Sharing Plan.	Same as IN 1	Same as IN1
7	Denman river extraction limited by existing infrastructure	DEN River extraction	Construction of river intake	Same as B	Same as B	Same as B	Same as B
8	Poor water supply quality (turbidity and hardness) at Denman	DEN WTP upgrade	New WTP	New WTP (with future capacity increase)	Same as T	Same as T	Same as T
9	Increase in per capita outdoor water use due to lower occupancy ratios	Development control planning	Taken into account in MSC provided growth projections	Same as B	Same as B	Same as B	Same as B
10	Unknown security and saline supply at Sandy Hollow	Security of supply	No change	No change	No change	Increase of security by dual reticulation reuse	Increase of security by indirect potable reuse
		SH WTP upgrade	As DSP (Conventional filter treatment + softening)	Same as B	B + add Pressure filter	IN1 + add Microfiltration and RO	Same as IN 2

Core Problem		Strategy	Base case (B) (04/05)	Traditional (T)	Integrated 1 (IN 1)	Integrated 2 (IN 2)	Integrated 3 (IN 3)
11	Lack of groundwater protection protocol for Sandy Hollow	Well protection	No change	Prepare GW management plan and Groundwater monitoring (cost included in OMA) + Well head protection	Same as T	Same as T	Same as T
12	Lack of comprehensive algal management protocol	Management plan	No change	No change	Develop comprehensive algal management plan (cost included in OMA)	Same as IN 1	Same as IN 1
		MBK and DNM water treatment	No change	Inclusion of PAC for quality improvement at MBK	T + membrane filter and softening at DEN	Same as IN 1	Same as IN 1
13	Water supply and environmentally sound sewage treatment processes at risk due to inadequate risk identification and emergency response strategy for water and sewer infrastructure	Contingency plan	No change	No change	Develop comprehensive water supply contingency plan (including human resources and flood impact) (cost included in OMA)	Same as IN 1	Same as IN 1
14	Need to improve septic systems management	On site systems	No change	Education program for better on-site septic system management and regular auditing (including increasing licensing of systems) (cost into general fund)	Same as T	Incentives for better on site technologies, upgrade of 800 high risk systems (identified in IWCM Concept report) over 5 years @ 1,000$/unit	Same as IN 2
		Best-practice onsite management systems compliance	No change	New systems to comply with best-practice on-site sewer effluent management policy as part of the approval condition	Same as T	Same as T	Same as T
		Sewer new growth (SH)	Do not provide sewer	Sewer SH	Same as T	Same as T	Same as T
		Sewer new growth (DEN)	As SBP	Provide sewer service to DEN new growth and core area growth	Same as T	Same as T	Do not provide sewer service to new development area (new DCP)
		Sewer new growth (MBK)	As SBP	Provide sewer to MBK new growth and core area growth	Same as T	Same as T	Do not provide sewer service to new development area (new DCP)
15	Poor catchment management practices, urban stormwater, effluent discharges, over-extraction and salinity have affected water quality in rivers	SMP	No change	Implement Stormwater Management Plan (and update when required) and impose levy	Same as T	Same as T	Same as T
		Catchment initiative	No change	Implement SoE catchment initiatives	T + Support CMA to implement catchment initiatives	Same as IN 1	Same as IN 1
		Trade waste plan	No change	Trade waste officer to review, manage and implement trade waste policy (cost included in OMA)	Same as T	Same as T	Same as T
		Stormwater harvesting	As in 1				
		Demand Management	As in 1				
		Effluent management	As in 3				
16	Insufficient fluoridation to meet NSW Health guidelines	Fluoridation	No change	Meet NSW heath guidelines (no cost added as dose change will cause little cost variation)	Same as T	Same as T	Same as T

* Demand requirements have been determined from the DSS model, refer Appendix C.

10.2 Financial Analysis

A capital works program, OMA schedule (Appendix G) and financial model (Appendix H) was set up for each IWCM scenario in order to compare levels of expenditure and typical residential bills (TRB) to be paid by water and sewerage customers under each IWCM scenario. This enabled the IWCM scenarios to be compared in terms of TRB, a key social criteria identified by the PRG.

