NSW Department of Commerce

DEPARTMENT OF ENERGY, UTILITIES AND SUSTAINABILITY
NEW SOUTH WALES GOVERNMENT

Bonalbo Long Term Water Supply and Drought Strategy

Water Cycle and Strategic Planning

Prepared by Department of Commerce (formerly Department of Public Works and Services)

Date: July 2005

Report No.:05120

FORWARD

This Long Term Water Supply and Drought Strategy Report has been prepared by the New South Wales Department of Commerce (formerly Department of Public Works and Services) for the Department of Energy, Utilities and Sustainability (formerly Department of Land and Water Conservation) and Kyogle Council.

The Department of Commerce acknowledges the significant contribution made by the Kyogle Council project team led by Graham Kennett.

Issue No.	Version	Document Status	Date
1	Bonalbo LTWS Draft01.doc	First Draft	15th March 2005
2	Bonalbo LTWS Draft05.doc	Final Draft	18th May 2005
3	Bonalbo LTWS Final.doc	Final	22nd July 2005

PROJECT TEAM

The core Department of Commerce project team involved in the preparation of the Bonalbo Long Term Water Supply and Drought Strategy included:

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NOTE

Under the Public Sector Employment and Management (General) Order of 2nd April 2003 the Department of Public Works and Services (DPWS) was abolished and its branches transferred to the Department of Commerce.

EXECUTIVE SUMMARY

Introduction

Water is a precious natural resource essential for the maintenance of ecosystems and all human activities. New South Wales is now at the limits of its available water resources and the existing nature of our groundwater, rivers and estuaries provides clear evidence that they are undergoing environmental degradation and stresses. New water legislation has been introduced to provide for the sustainable and integrated management of the State's water resources, so as to protect water for present and future generations.

In 2002, Kyogle Council sought and gained subsidy for the upgrading and drought management of the water supply at Bonalbo. The work covered by the subsidy includes:

- Dam safety;
- Investigations into water treatment and preparing D&C Contract;
- Update the long term supply strategy and
- Review the drought strategy.

This report covers the update and renewal of the long term supply strategy and a review of the drought strategy, based on the findings included in this report.

This study aims to provide Kyogle Council with a vision for the future long term management of Bonalbo village's water services, such that the water services are managed in an ecologically sustainable manner. This study uses integrated water cycle planning as an innovative planning approach for reviewing the management of the urban water services. The report examines long term supply options to improve the drought security of the existing water supply to meet current and future urban growth requirements. The strategy is long term in its outlook, (30 years), but flexible, affordable, and economically, environmentally and socially responsible.

The broad objectives of this strategy are to achieve more efficient water use, to reduce environmental impacts from water diversions, reuse, treatment and discharges, increase drought security and to reduce long term costs of water services for the Bonalbo village residents and businesses.

The Issues

This study provides an analysis into the urban water demands for Bonalbo. As a part of this analysis, the historic and current population and tenement numbers were used to forecast future demographic projections. The current average and peak day water demands together with the demographic projections and other relevant information have been used to estimate the future urban water demands for Bonalbo from 2001 until 2034.

As directed by Council, the strategy study is based on a projected population growth rate of 0.5% p.a. as reported in the Bonalbo Water Supply Augmentation Strategy Report, Report No. 97113 September 1998 and updated to include the 2001 Census figures. Of particular importance for management of the water services in Bonalbo village is the future urban population growth and the resulting fresh water needs and sewage discharges. In view of the lack of significant population growth pressures in Bonalbo and under the advice of Kyogle Council, this report initially investigated four population growth rates of 0.5% p.a., 0.0% p.a., -0.8% p.a. and 1.0% p.a. with an occupancy ratio of no less than 2.45 people per occupied dwelling. After considering the results of these growth rates, Council directed that only static and positive growth rates should be investigated further in the development of water management options. Table S-1 gives a summary of the population statistics and water consumption for the growth scenarios investigated within this study.

Table S - 1: Summary of Population Statistics and Water Usage

		1991	1996	2001	2004	2021	2034
ABS	**Population**	420	379	347			
	Occupied Tenements	139	139	134			
1998 Strat.	**Population**	448		465		515	550[1]
	Occupied Tenements			165		185	197[1]
0.0%	**Population**			347	347	347	347
	Occupied tenements			130	130	130	130
0.5%	**Population**			**347**	**352**	**378**	**401**
	Occupied tenements			**130**	**133**	**150**	**164**
1.0%	**Population**			347	356	413	464
	Occupied tenements			130	135	163	188
Unrestricted Average Annual Demand[2] (ML/year)					49.6	49.4 (46)[3]	50.0
Drought Demand (ML/year)[2]					63.3	68.2	72.1
Average Year Peak Day Demand[2] (kL/day)					240	250 (278)[3]	250
Drought Peak Day Demand[2] (kL/day)					240	260	280
Proposed Water Treatment Plant Capacity[4] (kL/day)							300

[1] *Extrapolated from 1998 Strategy demographic forecasts*
[2] *Using 0.5%p.a. Population Growth Scenario*
[3] *1998 Strategy demand estimates*
[4] *2004 WTP Concept Design Report*

At Councils direction the following assumptions and projections were used:

- 0.5%p.a. population growth was assumed, leading to a projection that the population will grow from 347 in 2001 to 401 in 2034,
- It is projected that the total residential dwelling number in Bonalbo will grow from 155 dwellings in 2001 to about 194 dwellings in 2034. This indicates a change in the occupancy rate.

The objectives of this strategy are to:

- Identify key water cycle issues within the catchment and urban planning context
- Identify water supply opportunities and integrated water management options that achieve the best balance between environmental, social and economic values.

During this study the water supply and water cycle issues relating to Bonalbo village were reviewed. Water supply issues were reviewed from the perspective of increasing the security of supply and water cycle issues from the perspective of legislative compliance, catchment and urban water management, urban planning and infrastructure performance. The issues are discussed in detail in Section 2.0 of this report.

The yield analysis using 100 years of stream flow records has estimated that under current extraction license conditions the secure yield of the existing headworks is between 25ML/year to 60ML/year depending on the accuracy of the modelled rural water demand diversions (see section 2.3.2 page 14). This confirms that the secure yield of the existing water supply headworks under current extraction license conditions is less than the current annual urban water demands and further less than the estimated unrestricted urban water demand. The analysis also indicated that if license conditions were amended to be consistent with the Water Management Act principles then the secure yield of the existing headworks would be halved for the 95/30 access condition. The shortage in yield is not due to the magnitude of the available water resources but due to the shortage in storage capacity to retain water for use during low creek flows and the limited pump capacity of Pump Station 1. To meet this shortfall in secure yield and to provide for the future urban water demands, a number of supplementary supply options were evaluated, such as:

- Upgrading the capacity of Pump Station 1
- Groundwater investigation of Bonalbo area and utilisation of bores
- Rainwater tank optimisation
- Water cartage
- Raising the dam wall
- Pipeline connection to the Clarence River and other transfers

Water Management Opportunities

All available water supply opportunities and management options were identified and screened in consultation with Council staff. This shortlisting of water supply sources and supply opportunities can be found in Appendix J. The basis for the shortlisting and acceptability of opportunities is discussed within Appendix B. The shortlisted water sources and management opportunities were then evaluated and assessed from a Triple Bottom Line (TBL) perspective. The shortlisted water sources and supply opportunities were then combined using a bundling process to form integrated water management options. Due to the nature of the existing regional stormwater and wastewater 100% reuse in Bonalbo; the potential for expansion and integration is limited. The bundled management options differ little from the higher ranked water supply opportunities.

The issues relating to existing water services infrastructure and their current management have been reviewed in Section 2.0. Water management opportunities and integrated options have been formulated in order to assist Council in the future management of the water supply and water cycle. Table S - 2 shows the integrated water management options and the opportunities/components that form each option. The traditional option indicates how the water services at Bonalbo village would have been managed in the absence of this Water Management Strategy. The traditional option is provided as a baseline or comparison of the integrated water management options developed in this strategy. As one moves left to right more opportunities are integrated within the water cycle and the social and environmental benefits accumulate with a consequent reduction in fresh water extractions, wastewater discharge and more land-based reuse of the effluent and stormwater. The water supply opportunities and integrated water management options are discussed in Section 3.0.

Table S - 2: Integrated Water Management Options

		Integrated Options					
		1 (Traditional)	2	3	4	5	6
Waterwise Education		✓	✓	✓	✓	✓	✓
Comprehensive Demand Management Program		✓	✓	✓	✓	✓	✓
Upgrade capacity of PS1		✓	✓	✓	✓	✓	✓
Rainwater Tank Optimisation for village area		-	-	✓	✓	✓	✓
WSUD for new developments		-	-	-	-	-	-
Raw water for residential garden watering (Dual reticulation - Peak day supply (ML/day))		-	-	-	✓	-	-
Reclaimed Water Reuse	*Urban Open Space*	✓	✓	✓	✓	✓	✓
	Agricultural	-	-	✓	✓	✓	✓
	Environmental Reuse – flow	✓	✓	✓	✓	✓	✓
	Environmental reuse - wetland	-	-	-	✓	✓	✓
Stormwater Reuse	*Bowling green*	✓	✓	✓	✓	✓	✓
	Environmental Reuse – Peacock Creek	✓	✓	✓	✓	✓	✓
Water Carting		-	-	✓	✓	-	-
New Groundwater Supply		✓	✓	-	-	-	✓
Current peak day reticulated potable water demand (ML/d)		0.24					
Future Peak day reticulated water demand (ML/d)		0.27	0.19	0.08	0.13	0.1	0.19

The above table shows that as one moves from left to right more opportunities are integrated to the water cycle and the social and environmental benefits keep accumulating with the consequent reduction in freshwater extractions and wastewater discharges and more land-based reuse of the effluent and stormwater.

Table S - 3 provides the environmental, social and economic rank of each option based on the consistent application of the qualitative TBL assessment criteria developed for this study. The TBL assessment criteria are shown in Table B-1 in Appendix B.

Table S - 3: Integrated Options ranked by Triple Bottom Line assessment

	Opportunity					
	1	**2**	**3**	**4**	**5**	**6**
Functional Rank	1	1	4	6	4	1
Technical Rank	4	3	4	4	1	1
Environmental Rank	4	1	4	1	4	3
Social Rank	3	2	3	6	5	1
Political Rank	3	1	3	6	3	1
Economic Rank	2	2	6	5	2	1
Total	52	57	49	42	52	62
OVERALL RANK	**3**	**2**	**5**	**6**	**3**	**1**

All of the supply sources have been evaluated and assessed from a TBL perspective, to identify the preferred supply source and assist in the development of a preferred combination. Based on consistently applying the TBL assessment criteria, the best ranked supply option is a new groundwater source in combination with optimisation and augmentation of existing supply sources and infrastructure. Figure ES - 1 is a diagram of the preferred opportunity.

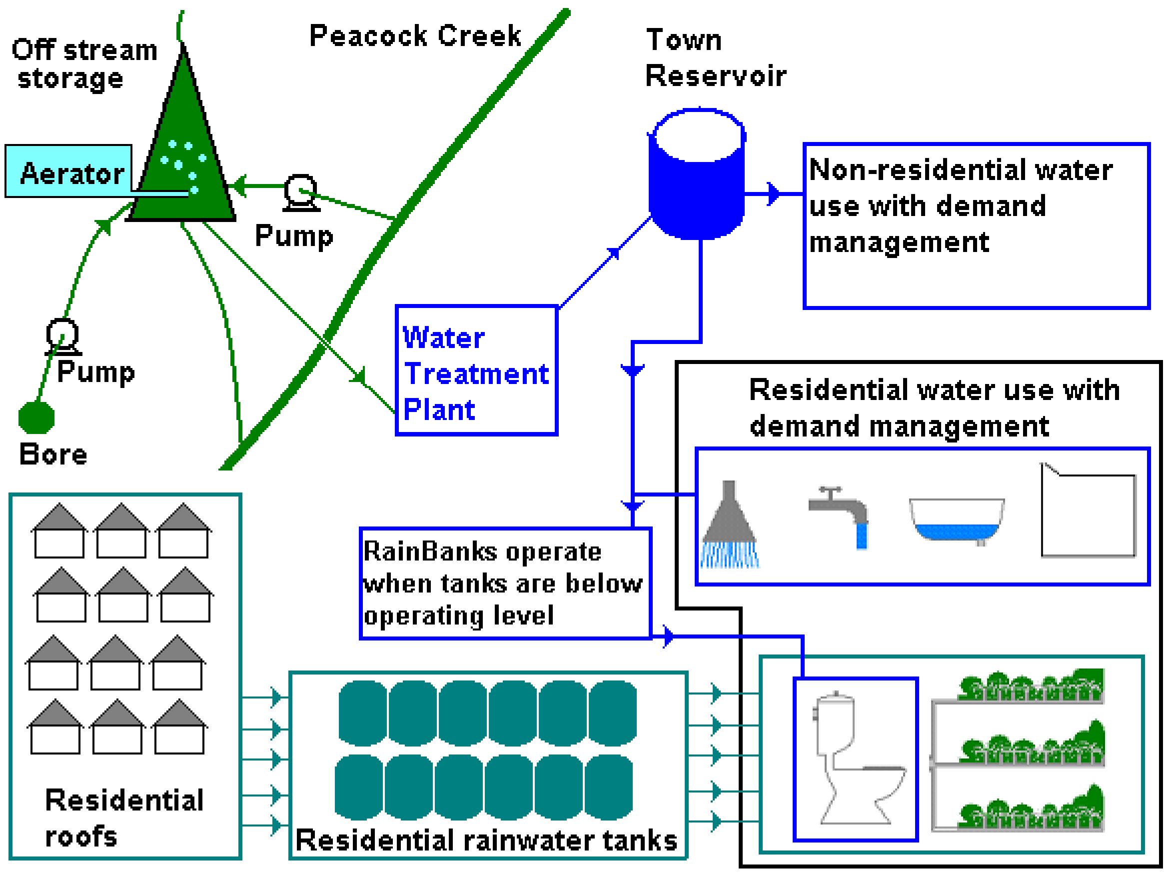

Figure ES - 1: Diagram of preferred integrated water supply opportunity

In summary the development of this source would require the following major infrastructure works:

- Bore(s) for groundwater extraction
- Pipeline to dam and intake
- Optimisation of rainwater tanks
- Demand management program
- Water filtration plant
- Power supply
- Telemetry

Other suggested options which Council may consider as supplementary to the findings of this study include:

- Upgrading of Peacock Creek raw water pump station (PS1) and installation of weir pool,
- Upgrading of the capacity of pump station 1,
- Relocation of pump station 1 to upstream of the river gauge to capture flows recorded at gauge but not observed at the existing extraction location and
- Study of groundwater/Peacock Creak flows between gauge and extraction point.

To realise and sustain the environmental, social and economic benefits and outcomes, Council requires both the physical assets discussed above and non-structural solutions. The non-structural solutions include:

- Community education and participation
- Coordinated dwelling and population growth, dwelling type, rate database, strategic operational data and asset management systems
- Common water fund and appropriate pricing policies
- Environmental, OH&S and public health monitoring programs and systems

Although this strategy has been developed for a planning period of 30 years, the strategy review cycle should be every 5 years and not greater than 10 years.

Indicative costs for the opportunities identified above have been provided by Kyogle Council and are shown in Table S-4. These preliminary estimates are to be used for financial modelling and should be checked by a quantity surveyor prior to allocating budgets for their implementation.

Table S - 4: Preliminary Estimates for Water Supply Opportunities

Item Description	Cost Estimate*	Notes
Construct and commission bore/s for groundwater supply	$96,000	Estimate taken from the *Kyogle Council Water Services Drought Management Plan, June 2005.* Includes drilling and sleeving, power supply, pump supply and installation, and rising main to dam if required.
Provision of individual rainwater Tanks	$182,000	Estimate of $3,500 per installation, including connection to toilet for flushing. Cost estimate to Council assumes a rebate of $1,000 per connection based on the existing 182 connections taken from Table 2-3.
Demand Management Program	$15,000 pa for five years, then $3,000 pa ongoing	Includes all residential and non-residential components discussed in this report, including education programs
Water Filtration Plant	$1,100,000	Includes dam destratification unit, estimate based on the 0.3ML/d capacity taken from the *Bonalbo Water Treatment Plant Concept Design Report July 2004*
Peacock Creek Pump Station Upgrade	$70,000	Estimate includes upgrade to meet OH&S requirements, as well as an upgrade in capacity to 5L/s, but not construction of any weir.
Provision of Telemetry	$25,000	Based on five sites at $5,000 each. Assumes power supply already provided, and electrical cabinets have room for telemetry equipment.

*Figures shown are in 2005 dollars and exclude any GST components

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1 INTRODUCTION

1.1 Location of Bonalbo

Kyogle Council (KC) is located in the North Coast Hinterland region of north-eastern New South Wales (NSW). Figure 1-1 shows the regional location of Kyogle, Bonalbo and KC.

KC services an area of approximately 3,589 km^2 and adjoins the Beaudesert Shire in Queensland and the Northern Rivers Shires of Tweed, Lismore, Richmond Valley, Copmanhurst and Tenterfield in NSW (KC, 2004). It is predominantly rural in character, comprising lands cleared and used for agriculture (2,512 km^2 – 70.15%) and lands used for forestry and nature conservation (1,071.5 km^2 – 29.85%) (KC SOE, 2000). At the time of the 2001 Australian Bureau of Statistics (ABS)

Population and Housing Census, KC had a population of 9,169 (ABS, 2001).

Figure 1-1: Regional Location of Kyogle and Bonalbo within KC and NSW

The township of Kyogle is the main administrative centre within KC. Bonalbo is a small country village within KC, with a population of 347 (ABS, 2001) and a small urban footprint of no more than 0.61 km^2, equating to 0.02% of KC land area.

Bonalbo is approximately 900 km north of Sydney, 100 km west of Lismore, 45 km west of Kyogle and 24 km north of the Casino/Tenterfield Road (Bruxner Highway), as shown in Figure 1-1. The village was established in 1910 and as 'The Heart of the Upper Clarence', provided services for the surrounding timber, dairy and cattle-grazing industries. Bonalbo has developed on the northern side of Peacock Creek and is situated on the western side of the Richmond Range. It sits at the lower end of Peacock Creek, before its confluence with the Upper Clarence River.

1.2 Study Context

The existing Bonalbo water supply scheme is owned and operated by KC. The permanent population of the Bonalbo village currently serviced by the scheme (as of March 2004) is estimated to be 352 and there are approximately 157 dwellings and 16 other water users including commercial, recreational, public and institutional. Within the last decade, Council has imposed water restrictions on numerous occasions as a result of low rainfalls, low streamflows and a decreasing water level in the off-stream storage of Bonalbo Dam (also known as Petrochilos Dam). The 2002/03 drought further exposed the vulnerability of the water supply headworks.

In 1998 a Strategy Study conducted by the NSW Department of Public Works and Services (DPWS) reviewed the future population and water needs, the existing water services and its deficiencies and recommended various infrastructure augmentations. The study found that the water supply infrastructure needed to be improved to maintain service levels and to achieve legislative compliance. Additionally, it was also found that with a projected increase in the future water needs, **the existing inadequacy of the Peacock Creek catchment's secure yield would only increase** (DPWS, 1998). The report recommended that KC implement the following measures to improve the water quantity and quality of the town water supply:

- Provide a new pump station and pipeline for a water supply from the Clarence River;
- Provide a water treatment plant for the scheme;
- Undertake remedial work upgrading Pump Stations 1 and 2;
- Adjust the operation of the trunnion in Bonalbo Dam to improve water quality; and;
- Provide aerators to promote mixing and assist the settlement of iron and manganese in Bonalbo Dam.

Council has since, ruled out the Clarence River option due to the cost of implementation and in 2002 gained subsidy for investigations into water treatment and a D&C Contract for a water treatment facility. Subsequently in July 2004, the NSW Department of Commerce (Commerce) submitted the Bonalbo Water Supply Augmentation Concept Report, for the investigation and concept design for a water treatment plant.

The 1998 Strategy Report also recommended that the inadequacy in supply is likely to be met by adopting 'best practice management' in the delivery and management of the water supply service. This includes:

- Bulk water production metering;
- Leakage reduction;
- Implementation of a water usage reduction program;
- Waterwise community education program; and
- Wastage reduction.

This current study addresses the introduction of water usage reduction programs and the integration of water services infrastructure. Various options for best management measures are presented to aid KC in making decisions regarding the future long term sustainable management and usage of the water resources at Bonalbo.

Presently, Bonalbo has a number of agricultural festivals held throughout the calendar year, which act as major tourist attractions and make tourism the major economic activity within the village. The main feature of the KC area is the Richmond and Clarence Rivers and the intensive agriculture and horticultural activities that are associated with the available water within their catchments. Therefore the downstream activities directly affect Bonalbo's water supply through the need to consider downstream allocations and environmental flow requirement for Peacock Creek.

Outdoor water use has been prohibited for several months. There was no steady daily extraction of water from Peacock Creek between September 2002 and March 2003. Until 24th February 2003 there was no flow in Peacock Creek, severely limiting the off-take of creek flows to Bonalbo Dam. Flow in Peacock Creek over this period is given in is given in Appendix A Commerce was commissioned by KC to prepare this Long Term Water Supply and Drought Strategy for the Bonalbo water supply scheme. The report briefly outlines the existing catchment conditions, describes the existing water supply and operation and provides long term water supply options. The strategy also aims to provide KC with a vision for the future management and implementation of Bonalbo villages' water services, in order to alleviate environmental degradation and minimise and manage stresses on water resources in an ecologically sustainable manner. Drought management work in this study was planned to be limited to providing trigger levels in the dam for activating the tasks within the drought strategy, however as detailed in section 2.3.2, the hydrology is inconclusive and therefore this cannot be specified with any detailed accuracy. There fore the main purpose of this report in relation to drought management planning will be to conduct a review of the appropriateness of the drought strategy within the context of the proposed long term supply strategies. KC also services the two other water supply schemes of Kyogle and Woodenbong but assessing the present and future water management of these villages is outside the scope of this report.

1.3 Existing Scheme

Figure 1-2 shows the location of Peacock Creek, the Peacock Creek off-take, Bonalbo Dam and its local catchment (0.137 km^2), the water reticulation (**blue**), the sewerage reticulation (**black**), the stormwater system (**green**) and respective discharge points. Water is pumped from Peacock Creek to Bonalbo Dam, pumped and chlorinated to the village reservoir and then reticulated throughout the village. A detailed description of the water supply infrastructure is given in Section 2.6.1. There is several months' supply with the current restriction levels. However, as the level drops, water quality may deteriorate, requiring constant monitoring.

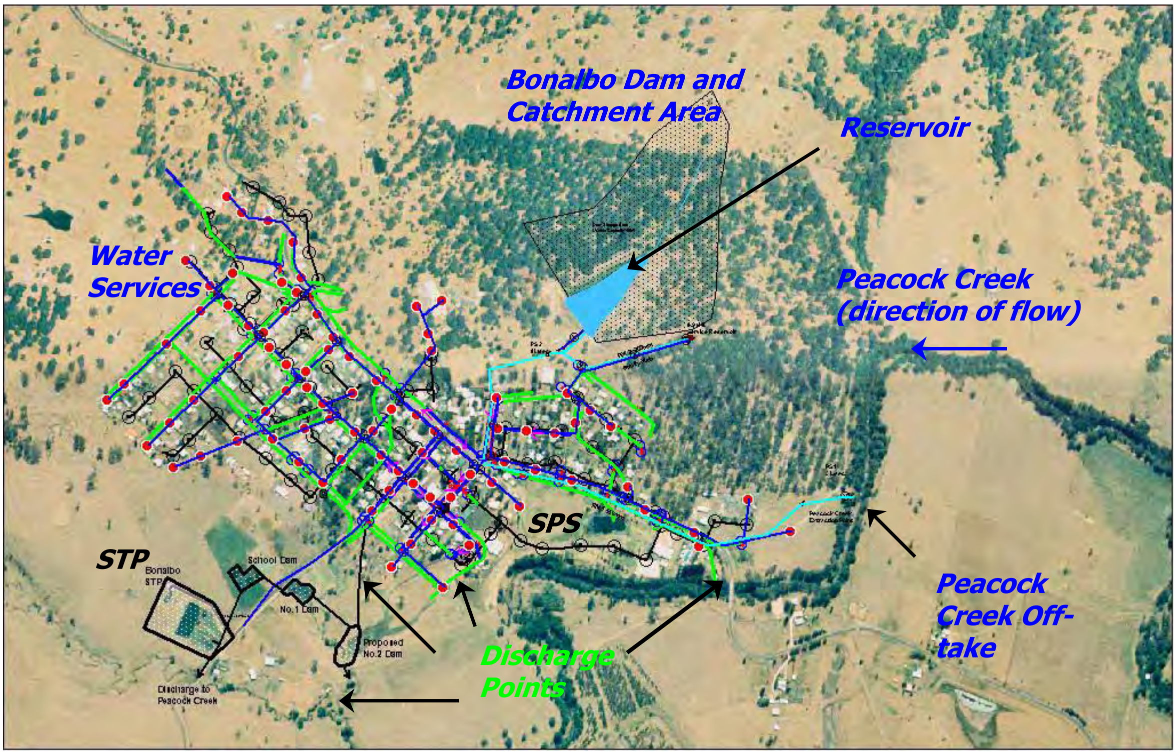


Figure 1-2: Bonalbo Village, location of Bonalbo Dam, Peacock Creek and Water Services Infrastructure

Sewage is reticulated to the Sewage Pump Station (SPS) and pumped through a rising main to the Bonalbo Sewage Treatment Plant (STP). A Pasveer Channel, oxidation ponds and sludge drying beds treat the sewage, before being either discharged to Peacock Creek or reused on the school agricultural property and golf course. Currently 100% of the treated effluent is reused. A detailed description of the sewerage infrastructure is given in Section 2.6.2.

Stormwater drains from three sub-catchments within the urban footprint, flow through the stormwater network and discharges to four outlets. One outlet flows directly into Peacock Creek, another a natural lagoon which acts as a stormwater detention basin and the two remaining outlets flow overland to a stormwater/effluent detention basin employed for reuse. Overflow from this latter detention basin drains to Peacock Creek. A detailed description of the stormwater infrastructure is given in Section 2.6.3.

1.4 Study Methodology

Long-term strategic water services' planning is an innovative way of managing urban water and incorporates all components of urban water services. It is long term in its outlook, (30 years), but flexible, affordable, and economically, environmentally and socially responsible. The study methodology is structured as follows:

- Establish population and tenement forecasts for the next 30 years;
- Establish current and future annual, average day and peak day demands with and without the use of Rainwater Tanks (RWTs);
- Identifying various 'bundled' demand reduction opportunities and their cost-benefit available for reducing and managing demands;
- Establish the secure yield of the existing headwork system;

- Listing of available water sources and a short-listing of these sources with a Council representative;
- Identification of relevant issues of compliance, responsibility and performance;
- Evaluation of alternative supply sources and water management opportunities;
- Development of integrated water management options;
- Ranking of the integrated water management options based on sustainable yield, cost, risks and Triple Bottom Line (TBL), and the incorporation/adoption of the preferred option as the long-term water supply strategy; and
- Review of relevant reports and an evaluation of their appropriateness given the objectives and future directions given in the long-term water supply strategy.

Additionally, a survey of the residents was undertaken. The survey was used to collect data on the number of people living in each tenement, age distribution of the residents, the water source (either reticulated or rainwater tank) used for different indoor and outdoor activities, and the types of fixtures and appliances that the household uses. This information was then used in the RWT modelling and the assessment of management options.

1.5 Study Objectives

The broad objectives of this strategy are to provide long-term water supply options and review the short to medium term drought security within a long-term context for the Bonalbo water supply scheme. This looks to achieve more efficient water use and to reduce the environmental impacts of water diversions, wastewater and stormwater reuse, treatment and discharges, while reducing the long term costs of water services provided to Bonalbo village residents and businesses. Other objectives of this strategy are:

- to identify key water cycle issues in Bonalbo village;
- to identify the catchment and urban planning context for these issues; and
- to offer integrated water supply and management options that achieves the best balance between environmental, social and economic values, while providing a sustainable yield equivalent to the future projected urban demand during a potential worst case drought scenario.

1.6 Water Supply Strategy Assessment Criteria

To establish the business objectives and the related assessment criteria for the future management of the urban water cycle, the 1999/00 Strategic Business Plans for Water Supply and Sewerage and the Kyogle Council 2003/04 Management Plan were consulted. The Integrated Catchment Management Plan for the Upper North Coast Catchment 2002 - Catchment Blueprint incorporates the area of Bonalbo and has set numerous objectives and target dates. These objectives have been included within the Strategy Assessment Criteria.

In September 1999, the NSW Government approved the interim environmental objectives for various river catchments in NSW. The Healthy Rivers Commission had completed public inquiries for the Clarence catchment at that time and therefore interim environmental objectives were not provided for the catchment. No explicit environmental objectives for the Clarence River catchment have been included within the assessment criteria.

Underpinning the environmental objectives discussed within the documents consulted is the need to conserve, efficiently use, reclaim and recycle urban water to improve economic and community outcomes whilst minimising environmental impacts. This is otherwise known as the Triple Bottom Line (TBL) focus and recognises that human quality of life depends not only on economic values, but also on the social systems and ecosystems in which we exist. Our existence should aim to value the standards of ecologically sustainable development (ESD), in order to use, conserve and enhance community's resources so that ecological processes and total quality of life are not compromised but rather at the very least maintained, for present and future generations.

Appendix B outlines the strategy assessment criteria for the water supply options and the strategies that would achieve compliance with each TBL assessment criterion.

For each water source opportunity and integrated management strategy considered for implementation in the Bonalbo village, every criterion in Appendix B was given a score from 0 to 3. It is important to note that the scoring of strategies is completed on a relative qualitative basis for each criterion.

- A score of 0 - given to the opportunity, which provides no improvement or benefit
- A score of 1 - given to an opportunity, which provides little to reasonable improvement or benefit
- A score of 2 – given to an opportunity, which provides good improvement or benefit
- A score of 3 - given to an opportunity, which provides the best achievable result

The sums of scores for all criteria represent the final score for that particular management option. The highest scoring management option is identified as the best outcome and will be ranked highest.

The process is acknowledged as being subjective, however it is believed that with the relevant background knowledge the same overall ranking will result if another individual or group conducts the analysis.

2 THE ISSUES

2.1 Government Initiated Reform Compliance Issues

In 1995 the Council of Australian Governments (COAG) ratified the National Competition Policy (NCP). Of particular significance to the water services functions of a Council is the application of competitive neutrality to operations. The purpose of this is to have councils "operate under similar competitive pressures to those experienced by the private sector".

The NSW Government has embraced these principles and set in motion a number of policies to increase the efficiency and the competitiveness of this type of business area. (Refer to the NSW Government Policy Statement on the Application of NCP to Local Government)

The policy is based on macro and micro economic reforms across the various levels of governments to achieve efficiency, equity and transparency in governance and to achieve sustainability in resource management. Since Commonwealth funding to States is tied to achieving certain levels of implementation of the policy, the NSW government has embarked on a number of independent but related reforms within the framework of the competition policy. Some of the reforms, relevant to this study include, the water reforms, full cost recovery service pricing of essential monopoly community services, transparencies in decision making and regional capacity building. The subsequent sections provide a brief overview of these reforms and Bonalbo village's compliance status with these reform objectives.

2.1.1 Best Practice Management of Water Supply and Sewerage

The NSW Government is required to demonstrate compliance with the NCP. The approach adopted since 1995 for the non-metropolitan Local Water Utilities (LWUs) is to progressively encourage best-practice management to ensure effective, efficient and sustainable water supply and sewerage businesses.

Originating from best-practice, is the capacity to deliver returns to the owners in the form of dividends. Demonstrated best-practice management is therefore a pre-requisite for payment of a dividend from the surplus of a local government LWU's water supply and sewerage businesses.

The Ministry of Energy and Utilities (MEU), now Department of Energy, Utilities and Sustainability (DEUS) provides subsidies for backlog works to greatly reduce the burden facing LWUs for these "backlog" debts. The pre-requisites for receiving this financial assistance since 1995 have included compliance with statutes and the adoption of best-practice management. These pre-requisites form the basis of the 11 criteria (6 business criteria and 5 operational criteria) for demonstrating compliance with best-practice, and hence, the eligibility/justification for the payment of dividends from the water supply or sewerage business to the council's general revenue.

LWUs that demonstrate best-practice management by achieving the outcomes required by the Guidelines (Appendix C - Table 1-I) will comply with the NCP and will have effective and sustainable water supply and sewerage businesses. This is essential to assure the local community that its LWU is managing the local water supply and sewerage businesses responsibly and that charges for these services will not increase unexpectedly.

Best-practice management involves TBL focus, which provides a balanced view of the long-term sustainability of NSW water utilities. TBL accounting (social, environmental and economic) involves consideration of an LWU's business plan together with its social and environmental management practices. Best-practice management of water supply and sewerage involves the following 11 criteria:

Business Criteria:

- Strategic Business Planning
- Water Supply, Sewerage and Trade Waste Pricing

- Water Supply and Sewerage Developer Charges
- Annual Performance Reporting
- Occupational Health and Safety (OHS)
- Asset Management

and Operational Criteria:

- Liquid Trade Waste Management
- Demand Management
- Drought Management
- Environmental Management
- Integrated Water Cycle Management

Detailed descriptions of each of the above and requirements for the payment of dividends are discussed within Appendix C.

The review of compliance with the Best Practice Management of Water Supply and Sewerage is included in Table 2-1.

Table 2-1: Review of Compliance with DEUS Best Practice Management

Best-Practice Criteria	Date Required	Level of Compliance (expressed as % for simplification)	Comments
Strategic Business Plan and Financial Plan	June 2004	100%	Updates to be produced upon completion of Kyogle IWCMS including financial modelling.
Water Supply, Sewerage and Trade Waste Pricing	June 2004	100%	
Water Supply and Sewerage Developer Charges	June 2004	50%	DSP's to be developed upon completion of Kyogle IWCMS, and adoption of preferred options for all three villages.
Annual Performance Reporting	Sep 2003	100%	
Occupational Health and Safety	June 2004	100%	Corporate OHS&R Management System developed and implemented.
Asset Management	June 2006	60%	Capital Works programs to be finalised upon adoption of preferred options for each village.

Best-Practice Criteria	Date Required	Level of Compliance (expressed as % for simplification)	Comments
Liquid Trade Waste Management	June 2005	100%	
Demand Management	June 2004	100%	
Drought Management	June 2005	80%	Will be completed with the completion of this document
Environmental Management	June 2005	50%	Subject to compliance with EPA licensing conditions
Integrated Water Cycle Management	June 2006	50%	Part 1: Context Study completed, Tenders for Engagement of Consultant to be advertised in April 2005.

Many of the documents produced to ensure compliance with the criteria outlined in Table 2-1 are described in Appendix D.

2.1.2 Water Reform Issues

The NSW water reforms are a key driver of change for all water users. In 1994, the COAG agreed to implement a strategic framework to achieve an efficient and sustainable water industry as part of national microeconomic reforms. The water reforms agreed upon by COAG aim to achieve clean healthy rivers and an efficient and sustainable water industry in consultation with the community and stakeholders.

As part of these reforms the NSW government introduced the Water Management Act 2000 (WM Act). The WM Act aims to achieve a better balance between water use and environmental protection through setting environmental objectives for all NSW rivers and covers river flow and water quality objectives. The Act requires that the low flows in the rivers be left for the environment (environmental flows). This in effect, formalises the current informal arrangements and better defines the environmental needs and the water users rights and water resource share. The objectives of the Act are being implemented through water sharing management plans.

A water sharing management plan for the Clarence River is yet to be developed under the Act and should define the environmental needs, the access rights and the flow-sharing regime between the users. Bonalbo's village water use is subject to a maximum extraction volume. Village water access licences are to be reviewed every five years and varied according to changes in population and associated commercial activities. KC currently has a license to extract a total of 85ML/yr from Peacock Creek for the Bonalbo urban water supply under Licence No 30-SL-29902. However, the average extraction from Peacock Creek for the village over the last 4 years was in the order of 7.5 ML/a. The average daily flow in the creek is 10ML/day according to the stream gauge.

The areas of **non-compliance** with the Water Reform include:

- The secure yield of Peacock Creek under current environmental flow regime has not been established.
- There is no structured water conservation and demand reduction program to ensure water use is efficient.

- No stakeholder consultation in the development of urban water management strategies.
- No community education program.
- No water loss and leakage reduction program.
- A system of review of measures every two years so as to ensure that there is an appropriate level of investment in the maintenance and upgrading of both the utility's and the customers' equipment.

2.1.3 Pricing Reform Issues

The Independent Pricing and Regulatory Tribunal (IPART, previously Government Pricing Tribunal) was set up to determine and advise prices and pricing policies for government monopoly services.

The Tribunal currently has powers to set prices for Sydney Water, Hunter Water and Gosford and Wyong Councils. This includes service usage charges and developer contributions.

The Tribunal does not intend, in the near term, to regulate prices for water supply and sewerage services in country NSW. Instead it has recently released Pricing Principles for Local Water Authorities, which sets out pricing recommendations for Council's to adopt in the pricing of their services. Through using these pricing principles, the State Government has developed best practice pricing and developer contribution charge guidelines for use by Councils under Section 60-64 of the Local Government Act (see Appendix E – Legal Instruments - Local Government Act 1993 s60, s64). Essentially these sections refer to the restraints and qualifications that apply to the service functions of water supply, sewerage and stormwater drainage works and facilities.

A brief review of KC's current pricing policy for water services indicates the following **non-compliance** issues:

- Council has not yet established the true cost of providing water, sewerage and stormwater services to existing and new developments. It is recommended that water usage prices be reviewed.
- Section 64 – The current level of developer contribution is far less than the 'true' costs. This results in significant subsidy to developers by the existing rate payers and also results in revenue loss to Council
- No Section 60 – Compliance certificate applications

There is inadequate funding for urban stormwater management and treatment measures and for catchment improvement works. This is because the cost of providing these services is generally funded through the general rates, which are currently 'pegged' by the State Government. The State Government does offer grants in some instances for stormwater projects that meet grant guidelines.

2.2 Legislative Compliance Issues

The NSW government through the use of a number of legal instruments regulates the provision of water services by Kyogle Council.

Appendix E contains an extensive legal review of Bonalbo's water supply related issues and an overview of the legal and health implications associated with the use of reclaimed water. The following is a summary of the salient points presented in Appendix E. The legal instruments impacting upon the management of both the Bonalbo water supply and Bonalbo sewerage system fall under both common law and statutory law.

Common Law

Common law involves the setting (and changing) of precedents derived from court or judge-made decisions. Under common law the terms 'duty of care' (how a "reasonable person" might act in a particular situation) and 'standard of duty' (taken as meeting, or if sufficient in-house knowledge is available, surpassing the current best practice) are most relevant to water utilities and how they discharge their responsibilities. Under common law a water utility:

- Has a responsibility to ensure that decisions in relation to the urban water cycle, are made with the appropriate duty of care and follow the appropriate standard of duty;
- Owes a duty of care to its customers, its staff and those in the proximity of its urban water cycle management business operations;
- Needs to be aware of current and emerging OH&S issues relating to water cycle management; and
- Needs to be aware of and understand the practicality of any urban water cycle control measures for the mitigation of any potential identified risks.

Statutory Law

The statutes identified pertaining to the provision of water and sewerage services in Bonalbo include:

- The Water Management Act (WMA) 2000;
- The Water Management Amendment Act 2002;
- The Fisheries Management Act 1994;
- The Protection of the Environment Operations Act (PEOA) 1997; and
- The Occupational Health and Safety Act (OH&S) 2000.

These statutes and their relevance for Bonalbo are discussed further in Appendix E. Appendix E also includes an overview of legal and health liabilities associated with reclaimed water. The main issue for KC with reclaimed water being used is to ensure that in managing a reclaimed water scheme, it has taken measures to:

- Reasonably identify and assess risks to its systems; and
- To have taken all reasonable precautions in managing those risks.

The above two points form the basis of a sound risk assessment and management system. Such a system would allow the facilitation of a 'due diligence' defense in the case of a legal dispute.

Commerce has included the microbiological values of reclaimed water for the intended use of open access urban residential reuse from the NSW Guidelines for Urban and Residential Use of Reclaimed Water (1993). It is noted that the guidelines are over 10 years old and care should be taken in the use of the presented parameters.

Appendix E provides a list of relevant legal instruments and the sections that apply to the management of water services along with the Agency responsible for the management of each Act.

The areas of **non-compliance** to the relevant Acts include:

- Absence of a formal Environmental Management System
- Absence of a formal Public Health Management System. – operations manuals from the Water Directorate are used as a guide with water sampling and testing in accordance with NSW Health guidelines and protocols for management of Blue Green algae are also used. (Kennett, 2004).

- Absence of formal emergency response (Public Health, Drought etc.) and incident management strategies. - KC is currently developing a Dam Safety Emergency Plan for the Bonalbo Dam through the Dams and Civil Section, Commerce. It is not expected to be complete for a couple of months. However, the Local Emergency Management Committee has a Disaster Plan covering the whole Local Government Area, including Bonalbo (Kennett, 2004).

- Certain assets do not comply with current O H & S requirements. e.g. Dam intake valve, river intake and existing weir pool, STP oxidation ponds fencing, chlorine dosing inside pump station potential for corrosion, reservoir ladders and roof etc.

- Absence of quality assurance systems to confirm the services provided are 'fit' for purpose

2.3 Catchment Issues

2.3.1 Climate

The average annual rainfall within the Kyogle Shire is 940 mm per year while the median annual rainfall is 876 mm. Figure 2-1 shows a typical seasonal rainfall pattern for the area, which indicates that there is higher rainfall in the summer months than the rest of the year. The region experiences distinct seasons due to elevation above sea level and its proximity to the ocean. The following temperature values have been taken from the nearest weather station to Bonalbo at Tabulam, approximately 17km SSW from Bonalbo. Temperatures in the region range from a mean daily maximum of 27°C in January to 16.2°C in July. Mean daily minimum temperatures range from 16.9°C in January to 7.2°C in July. A temperature maximum of 39.8°C and minimum of 0.0°C have been recorded at Tabulam (BoM, 2004) during the last 33 years of record.

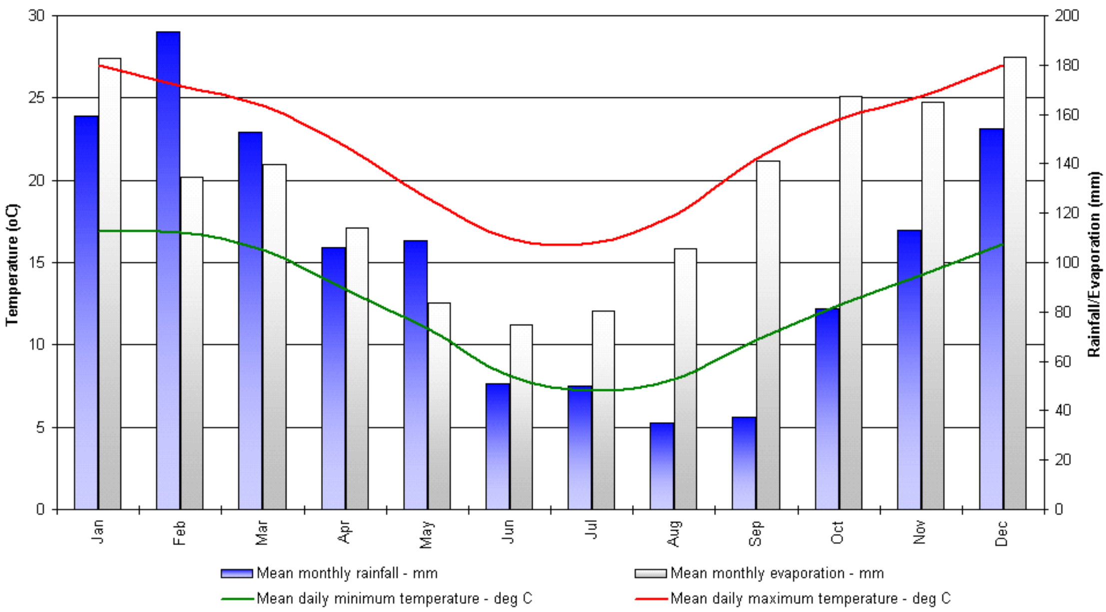


Figure 2-1: Average Rainfall and Temperature at Tabulam

On the basis of a large annual temperature variance, there is a strong seasonal pattern of evaporation in Bonalbo, totalling an annual average of 1462 mm (BoM, 2004).

2.3.2 Land Use

The village of Bonalbo is within the Peacock Creek catchment, which is part of the greater Clarence River catchment area, administered by the North Coast Catchment Management Board. The Peacock Creek catchment covers an area of 170 km^2 (120 km^2 upstream of Bonalbo) with the Bonalbo urban footprint covering less than 1.0 km^2 of the catchment area.

The catchment area upstream of the Bonalbo Peacock Creek extraction point has a mixture of rural developments and farming, with a large proportion of native trees and in the upper parts of the catchment, the Toonumbar National Park.

Figure 2-2 shows the various land use groups and the Peacock Creek catchment percentage land use composition. The percentage land uses have been assessed purely at a desktop level and should be referenced as rough estimates.

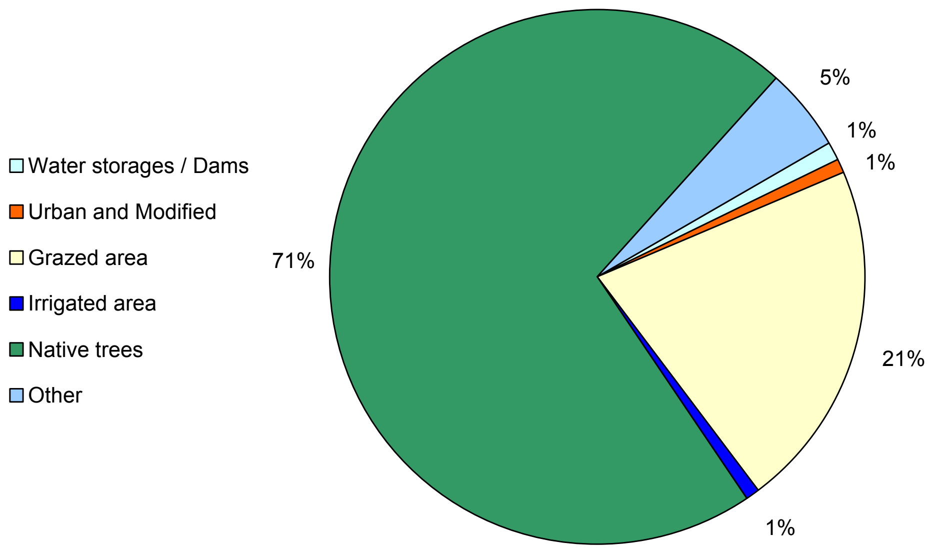


Figure 2-2: Peacock Creek Catchment Landuse

The main **catchment issues** relevant to the urban footprint include:

- Water Supply Security: There is a need to improve and enhance water supply security, particularly drought security and enable the provision of a more secure water supply for the needs of both the community and the environment. The hydrology component of this study has established the following:

"The hydrology study has modelled several flow sequences using the AWBM model using the gauging stream records in the vicinity. The modelled flows are not very convincing when compared with the recorded flows. However the recorded flows may not be that convincing either. For example there are occasions when the recorded data says there was flow in the river near the offtake but Council advices there was no water for them to pump.

The hydrology study has completed numerous runs (over 13) of the existing system using different streamflow sequences including different estimates for the Bonalbo storage dam catchment area. The secure yield estimates range from 25 to 60 ML/year, which suggests either that Bonalbo has enough water or the village has not enough water.

At this stage it is not clear how to advance the study. Since we did the flow modelling there have been some improvements to the AWBM model, which we could try on Bonalbo to see if it helps. But there is no guarantee. If the data is not very good quality then it does not matter how good the model is." (Cloke, 2004)

The Water Supply Security is also impacted by the surface water licences upstream of Bonalbo. Communications with DIPNR about the licences and other extraction rights are included in Appendix F and are summarised below:

  - There are 5 water extraction licences, 3 of which are thought to be not in use (one has since been found to be invalid)
  - The probable maximum annual volume for all licences would be about 78ML/year or approximately 0.20ML/year during August through February and a further 0.01ML/day all year for dairy washdown
  - Basic Rights use (formerly known as riparian rights) can be estimated from details of the properties bordering the river but are not tracked by DIPNR

- Stream reliability is relatively poor, therefore downstream water users probably extract water from the entire catchment

- Water Quality: There is a need to improve and enhance water quality and enable a better quality of water to be provided for the needs of both the community and the environment. High suspended sediment loads throughout the catchment in high flow events occurs due to gully erosion in highly dispersible soil types, roadside erosion, riverbank erosion and erosion from agro-forestry and agriculture in the upper parts of the catchment. There are often high nutrient concentrations and low dissolved oxygen in the tributaries to and in the Clarence due to low river flows and nutrient discharge from villages and agriculture. The urban footprint catchment has high stormwater pollution levels and therefore is not a potential or suitable water source. There are also concerns about the possibility of potentially harmful organisms entering the water from the cattle upstream.

- Soil Health: There is a need to improve soil management through adequate maintenance of septic systems, groundcover and treatment of acid/dispersive soils.

- Biodiversity: Protection and enhancement of priority native vegetation types is required to improve and protect the biodiversity of the catchment. The identification and management of pest species is encouraged. Current activities in this area in this area include the enhancement of significant native vegetation in the Bonalbo area and a weed control and replanting program on a section of Peacock Creek's banks.

- Social/cultural: A better-informed Peacock Creek community is required to develop a culture of stewardship of the environment. Grants and incentives are recommended to encourage voluntary participation.

2.4 Urban Planning Issues

Figure 2-3 shows the age profile of the Bonalbo population based on the 2001 ABS Census. The figure shows that the majority of the population is in the age group 25-44 years. This age bracket and the 0-14 years and 15-24 years are likely to encompass young to developed families, where water usage is typically high. The ABS Census 2001 median age for Bonalbo is 44 years.

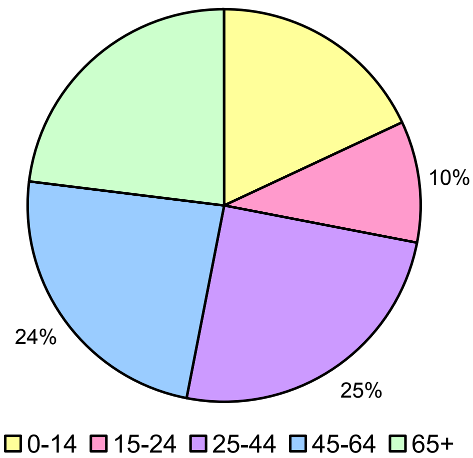


Figure 2-3: Population Age Distribution of Bonalbo Township (ABS, 2001)

The township age structure is shown in Figure 2-4. The difference in sexes between various age groups is substantially marked, except in the 45-65 years age bracket where the female population is greater that the male by less than 1.5%. However, the figure does emphasise the fact that the majority of the population are greater than 25 years of age.

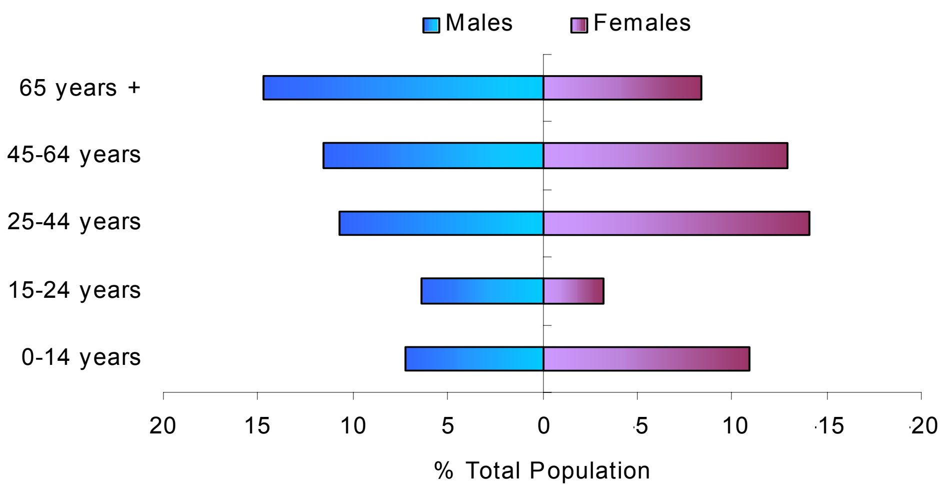


Figure 2-4: Age structure for Bonalbo Township (Age bracket as a % of total population) (ABS, 2001)

The demographic figures illustrated in Figure 2-3 and Figure 2-4 indicate that the future provision of water services for Bonalbo village needs to be sensitive to the following aspects:

- The aging population, their special needs and their purchasing power
- The possibility of a declining population but stabilising dwelling and account numbers

The design and assessment of a water supply system is based on the size of the population to be served, the number and type of dwellings serviced and the non-residential development to be serviced. Council has provided information forecasting that dwellings growth is occurring, with the approval of several development applications for Bonalbo. Council has indicated that even allowing for nil expansion and nil subdivision, there is a potential for 35 "new" dwellings to be built on the 35 existing vacant parcels of land available within the existing water and sewerage service areas. Therefore while in the short term there may be some dwelling growth, in the long term it is considered that the dwelling numbers will stabilise. Council's dwelling target under a 30 year planning vision is that all the existing fully serviced land be completely occupied by 2034.

2.4.1 Historic Growth and Demographics

Population

In assessing the urban planning issues for Bonalbo, it can be concluded that the 1998 Strategy Report provided a population projection, which was not representative of the true population growth between 1991 and 2001 and the real future growth. Figure 2-5 shows the 1998 Strategy Reports projection against Bonalbo village's population numbers since 1971. It should be noted that at the time of production of the 1998 Strategy Report, the 1991 ABS Census was published only in paperback and the 1996 ABS Census 1996 was not published.

The numbers from the past ABS Censuses were used to construct a demographic profile of Bonalbo village. The figure shows that the population in Bonalbo village and rural areas have been steadily declining since the mid 1970's, with a sharp decline in population numbers since 1991. The village's permanent population has decreased by 35% since 1966.

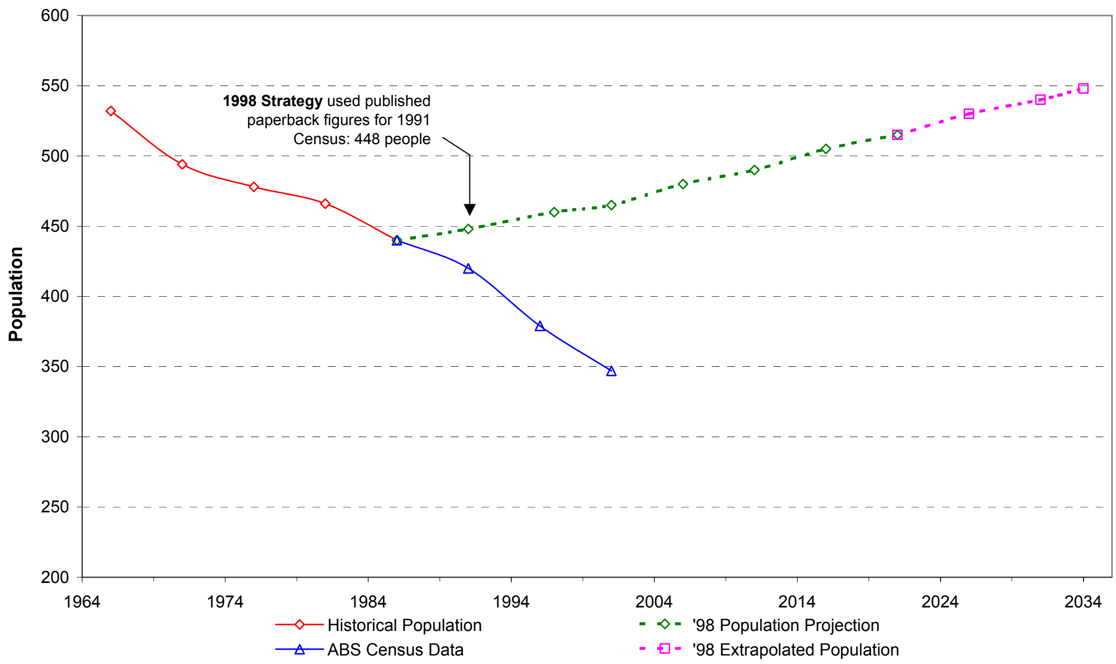


Figure 2-5: Historical Population Growth and 1998 Projected Population

Figure 2-5 further shows the 1998 Strategy projection extrapolated out until 2034. The 1998 projection would have seen approximately 550 people living in Bonalbo by 2034.