In the capital works programs, the projects are classified as improved level of service (ILOS), growth (new system assets) or renewals. ILOS works are those required to achieve the agreed level of service or meet regulatory requirements. New system assets are those that serve new growth. Renewals expenditure is discussed in Section 6.1. The three categories are usually funded from different sources (i.e. grants, annual bills, developer contributions and cash). The capital works and OMA expenditure for each scenario is given in Table 10-4. The financial analysis is included in Appendix H.

Table 10-4: Capital and Recurrent (OMA) Expenditure for the Draft Scenarios.

Component	Water Supply 30 year Capital Works Program (05/06 $'000)	Water Supply 30 year OMA Expenditure (05/06 $'000)	Sewerage 30 year Capital Works Program (05/06 $'000)	Sewerage 30 year OMA Expenditure (05/06 $'000)
Base Case	28.7	85.2	27.1	60.0
Traditional	36.2	101	61.1	97.5
Integrated 1	33.6	110	61.1	97.5
Integrated 2	34.3	110	68.9	109
Integrated 3	33.4	108	65.9	114

10.3 Stakeholder Review

As they will be critical to the successful implementation of the IWCM Strategy, stakeholders were invited to participate in the process of reviewing and selecting a scenario for implementation. As discussed in Section 2.2, a second PRG workshop was held to:

- Review the solutions proposed to address the identified issues;
- Discuss the draft scenarios;
- Evaluate the draft scenarios considering the social, economic and environmental costs and benefits of each scenario; and
- Identify a preferred scenario or preferred scenario components.

Prior to the workshop, participants were issued with a project briefing paper (refer Appendix B).

10.4 Triple Bottom Line Assessment

Consistent with the DWE IWCM framework, the scenarios developed were ranked based on their performance against a series of economic, social and environmental criteria (a Triple Bottom Line assessment). The methodology and outcomes of this assessment for MSC is detailed in the following sections.

Triple Bottom Line (TBL) assessment is an approach of assessing individual or bundled management options against a set of social, environmental and economic criteria. It is possible to develop many environmental and social criteria upon which to measure the appropriateness of the management options. However, for practical purposes, it is necessary to identify key criteria which best represent local values.

The inputs of the PRG, government agencies and MSC staff, as part of the community consultation process were utilised to determine a set of triple bottom line assessment criteria for MSC (refer Appendix B, Appendix G and Section 2.2). Each of the three scenarios were ranked, using the TBL criteria developed by the PRG, to assess the relative desirability of the outcomes from implementing the different scenarios.

Based on the criteria set, each option was assigned an environmental score and a social score and weightings for each measure were assigned by the PRG members. In order to rank the relative TBL performance of each option, the environmental and social scores for each option were summed and then divided by the net present value of the option. Ranking each option in this manner provides a measure of how many positive social and environmental outcomes every dollar invested would buy. Hence, this process provides an opportunity to assess the relative desirability of the outcomes of implementing different scenarios.

A ranking of the draft scenarios was presented to the PRG in the second PRG workshop (refer Appendix B and Appendix G).

11 Preferred Scenario

The preferred scenario for MSC's water, sewerage and stormwater businesses was determined through consultation with the PRG, steering committee meeting and TBL assessment.

Based on the results of the consultation program and the scenario ranking, Integrated 1 was identified as the preferred scenario for implementation. This section summarises the preferred scenario and the method for its implementation.