Dwellings

The 1998 Strategy Report projected a similar growth in total dwellings to that reported by the ABS Census in 1996. The census data on total, occupied and unoccupied dwellings are shown in Figure 2-6.

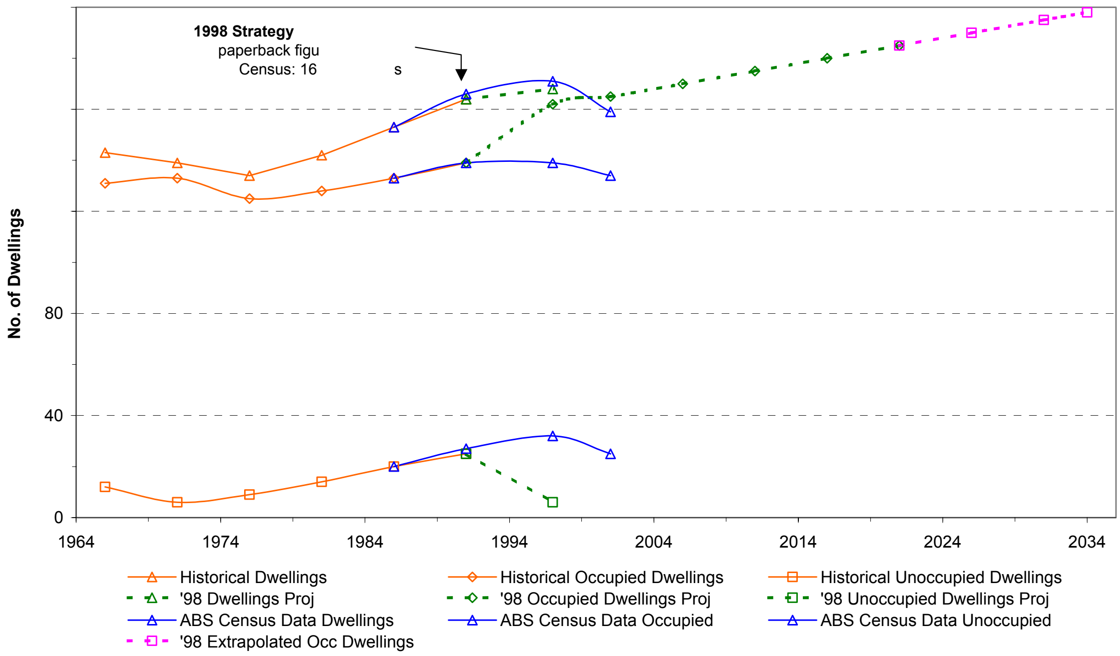


Figure 2-6: Historical Residential Dwelling Growth and 1998 Strategy Projected Residential Dwellings

Analysis of the dwelling occupancy shows a decreasing occupancy rate from 1991 to 2001. Figure 2-6 shows the 1998 Strategy occupancy rate projection versus the historical occupancy rate. This concurs with the trend that the number of unoccupied dwellings has generally increased.

The total occupied and unoccupied dwelling numbers for the Bonalbo village are available for all Census years from 1971 to 2001. In contrast the number of single detached and multi dwellings for the village are only available for the 1991, 1996 and 2001 Censuses. Table 2-2 shows that dwelling numbers have grown from 147 in 1991 to 164 in 1996 and decreased to 159 in 2001. Occupied dwellings have remained around 130. This suggests that there was a small amount of building activity in the period 1991 to 1996, with the occupation of those extra dwellings being minimal. The decrease in ABS dwellings numbers in the 1996-2001 period was possible due to a number of reasons explained below.

Table 2-2: Historic ABS Dwelling Numbers and Average Growth rates for Bonalbo

Dwelling Type		ABS Census			Change betw. 1996-2001
		1991	1996	2001	
Detached	Total	147	153	152	-1
Dwellings	upied	123	121	127	
Semi Detached	Total	4	0	0	0
Dwellings		4	0	0	

Dwelling Type		ABS Census			Change betw. 1996-2001
		1991	1996	2001	
1-2 Apartment	Occupied	0 3	3 6	0 0	-6
Caravans	Total Occupied	5 5	6 6	4 4	-2
Flat attached to comm.		7 7	6 6	3 3	-3
Dwellings	Total	166	171	159	-12
	Average Growth	-	0.6%pa	-1.4%pa	
	Occupied	139	139	134	-5
			0%	-0.72%	

In Table 2-2 there is a decline of 12 dwellings between the 1996 and 2001 Censuses. also shows the change in residential dwellings between 1991 and 2001. Council has not been able to account for this decline reported between the Censuses (perscomm. Kennett, 2004).

Commerce checked Census Data and the boundaries of the Collection Districts. Figure 2-7 shows the Bonalbo Collection District boundaries in 1991, 1996 and 2001. It is thought that the differences in boundaries are not significant enough to explain the decline in dwellings between the Censuses, however it is possible that there are dwellings in areas that are outside the Bonalbo village census collection districts.

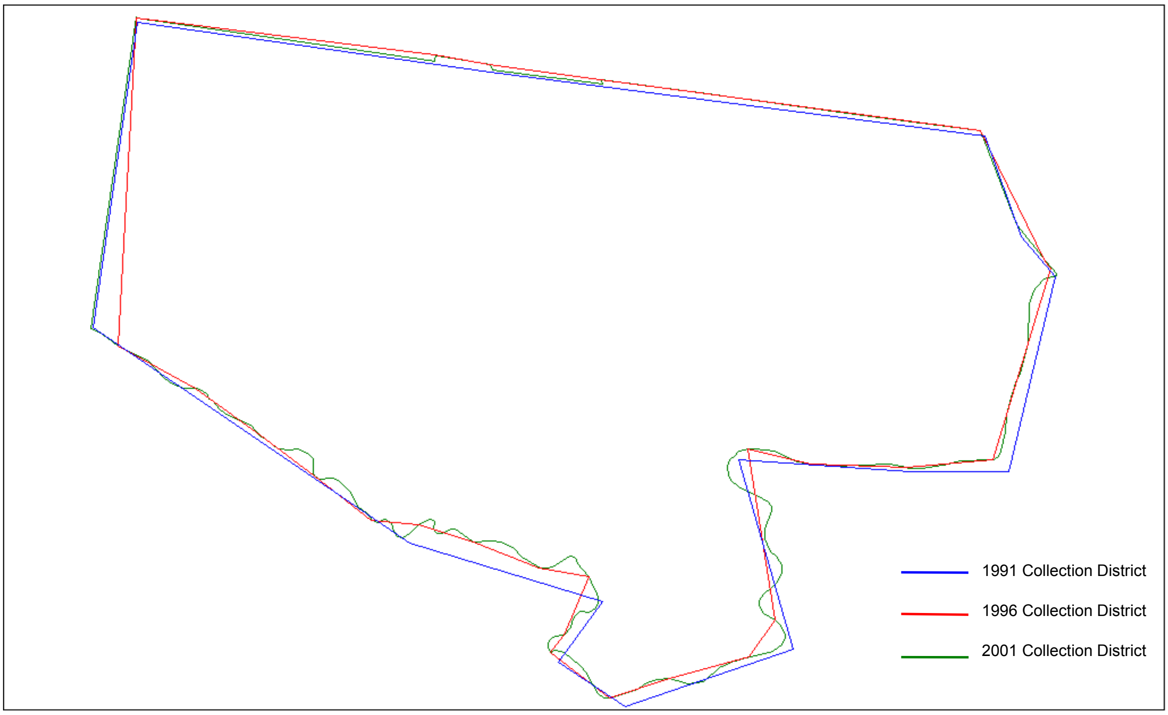


Figure 2-7: Collection District Boundary

Other reasons could include:

- When small numbers of dwellings exist within a specific dwelling type, such as 2 dwellings, the tally is rounded up to 3, and if there is 1 dwelling, then the tally is rounded down to no dwellings. This process involves the adjustment of small numbers to prevent the release of information that may allow for the identification of an individual. The ABS controls Census dwelling data in this manner for 'confidentiality' purposes as required by law. (Perscomm. Smedley, 2004). This process is known as Confidentiality Randomisation or Introduced Random Error. Appendix G further explains the concept of Confidentiality Randomisation.

- There have been very small changes in the ABS definition of dwelling types other than separate houses, such as 'Caravans, cabins, houseboat' and 'House/flat attached to shop'

Water assessments and serviced population

In 1996 water metering works were completed. The water-metering program included installation of customer meters at each property and business and quarterly recording of water use. In 1997 meter reading was then reduced to half-yearly recording for residential and quarterly recording for all other user groups.

KC provided Commerce with data from their customer consumption database for the period 2000/01 to 2002/03 water years. An investigation was undertaken to initially identify and count both residential and non-residential consumer assessment numbers. Assessments were further identified and split between private and non-private residential consumers.

Table 2-3 shows the number of residential and non-residential water assessments connected to the Bonalbo water supply. Note that one residential assessment is assumed to be equal to one connected lot with a greater than zero recorded consumption. A non-residential assessment was set to a meter with greater than zero recorded consumption, regardless of the number of lots it covered. Vacant lots were identified as assessments that metered a total usage of zero in a particular water year.

Table 2-3: Water Assessment Numbers Connected to Bonalbo Water Supply

Assessments Connected	2000/01	2001/02	2002/03
Residential	145	148	142
Non-Residential	23	23	23
Vacant lots	15	12	18
Total	183	183	182

A comparative assessment of the total dwelling numbers in 2001 ABS Census and the numbers in the Council water assessment database for the 2000/2001 water year shows that there were 15 water meters connected to vacant allotments and 145 water meters servicing 145 residential single detached dwellings. There were also 23 water meter assessments classified as non-residential, including 3 "dwellings attached to a shop" (as identified by ABS Census) metered assessments and one metered assessment for the caravan park. The caravan park meter services 4 caravan dwellings.

This study has projected on the basis of classifying 145 residential single detached metered dwellings, 3 "dwellings attached to a shop" and 4 caravans as residential dwellings, totalling 152 residential dwellings, being serviced by 149 assessments.

Of the 152 residential dwellings, 25 have been assessed as being unoccupied in 2001, leaving 127 of the residential dwellings as occupied, being serviced by 124 assessments including single detached dwellings, "dwellings attached to a shop" and caravans. The Teachers Housing Association own 4 one-bedroom units, which have one metered assessment. The private residential demand projections were therefore based on a total of 123 privately occupied dwellings and 123 assessments including single detached dwellings, "dwellings attached to a shop" and caravans. This allows for the single metered connections supplying the caravan park (i.e. 4

caravans in the caravan park as reported in 2001 ABS Census) and the 4 units owned by the Teachers Housing Authority designated as non-private.

Non-residential metered connections have remained the same since the year 2000. They have not been recorded within the ABS Census because of their classification as non-residential. It has been assumed that non-residential assessment numbers will remain much the same over the next 30 years, assuming that the population requiring services by these assessments, remains in a steady state or minimally grows.

Additionally it has been assumed, based on the analysis of 2001 ABS Census and Council's water assessment records, that each dwelling (residential or non-residential) has a single water assessment meter. The only exception to this applies to the caravan park and four Teachers Housing Authority properties, where dwellings are connected through one metered connection.

Based on this assumption, residential assessments in 2001/02 and 2002/03 show that there has been a net decline in assessments and therefore dwellings.

Because the water metering works in Bonalbo village were only completed in 1996, there has been no further comparison of the change in total water assessments and dwellings over time.

Occupancy Rate

Analysis of the dwelling occupancy shows a decreasing occupancy rate from 1991 to 2001. Figure 2-8 shows the 1998 Strategy occupancy rate projection versus the historical occupancy rate. This concurs with the trend that numbers of unoccupied dwellings have generally increased.

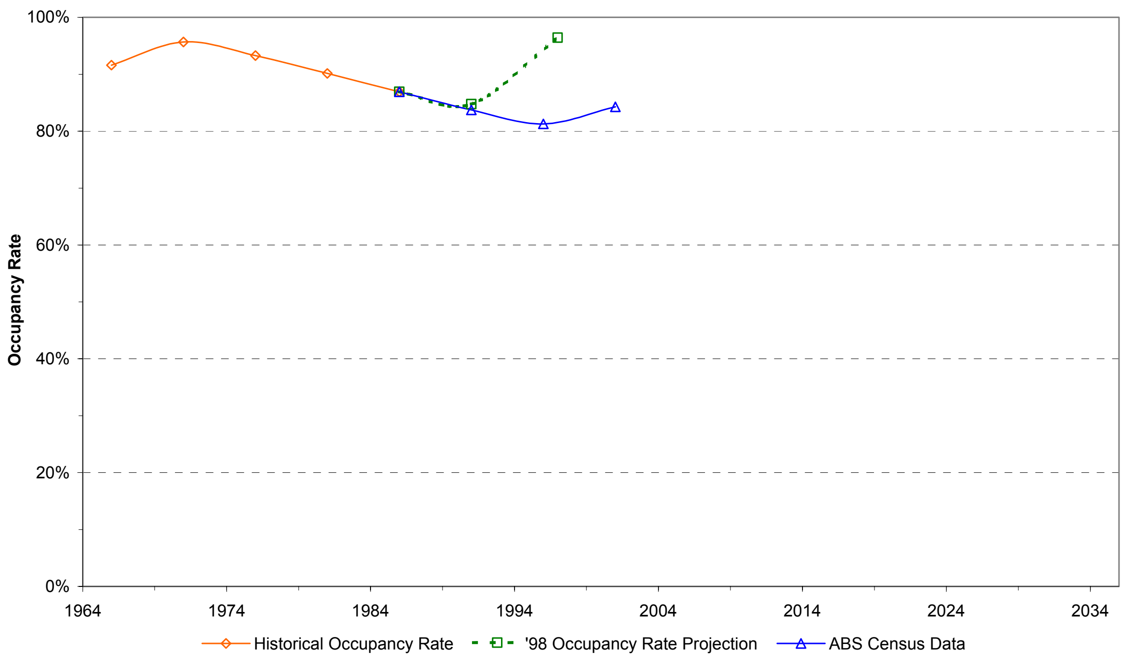


Figure 2-8: Historical Occupancy Rate and 1998 Strategy Projected Occupancy Rate

The figure also shows that the occupancy rate for single detached dwellings is very similar to that of the overall occupancy rate. This indicates that there are a relatively small number of multi and other dwellings in Bonalbo. The census figures show that despite a declining population the number of dwellings in the village is stabilising indicating a declining occupancy rate.

This is consistent with the observation of declining population and increasing dwelling numbers. Table 2-3 gives the occupancy rates for single detached and multi dwellings for the Bonalbo village for the years 1991 to 2001.

Table 2-4: Occupancy Rates for Bonalbo Village 1991 to 2001 (Ref. 2)

Dwelling Type	1991	1996	2001
Single Detached Dwellings	83.7%	79.1%	83.5%
Multi Dwellings	84.2%	83.3%	100%

Household size

Figure 2-9 shows the 1998 Strategy household size projection against the historical household size.

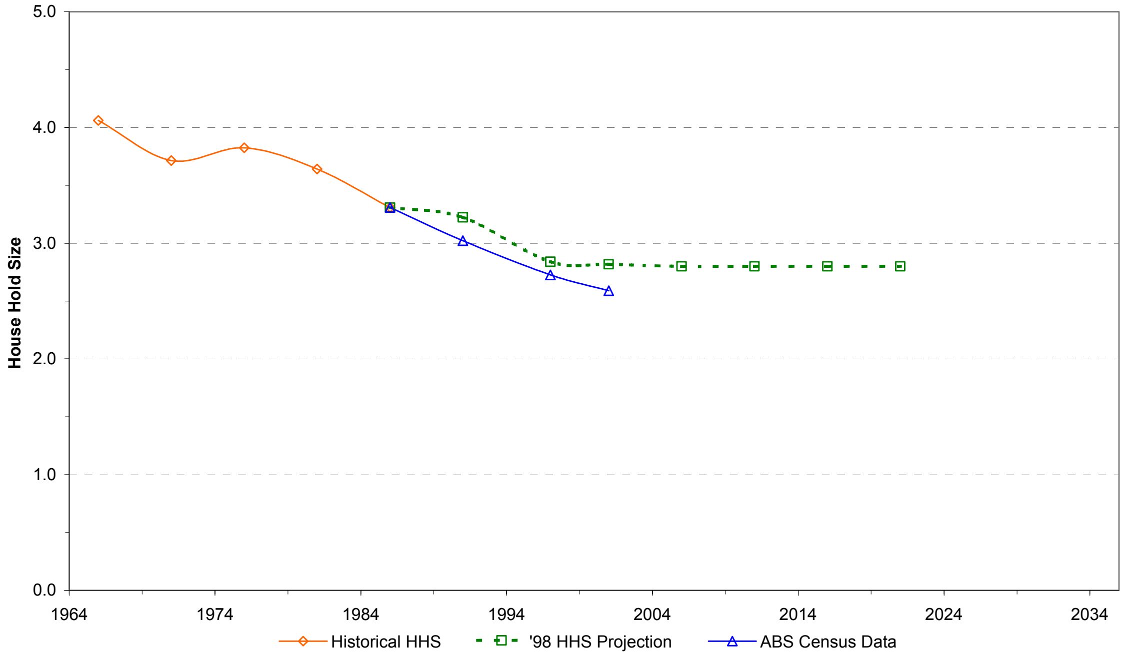


Figure 2-9: Historical Household Size and 1998 Strategy Projected Household Size

It can be seen with reference to Figure 2-5, Figure 2-6 and Figure 2-8 that as the population is declining, the number of dwellings is stabilising and occupancy rate is declining, then the household size must also stabilise. Stabilisation of the HHS is shown in Figure 2-9. The 1998 Strategy Report projected a very different scenario to this with increasing population number and increasing dwelling numbers, resulting in a similar household size.

2.4.2 Demographic Projections

Residential Surveys

Originally outside the scope of the project, a rainwater tank and household water appliance survey were conducted to all residents of Bonalbo village. Commerce and Council agreed that such surveys would assist the project to grasp the true number of people currently living in the township and the manner in which they use mains water and rainwater tank supplies.

Despite some excellent results being produced from the survey and subsequent analysis, roughly only 50% of the surveyed residences returned completed surveys to Council. Unfortunately this has not made an estimation of the current population any clearer. However it is worth noting that there are 173 people living within the returned surveyed residences. On this basis it can be extrapolated that the current population might be 346 people in 2004. This figure seems at the very least quite reasonable in comparison with the 2001 ABS Census.

The results and the analyses of the survey are presented later within this report.

Projected population growth

Although the population numbers have been decreasing since 1966, dwelling numbers have gradually increased to 1991 and since stabilised. Council's Strategic Business Plans for Water Supply and Sewerage assume a positive population growth. Although this assumption is questionable given the trends in ABS figures, what is important in water services planning is to develop a cohesive and flexible water management strategy for the next three decades. Thus it is necessary to consider a range of population growth impacts. Therefore, this study originally considered three population growth scenarios. Figure 2-3 shows the population numbers until 2034 based on the original 3 growth scenarios as outlined in Table 2-5. Growth Scenario 4 (GS4) was added later in the study as a Council expected growth rate or sensitivity growth rate.

Table 2-5: Average Annual Growth Rates for Population Forecast Scenarios

Scenario	**GS1**	**GS2**	**GS3**	GS4
Average Annual Growth Rate	**0.5% pa**	**0.0% pa**	**-0.8% pa**	1.0%

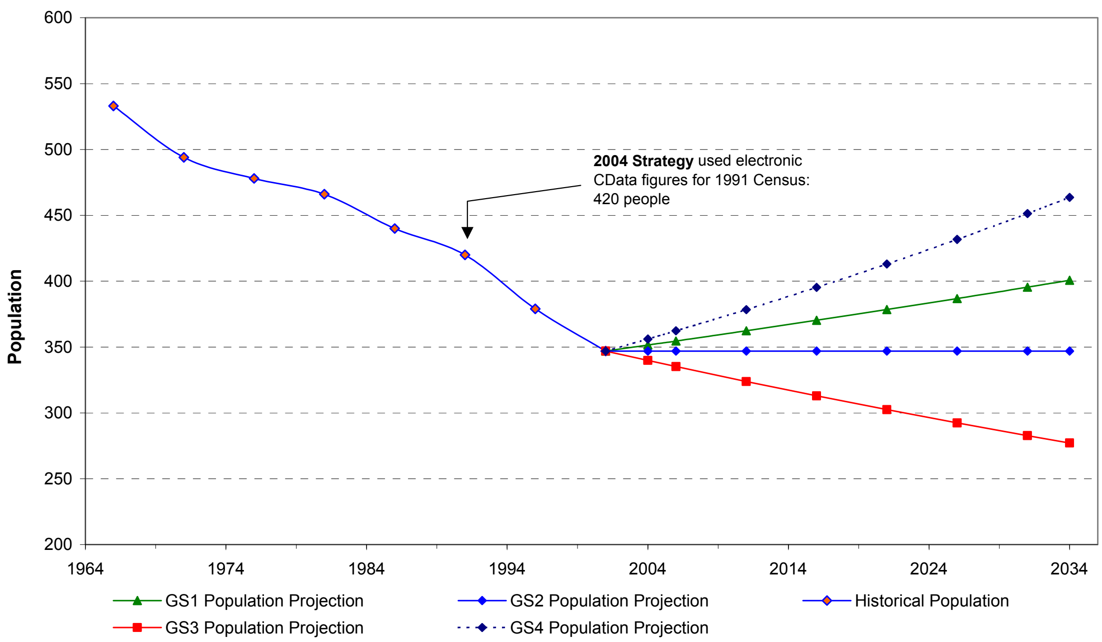


Figure 2-10: Population Forecast Scenarios for Bonalbo Village from 2001 to 2034

Growth Scenario 1 – Near "Static" Traditional Growth

Scenario 1 is based on the growth projection in 1999/2000 Strategic Business Plans for Water Supply and Sewerage. This is a standard population growth rate employed when modelling a near "static" population of 0.5% p.a. It is very plausible that this growth rate may occur over the next 30 years, as Bonalbo may start to attract people to the village to live for numerous reasons. In this scenario the Bonalbo village population is projected to increase from 347 people in 2001 to about 401 people in 2032.

Growth Scenario 2 – No Population Growth

Scenario 2 has been projected for reference purposes and due to the sensitivity of demographic projections and demand projections when considering small populations such as that experienced in the township of Bonalbo.

Growth Scenario 3 – Current Growth Rate Continues

Scenario 3 projection has been based on the growth rate seen from 1976 to 1991 in ABS figures. It is considered that between 1991 and 2001 the decline in population with a growth rate of -2.2 % p.a. has been an influence of drought, and therefore these years have not been included the calculation of Bonalbo's representative growth rate. Yet, in this scenario the Bonalbo village population is still projected to decrease substantially from 347 people in 2001 to about 277 people in 2032, equivalent to a 20% reduction in population.

The difference in projected village population between Scenario 1 and Scenario 3 is close to 125 people, significant when addressing future scheme augmentation requirements. Effects on water demands and sewerage flow for different population projections are seen when examining the water services infrastructure and integrated management options presented later in this report.

Additional population growth projection

Growth Scenario 4 – Council Expected/Sensitivity Growth Rate

Further compounding the marked difference between Scenario 1 and Scenario 3 is Scenario 4, requested by Council after expressing concerns that since the last Census, local observation suggests that the population has already increased and the use of nil or negative growth based on the Census figures may not be representative of the current population trends. Council has requested that sensitivity analyses should be extended to include a 1.0% p.a. population growth and the change to the annual demand figures and proceeding outcomes assessed. As shown in Figure 2-10 a 1.0% p.a. population growth would see the village's population increase to 464 people by 2034. This would see an increase in population in the village of 117 people since 2001.

Council is not convinced of the need to do any calculations for negative growth and has advised Commerce that only static, 0.5% p.a. and 1.0% p.a. growth rates need to be considered for demand projections. On this basis, Commerce does not intend on completing any demand management projections on the -0.8% growth rate, but have included the population projection figures in order that Council could do a sensitivity analysis for revenue collection purposes if required.

Council has further advised that there are 35 vacant parcels of land available within the existing water and sewerage service areas. So even allowing for nil expansion and nil subdivision, then Commerce should consider the fact that at a minimum 35 "new" dwellings are to be built and occupied. The population target for 2034 should be based on all existing fully serviced land being completely occupied. At the current 2.3 occupancy ratio for private dwellings this will give an additional population of 80 people. This assumes that there is to be no development of non-private dwellings in Bonalbo over the next 30 years and therefore a static population in non-private dwellings. Therefore Council expects a private dwelling population to have grown to a minimum of 380 people plus the non-private static population of 47 people in the year 2034. This amounts to a total population for Bonalbo village of 427 people and equates to a private dwelling population growth rate just over *0.7% p.a.*

A private dwelling growth rate of *1.0% p.a*. plus the static non-private dwelling growth rate would equate to a total projected population of 464 people. This figure would mean that even *more lots would be required to be built and occupied*.

The four population growth scenarios and their target populations for the year 2034 are given in Table 2-6 below.

Table 2-6: 2034 Target Populations for Growth Scenarios GS1 – GS4

Scenario	GS1	GS2	GS3	GS4
Average Annual Growth Rate (p.a.)	**0.5%**	**0.0%**	-0.8%	**1.0%**
Target Population	**401**	**347**	277	**464**

Projected Occupancy Rate

Figure 2-11 below shows the Historical Occupancy Rate from the ABS Censuses and the assumed future occupancy rate projections for private dwellings in the Bonalbo village. GS3 Occupancy Rate best fits the historical trend, however Council would prefer to see demand projections not consider any negative growth. GS1, GS2 and GS4 occupancy rates are expected to remain static over the next 30 years.

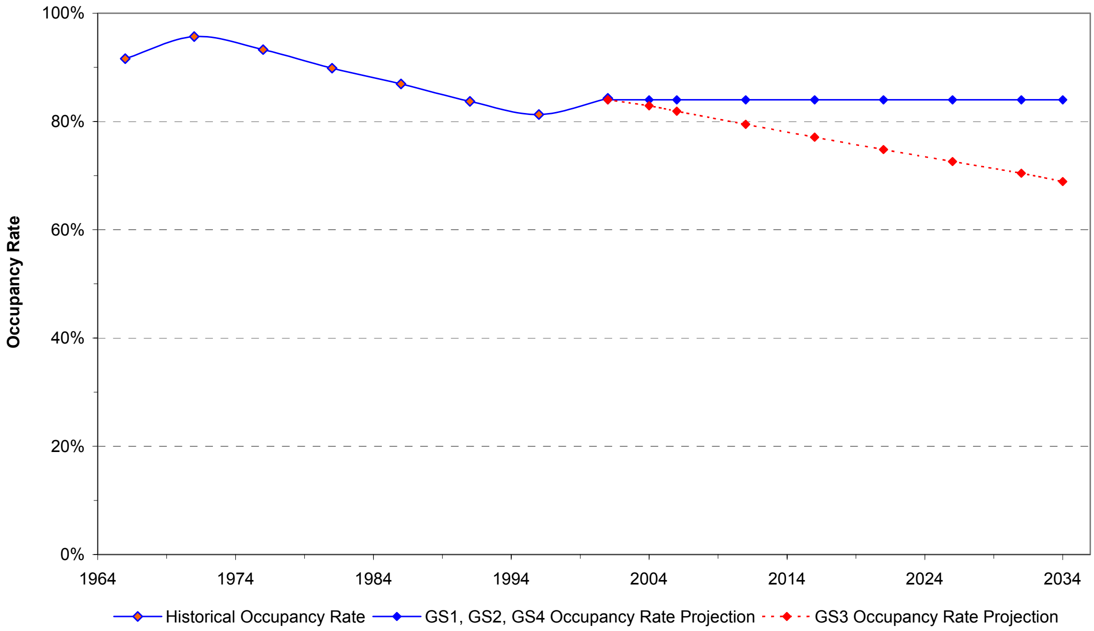


Figure 2-11: Occupancy Rate Forecasts for Bonalbo Village from 2001 to 2034

Projected Dwelling Growth

As the number of total dwellings more closely resembles the metered accounts than the occupied dwellings, the future growth of the metered residential accounts is based on the growth rates for total dwellings. As no distinction is made between dwelling types in the meter records, the future growth of all residential water accounts is based on a private dwelling growth rate of 3.55% p.a. for GS1, 5.75% p.a. for GS4 and a static private dwelling growth rate for GS2 and GS3. The forecast private dwelling projections together with the historical dwellings are shown graphically in Figure 2-12.