Table 11-1: Finalised Preferred Scenario

No.	IWCM Issue	Strategy	Preferred Scenario
1	The water supply and sewerage systems do not have sufficient capacity to service present needs and growth and are not expected to meet future licence conditions. The use of water resources within the shire is also inefficient due to high unaccounted for water, poor demand management and limited use of alternative water sources to minimise town water use.	Demand Management (Shire-wide)	Pricing, WELS, BASIX, UFW, residential audits, education (WSP 2).
		Water sensitive urban design - self-sufficient water supply (shire-wide)	None.
		Stormwater harvesting	Encourage individual developer / industry for stormwater harvesting.
		MBK WTP upgrade	WTP upgrade to 18.2 ML/d. Quality improvement through treatment process as in 12.
		Additional reservoir	No additional storage required.
		Sewer upgrade	Pumping stations and new trunk mains to fully service growth in East and North Muswellbrook.
		MBK STP upgrade	Secondary treatment (capacity 16,500 EP).
		DEN STP	New plant, secondary treatment (capacity 2,500 EP).
		SH sewerage system	Provide sewerage to SH and municipal effluent reuse (secondary treatment, capacity 150 EP).
2	There is insufficient renewals planning and investment that may cause operational issues, breach of DECC licence conditions and community service level expectations	Renewals planning	Development of condition based asset management plan.
		Renewals investment	Renewal of mains, reticulation, pumps, reservoirs and bores to meet licence requirement and condition based asset management plan.
3	Effluent reuse must be sustainable within the context of overall government and community strategic directions	Effluent management (MBK)	Continue existing mine reuse and golf course reuse until most beneficial reuse option is determined through an effluent management strategy.

No.	IWCM Issue	Strategy	Preferred Scenario
		Effluent management (DEN)	Continue existing golf course reuse and develop an effluent management strategy.
		Effluent management (SH)	Municipal effluent reuse with provision of reticulated sewerage.
4	Lack of resources to implement plans	Human Resources Provision	Additional resources required for each new project/program proposed are included in the cost of the respective project/program.
5	Lack of education and assistance for demand management measures may result in increased risk of unsuccessful programs	Education	Education program included in demand management (as in 1).
6	Need to ensure long term water supply security and allocation from Hunter River through appropriate provisions in the Water Sharing Plan	Liaison with CMA and DWE	Liaison with CMA, DWE to ensure water supply is secure through Water Sharing Plan.
7	Denman river extraction limited by existing infrastructure	DEN River extraction	Construction of river intake.
8	Poor water supply quality (turbidity and hardness) at Denman	DEN WTP upgrade	New WTP (with future capacity increase)
9	Increase in per capita outdoor water use due to lower occupancy ratios	Development control planning	Taken into account in MSC provided growth projections.
10	Unknown security and saline supply at Sandy Hollow	Security of supply	No change.
		SH WTP upgrade	Upgrade WTP with pressure filter and softening.
11	Lack of groundwater protection protocol for Sandy Hollow	Well protection	Prepare groundwater management plan, monitoring program and well head protection.
12	Lack of comprehensive algal management protocol	Management plan	Develop comprehensive algal management plan.
		MBK and DEN water treatment	Inclusion of PAC for quality improvement at MBK and membrane filter and softening at DEN.
13	Water supply and environmentally sound sewage treatment processes at risk due to inadequate risk identification and emergency response strategy for water and sewer infrastructure	Contingency plan	Develop comprehensive water supply contingency plan (including human resources and flood impact).

No.	IWCM Issue	Strategy	Preferred Scenario
14	Need to improve septic systems management	On site systems	Education program for better on-site septic system management and regular auditing (including increasing licensing of systems).
		Best-practice onsite management systems compliance	New systems to comply with best-practice on-site sewer effluent management policy.
		Sewer new growth (SH)	Provision of reticulated sewerage.
		Sewer new growth (DEN)	Provide sewer service to DEN new growth and core area growth.
		Sewer new growth (MBK)	Provide sewer to MBK new growth and core area growth.
15	Poor catchment management practices, urban stormwater, effluent discharges, over-extraction and salinity have affected water quality in rivers	Stormwater Management Plan	Implement Stormwater Management Plan (and update when required) and impose levy.
		Catchment initiative	Implement State of the Environment Report and support CMA to implement catchment initiatives.
		Trade waste plan	Trade waste officer to review, manage and implement trade waste policy.
		Stormwater harvesting	As in 1
		Demand Management	As in 1
		Effluent management	As in 1
16	Insufficient fluoridation to meet NSW Health guidelines	Fluoridation	Meet NSW heath guidelines.

11.1 Implementation

This IWCM Strategy has set the future direction for MSC by addressing a number of priority issues identified by MSC staff, government agencies and the local community.

The implementation of the preferred scenario is reliant on MSC's commitment to the capital works programs developed as part of this Strategy, as well as its ability to maintain financial stability over the next thirty years. Hence, the capital works programs (Appendix D) and financial model (Appendix E) of the preferred scenario have set the direction for MSC's Strategic Business Plan (SBP). The capital works and OMA programs presented will be reviewed during the development of the MSC SBPs and financial plans in order to finalise the price path and funding requirements. MSC will need to continuously develop, implement and review the components of this Strategy to ensure it is successful.

The major water supply capital works expenditure is to occur around 2008-2010 with the Muswellbrook water treatment works augmentation. A government grant of $1,345,672 under the Country Towns Water Supply and Sewerage program has been assumed for the Denman water treatment plant augmentation.

The major sewerage capital works expenditure is to occur around 2008/09 with the Muswellbrook and Denman sewerage scheme augmentation. No government grants have been assumed.

Where possible, the capital works program and recurrent expenditure is funded through existing cash levels which is determined by the amount of income generated from bills (TRB). Where planned expenditure exceeds the available cash levels, loans will be required.

The current TRB needs to increase to meet the operation and maintenance costs of the proposed new capital works items. A financial plan is required to determine the most appropriate medium term price paths and funding scenarios.

A summary of the financial implications of the preferred scenario is given in the following tables and figures.

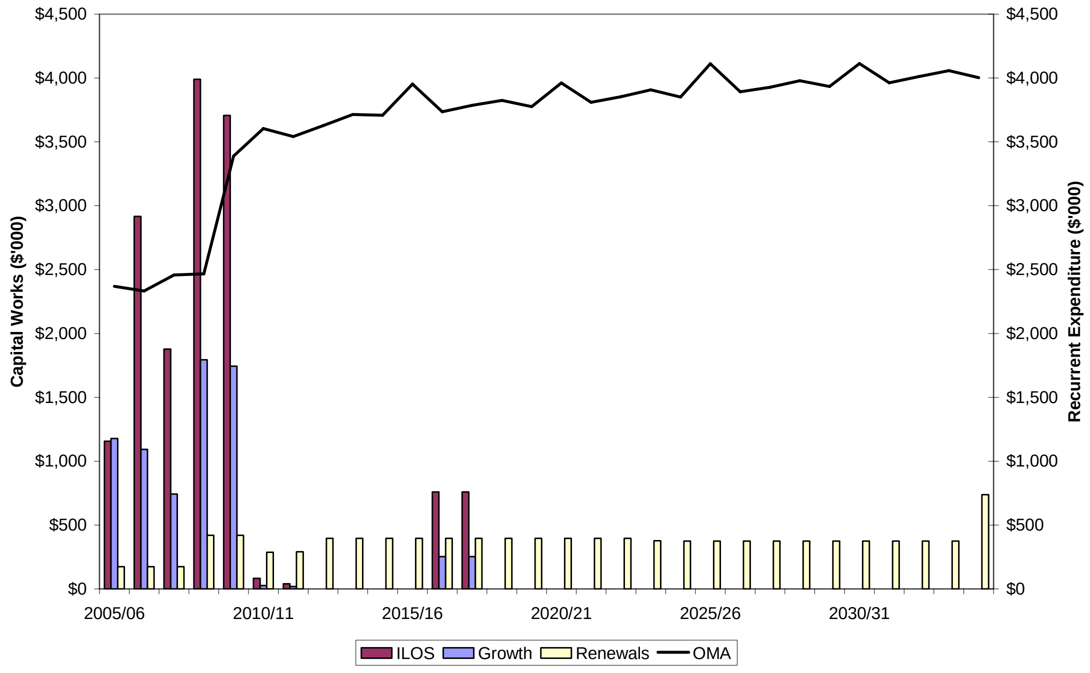
Table 11-2: Capital and Recurrent (OMA) Expenditure – Integrated 1.