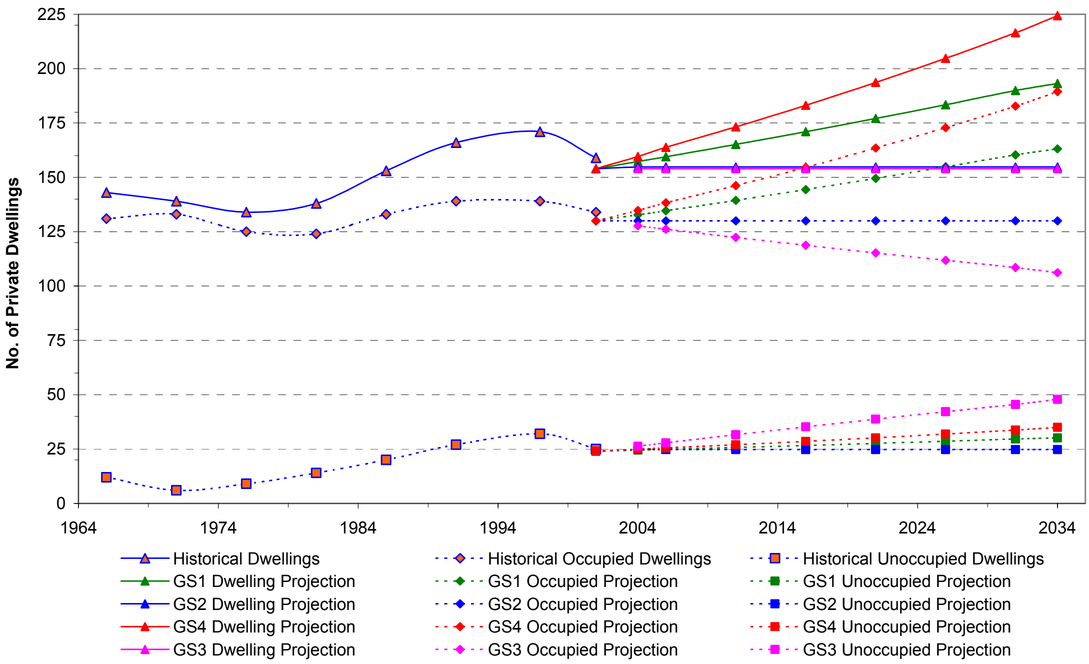


Figure 2-12: Historical and Future Occupied Residential Dwellings from 1966 to 2034

It has been assumed that non-residential water users comprising public, institutional, agricultural and commercial customers are to remain steady at the current total level of 16 users. This also assumes that the non-private population remains at 47 residents over the 30 years.

2.5 Urban Water Management Issues

The urban water management issues are a consequence of population and urban development. Bonalbo has experienced numerous water management issues in the past and presently is affected by the following:

- A high percentage of unaccounted for water as part of mains production;
- Some water consumers exhibiting relatively high consumption within the village;
- Large influxes of itinerant populations arriving in the village for the annual festivals;
- Lack of production meter recording to assess peak day demands and unaccounted for water;
- No formal linkage of Council's GIS and water account consumption records; and
- Water quality issues with reticulated supply.

These issues have been discussed in detail within the following sections.

2.5.1 Mains Water Usage in the Past and at Present

Figure 2-13 shows the metered consumption as recorded at the residences meters for water years 1996/97 to 2002/03. The average annual consumption for these years is 29,822 kL. The records show that annual metered consumption has been steady for unrestricted years. The water year 2000/01 was an unrestricted demand year where Council restrictions were not in force. On this basis an estimate of unrestricted demand could be made with demand predictions based on the demand data experienced within this water year.

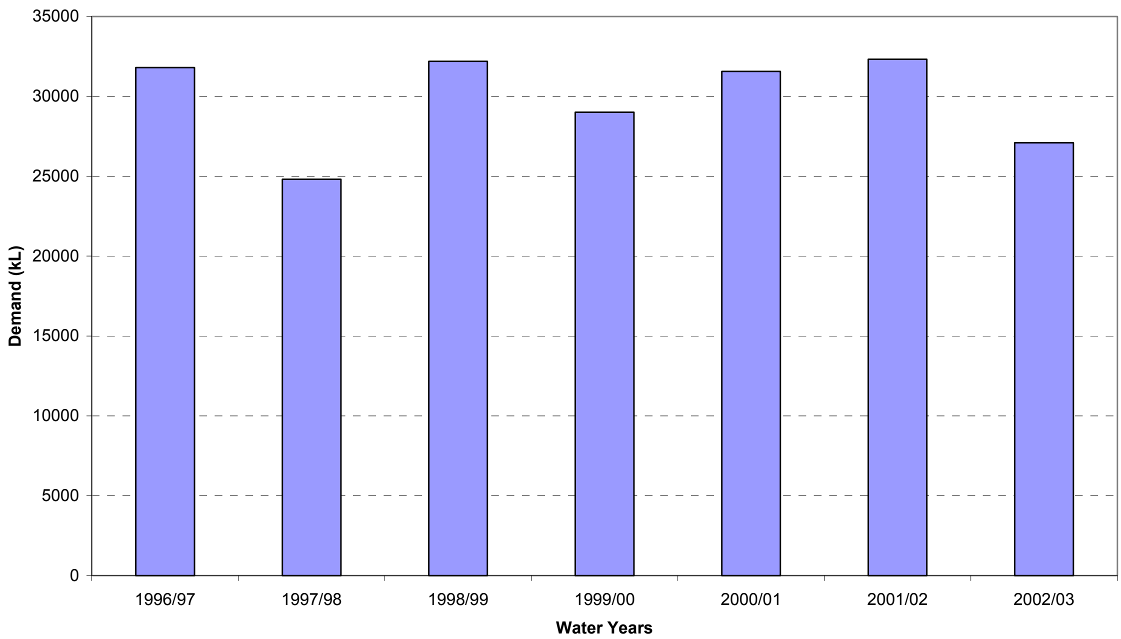


Figure 2-13: Metered Consumption (Mains Demand) 1996 - 2003

As shown in Table 2-7, if an Unaccounted for Water (UFW) level of 31.8% (noting that this was calculated as a quarterly average in a calendar year under Council restrictions) is employed to predict mains production for the average unrestricted year (2000/01), annual mains water production is estimated at 44,835 kL. If the predicted rainwater tank average annual yield (7,400kL) is added to this volume, an unrestricted average annual demand of 52,235 kL can be expected. This estimate compares well with the unrestricted average annual demand given below and shows that the UFW level (and RWT yield) is reasonably well estimated and maybe slightly conservative.

Table 2-7 below shows the annual water production and metered consumption since 1999/2000. The 25 unoccupied dwellings recorded over 30 kL/year in leakage and in 2003 the system was estimated to have around 12.4 ML in UFW.

Table 2-7: Annual Mains Production and Consumption Levels from 1999 - 2003

Water Year	Annual Mains Water Levels (kL/a)			UFW (%)
	Production	Consumption	UFW	
99/00	31,000	29,000	2,000	6.45%
00/01	33,200	31,556	1,644	4.95%
01/ 02	36,500	32,320	4,180	11.45%
02/03	34,800	27,089	7,711	22.16%
03/04	37,700	27,665	10,035	26.62%

An annual metered restricted production of 39,067 kL/year was recorded in the 2003 calendar year. Because there is no previous production data available, whereas consumption records are available, no estimate can be made of UFW in an unrestricted year. Council has advised that a large amount of mains water has been used in the past for mains flushing, festival consumption and other utility operational uses, but it appears that metering errors on the production meter could account for the increase in UFW since the 1999/00 financial year, particularly as some previously un-metered sites were metered in the 2003/04 financial year.

Commerce has estimated that the annual unrestricted demand on the town water supply is 49,800 kL/year, say 50 ML/year. On this basis, after RWT yield of 7,400kL it seems that the UFW should be around 29.7% of production, which correlates well with our original estimate.

Unrestricted demand is an important parameter in the process of assessing security of supply and in assessing the likely drought demands for the sizing of water supply infrastructure. Unfortunately every year of the Bonalbo water production data supplied by Council has been subjected to some form of water restrictions. Therefore it was very difficult to determine an average production and consumption within an average rainfall year. On this basis it was decided to estimate the unrestricted demand for the town using the following process:

- Calculation of the unrestricted internal water demand for private residences using the following steps:

  a. The results of the water use survey were entered;
  b. An average water use per person for each water use was estimated. For example, the survey asked for the type of shower heads in each house, and the number of people, this allowed an estimation of the number of people covered by the survey using A, AA, AAA and AAAA showers, it was then assumed that they all have 5 minute showers (the average recorded in studies of water use behaviour) and the total daily water demand for showers was calculated, this was then divided by the number of people surveyed, to come up with the average daily water demand for showers;
  c. It was assumed that the internal water use in surveyed dwellings was the same as that in unsurveyed dwellings; and
  d. The total internal water demand was calculated by multiplying the per-person results from the surveyed households by the total population in private dwellings.

- The water demand for commercial premises and non-private residences was assumed to be the same every day with annual demand equal to the highest demand from the 3 years of data available, there was no split for internal and external water use as there is little data on water use for non-residences and very few of the surveys were returned by this group.

- The unrestricted external water demand was calculated by assuming that each dwelling had 250 m^2 of area irrigated from the potable water supply. The plants in this area were assumed to have a crop factor of 0.5 and have particular soil characteristics. A simulation was then undertaken using the model to estimate irrigation demand using recorded rainfall and evaporation data.

- The model calculates a soil moisture deficit, in which the limit was reached every 3 days during continuing hot dry periods. We therefore assumed that 1/3 of the town on average irrigates per day over and in an unrestricted year.

- The total demand was then calculated by adding the total of the internal demand for private dwellings, the external demand for private dwellings and the daily demand for commercial premises and non-private dwellings.

- The total unrestricted production was then calculated by including 15% UFW allowance for the future of the Bonalbo water supply. In light of the current operational usage and the proposed future Water Filtration Plant installation to the system, it is believed that mains flushing and other uses contributing to UFW may be reduced to a level which Council believes should exist – that is 15% of production.

No daily water production figures are available, meaning that a Demand Tracking Model (DTM) analysis of the observed consumption data and data predicted using climatic variables, was not possible. This analysis would confirm whether or not water consumption is a function of climate or behavioural influences. The analysis of daily mains consumption using the Demand Tracking Model (DTM) would also give a good indication of a peak day demand and a peak to average day ratio. Therefore predicted baseline annual demands have been projected based on population and dwellings growth. Current peak day mains production has been estimated by Council to be 0.23 ML/day, but only minimal estimation of peak day projections has been carried out through this study.

Daily records of mains water production have been taken in order to better assess the unaccounted for water and peak day demands experienced within the town reticulation, since May 2004 and the results are shown graphically below in Figure 2-14. The data shown is recorded when Bonalbo was under Level 2 Restrictions for the entire period.

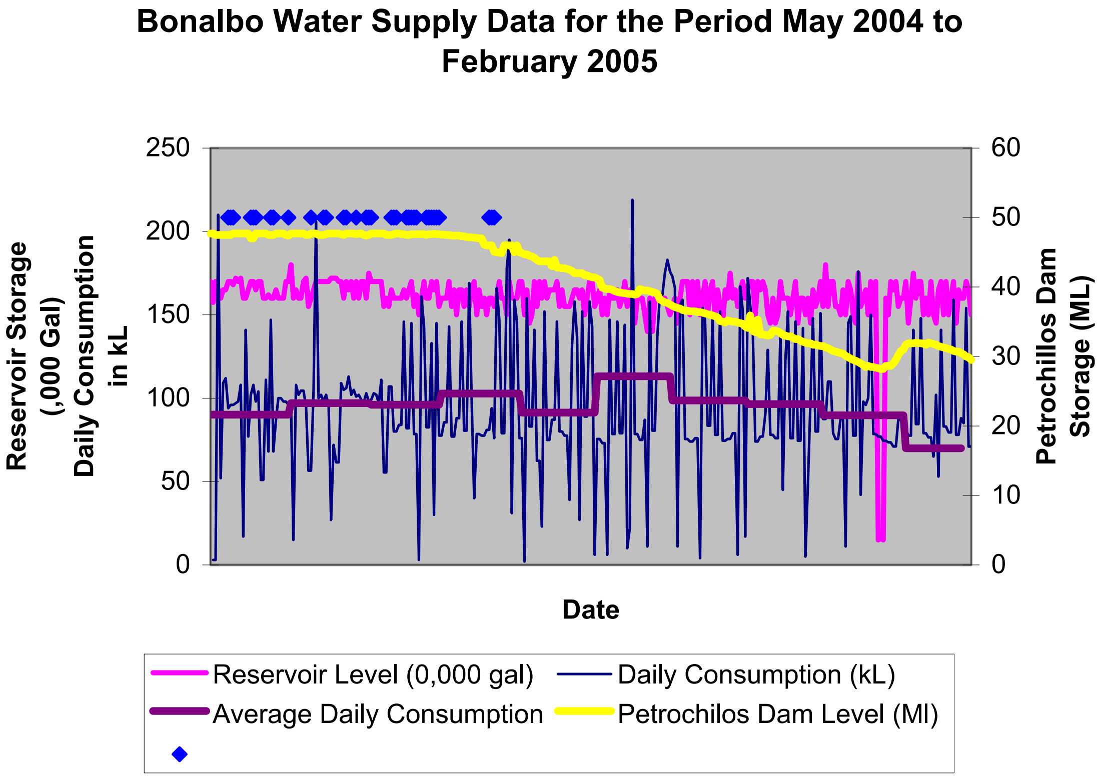


Figure 2-14: Water Supply Data from May 2004 to February 2005

Metered consumption records for the water years 2000/01 and 2001/02 and Council's GIS system have been used to identify the major water users within the township of Bonalbo. The Figure 2-15 shows the major water users within Bonalbo. The large shaded areas include the Public School, the Swimming Pool, the Nursing and Nurses Home and the Teachers Housing Authority. The meter at the Caravan Park was also identified as having a large consumption, however it was recognised that the meter services 4 caravans each with a less than average consumption.

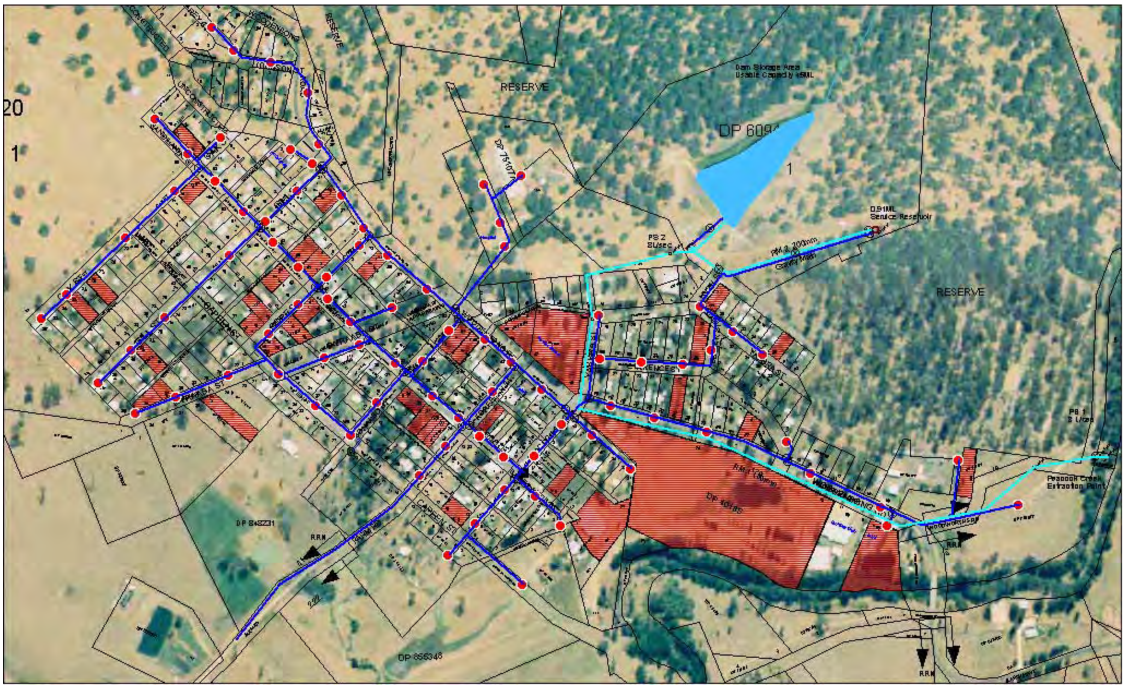


Figure 2-15: Major water users in Bonalbo Township

It is recommended that in order for Council to target major water users within a water education or demand reduction program, the water metering records should be linked to the Council GIS property database.

Council records show that the current typical daily mains water production is approximately 0.096 ML/day. By considering the difference between bulk production and metered consumption data, an average daily unaccounted for water of 31.8% was determined. This level of system loss is extremely high in comparison to the village water supply systems surveyed by the Department of Sustainable Natural Resources (formerly DLWC) and Local Government and Shires Associations (LGSA), mostly attributable to annual festival usage, mains flushing and other operational uses.

The unrestricted daily mains water production is calculated to be 0.136ML/day and peak day mains production is 0.24ML

Figure 2-16 shows the current urban communities annual water consumption profile. This indicates that the residential sector is the major water user group in Bonalbo.

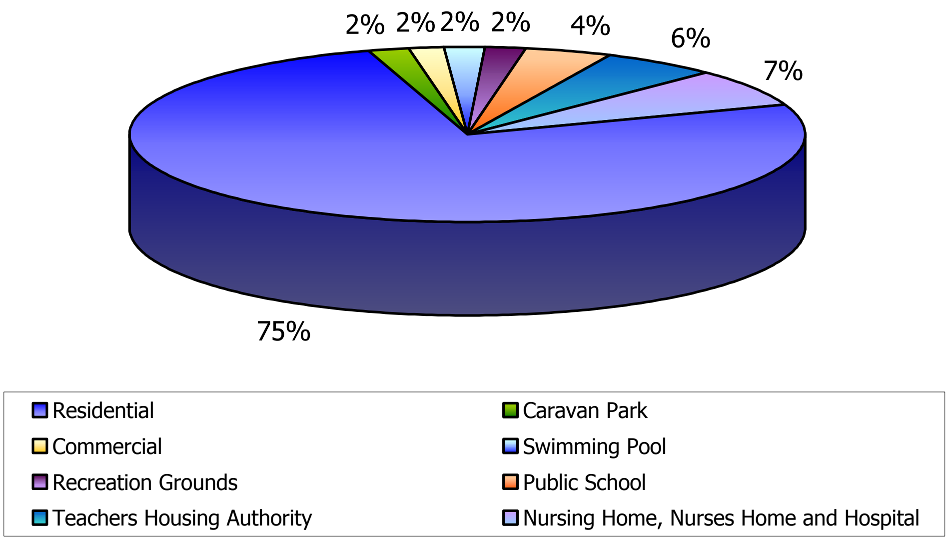


Figure 2-16: Relative Contribution to Total Consumption of Each Customer Category

Analysis indicates that the current average annual mains demand on a per metered residential account basis is in the order of 178 kL/account/year. Further analysis shows that there are a small number of metered users that consume a disproportionately high volume of water. The consumption distribution is outlined in Figure 2-17.

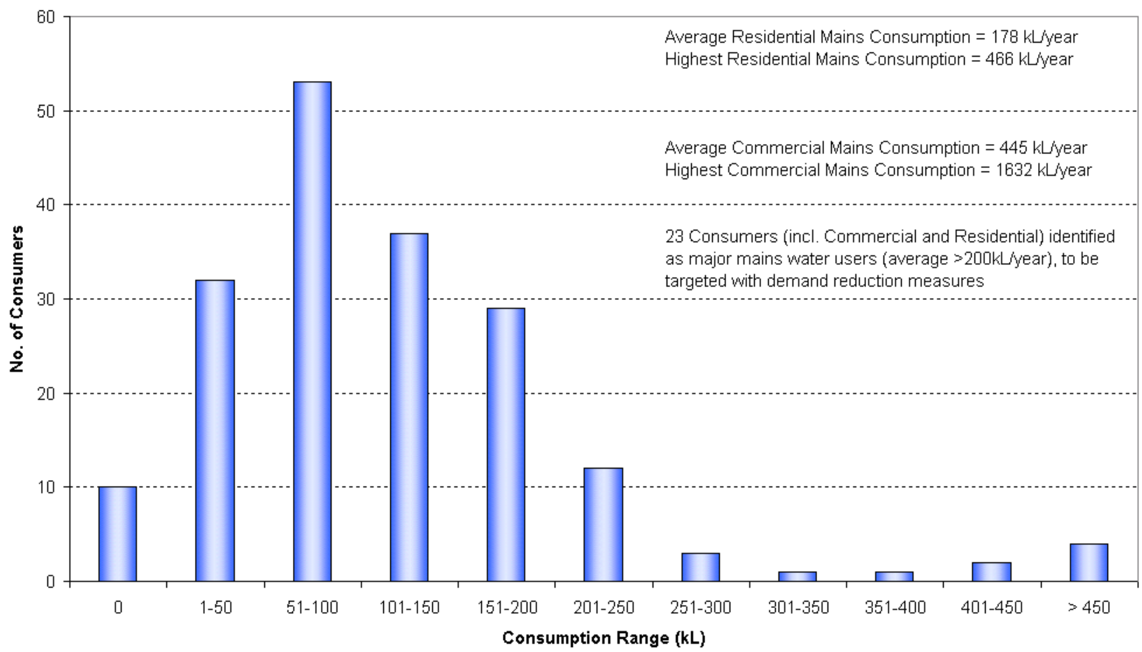


Figure 2-17: The water consumption distribution

Figure 2-18 shows the split between the current residential internal and external average annual consumption per account. The current average annual demand figure is relatively low compared to most other inland creek communities in the state. It is considered however that there is scope to better manage this usage through behavioural changes, community education and the adoption of more efficient and conservation practices.

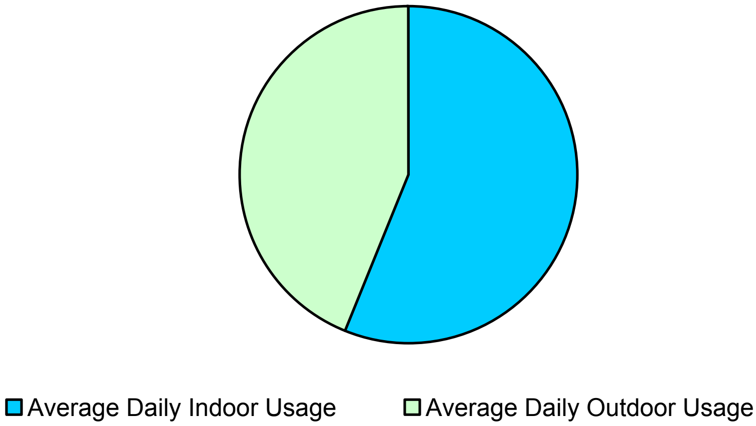


Figure 2-18: Internal and External Water Consumption in Bonalbo

The average per capita water consumption is broken down into the specific end uses in Table 2-8.

Table 2-8: Distribution of Residential Water Usage

Area of Usage	Times/day	L/Time	L/person/day
Drinking			2
Food preparation			1
Rinsing			2
Washing-up	0.5	12	6
Dishwasher	0.2	25	5
Full flush	1	6	6
Half flush	4	3	12
Teeth Brushing	2	0.25	0.5
Handwashing	6	1	6
Bath	0.071	175	12.4
Shower (1)	5 mins	10 L/min	50
Cloth Washing	0.3	140 L/load	42
Other Cleaning	0.043	20	0.9
TOTAL			145.8

The current per account demand during a peak day has been estimated from the analysis to be approximately 5.8 kL/account/day, which is based on observed daily bulk production data and includes the unaccounted for water volume.

A past and present issue affecting the management of the urban water supply has been the added pressure of the festivals that are held in Bonalbo each year. The festivals are a source of transient population, which come into Bonalbo throughout the year. Five festivals per year place a considerable demand on the town water supply, however it is expected that the majority of non-residents attending the festival would carry a considerable proportion of their water needs. Stock water requirements are also expected to be considerable. Due to the fact that no daily water consumption records are available it is difficult to measure the sensitivity of the water supply to the periodic influxes of water users. It is recommended that the festival water consumption be monitored closely in the future, to allow Council to plan for water supply allocation. Table 2-9 lists the annual festivals in Bonalbo and their respective increased water user loads.

Table 2-9: Annual Festivals in Bonalbo

Date (2003)	Festival	Duration (days)	People	Stock
26th Jan	Australia Day (Every 3 years)	1	tba	tba
23rd-24th April	Bonalbo Show	2	100	100 horses
7th-9th June	June Long Weekend	3	tba	tba
25th –27th June	Endurance Ride	3	300	100 horses
21st – 22nd Aug	Camp Draft	2	500	500 horses & 500 cattle*
18th – 19th Sept	Horse Cutting Weekend	2	100	100 horses
18th – 19th Sept	Arts and Craft Festival	2	tba	tba
27th – 30th Sept	Stockhorse Youth Camp	4	200	100 horses

* *"Cattle do not always drink in town, they are on the move."* Perscomm. Kennett, 9th Feb, 2004

In addition to the festivals listed above, Junior Horse Cutting camps are held irregularly throughout the year. The majority of festival participants camp at the showground. The showground has sewered toilets and water connections to the town water supply. Figure 2-19 gives irregular water production metered readings, which can be cross-reference with the dates of past events. These values are currently the best available, so it is suggested that in the future festival water requirements be closely monitored for future planning.

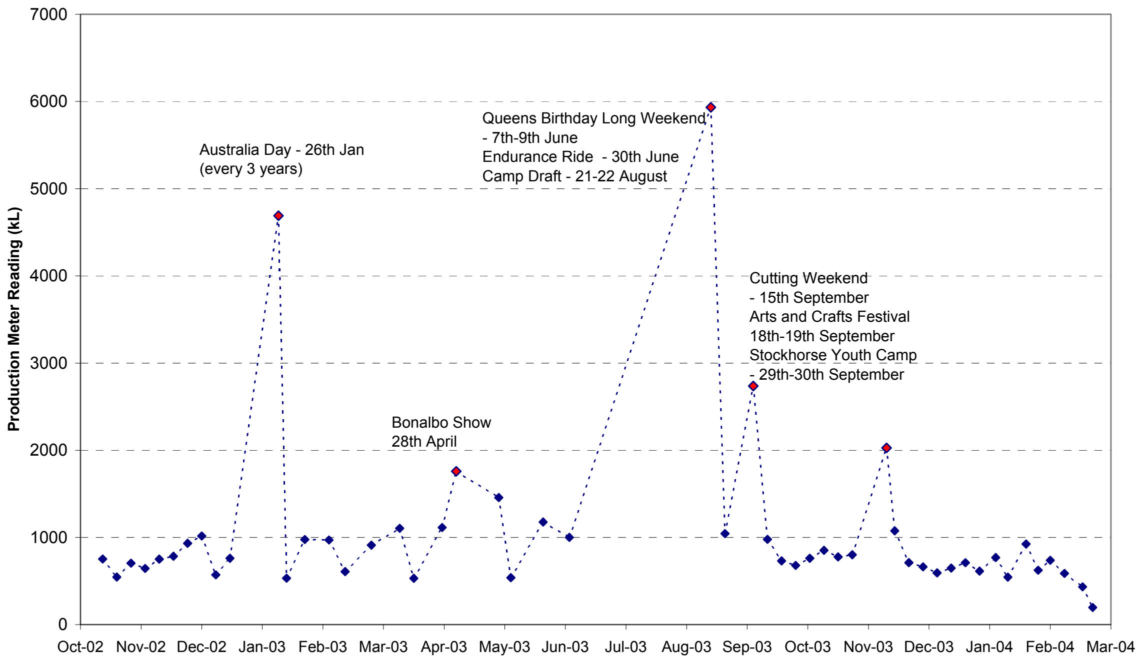


Figure 2-19: Water Production Metered Readings

As can be seen in Figure 2-19, the irregularity of production meter readings makes it difficult to know the relative water consumptions of a particular event. For example the production meter reading on the 8th September was cross-referenced with three festivals' demands, (Queens Birthday Long Weekend, Endurance Ride and Camp Draft) because the previous reading was on the 30th June, between which times the festival events occurred.

2.5.2 Rainwater Tank Usage in the Past and at Present

As part of this study, rainwater tank modelling has been conducted for an average house in the village of Bonalbo. Much of the site-specific information was obtained through a household survey conducted as part of the study. The average lot size in Bonalbo was discovered to be very large at 985 m^2 and the average roof size was around 200 m^2. The average size of rainwater tanks in Bonalbo is currently about 4.5 kL.

On this basis, the rainwater tank modelling was undertaken to model existing rainwater tank consumption. In this study roofwater harvesting using rainwater tanks was modelled as a supplementary source of supply for mains water. That is, when available, the harvested roofwater is used first with mains water meeting the residual demand. It was modelled for the existing residential development within the village. It was found that the harvested roofwater from a 4.5 kL tank could potentially yield about 58 kL in an average rainfall year, which is about 14% of the total average demand of a typical residential house. It should be noted that rainwater tank modelling assumed that there was trickle feed mains top-up, however most existing tanks do not have this capability.

Rather than being used solely to supplement outdoor garden watering, as has been the case in the past, rainwater tanks are now being used for toilet flushing and for laundry. Although the NSW Health Department does not recommend the use of rainwater for potable purpose where there is a reticulated water supply, there are cases of rainwater being used for potable purpose. Bonalbo is one such case, where rainwater has been adopted as the main potable supply. As seen in Figure 2-20, rainwater has been employed by a majority of residents for drinking water purposes and some residents have employed rainwater for other indoor uses such as dishwashing, clothes washing and to a lesser extent showering and toilet flushing. A large proportion of residents also use their rainwater tanks for outdoor uses such as hand held irrigation of plants and car washing. The adoption of rainwater has essentially been due to the poor quality of the mains supply.

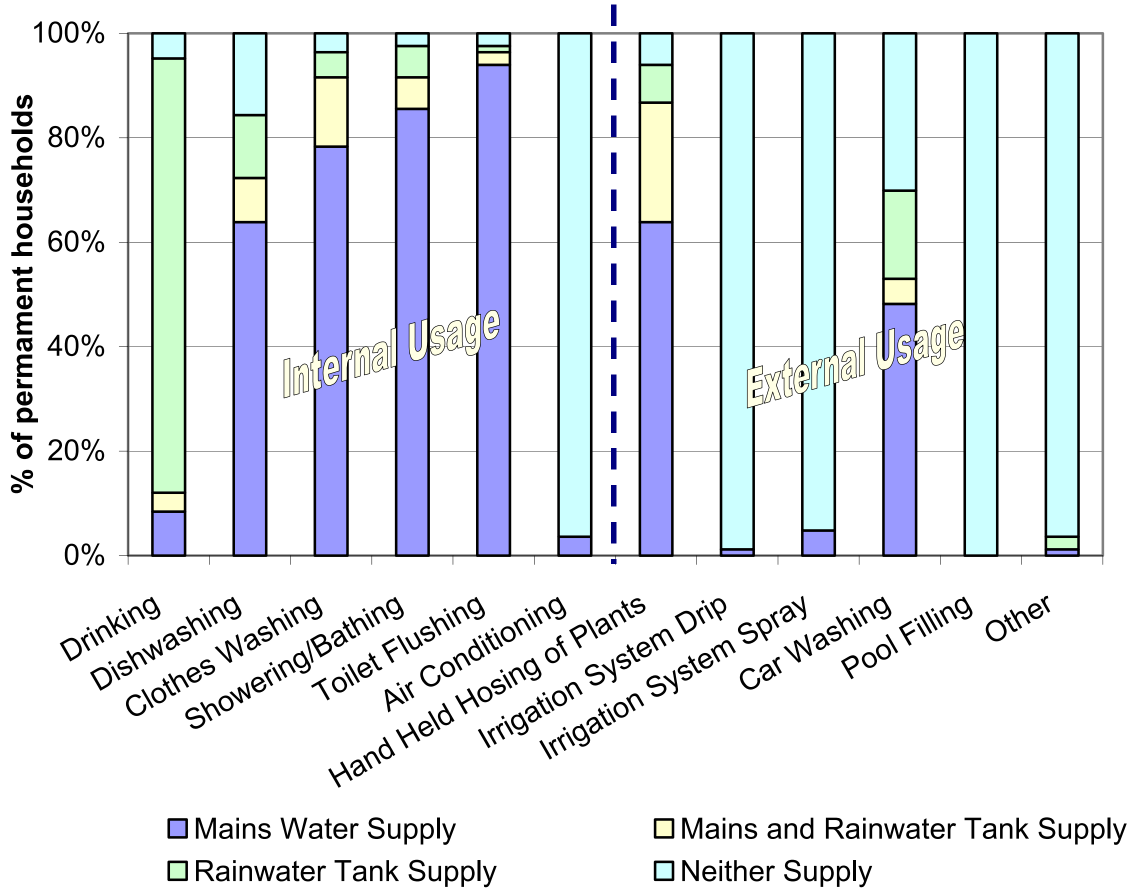


Figure 2-20: Bonalbo Water Supply Sources and Household End Uses

Further, there are currently 10% of properties in Bonalbo that do not have a rainwater tank. Rainwater tank installations on these properties would serve little purpose in providing an extra water source for irrigation. However the provision of rainwater tanks with trickle feed for indoor uses would reduce the peak day and peak instantaneous demand on the main supply system, attenuating the level to which excessive draw-down in the local reservoir is observed.

2.5.3 Mains Water Usage in the Future

The contemporary approach that uses the Demand Management Least Cost Planning Decision Support System (DSS) is used for predicting the future annual demands at Bonalbo. The contemporary approach differs from the traditional approach, as this approach, in addition to accounting for the change in population and dwellings numbers, it also takes into account the mandatory implementation and customer choice based projected propagation of water efficient devices. Figure 2-21 below shows the historical demand and GS1, GS2 & GS4 baseline average annual demands. The historical demand has been adjusted to include an average annual rainwater tank demand.

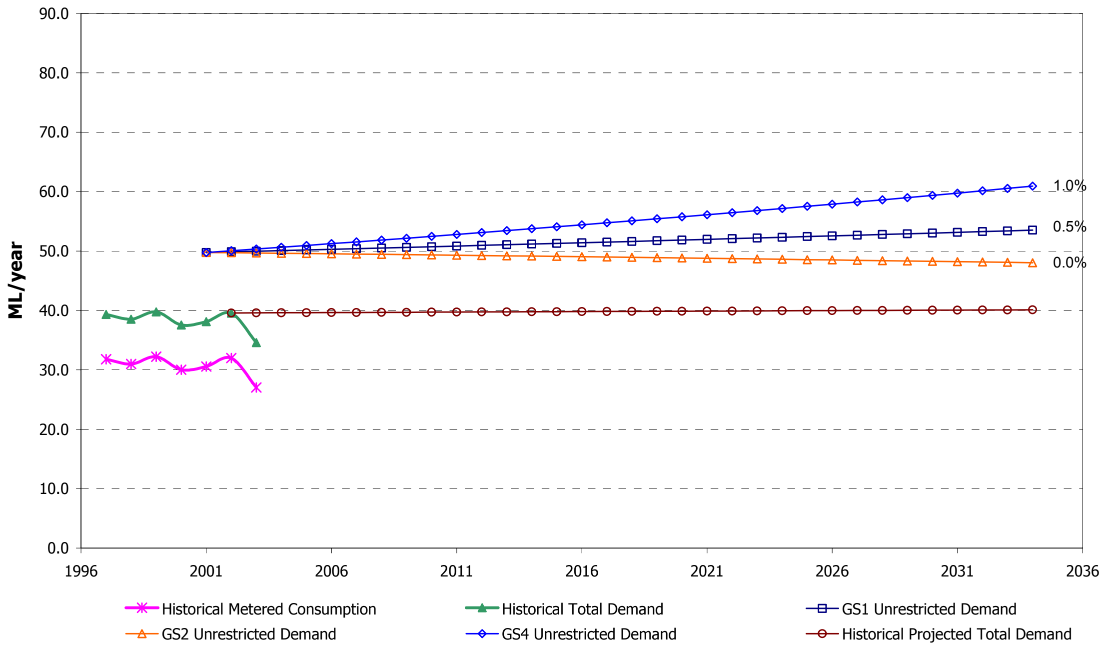


Figure 2-21: The Consumption Trend and Projections

The following projections are calculated by the DSS as a baseline prediction and include a natural level of water efficient appliance propagation. The baseline does not include any form of demand management, water efficiency program or active measure to encourage wise water usage. Based on Council's advice, production figures have been calculated as the projected consumption plus unaccounted for water (UFW). Due to the lack of production data, we have assumed 15% UFW of total production. Total production is defined as the addition of UFW and the unrestricted average annual demand.

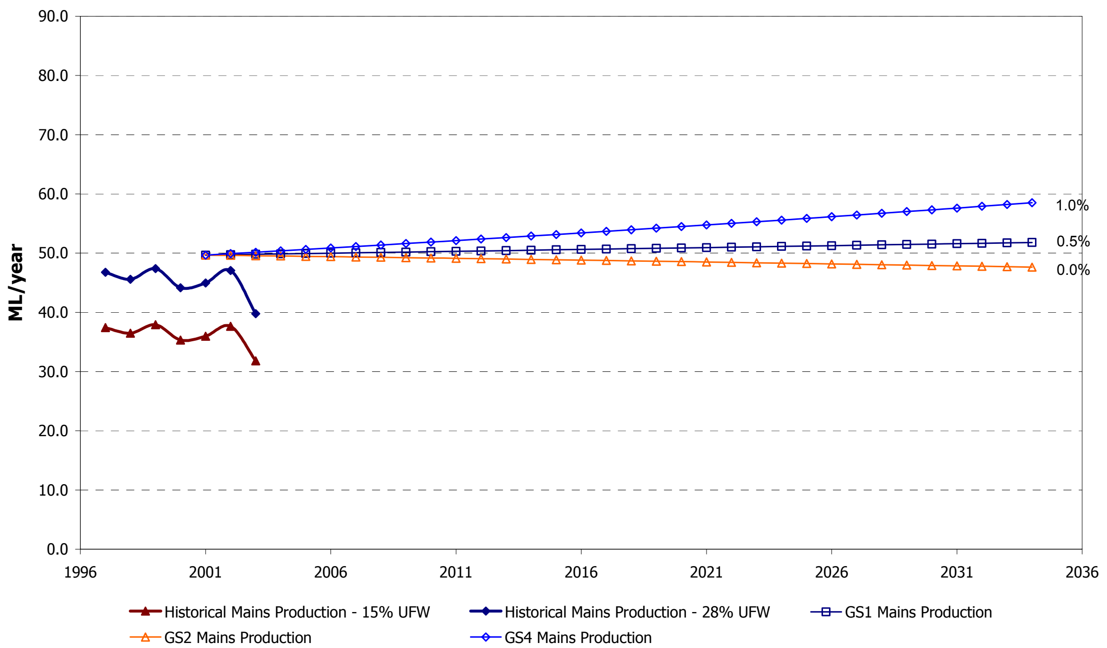


Figure 2-22: Projected Average Annual Mains Water Production

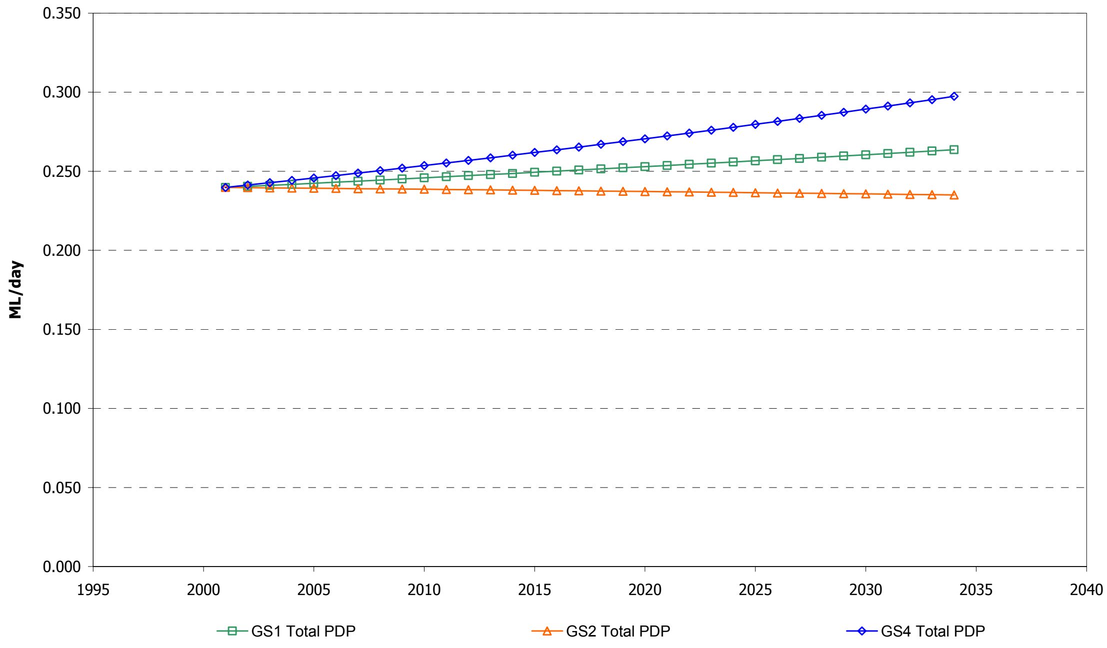


Figure 2-23: Projected Baseline Peak Day Production (excl. RWT attenuation)

The above figures show that the difference in future water use between the three growth scenarios, although not significant in volume, their impact on the water service infrastructure could be considerable. In this study, in the absence of any significant population growth in the ABS data, the growth scenario 1 has been adopted in the development of water management options. Figure 2-23 shows the projected baseline peak day demand for all growth scenarios.

In order to combat festival water consumption in the future, as previously suggested it would assist Council in planning if daily production meter readings were taken. This would provide information on the sensitivity of the water supply to each festival event and allow Council to make informed decisions about the future management of a potable water supply. Council may impose restrictions prior to each event to allow storage levels to remain high or otherwise Council may use tankers to supply water on-site at the showground or the site of the festival.

2.5.4 Rainwater Tank Usage in the Future

The average size of rainwater tanks in Bonalbo is currently about 4.5 kL. In modelling a tank of this size and depending on the end-use scenario, it was established that a yield of up to 58 kL of water in an average year could occur. With a tank size of 22 kL it was found that the rainwater yield could be increased to 71 kL of water in an average year. The following tables gives results of modelling for an average year and drought year for tank sizes of 4.5 kL, 10 kL and 22 kL.

Table 2-10: Yield for 4.5 kL, 10 kL and 22 kL Tanks in Bonalbo during an Average Rainfall Year

End Use Scenario	Garden + Toilet			Garden, Toilet +			Toilet, Laundry +		
Tank Size (kL)	4.5	10	22	4.5	10	22	4.5	10	22
Average annual consumption of reticulated potable water as top-up (kL)	82	70	59	104	93	84	73	66	60
Average annual roof water consumption (kL)	39	51	62	48	58	67	58	66	71
Average annual total demand (kL)	122	122	122	152	152	152	131	131	131
Average no. of days in a year that tank is topped up with mains supply	107	90	73	135	120	105	223	199	182

Table 2-11: Yield for a 4.5 kL, 10 kL and 22 kL Tanks in Bonalbo during a Drought Year

End Use Scenario	Garden + Toilet			Garden, Toilet + Laundry			Toilet, Laundry + Shower		
Tank Size (kL)	4.5	10	22	4.5	10	22	4.5	10	22
Average annual consumption of reticulated potable water as top-up (kL)	175	205	109	171	205	109	165	205	109
Average annual roof water consumption (kL)	22	22	22	22	22	22	22	22	22
Average annual total demand (kL)	197	227	131	193	227	131	187	227	131
Average no. of days in a year that tank is topped up with mains supply	196	220	287	197	219	287	197	219	287

The above tables show that the end-use scenario involving only indoor end-uses for all tank sizes more efficiently uses the rainwater tank during an average year by producing a higher yields and therefore reducing the amount of top-up from mains supply (20%-60% of the days in a year). However, during a drought year tank size and end-use scenario have little effect on the tank yield or efficiency, based on the fact that there was never enough rainfall to have a tank overflow and from 50% - 75% of the days in a year, tank top-up was occurring. For end-use scenarios where garden watering was involved, an average of 0.9 kL per top-up day was experienced per tank in an average year. This top up is equivalent to 120 kL when considering the entire residential sector and would be a substantial load on the drought effected town water supply.

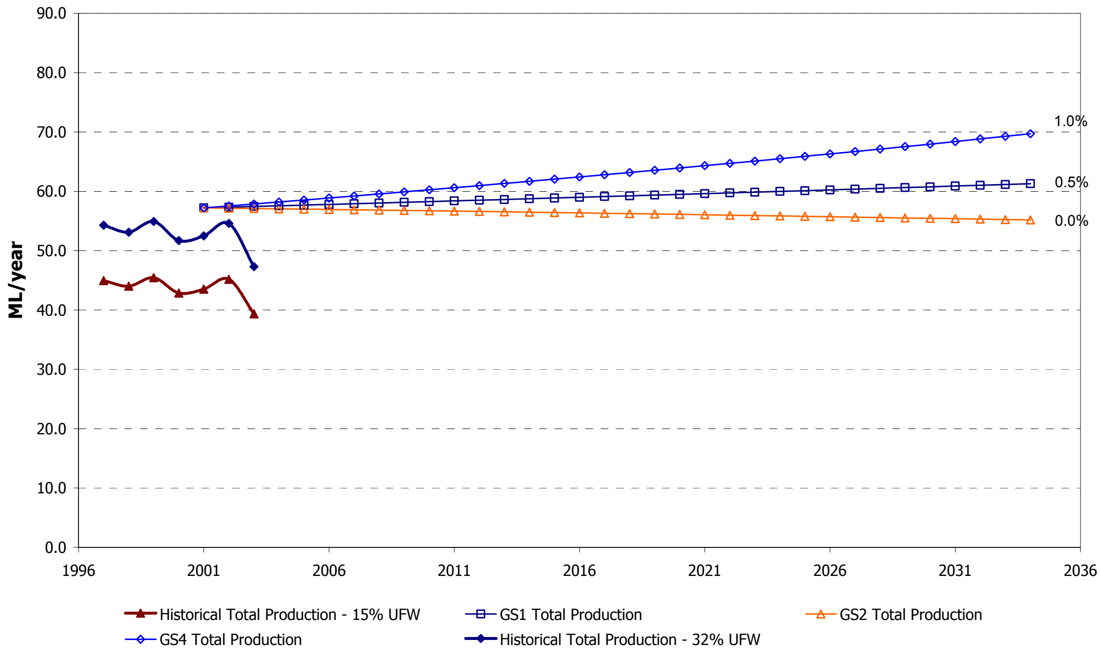


Figure 2-24: Projected Average Annual Total Water Production (Mains & RWT)

During an average year the use of rainwater tanks in the future will assist in attenuating the average annual and peak day production (PDP) volumes. Figure 2-24 shows the projected average annual total water production including both mains production and rainwater tank production. This figure can be contrasted with Figure 2-22, where the total annual rainwater tank yield for all tanks in Bonalbo in included. It should be noted that the expected potential yield from all rainwater tanks in Bonalbo has been calculated using an average tank size of 4.5kL.

This occurrence has been calculated based on average day yield rather than peak day yield for an individual rainwater tank. However, Figure 2-25 provides an indication of the value of rainwater tanks in reducing the peak day mains demand and therefore the peak day mains production.

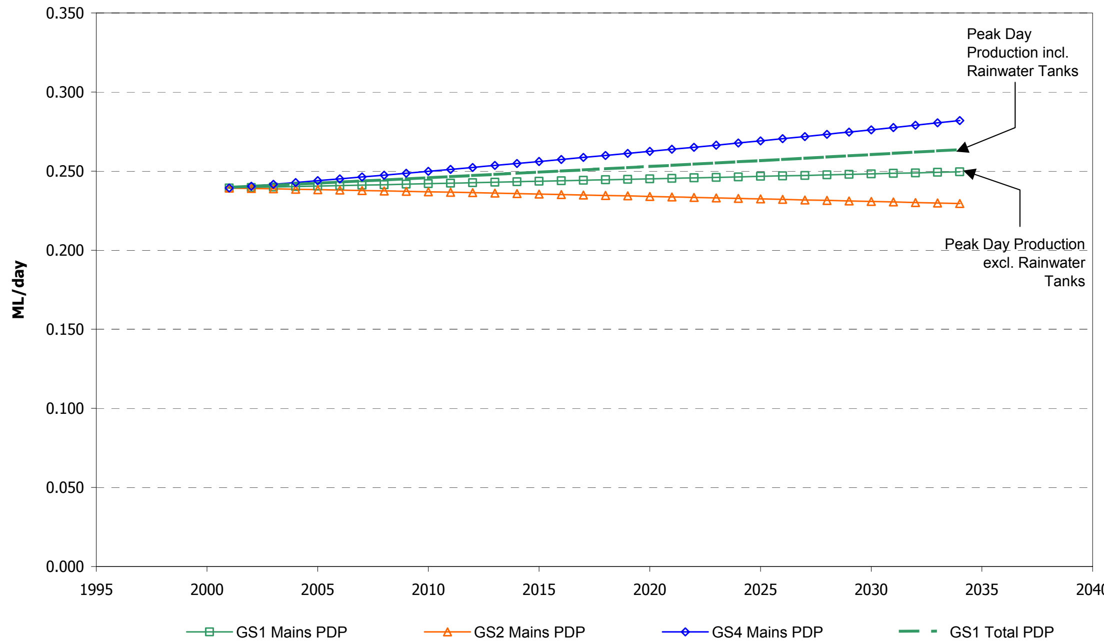


Figure 2-25: Peak Day Mains Production (incl. RWT attenuation)

As depicted in Figure 2-25 the effect of rainwater tanks on an average year's peak day demand and production can be seen in the difference between Total PDP and Mains PDP for GS1 as 0.25ML/day in 2034. It should be noted that rainwater tanks provide no attenuation on peak day demand or production in a drought year. This is due to all tanks being empty and therefore a peak day production should be designed to 0.25ML/day.

2.5.5 Urban Water Discharges in the Past and at Present

Wastewater

All Bonalbo residential and commercial assessments are serviced by the village sewerage system and the wastewater undergoes secondary treatment. Approximately 5% are estimated to have their own on-site greywater management systems, which are employed for toilet flushing and/or garden watering. The table below shows the volume of historical annual wastewater levied at Bonalbo from the serviced assessments and illustrates the significant volumes of inflow and infiltration entering the sewer network.

Table 2-12: Volume of Wastewater produced from Serviced Accounts

Year	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Base Volume Estimate[1] (kL)	25,065	24810	25,840	23,920	24,320	25,355	21,295
Total Volume Recorded (kL)	30,200	29,891	31,135	28,820	29,300	30,547	25,655
Rainfall (mm)	922.8	809.7	1043.9	902.3	913.2	718.4	-

[1] Based on 17% Inflow and Infiltration (DLWC, 2002)

The annual wastewater discharge volumes have been levied on a quarterly basis. This allows a comparison with the quarterly levied water consumption. The wastewater discharge volume is a summation of the total mains water consumption less the external mains water consumption plus an amount of inflow and infiltration (I/I).

The Healthy Rivers Commission conducted the *HRC Clarence River System Inquiry, November 1999* and assessed that it is likely that the infiltration and inflow in the Kyogle region is causing significant additional loads, further approximated as 17% of flow volumes as reported in the comparative statistics (DLWC, 2002). The Ministry of Energy and Utilities (MEU) reported in the 2001/02 NSW Water Supply and Sewerage Performance Monitoring that the percentage of total wastewater collected that could be attributed to I/I was 23%. In 2002/03 it was reported that this amount was 9% of total wastewater.

Due to the age of the existing sewerage infrastructure at Bonalbo, an approximation of 17% I/I seems reasonable and has been adopted as an average annual percentage of Bonalbo's levied wastewater. It has further been used as a quarterly average purely for estimation purposes and its volumetric contribution is displayed in Figure 2-26. Due to the fact that an average value for I/I has been employed; the sensitivity of the sewerage infrastructure to rainfall cannot be captured or depicted in the figure. Typically after high rainfall there would be an increase in the amount of infiltration and inflow and during low periods of rainfall, there would be an infiltration baseflow attributed to groundwater. This fact cannot be seen in Figure 2-26, but rather there is a uniform volume of I/I over the estimated baseload wastewater. The addition of the historic baseload sewage flow and I/I flow provides the levied sewage volume. Although it has been assumed that the existing sewerage system is affected by I/I, Council has not reported any overflows and/or sewage treatment plant bypasses that have caused or are likely to cause adverse impacts on the environment or public health. Therefore it may not be any further an issue other than, the fact that

Council and its residents are paying to treat and discharge the additional wastewater volume created.

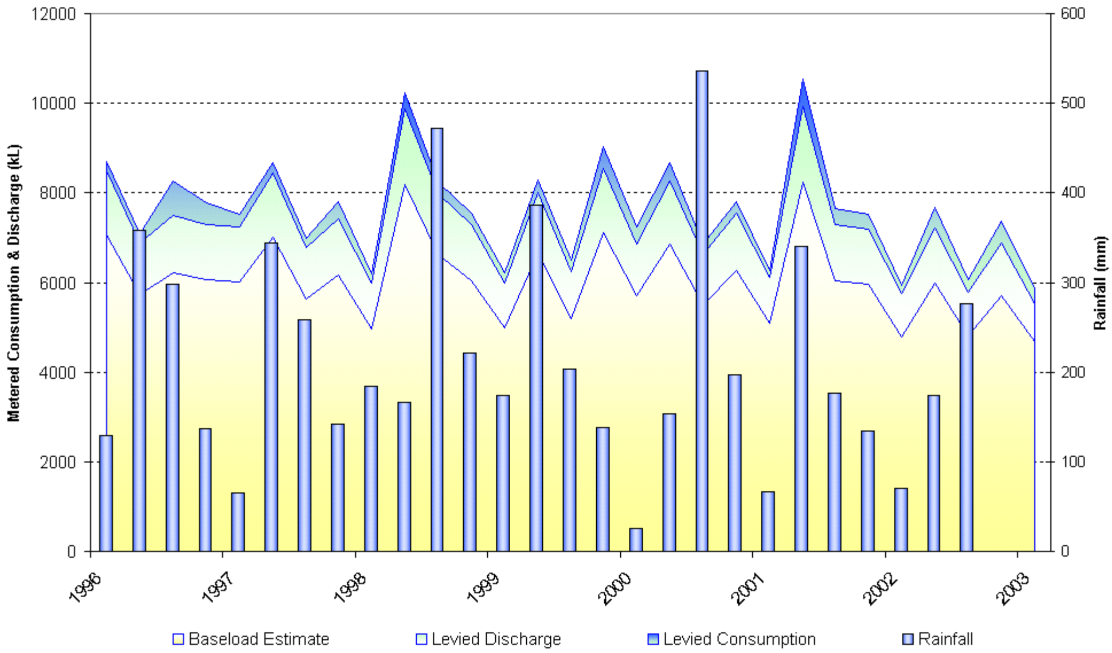


Figure 2-26: Quarterly Rainfall, Water Consumption, Inflow and Infiltration and Sewer Discharge

Figure 2-26 also presents the volume of total historic water consumption on a monthly basis. This amount and the monthly wastewater baseload estimate, allows us to estimate the historical external mains water consumption. It can be seen that there is a coarse correlation between rainfall and garden watering, where external water consumption increases after a period of low rainfall and decreases after a period of high rainfall. Typically, this trend is more accentuated, however it is expected that consumption of mains supply for external end-uses has been attenuated by the use of existing rainwater tanks in Bonalbo. It can be further calculated that the consumption of mains supply for external end-uses comprises 20% of total mains supply.