Component	30 year Capital Works Program (05/06 $'000)	30 year OMA Expenditure (05/06 $'000)
Water Supply	33.5	110
Sewerage	61.1	97.5

Table 11-3: Typical Residential Bills (TRB) – Integrated 1.

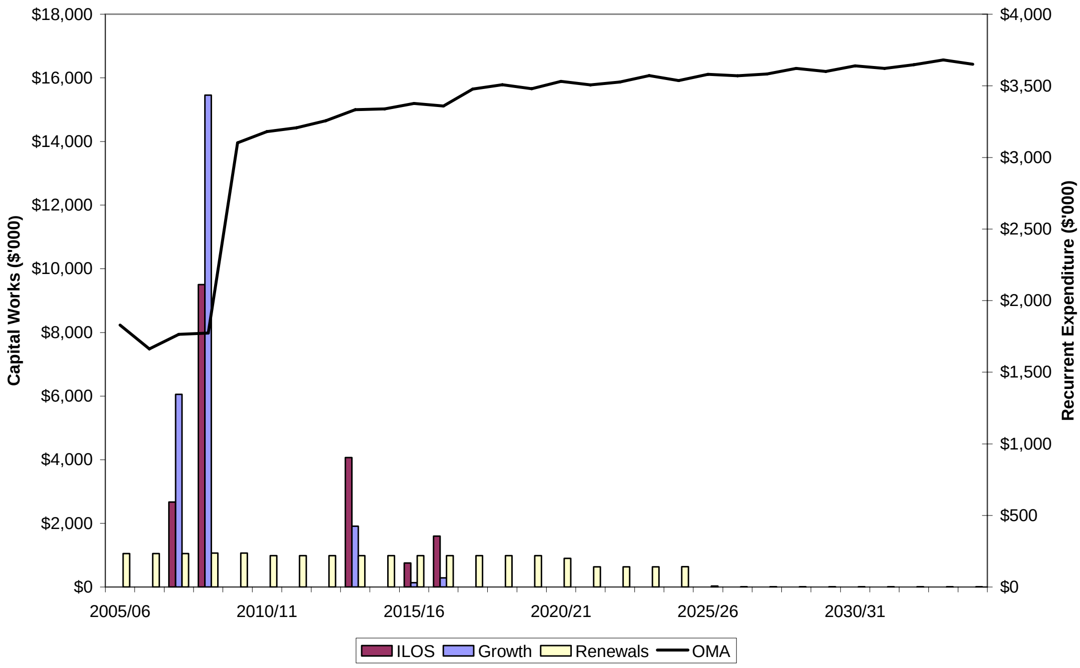
Component	Typical Residential Bill (05/06 $ per assessment)	Typical Residential Bill (06/07 $ per assessment)
Water Supply	620	640
Sewerage	890	910

Figure 10: Water Supply Capital and Recurrent (OMA) Expenditure – Preferred Scenario [1].



1. Capital works have been divided into works for improved levels of service (ILOS), growth and renewals (refer Section 2.5)

Figure 11: Sewerage Capital and Recurrent (OMA) Expenditure – Preferred Scenario [1].



1. Capital works have been divided into works for improved levels of service (ILOS), growth and renewals (refer Section 2.5)

11.2 Best-Practice Management

IWCM is just one of the eight Best-Practice criteria set by DWE which aims to promote the long-term sustainability of LWUs and their water and sewerage businesses. The progress of MSC in meeting each of these criteria and their relationship with this IWCM Strategy is set out in Table 11-4.

Some of these reports will require updating now that the IWCM Strategy has been completed to incorporate relevant changes.

Table 11-4: MSC's Best Practice Management Progress.