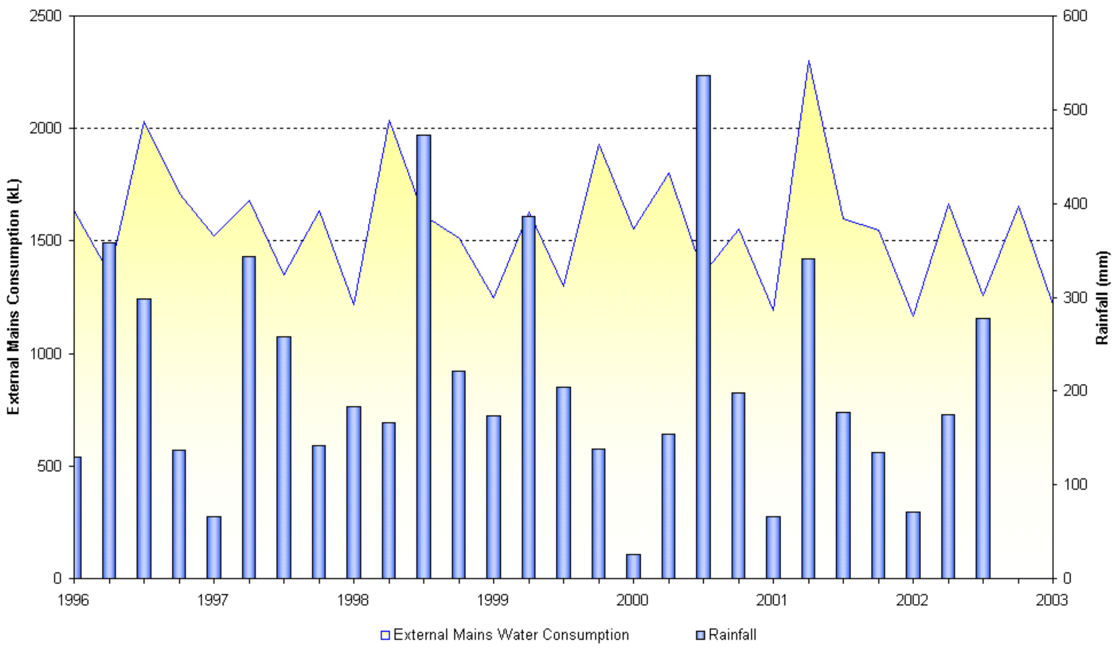


Figure 2-27: Quarterly Rainfall & External Mains Consumption

Stormwater

The Bonalbo stormwater system is extensive in its coverage of the urban area and currently provides a large potential for reuse on open space areas. Figure 2-28 shows the relative average stormwater volumes that could be conveyed through the stormwater pipes per year. A large percentage of this stormwater will be captured within the two retention basins and made available for reuse. Council has reported frequent nuisance flash flooding in the urban area, but no stormwater pollution hotspots.

The Bonalbo stormwater system is extensive in its coverage of the urban area and currently provides a large potential for reuse on open space areas. The following table gives the areas and an estimate of stormwater exiting each catchment displayed in Figure 2-32, on a yearly basis.

Figure 2-28: Bonalbo Sub-catchment Stormwater Conveyance

Sub-catchment	Area (ha)	Stormwater Volume (ML/a)
Lower Woodenbong Road	12.8	159.3
Peacock Street	5.1	62.6
Capeen Street	27.9	347.1
Total	45.4	569

Previously a large proportion of this stormwater volume was harvested and reused at the School agricultural site and the golf course. Previous reports list the estimated re-use for the golf club and the school agricultural plot as 3ML and 10ML respectively. These figures were prior to the construction of the reuse scheme, which eliminated the inflow of stormwater from the storage dams. The following site areas are still available for reuse irrigation:

- 1.5ha grazing pasture at school
- 2.7ha of various crops at school

- Golf Course - 11Ha total, but irrigation of fairways only done in extreme dry weather, so say 5% of this area is greens and tees, which are irrigated all year round.

There is no routine street sweeping for leaf and litter collection, but the majority of the urban area consists of grass swales rather than kerb and guttering. There is some localised flooding outside the bounds of the urban footprint, on the Golf Course and open space area along the edge of Peacock Creek. The town slopes considerably towards the creek and therefore it is not expected that any flooding will occur within the urban area in the future. Council has made no indication of any potential sources for the creation of stormwater pollution hotspots.

2.5.6 Urban Water Discharges in the Future

Wastewater

Table 2-13 below shows the predicted wastewater volumes for 2034.

Table 2-13: Predicted Wastewater Volumes for 2034

	2001	2034
ADWF (ML/d)		
Baseload (ML/a)	25.4	20.3
Annual Volume (ML/a)	30.5	25.4

The above table shows that the baseload in the next 3 decades would decrease by about 20%. However, due to the aging infrastructure, the contribution of rainfall and ground water to wastewater is likely to increase without good maintenance and renewals programs.

Effluent water is currently produced at the sewage treatment plant owned and operated by Council. Table 2-13 shows the current and forecasted baseline volumes expected to be produced in the next 30 years from the STP, excluding inflow and infiltration.

When stormwater flows into sewage pipes treatment volumes at sewage treatment plants are elevated due to coping with the additional demand. Strategies for decreasing the level of infiltration/ exfiltration and inflow include the following:

- Smoke testing for illegal connections of downpipes to sewer. (conducted in 2003/04).
- Sewer flow modelling and measurement, diagnosis and repair of leaking sewers. (relining program commenced in 2004/05 based on results of extensive CCTV survey)
- Continued compliance monitoring for the quality of work on sewer installations in new developments.
- Construction of pressurised or vacuum technology small bore reticulation sewer systems.

These options can form part of alternative servicing possibilities for new developments, which can have other advantages in terms of improving the control over sewer flows allowing more efficient operation and downsizing of sewage treatment plants. There are then synergistic benefits with improving water efficiency and reducing base flows

Gradually providing a more effective sewage treatment and stormwater management system will also reduce these loads.

Stormwater

The discharge of stormwater from the urban area has been steadily increasing with the expansion of the urban footprint. Continual urban development without considering appropriate stormwater management options will result in the continual increase in stormwater volumes and a decline of environmental water quality and represent an increased risk to public health.

It is not expected that the existing stormwater situation will change largely in the future. The ability to utilise the large percentage of stormwater currently captured within the existing natural stormwater retention basins and making this water available for reuse is a possible option for the future. As previously discussed Council has made no indication of any potential sources for the creation of stormwater pollution hotspots. It has been identified that there is a potential for contaminants to exist within stormwater but this water is believed to be suitable as a dual supply option.

It is suggested that in order to improve the quality of the urban stormwater, the construction of a wetland to detain, treat and divert stormwater runoff before discharging to the Peacock Creek, will in the long-term reduce urban stormwater impacts on catchment. This project would also act as a site of interest for tourism and schools within the regional area.

2.6 Infrastructure Performance Issues

The 1998 Strategy Report has concluded, "in reality, the supply is not sufficient". The scheme water supply was critically low in 1994 and emergency measures had to be activated. The reason for the insufficient flow appeared to be the construction of farm dams upstream of the intake that reduced the streamflow to what was believed to be a secured yield dam. Hydrology analysis was recommended to assess the recently constructed upstream farm dams. This study has estimated the number of farm dams in the catchment, upstream of the water supply intake approximately to be 70.

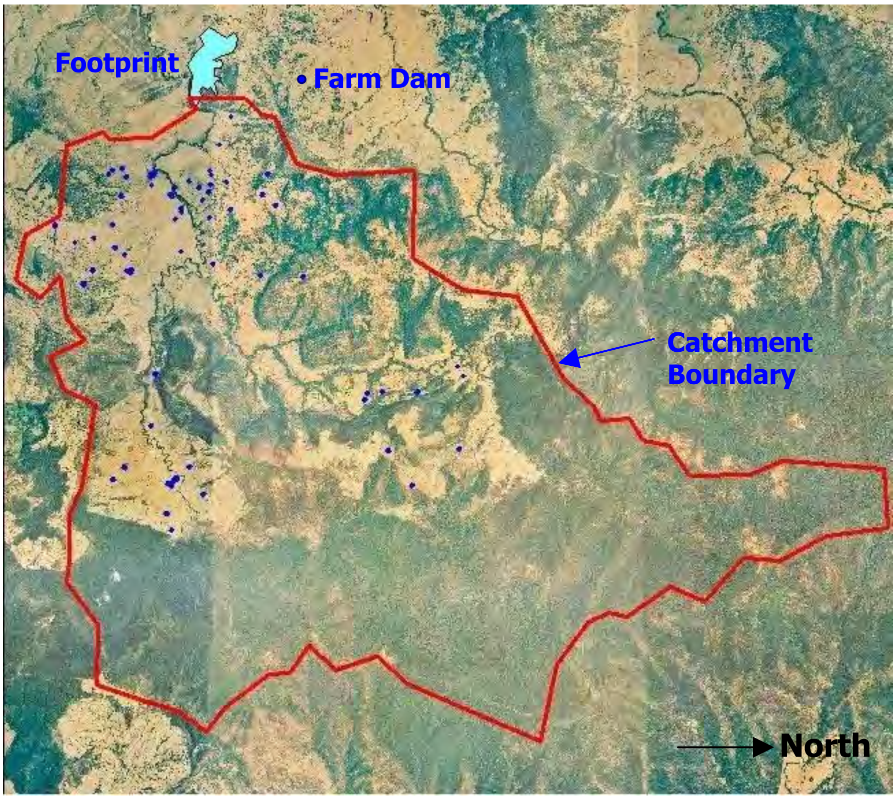


Figure 2-29: Farm Dams within upper Peacock Creek Catchment

Their size and depth would most certainly vary, however an average depth of 1.0 m has been assumed in this study, allowing an overall farm dam full capacity in the upper Peacock Creek catchment of 46,800 GL. It should be noted that only a desktop assessment was conducted through visual inspection of aerial photographs on Council's Graphical Information System (GIS).

The 1998 Strategy Study assessed available water quality data at:

- Peacock Creek water, which could be used to supplement the dam, is high in colour, turbidity, hardness, iron and manganese, and contains coliforms.
- Bonalbo Dam water, which will supply the water treatment plant for Bonalbo, is high in colour and turbidity.
- The Clarence River water, which was assessed as a supplementary supply, is high in iron.

The above results, except for microbiological results, were based on a single set of tests and therefore cannot be taken as a conclusive characterisation of the water quality.

The report also concluded that improvement in the water quality is needed by either adjusting the operation of the trunnion at the dam to enable more controlled withdrawal of water, artificial destratification at the dam to reduce iron and manganese, or full water treatment.

The Strategy Report also concluded that if a treatment plant is selected for the water supply augmentation the capacity of the treatment plant should be 0.3 ML/day based on the projected peak day demand of 278 kL/day in the year 2020. This study has found that the peak day demand is at most 256 kL/day (GS3 – 185kL/day).

2.6.1 Water supply scheme

The Bonalbo water supply scheme was installed around 1966. Presently, Bonalbo is supplied by raw water drawn from Peacock Creek and Bonalbo Dam. During a recent site visit it was noticed that the creek was near dry and the majority of the water within the dam was harvested purely from the local dam catchment's runoff. Appendix H contains photos of the water supply scheme. The scheme currently comprises:

- A 'makeshift' weir pool and intake pump station (Photo I), Pump Station 1 (PS1 - Figure 2-30), are located at Peacock Creek. The pump station is 4.5 m deep with a 1.2 m diameter dry well (Photo II). There is a single submersible pump in the well with a capacity of 3 L/s at 75 m head. The pump is complete with switchgear (Photo III). PS1 is supposed to supplement the dam whenever possible.
- A 150 mm AC Class C rising main (RM1 - Figure 2-30) from the creek to Bonalbo Dam.
- Bonalbo Dam (Photo IV) which is an off stream storage with an overall volume of 47 ML and a useable volume of 45 ML. Appendix I shows the Bonalbo Dam – Storage versus Depth Curve. The dam has an offtake structure comprising a 200 mm CI trunnion (Photo V) and 300 mm CI pipeline that conveys water from the dam to a nearby pump station (Photo VI), Pump Station 2 (PS2 - Figure 2-30).
- A hypochlorination system (Photo VII) housed in a separate brick building adjacent to PS2.
- Water is pumped from Bonalbo Dam PS2 to the 0.9 ML reinforced concrete service reservoir. PS2 comprises a brick building housing two delivery pumps (duty/standby) (Photo VIII) each with an estimated capacity of 7.6 L/s at 38 m head complete with switchgear (Photo IX). The pumps are very old but can be restored by either replacing the ageing motor with variable speed drive motors and renewing the switchgear or by replacing the pumps with new pumps complete with a new switchgear.
- A 200 mm AC Class C rising main (RM2 - Figure 2-30) from PS2 to the reservoir.
- The 0.9 ML roofed concrete service reservoir (Photo X) that gravity feeds the reticulation.
- Reticulation network throughout the town comprising 100 mm, 150 mm, and 200 mm AC pipes.

The water quality in the dam is currently being assessed fortnightly and the collected results will be used for the design of the new water treatment plant. The recent collected results confirm the need for full treatment.

The village of Bonalbo is supplied with reticulated unfiltered and disinfected water derived from water pumped from an intermittently running creek to a small off-stream storage. There is currently a raw water intake/pump station No.1 (PS 1) with a capacity of 3 L/sec, located at Peacock Creek, which pumps water from a make-shift weir pool, through a 150 mm AC Class C rising main to a 45 ML off-stream storage, located above the village. Figure 2-30 shows a schematic diagram of the Bonalbo non-potable water supply scheme.

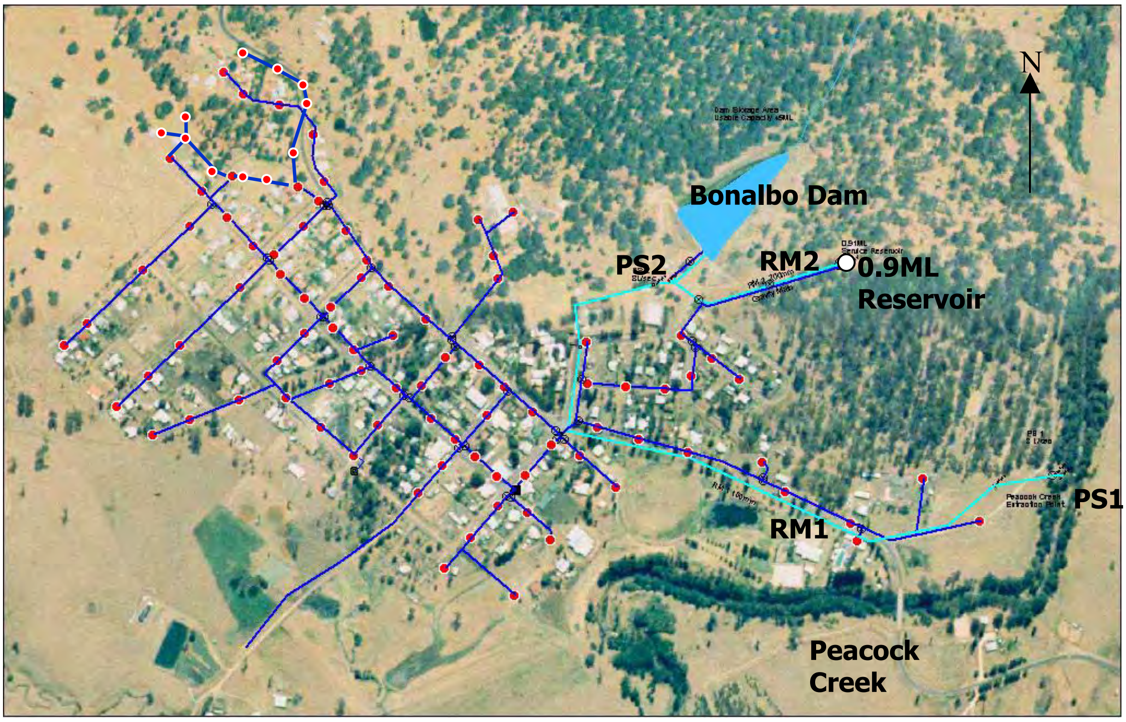


Figure 2-30: Schematic of Existing Bonalbo Water Supply System

Water is drawn from the storage, chlorinated and pumped at a capacity of 8 L/s through a 200 mm AC rising main to a 910 kL reservoir above the village. The water supply is then gravity fed to the village reticulation.

The majority of residents within the village use Rainwater Tanks (RWTs) (Photo XI, Photo XII, Photo XIII & Photo XIV) for drinking water purposes and most have RWTs connected to other end uses.

<u>Water Quality Issues</u>

- The weir pool supplies water, which has high levels of colour, turbidity, hardness, iron and manganese. Previous sampling has contained coliforms (DPWS[x], 1998).
- Bonalbo Dam supplies water, which has high colour and turbidity; other parameters are unsatisfactory (DPWS[x], 1998). Council has concerns over cattle grazing on private property at the head of the storage's local catchment. Council has expressed the possibility of acquiring and fencing the small portion of land, to reduce the risk of faecal contamination.

- The dam is only small. The opportunity for natural die-off of pathogens could be expected to be less than for a larger dam with longer residence time. Anecdotally, a significant proportion of the village's safe yield has come from local runoff (Hennessy, 2003).

- The contact time with chlorine to achieve effective disinfection is less than the recommended value of 30 mins. The inlet and outlet of the reservoir need to be reconfigured to allow detention time before the reticulation draws on the service reservoir.

Supply Reliability and Capacity Issues

- Peacock Creek is an unreliable source, often drying up during summer months. During droughts restrictions are frequent; on average 3-5 months per year. In 1996 there was no storage in the dam.
- When flow in Peacock creek is substantial enough for PS 1 to pump continuously, the pump capacity of 3 L/s permits a maximum of only 0.24 ML/day over a 22-hour pumping day. There is insufficient pump capacity to guarantee supply with no restrictions.
- PS 1 has no stand-by pump; the duty pump is new (installed 1997) but the switch gear appears to be in a poor condition.
- The condition of the 150 mm rising main from Peacock Creek to Bonalbo Dam and the 200 mm rising main from Bonalbo Dam to the village reservoir is unknown.
- The condition of the off-take trunnion is unknown. Council have expressed interest in providing a walkway from the dam edge to the trunnion. Currently the trunnion is lowered and raised manually by a winch mounted on the access platform which must be accessed by boat. (see Photos)
- The condition of Pump Station 2 (PS2), located at the tow of Bonalbo Dam, appears to be approaching the end of their serviceable life; the switchgear appears to be in a poor condition.
- The village service reservoir has experienced severe leakage problems, which were rectified in December 2003. The internal and external ladders and platforms do not comply with safety requirements. The level indicator is not operating (Bonalbo has no telemetry and relies on the level indicator for operation).
- There is no provision to clean the reservoirs. Previously Council have pressured the water supply by pumping directly from the dam into the reticulation, bypassing the reservoir and allowing the reservoir to be taken offline and cleaned and repaired.
- Water supply pressure in unsatisfactory in some higher areas. The adequacy of the system to fight urban fires is currently not known.
- Level of water supply interruption and complaint response times are satisfactory.
- Water use level is below average due to the frequent and extended restriction periods.
- A reticulation analysis has not been assessed within this study. No major problems in the reticulation system have been advised by Council
- The system controls have not been assessed in this study. They may need to be considered during the detailed investigation phase.

2.6.2 Sewerage Scheme

The sewered area is gravity fed into a pump station and then pumped to the treatment plant of 500 EP capacity. There is a problem of stormwater infiltration into the system. The problem is scheduled for treatment in the capital works plan.

The sewerage treatment plant, which was built in 1964, is situated west of the village centre. It is a Pasveer channel plant that discharges into oxidation ponds, which in turn discharge effluent into the peacock creek via a natural watercourse.

The current effluent reuse scheme supplies gravity reticulated tertiary treated effluent to the Bonalbo Public School agricultural plot (next to the STP outside the village) of 1.5 Ha grazing pasture and 2.7 Ha of various crops and the Bonalbo Golf Club of 11 Ha. The golf course irrigates its fairways only in extreme dry weather and irrigates its tees and greens year round. These comprise 5% of the total Golf Club land. Currently the sites combined reuse 100% of the treated effluent available. All storage dams have been bunded and do not collect stormwater so they have no overflow systems constructed (other than a dam wall overtop in the case of an extreme storm event) Any discharge or surplus treated effluent from the STP flows into a natural waterway via the Authorised Discharge Point located on the southern boundary of the STP site. This natural waterway then flows to Peacock Creek downstream of the village. The Environmental Protection Authority has given approval to operate without a license as long as there is no threat of polluting waters.

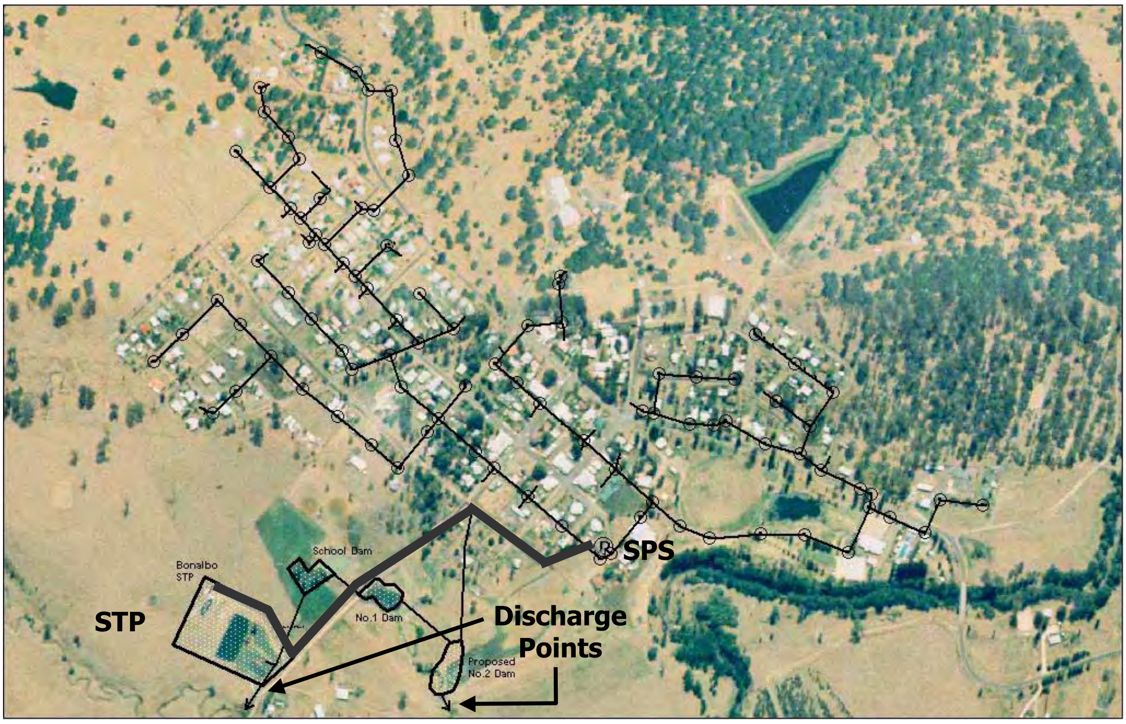


Figure 2-31: The Sewerage System, Treatment Plant and Outlets

The issues associated with the sewage management at Bonalbo village are as follows:

- When reuse storages are completely full, treated effluent discharges into a small watercourse flowing into Peacock Creek.
- Plant can currently achieve EPA License discharge conditions. However more stringent license conditions may be imposed in the future.
- There are a few problems with blockages/overflows. Stormwater inflow and infiltration is a problem during large rainfall events.
- The Bonalbo Golf Club has requested to use the effluent to irrigate the fairways as well as tees and greens.

2.6.3 Stormwater System

Bonalbo stormwater drainage system is split into three sub-catchment areas. The sub-catchments are defined as per the following figure and are Lower Woodenbong Road sub-catchment, the

Peacock Street sub-catchment and the Capeen St sub-catchment. The sub-catchment boundaries and their respective outlets are shown in Figure 2-32.

The Lower Woodenbong Road sub-catchment system receives stormwater from approximately 28% of Bonalbo's urban area and presently discharges to Peacock Creek and a potential stormwater retention basin, adjacent to the Bonalbo Oval.

The Peacock Street sub-catchment system receives stormwater from approximately 11% of Bonalbo's urban area and has one outlet at the lower end of Capeen Street, discharging directly into a stormwater and effluent reuse basin adjacent to the Bonalbo golf course.

The Capeen St sub-catchment system receives stormwater from approximately 61% of Bonalbo's urban area and has an outlet at the intersection of Koreelah Street and Farm Road. At this location the stormwater discharges to a watercourse leading to the same stormwater and potential effluent reuse basin adjacent to the Bonalbo Golf Course. This basin acts to retard the stormwater flow.

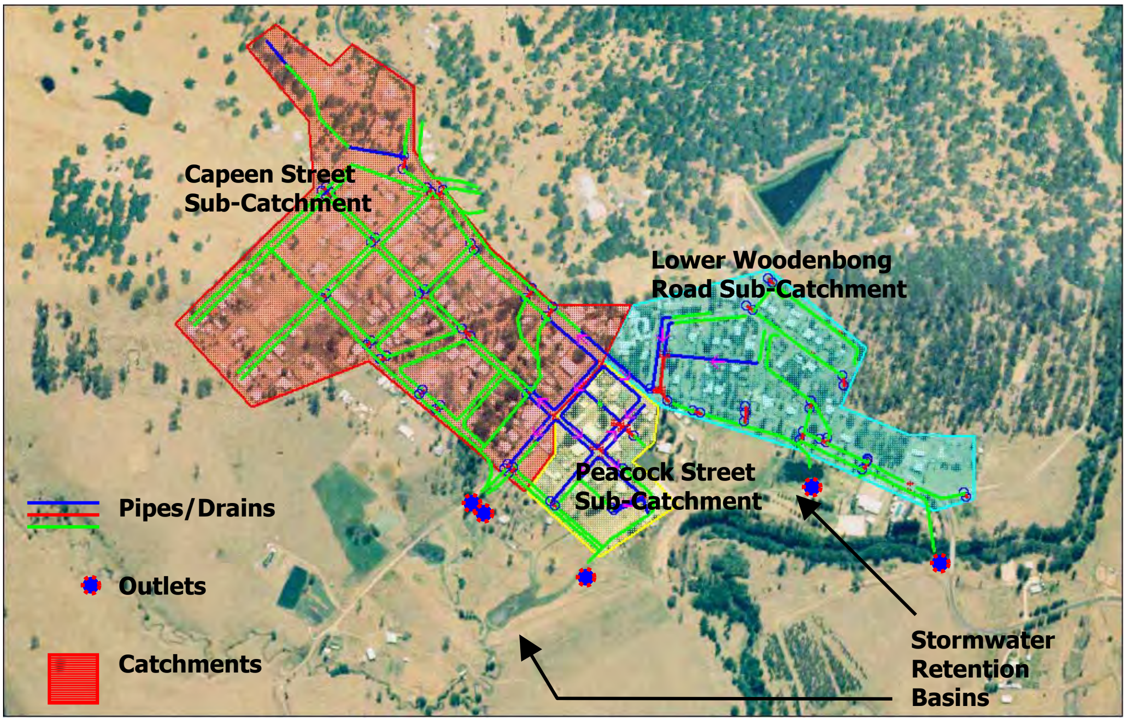


Figure 2-32: Stormwater Catchment and Outlets

The formation of the drainage system in Bonalbo village is one where stormwater is transported along the roads by grass swales and some kerb and gutter to side entry and grated pits, whereupon it enters the drainage network. Many of the roads within Bonalbo have only a central sealed strip with gravel shoulders, allowing overland flow to occur.