DWE Best Practice Management Criteria	Relationship to this IWCM Strategy	Action
Strategic Business Plan	The preferred scenario and capital works programs developed in the IWCM Strategy will be used to set the direction of MSC and form the basis of MSC's strategic business plan.	To be updated.
Financial Plan	The preferred scenario and capital works programs developed in the IWCM Strategy were used as inputs into the FINMOD analysis.	Attached in Appendix E. To be updated as part of Strategic Business Planning.
Best-Practice Pricing	Included as a demand management measure in demand analysis. Requires updating to reflect the IWCM Strategy capital works program and financial plan.	To be updated.

DWE Best Practice Management Criteria	Relationship to this IWCM Strategy	Action
Demand Management Plan	Results from the demand analysis (refer Section 3) will be used in developing MSC's demand management plan.	Currently being prepared.
Drought Management Plan	Demand analysis and results of IWCM Concept Study will be used in the development of MSC's drought management plan.	Currently being prepared.
Development Servicing Plan	The capital works programs and financial plan developed in the IWCM Strategy will be used as inputs into MSC's development servicing plans.	To be updated.
IWCM	This IWCM Strategy Plan completes the second phase of the IWCM process. Results from the Concept Study were used in the development of this document.	Refer to MSC's IWCM Concept Study (Appendix A) and this document.
Reporting	MSC must provide reporting information annually to DWE, in order to assess MSC's progress at achieving a sustainable business.	Ongoing.

11.3 Monitoring and Review

Monitoring is an essential part of the IWCM process to ensure that the management strategies which have been identified as part of this study have been successful at addressing the water cycle issues. In addition to this, it is important that any new or changes in severity of individual issues are documented and appropriate changes made to the Strategy document, capital works program and financial plan. In addition, MSC will review the need to implement components of Integrated 2 and 3 (including dual reticulation and indirect potable reuse) to determine if additional, more integrated measures are required to solve the identified IWCM issues.

It is recommended that this document should be reviewed in 2012 and every five years afterwards on an ongoing basis.

However, annual reviews should take place in the form of DWE Reporting which should provide an indication of the success of MSC's IWCM Strategy and the other Best-Practice planning documents in achieving sustainability and progress in meeting MSC's business goals and social and environmental responsibilities.

12 Qualification

1. In preparing the report and estimate of costs JWP has exercised the degree of skill and care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering design principles.

2. JWP has used all reasonable endeavours to inform itself of the parameters and requirements of the project and has taken all reasonable steps to ensure that the report and costs estimate is as accurate and comprehensive as possible given the information upon which it is based.

3. It is not intended that this report and costs estimate represent a final assessment of the feasibility of the project.

4. JWP reserves the right to review and amend all calculations, cost estimates and/or opinions included or referred to in the report if:

   (a) additional sources of information not presently available (for whatever reason) are provided or become known to JWP; or

   (b) JWP considers it prudent to revise the estimate in light of any information which becomes known to it after the date of submission.

5. The report and cost estimate are preliminary only and restricted in that certain information is obtained from external sources and has not been independently verified.

6. JWP does not give any warranty nor accept any liability in relation to the completeness or accuracy of the report and cost estimate.

7. If any warranty would be implied whether by law, custom or otherwise, that warranty is to the full extent permitted by law excluded.

8. All limitations of liability shall apply for the benefit of the employees, agents and representatives of JWP to the same extent that they apply for the benefit of JWP.

9. This report and cost estimate is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report and cost estimate.

10. If any claim or demand is made by any person against JWP on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report and cost estimate or information therein, JWP will rely upon this provision as a defence to any such claim or demand.

13 References

Department of Energy, Utilities and Sustainability (DEUS) 2004, *Integrated Water Cycle Management Guidelines for NSW Local Water Utilities*.

Department of Energy, Utilities and Sustainability (DEUS) 2004b, *Best-Practice Management Guidelines for NSW Local Water Utilities.*

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Muswellbrook Shire Council (MSC) 2006c, Population Projection electronic file titled "*BM Population Growth 2005-35a rev 2.xls*", supplied in August, 2006.