The issues associated with stormwater management in Bonalbo village include:

- There is no regular cleaning of pipes leading to a reduced performance capacity.
- Leaf litter potentially could lead to local nuisance flooding.
- The first flush stormwater quality is reported to be unsuitable as a treated potable water source. It is advised that the runoff potentially contains herbicides, pesticides, paints, and other chemicals including petrochemicals as well as litter and sediment. These substances are difficult to treat. They are not removed by membrane filtration and require additional expensive treatment. Stormwater reuse is suitable for a dual supply. There is no routine street sweeping for leaf and litter collection.

3 WATER MANAGEMENT OPPORTUNITIES

3.1 Overview

All available water sources and water management opportunities have been identified along with their stand-alone social and environmental and economic benefit. In consultation with Council staff, the water sources and the water management opportunities were screened and shortlisted using qualitative social, environmental and economic merits and demerits. Appendix J provides the list of water sources and management opportunities considered and the reason for their shortlisting and/or elimination from further consideration. Although the screening process was done on an individual basis for each water source and management opportunity, the screening process acknowledges the benefits when a source or management opportunity is combined with another. This resulted in the shortlisting of some water sources and/or management opportunities which otherwise would have been eliminated when considered in isolation (e.g. roof water harvesting by tanks). Demand reduction measures, local and regional water supply sources and urban water harvesting and reuse have been assessed as potential opportunities to aid in the Bonalbo water supply management.

A reticulation improvement program in addition to targeting service level improvements and legislative compliance was also examined and would be aimed at reducing leakage from the system. Measures assessed for reducing leakage included replacing leaking pipes and tanks and installing efficient level control and monitoring systems.

A Waterwise community education program together with a communication strategy has been assessed as providing management opportunities for Bonalbo water supply. It is Commerce's belief that such a program and strategy could be conducted once water pricing and demand management strategies are chosen. It is envisaged that the Waterwise community education program would develop a series of worksheets with specific advice for the residential sector of the community and the major water users in other sectors to reduce their water consumption and wastage. The communication strategy will examine the media and education options for communicating both the findings of the present study as well as the strategy necessary for sustaining the overall measures within the best practice management program.

3.2 Opportunities for Demand Reduction

Demand reduction opportunities are based on water conservation principles of improved water efficiency, increased water reuse and recycling and reduced water waste. Benefits include an increase in awareness of the importance of water conservation, reduction in water demand, cost savings, reduced pressure on natural environments and a decrease in treatment costs (and chemical use).

Bonalbo has made limited gains in water conservation and demand reduction. 'User pays' pricing and community awareness programs have been implemented in Bonalbo but have not been harnessed with a sustained effort. They have had little impact on reducing water consumption, rather the effect of drought and water restrictions has been largely a cause in reducing water consumption. Household water consumption in Bonalbo is currently stable and averages around 20% lower than many other inland river villages in NSW (DLWC, 2001).

A lack of demand reduction opportunities, including appropriate water pricing charges, compounded by a wasteful behavioural influence leads to increasing per capita water consumption, which results in almost unrestricted usage. Bonalbo's consumption in recent years has been severely restricted by the drought. In non- drought years consumption is typically higher yet no higher than the State wide average. Implementation of certain measures is required to reduce the impacts of human behaviour and urban development on the environment. Recommended water conservation and demand reduction programs to be implemented by the Council should include elements such as; water demand reduction through appropriate planning controls, improved water efficiency, increasing water conservation awareness through promotion and education, loss reduction, pricing, and continuance of urban water harvesting and water recycling. Implementing effective initiatives also release water to accommodate commercial growth as future commercial water requirements will not be accommodated for by the new licensing regime under the WM Act. The available demand reduction opportunities together with the cost, benefits and impacts are discussed below.

3.2.1 Planning Controls

Kyogle Council, as the determining authority for most new developments, is in a strong position to use planning controls to reduce future water consumption. This could be achieved by mandating the installation of water efficient appliances, particularly high efficiency appliances and water sensitive urban design (WSUD) in a Residential Design and Development Guidelines Development Control Plan (DCP). WSUD is a planning framework designed to reduce water consumption and to minimise stormwater runoff (see Section 3.3.1 subsection 3 page 72 for details).

Kyogle Council is yet to address the energy efficiency of residential housing in its Residential Design and Development Guidelines DCP. Thus, there is scope for Council to include energy and water efficiency clauses in their DCP. Mandatory water efficiency measures also have the flow-on benefits of reducing energy consumption. For example, the installation of AAA rated showerheads and high efficiency clothes washing machines will reduce hot water consumption and thus energy consumption. The inclusion of other water efficiency measures such as low flow dual flush toilets and the planting of low water using native plant species in house gardens may cover a greater water conservation message in a Residential Design and Development Guidelines DCP. A number of Council's in NSW have amended their DCP's to accommodate water and energy efficiency measures and concepts.

3.2.2 Education Programs

Over the past 5 years, Kyogle Council has issued a small number of pamphlets throughout the community in an education program aimed at water conservation and wise water usage. The challenge to Council in the future will be to raise and maintain awareness of water conservation issues in the community and translate them into a lasting behavioural change in water use patterns. In order to achieve this, Council could operate a variety of community education programs and engage in an extensive Waterwise and Water Conservation Education Program. Details of a such a program for implementation in Bonalbo is given in Appendix K. The operation of the program is outlined below.

As the residential sector is the largest proportion of water use in Bonalbo, an education program that targets residential customers is highly recommended. Outdoor water use accounts for more than 44% of total residential demand in Bonalbo, which is a relatively low proportion for an urban centre in NSW. However there is scope to reduce and better manage and optimise outdoor water use through an education campaign for all water customers in Bonalbo, which targets issues such as correct lawn and garden watering times and practice, appropriate frequency and duration of garden watering and promotes the savings achievable by planting native plant species that require less water. Further programs might include increasing community involvement at a local level, targeting specific groups within the community for specially tailored sessions and promoting the Standards Australia Water Conservation Rating and labelling scheme for water using appliances.

A well-run residential education program that will change consumer water usage over time requires an investment in Council resources. As a minimum, Council investment should include allowance for the annual salary for a part-time program coordinator and for other costs and disbursements to run the education campaign. An estimate of the costs involved would include an annual up front cost of $5,000 for the first two years of the program and $2,000 every year after commencement for 3 years, then allowing the same cash flow on a 8 year cycle. It is estimated that through running an education program targeting residential outdoor watering, a daily water supply reduction of 9 kL/day can be achieved on its own, an equivalent of an average of 3.33 ML/year. Over thirty years the program as a stand-alone measure would reduce peak day demand to 229 kL in 2034.

A further non-residential education program that will change water usage over time requires further investment. On a similar basis as the residential program with the potential to simultaneously conduct programs, an estimate of the costs involved for a non-residential education program would include an annual up front cost of $2,500 for the first two years of the program and $1,000 every year after commencement for 3 years, then allowing the same cash flow on a 8 year cycle. It is estimated that through running an education program targeting nonresidential outdoor watering, a daily water supply reduction of 5.7 kL/day can be achieved on its own, an equivalent of an average of 2.12 ML/year. Over thirty years the program as a stand-alone measure would reduce peak day demand to 235 kL in 2034.

3.2.3 Residential water efficiency program

Internal water use

Internal residential water use should reduce over the next 30 years due to the natural propagation of water efficient fittings in new homes and the availability of more efficient washing machines and other water using appliances. The household survey conducted in Bonalbo has established that the level of existing water efficient appliances is minimal.

Toilet demand will significantly reduce between 2004 and 2034 with the natural propagation of water efficient toilets. The water consumption for both shower roses and clothes washing machines will also fall over this period but to a lesser extent. This is because the installation of water efficient dual flush toilets is mandated through national plumbing codes, and the installation of other fixtures is assumed to be governed by consumer choice and availability of products in the market place.

Toilets

The effect of regulations governing the installation of low flow toilets that is assumed in the base case demand projection is shown in Figure 3-1. This shows that the proportion of less water efficient toilet flushes will reduce from the current level of 45% to 20% by year 2034 without any active campaign by Council. The plumbing code mandates the minimum performance standards for the installation of dual flush toilets whenever the current toilet is being refurbished and when installing toilets in new homes.

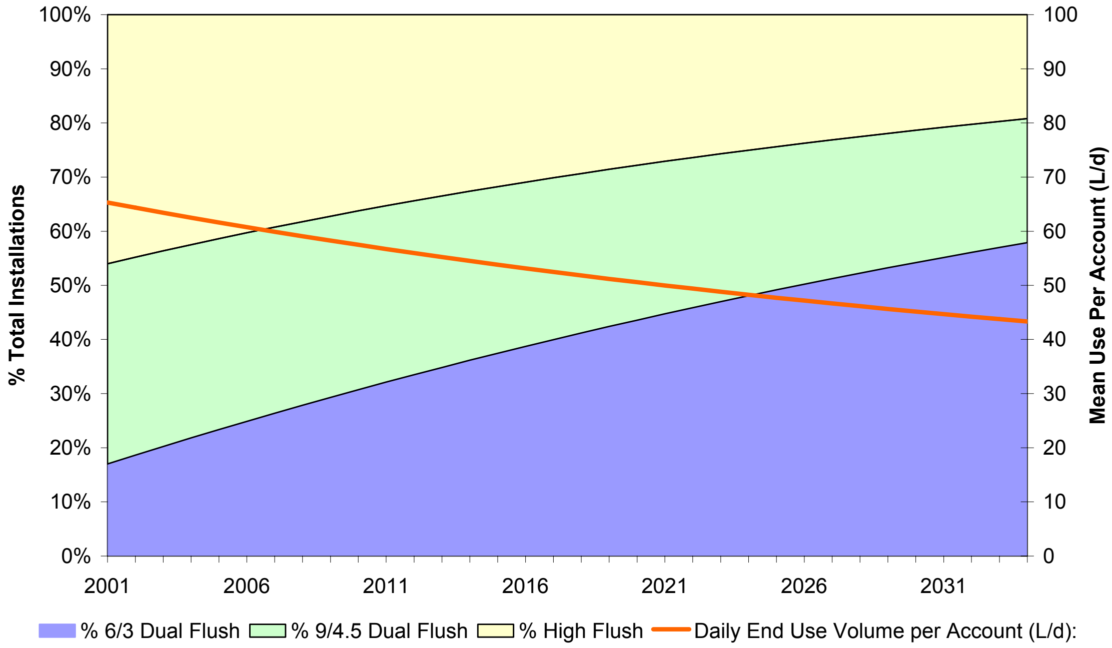


Figure 3-1: Natural Propagation of Water Efficient Toilets

The following table lists the percentages of all appliances and their respective level of water efficiency according to the Standards Australia Water Conservation Rating and labelling scheme for water using appliances. The percentages have been taken as an estimate of the entire village water appliance composition, even though only 16 commercial properties and 83 residential properties completed and returned the survey.

75% of commercial properties and 98% of residential properties surveyed have a toilet or at least one form of toilet.

Toilets	Standard	Displaced	AA	AAA
Commercial	74%	2%	17%	8%
Residential	37%	9%	37%	17%

It can be seen that the percentage of standard or displaced toilets in Bonalbo's commercial and residential sectors is reasonably high and could be targeted through a water efficiency program, retrofitting and/or Council rebate program. If Council were to offer a 50% rebate on a $450 6/3 L dual flush toilet as part of a retrofit program then re-plumbing and connection to the household rainwater tank may also be offered, with the onset of a new potable reticulated water supply. An active campaign starting in 2006 costing $5,000 conducted by Council could increase the number of 6/3 L dual flush toilets to 90% of total accounts by 2016.

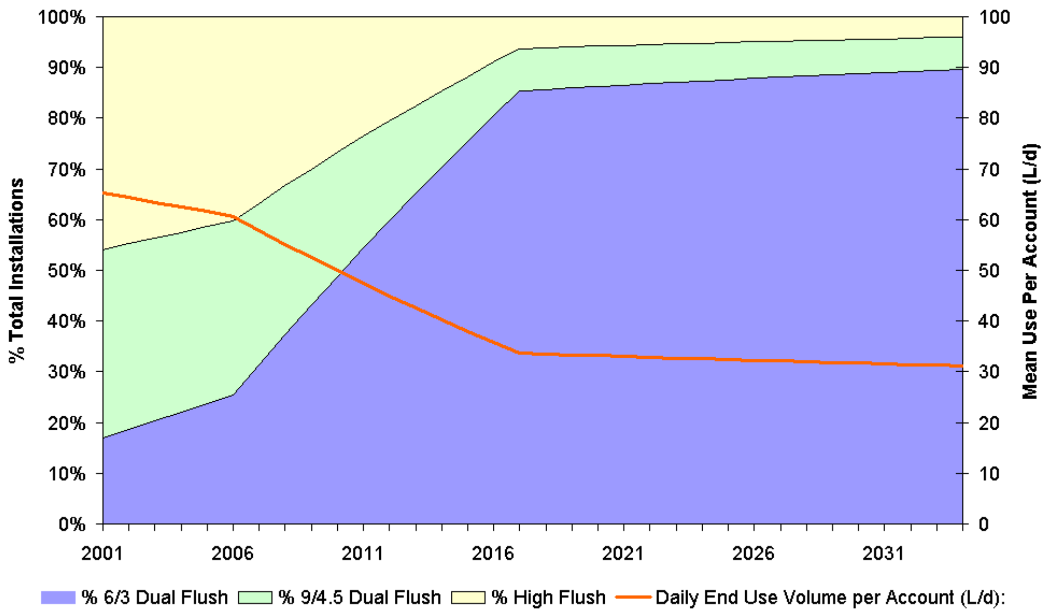


Figure 3-2: Demand Managed Case of Water Efficient Toilet Retrofit Program

The previous figure shows the reduction in mean use per account per day would reduce to 31 L/day and the percentages of water efficient toilets that Council might achieve if such a program were adopted. Such a program would ultimately save up to an average of 0.65 ML/year and 0.71 ML in the year 2034, however the cost of savings would be quite high at $670 per ML. A cheaper option to achieve a significant decrease in the consumption of water could be to offer toilet cistern displacement devices. The reduction in water consumption from a 3 L displacement device in a toilet cistern is up to 3.0 kL/year per household with an average lifetime of 5 years per device.

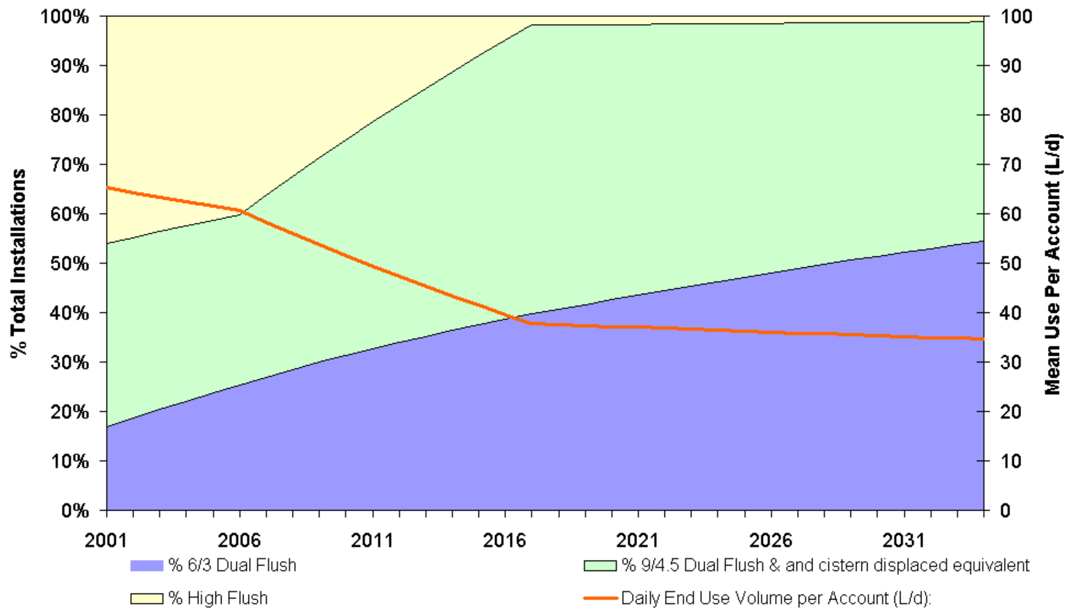


Figure 3-3: Demand Managed Case of Toilet Retrofit with Displacement Device Program

The previous figure, Figure 3-3 shows the reduction in mean use per account per day and the percentages of water efficient toilets that Council might achieve if such a program were adopted. As can be seen the percentage of 9/4.5 L Dual Flush Toilets and Cistern Displaced toilets would increase to 45% and the mean use per account would decrease to 35 L/day. At a rough estimate this could presently and potentially save up to 0.49 ML/year. By 2034, the projected stand-alone savings from cistern displacements may save up to 0.50 ML/year and the cost of savings are much less than that of the water efficient toilet retrofit at $190 per ML. It is therefore suggested that a Toilet Retrofit with Displacement Device be adopted as a measure in the Residential Water Efficiency Program.

Showerheads

Figure 3-4 illustrates the natural propagation of low flow showerheads within the planning period. The replacement of existing shower roses with more water efficient models or the installation in new houses are only governed by customer choice and market forces rather than a legislative control such as those for toilets.

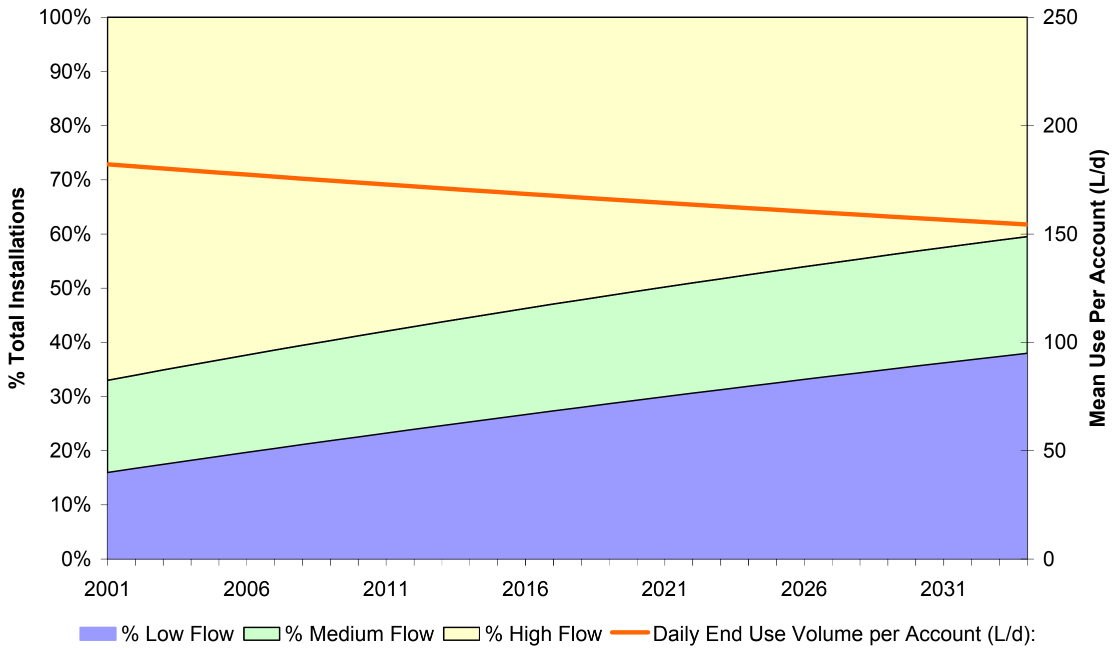


Figure 3-4: Natural Propagation of Water Efficient Shower Roses

Three levels of water efficient showerheads are shown in Figure 3-4 low, medium and high flow. These flow levels can be considered equal to the 'A', 'AA' or 'AAA' ratings of the Standards Australia Water Conservation Rating and Labelling Scheme. That is a high flow shower rose would use more than 12 L/minute of water, a medium flow shower rose between 9 and 12 L/minute and a low flow shower rose less than 9 L/minute.

To assist the natural propagation process, Council should consider including specific provisions in its Development Control Plans to cover minimum performance standards for all water using fixtures for all new and replacement installations. Water efficient appliances and fittings such as water efficient shower roses, 6 L/3 L dual flush toilets and tap aerators can be installed in new houses at little or no extra cost.

Alternatively, instead of waiting for the natural propagation of some of the above water efficient appliances, Council could actively provide a retrofit program covering water efficient appliances and fittings.

50% of commercial properties and 95% of residential properties surveyed have a showerhead or at least one form of showerhead.

Showers	Standard	A	AA	AAA	AAAA
Commercial	95%	0%	5%	0%	0%
Residential	53%	14%	17%	13%	3%

It can be seen that the percentage of standard or low rating showerheads in Bonalbo's commercial and residential sectors is very high and poor in terms of efficiency. A residential showerhead retrofit program should be implemented as part of a wider demand management program. Council could offer a rebate as part of the retrofitting. It is recommended that Council implement a smart showerhead program. An initial marketing and management set-up cost to Council would be $10,000. The cost to Council per AAA showerhead installed would be $30 and the cost to the customer would be $30, meaning that if all shower roses were retrofit with an efficient unit, the program would cost approximately $20,000.

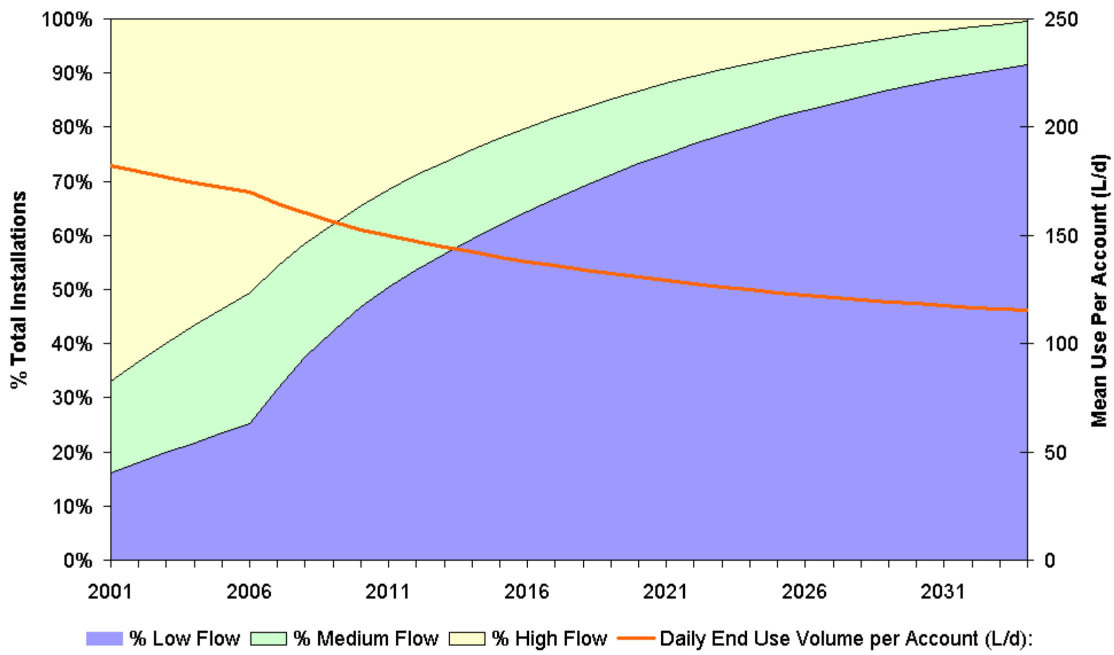


Figure 3-5: Demand Managed Case of Water Efficient Shower Roses

Such installations have other benefits extending from water savings to energy savings. According to SEDA estimates it is expected that an annual reduction in energy consumption per household of 700kWh would occur from installing a water efficient showerhead. As an average over the 30 years, this program could potentially save up to 0.73 ML/year. By 2034, the projected stand-alone savings from low flow AAA showerhead retrofit replacement may be up to 1.08 ML/year. These savings are substantial and furthermore with a Net Present Value (NPV) on hot water saving over the next 30 years calculated to be around $30,000. It is therefore suggested that Retrofitting Water Efficient Shower Roses be adopted as a measure in the Residential Water Efficiency Program.

Clothes Washing Machines

25% of commercial properties and 88% of residential properties surveyed have a washing machine or at least one form of washing machines. According to SEDA estimates it is expected that an annual reduction in energy consumption from installing a front-loader washing machine per household over a top-loader would be in the order of 100kWh. This is a conservative estimate, based on the predominance of cold washes in Australia.

Clothes Washing Machines	Top	Front
Commercial	75%	25%
Residential	92%	8%

It was very hard to establish the efficiency of clothes washing machines in Bonalbo. Householder identification was often not specific enough to determine the efficiency rating given to the washing machine. However, it seemed that the majority of residential clothes washing machines were AA standard. This is reflected in the number of top loader washing machines reported, as most top loading washing machines in Australia have no more than a AA standard.

The following figures show averages for a number of machines available on today's market.

	Capacity (kg)	Water Used / wash (L)	Average Retail Price ($)	Lifecycle Cost ($) of Water @ $0.86/kL per week	Total Cost ($)
Front Loader	6.2	76	1,400	225	1,625
Top Loader	6.9	156	925	460	1,385

Figures are taken from Choice Magazine, 2003

As can be seen the average volume of water used per wash for a front loader is less than half the water used per wash for a top loader, however the cost of the water and the top-loader washing machine is less than the front-loader. Essentially this means that the price of a water efficient clothes washing machine to the consumer is too high. If Council was to offer a rebate on Front Loader Washing Machines, residential customers may find the water efficient models more attractive. A more detailed summary of the results of the Choice research are contained Appendix L.

It is not recommended that any demand management programs include clothes washing machines retrofitting, until a clearer understanding of the existing situation is possible. It is however recommended that Council include some community education in the form of brochures on the differences of having a front-loading clothes washing machine over a top loader. Often despite higher lifecycle cost, people would prefer to be pay extra over the life of the machine in order to save water.

Dishwashers

6% of commercial properties and 10% of residential properties surveyed have a dishwasher or at least one form of dishwasher.

Dish Washer	AA	AAA
Commercial	100%	0%
Residential	38%	63%

It is not recommended that a dish washer retrofit be employed within any demand management program, as the number existing within households is minimal and of the 10% of households owning a dishwasher, 63% of them already have a AAA machine.

Taps

44% of commercial properties and 99% of residential properties surveyed have a tap or least one form of tap.

Taps	Common	Aerator
Commercial	96%	4%
Residential	90%	10%

There is a large potential for water savings by including a residential tap flow installation and rebate program in Bonalbo. It is estimated that the reduction in water consumption from tap flow regulators is up to 3.0kL/year per household and the average lifetime of a tap flow regulator and aerator is 13 years. If a tap retrofit was undertaken to convert common taps to aerator (AAA/AAAA rated) then the Council would need to invest $15,000 over 15 years. At a rough estimate this could presently and potentially save up to an average of 0.46 ML/year. By 2034, the projected stand-alone savings from tap flow aerators/regulators may save up to 0.32 ML/year. It is therefore suggested that retrofitting taps be adopted as a measure in the Residential Water Efficiency Program.

External Water Use

Consideration should also be given by Council to undertake programs that increase garden watering efficiency. As was stated earlier, promoting improved garden watering practices through an education program could be used to alter the current wasteful habits employed by water customers in Bonalbo. Significant savings in water use can be made by addressing these practices in an education program with the end result being an increased public awareness of water conservation issues and improved behavioural patterns of water use.

Specific topics to include in an education program that targets garden watering: include stressing the benefits of planting native flora species that require less water; watering less often but for longer periods thus promoting deeper root growth; and converting lawn areas to mulch. Addressing current watering and gardening practices such as watering during the early morning and evening only, applying mulch to gardens and keeping grass at a reasonable length will reduce the amount of evaporation. Further promoting the use of hand-held sprinklers than automatic sprinkler systems would reduce water consumption as specific areas can be watered rather than unwanted areas such as paths and driveways. The householder can decide when to water rather than a daily timer being used even when watering isn't necessary.

The goals of the education campaign targeted at outdoor water use can be further emphasised by Council actively promoting the sale of new high efficiency irrigation technologies and of appropriate gardening products. The purchasing decisions of customers could be influenced by Council offering financial rebates on products such as micro-sprinklers that deliver water directly to the plant's root, soil moisture controlled sprinkler systems, garden mulch and native plant species.

The coupling of the education campaign with rebates on increased water efficiency gardening products provides a better opportunity for Council to improve public awareness of wasteful outdoor water conservation issues and to alter the wasteful outdoor watering practices currently employed by water customers.

3.2.4 Non-residential Water Efficiency Program

Non-residential Water Audit

Further reduction in water consumption in the non-residential sector could also be achieved through water audits. The audits could be conducted as a free service and should provide advice to the user group on how to best conserve water and hence reduce their water bills. The customers targeted by such a scheme could be identified through water bills. Municipal water use should not be exempt. The three major users groups previously identified have been the school, the nursing home and the teachers housing authority. Although the nursing home and teachers housing authority are providing accommodation for people in Bonalbo, they are not strictly residential. For this reason program targeting end-uses in these three user groups has been called a Non-residential Water Audit. Such a program will assess the following end-uses as appropriate for each property: Toilets, showers, taps and irrigation. The Net Present Value of such a program would be in the order of $35,000 for the Council and $5,000 for the community. This would result in waters saving of 2.89 ML in the year of 2034 or 6.4 kL/day in external water savings and 1.5 kL/day in internal water savings. The average over the 30 years as a stand-alone measure would be 2.82 ML/year. The average cost of saving a ML of water through the non-residential audit would be $400 per ML.

Reducing water consumption in the non-residential sector is best achieved through water audits of each operation and by developing water cycle management plans for each operation. Council could conduct these audits at their own cost or at a discounted rate. A Council employee would typically visit premises and provide advice to the organisation on how to best conserve water and hence reduce their water bills.

Council could also make it mandatory for every non-residential customer to prepare a water management plan. The plan should address how each customer aims to conserve and minimise water use and manage the operation during water restrictions and emergencies.

3.2.5 Loss Reduction

Analysis indicates that the volume of unaccounted for water (UFW) in Bonalbo is about 32% of the total production (i.e. pumped from the dam but not accounted for through customer water meters). UFW in Bonalbo consists of the following three categories:

- Water use without metering
- Water use for operational purpose
- Wastage and meter error

Water use without metering: Council staff confirmed that the water used for watering the public parks and median strips are not metered as well as the water used in the caravan park, public toilets and sewage pump stations. This is evident by the high level of UFW figure. Metering the water use could rectify this situation. Additionally to reduce usage, Council could use more efficient irrigation practices such as watering in the night and on need by sequencing, alternating and timing the watering schedule, and by using more efficient appliances and fixtures (e.g. micro-sprayers). Council could also consider replacing the automatic flushing sequence in public toilets and metering the water cartage.

Water use for operational purpose: This water includes the water used for flushing, firefighting and for other operational activities. Anecdotal evidence suggests that this usage on average is about 8% of UFW and is very difficult to significantly reduce further.

Wastage and meter error: Wastage of water could occur due to pipe breakages and reservoir overflows, leakage and illegal connections. This wastage could be overcome by better telemetry and systematically reviewing the assets such as the reticulation pipe works. The meter error occurs due to fast or slow running meters. Again this could be overcome by calibrating the bulk water meters and systematically renewing the old water meters with new ones.

An UFW Program implementing the measures suggested in all three UFW categories could commence in 2015 with an NPV of $32,000. If the UFW volume is as previously reported at 32%, the future UFW as a percentage of production should reduce to about 24%. Further these reductions should be able to achieve as a stand-alone measure average daily water savings of about 1.78 ML/year and up to 3.87 ML in 2034.

3.2.6 Water Pricing

Appropriate pricing is fundamental for sustainable water services. Therefore, it is important that service providers set tariffs that reflect the cost of providing services while complying with best-practice guidelines (Appendix C). In addition, water supply tariffs should:

- Provide appropriate pricing signals that enable customers to balance the benefits and costs of using the services and promote efficient use of resources;
- Distribute costs equitably among its customers and eliminate significant cross-subsidies;
- Raise the annual income required for long-term financial sustainability of the water supply scheme and its management, including investment in new and replacement infrastructure; and
- Be transparent, consistent and simple to administer.

A major instrument of water management in the urban water sector has been price reform. Kyogle Council introduced 'User Pays' pricing in 1993. Bonalbo's current water charges comprise: a water service charge plus water usage charges. There is no free allowance and every drop of water passing the customer water meter must be paid for.

Kyogle Council's current water charges comprise:

- A fixed water service charge based on the area of the service connection with a base rate on a 20mm connection of $175 and a vacant property charge of $75,
- A water usage charge - this charge is applied to the total measured consumption at the customer's meter, the current charge is $1.00 per kL, and
- There is no base usage allowance.

Council's strategy has been to progressively increase the water use charge over a number of years to convey a water conservation signal. In 2001/02 Council increased water charges from $0.57 per kL to $0.63 per kL, and in 2002/03 increased to $0.65 per kL. Then in 2003/04 Council adopted best practice pricing, increasing water charges to $0.86 per kL and lowering annual access charges. The consumption charges were then increased in 2004/05 to $1.00 per kL. For the full charges, please see Appendix M. It is considered that in order to keep fit this best practice pricing a brief investigation into the new water pricing strategy be undertaken and its findings and recommendations given to maintain the standard. The current water usage charge is high compared to other State inland averages but by no means excessive. The following table lists some examples of neighbouring Shires and their water pricing.

Table 3-1: Water Pricing For NSW Shires

Council	Access charge ($)			Usage charge ($/kL)			Allowance (kL)
	01/02	02/03	03/04	01/02	02/03	03/04	
Kyogle	242	250	**175**	0.63	0.65	**0.86**	Nil
Lismore	84	86	86	0.85	0.86	0.86	Nil
Richmond Valley	116	140	229	0.40	0.40	0.90	Nil
Tenterfield	243	259	267	0.64	0.66	0.68	Nil
Tweed	220	105	106	0.73	0.60	0.62	Nil

Table 3-1 suggests that the price of water in Bonalbo is relatively high compared to its neighbouring Shires. However the water pricing administered at Bonalbo by KC is considered best practice. It is expected that this price regime would produce a strong water conservation message and increase the cost to closer reflect the true price of water in the future. Council should couple any further price increase with an extensive educational campaign to explain the reasons behind these decisions and the benefits to the community and to the environment. Any price increase should be based on a detailed developer contribution and price path analysis taking into account the IPART principles and the State Government guidelines.

Based on analysis of the existing water users in Bonalbo, Council could also consider a two-tier charge to encourage water saving by high users and seasonal charges to reduce peak summer demands. This ensures that those KC consumers on low incomes and businesses (and associated employment opportunities) are not disadvantaged.

3.2.7 Waste Water Ordinance

Water waste ordinance can be viewed, as a method of water conservation, however because of the limited community acceptance should only be introduced out of necessity. It is a form of demand reduction that the Bonalbo community is already well accustomed to, however it may cause members of the community to consider restrictions as an imposition and take up an emotive debate over their introduction. This may particularly be the case after the introduction of new water supply sources and greater security of supply. Water restrictions can adversely impact upon the high proportion of retirees in the area who spend a large amount of their leisure time gardening. Allegations may also be made by the community that inadequate management of the water resources has lead to the need for water restrictions. Therefore it is important that a rational, thorough and transparent decision-making process is followed and that the conclusions reached are conveyed to the community.

Even though water restrictions are generally viewed as an effective method of demand management, there is evidence to suggest that in some circumstances they may initially, result in increasing demand. Rather than instilling a conservation mentality in customer’s minds, some water users may not have realised that water was in short supply but feel that their present situation is too important to reduce consumption and instead increase their water use. This is usually seen when restrictions have only recently been introduced and the level is not very strict. Increased demand reduction will generally occur as the level of restrictions is increased and the need to conserve water is conveyed to the community. Also the ability of Council to enforce these restrictions through fines and penalties is important to the community’s adherence to them.

The present community sentiment toward water restrictions is that they are an imposition from Council and are only required during periods of severe drought. However, there is an opportunity to use the introduction of water restrictions in a broader context within the demand management framework. Restricting garden watering to early morning and evening is one water restriction strategy that could be applied permanently. This strategy not only achieves positive outcomes in terms of water efficiency, but is more beneficial for general plant health and growth. One of the major challenges facing Kyogle Council through the implementation of the water conservation strategy is to change customers’ current behavioural patterns and water use. As community awareness of water conservation issues increases through the implementation of a successful demand management program, a greater acceptance towards these issues is likely to result. This may also result in a change to the community’s current perception of water restrictions. Rather than only introduce restrictions during periods of severe drought, they could be used to help raise awareness and reduce peak seasonal summer demands by introducing mild restrictions every summer. The political repercussions of any decision made with regard to future water restrictions would need to be determined by Council prior to their introduction.

3.2.8 Shortlisting of Individual Demand Reduction Measures

In the preceding sections all potential demand management measures were examined as stand alone measures based on current and past available population, dwelling and demand data.

Tables 3-2 and 3-3 list the costs and benefits of all demand reduction measures considered at Bonalbo under all growth scenarios (GS). These costs and benefits are based on implementing the measure in isolation and hence the cost and benefit of implementing a particular opportunity. The benefits to both Council and the community of implementing each measure include the water savings and the associated reduction in water infrastructure, treatment and transfer costs. The additional benefits to the community include electricity savings from reduced hot water usage. There are also considerable savings to be made in peak day demands.

The combination of the cistern displacements, AAA showerhead replacement and tap flow regulators in a water efficiency program could save up to 3.45ML/year in water consumption in Bonalbo village in 2034.

Two bundled programs have been developed as follows:

- The Low Impact **Demand Management Program** consisting of:
    - Waterwise and water conservation education; and
    - Non-residential Water Efficiency Program.
- The Medium to High Impact **Comprehensive Demand Reduction Program** consisting of:
    - Waterwise and water conservation education,
    - Non-residential Water Efficiency Program,
    - Unaccounted for water reduction program,
    - Residential Water Efficiency Program – consisting of shower rose, toilet displacement and tap retrofits

Table 3-2 provides the cumulative cost and benefit of the two programs under Growth Scenario 1.

Table 3-2: DSS Integrated Programs Results Summary GS1

	Water Utility Benefit Cost Ratio	Total Community Benefit Cost Ratio	Average Water Savings (kL/d)	Cost of Savings per Unit Volume (c/kL)
Low Impact **Demand Management Program**	0.83	1.09	16.5	30.3
Medium to High Impact **Comprehensive Demand Reduction Program**	0.66	0.93	25.4	35.5

These two bundled demand reduction programs would be used in the bundling process for the integrated water management options.

Figure 3-6 and Figure 3-7 present the average annual and peak day demands based on the two bundled demmand reduction programs for the population growth scenario 1.

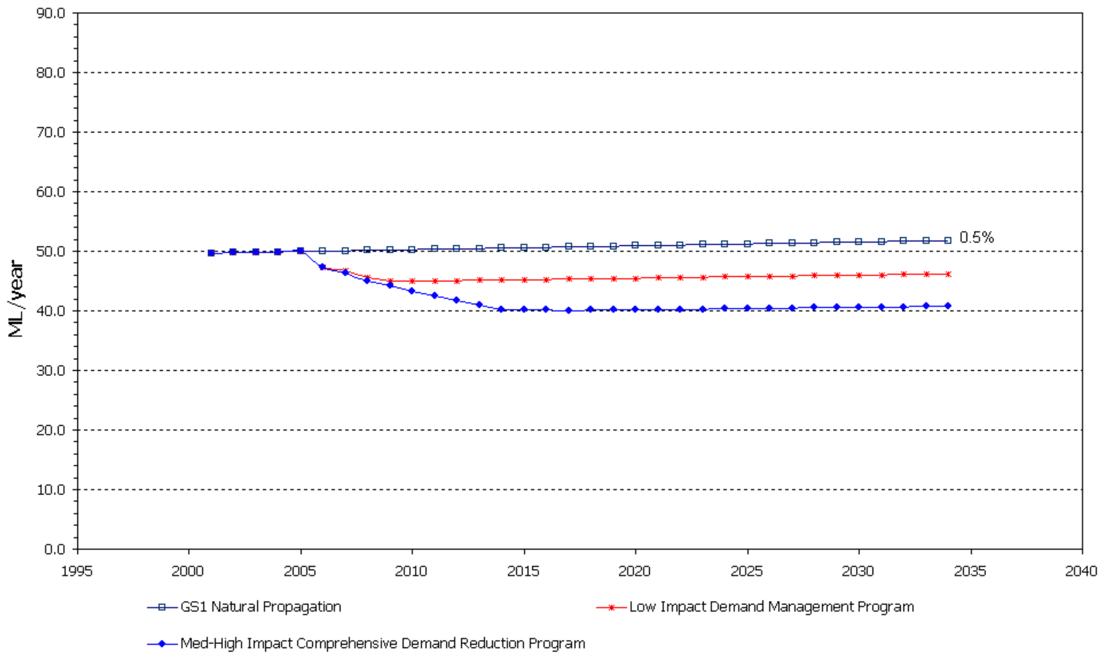


Figure 3-6: Growth Scenario 1 Annual Production Forecast

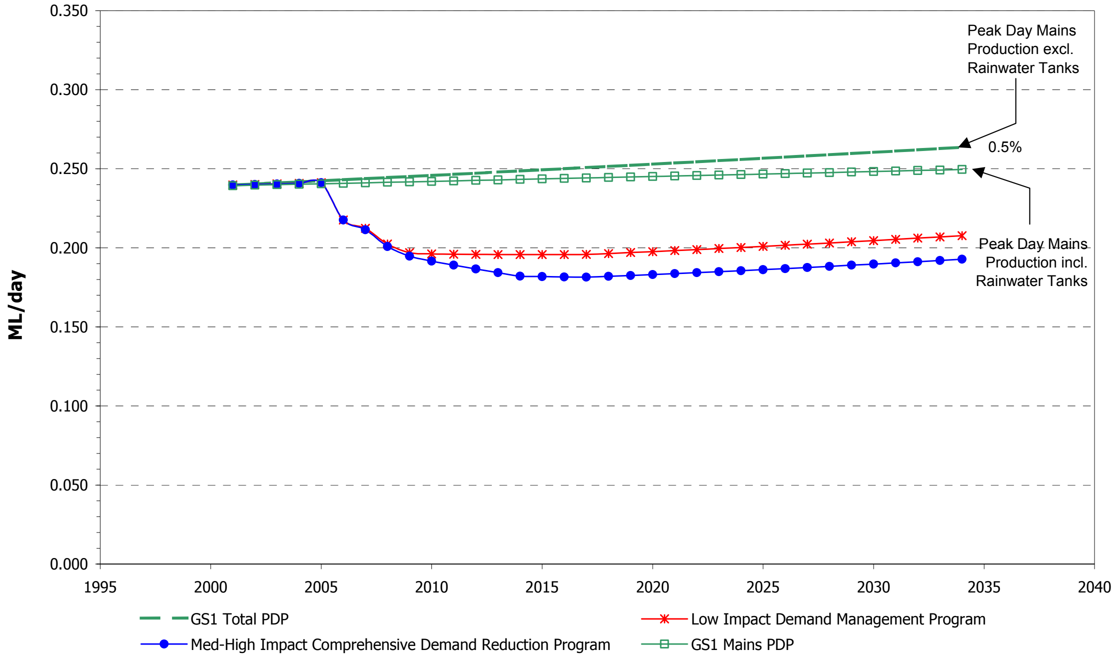


Figure 3-7: Growth Scenario 1 Peak Day Production Forecast

Analysis indicates that both the demand management programs have similar savings in peak day demand attenuation, but differ substantially when comparing daily and annual demand volume. It should be noted that the reduction in average annual demand for each of the demand management programs will be less than the sum of the water savings given in Section 3.2.2 to 3.2.5 due to the effect of the interaction between the individual measures.

3.3 Water Supply Opportunities

The following water supply sources have been considered for potable and non-potable water supply in Bonalbo village.

Water supply sources considered for potable and non-potable use:

- Surface Water – Peacock Creek and Bonalbo Dam catchment runoff;
- Surface Water – Toonumbar Dam;
- Surface Water – Woodenbong and Urbenville;
- Surface Water – Kyogle;
- Surface Water – Clarence River;
- Roofwater and WSUD;
- Greywater;
- Groundwater;
- Reclaimed Water; and
- Stormwater.

The coarse screening process shown in Appendix J was undertaken to select opportunities for further analysis and consideration. The outcomes of this screening process together with the main reasons for their scoring and decision for further consideration are summarised in Table 3-3 below. The scoring of supply sources is based on three levels of acceptance (High – H, Medium – M and Low – L) for four considered categories: Social Acceptance, Environmental Acceptance, Economic Acceptance and Regulatory Acceptance. Any supply source scoring two or more Low – L for considered categories has not been considered as a potential Water Supply Opportunity.

Table 3-3: Water Supply Source Screening Summary

Potable Supply Source	Average Scoring	To be considered further as Opportunity	
Peacock Creek and Bonalbo Dam catchment runoff	M	Yes	Existing regional supply, installation of WFP and transfer capacity required
Groundwater	M	Yes	Potential for a regional bore supply with minimal environmental pipeline issues and more affordable
Roofwater and WSUD	H	Yes	Existing local supply, residents acceptance of RWTs high, low cost to augment, WSUD recommended under BASIX
Water carting	M	Yes	Only as an emergency scenario or by user choice
Toonumbar Dam	L	No	Too costly and transfer through National Park
Woodenbong and Urbenville	L	No	Too costly and transfer through National Park
Kyogle	L	No	Too costly and transfer through National Park
Cla	L	No	Too costly and transfer through National Park
Gr	L	No	Not acceptable to the community
Re ater	L	No	Unacceptable to Regulatory Bodies

Potable Supply Source	Average Scoring	further as Opportunity	Reason
Stormwater	M/L	No	Unacceptable to DOH and contaminant removal not possible by Membrane Filtration.

Non-Potable Supply Source	Average Scoring	To be considered	Reason
Peacock Creek and Bonalbo Dam catchment runoff	H	Yes	Existing regional supply. Potential to be incorporated and harnessed further.
Groundwater	M	Yes	Potential for a regional bore supply with minimal environmental pipeline issues and more affordable
Toonumbar Dam	L	No	Too costly and transfer through National Park
Woodenbo Urbenville		No	Too costly and transfer through National Park
Kyogle	L	No	Too costly and transfer through National Park
Clarence River	L	No	Too costly and transfer through National Park
Greywater	M	Yes	Potential for local supply and use on household gardens
Reclaimed Water	H	Yes	Existing regional supply. Potential to be incorporated and harnessed further.
Stormwater (WSUD)	H	Yes	Existing regional supply. Potential to be incorporated and harnessed further.

The feasibility of the shortlisted local water supply source opportunities and regional supply source opportunities is evaluated in isolation in the following subsections. Greywater use, reclaimed water use and stormwater use are considered separately in Section 3.4 The outcome of the feasibility analysis would then be used in assessing the source opportunities' benefits for inclusion within integrated water management options presented in Section 4.

3.3.1 Opportunities for Local Water Supply

Rainwater Tanks

In low rainfall areas such as Bonalbo, it is possible to harvest small volumes of roof water using a rainwater tank. Recovery of roof water is not only a function of rainfall, roof size and tank size, but also a function of water use. Tanks are more likely to be full during or following wet weather when garden water needs are low. Conversely during drought periods, when demand is high, rainwater tanks are unable to supply demand because tanks are near empty. Daily availability and demand for roof water is therefore highly variable. An analysis of roof water systems for Bonalbo indicates that there is limited potential to supply household internal or external needs in a year of average rainfall.

Current practice uses a rainwater tank set up as shown in Figure 3-8. The main features of this set up from top to bottom are:

- Rainwater inlet where water from the roof enters the tank,
- Mains water inlet, where water from the reticulated system is fed in when the water levels are low,
- Air gap, which is an air space to ensure that water from the tank does not enter the mains water supply system, as the rainwater is untreated and so could potentially contain pathogens,
- Stormwater overflow, an outlet of greater or equal size to the inlet to ensure that the air gap is maintained during heavy rain,
- Detention orifice outlet, a small diameter outlet that allows water from the detention storage zone to be released over an extended period of time, reducing the peak flow entering the storm water system (this would probably not be used in Bonalbo as there is currently a lower level of concern about flooding compared to water supply),
- Rainwater storage zone, where rainwater is stored prior to use by the household,
- Mains water top up zone, where a volume of about 10% of the rainwater storage zone is used to store mains water during dry periods,
- Water supply outlet, to release the stored water for use by the household,
- Anaerobic zone, a space for debris that enters the tank to sit undisturbed until the tank is cleaned and
- Sludge tap outlet, a tap to allow the debris from the tank to be released during cleaning.

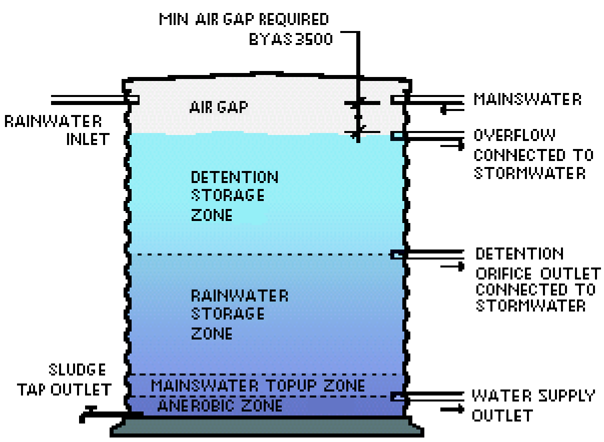


Figure 3-8: Rainwater tank set up

For Bonalbo, a detention storage zone would probably not be used as Bonalbo is rather dry and so this volume is better used for rainwater storage. As a part of the current study, a rainwater tank and water-use survey of all the households in Bonalbo was conducted. Of all residences in the village, 83 households (roughly 50% of the village) returned their survey and used rainwater for one or more purposes. The results of this sub population have been used as representative of the village and show the following:

- 87% of households use their rainwater tanks to provide drinking water;

- A smaller number of households using their tanks to provide water for washing dishes (20%);
- Washing cars (22%);
- Watering plants (30%);
- Washing clothes (18%); and
- Bathing (12%).

Figure 3-9 below shows both rainwater tanks and mains water supply sources and the manner in which the residential community uses each to supply the respective end-uses.

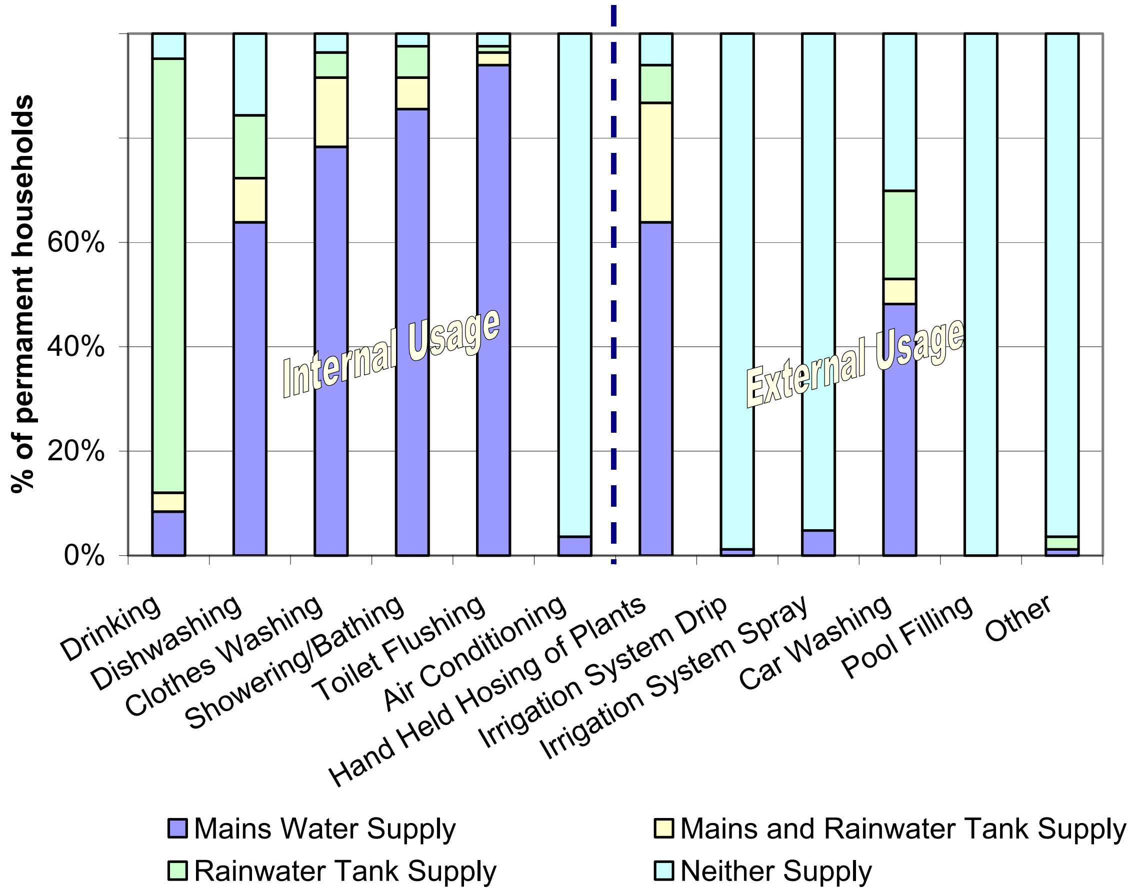


Figure 3-9: Bonalbo Water Supply Sources and Household End Uses

As seen in the figure, the most notable end-use of rainwater tanks is for drinking purposes. A small percentage of the community use both their rainwater tank and mains supply for drinking purposes and there are some residents that use neither. The other notable indoor end-use employing rainwater tanks is for dishwashing, clothes washing and showering. Notable outdoor end-uses employing rainwater tanks include the hand held hosing of gardens and the washing of cars. Approximately 75% of the community rely heavily on mains water supply for all major end-uses (excluding drinking).

The relatively high usage of rainwater for drinking, dishwashing and clothes washing is probably due to the taste, colour and odour problems in the current reticulated supply. The current restriction regime may be responsible for the usage of rainwater for washing cars and watering gardens.

For rainwater tanks to be used routinely for the households garden watering, toilet flushing and clothes washing, the water quality in the reticulated system will have to be improved and tanks fitted with a valve allowing the tank to be 'topped up' with the reticulated water. This would allow the reticulated system's peak day production to be reduced. This change means that the rainwater tanks become an integral component of the main supply system and so would be subject to the same water restrictions (if any) that are applied to the reticulated water during droughts. The main purpose of these changes to rainwater tanks in Bonalbo is to reduce the peak day production supplied by the main system resulting in the reduction of the water treatment plant size and capacity of other water supply infrastructure. It is expected that in 2034, the effect of rainwater tanks on the water supply will be such that the peak day demand and therefore the peak day production requiring to be supplied to the village will be reduced by a minimum of 5% to 0.25 ML/day. Other benefits include additional water supply at the point of use, additional system yield and reliability and reductions in stormwater runoff. Figure 3-10 shows the unrestricted peak day mains production minimum attenuation due to rainwater tanks as part of the reticulated water supply. The attenuation shown below is a result of modelling the existing average rainwater tank size in Bonalbo.

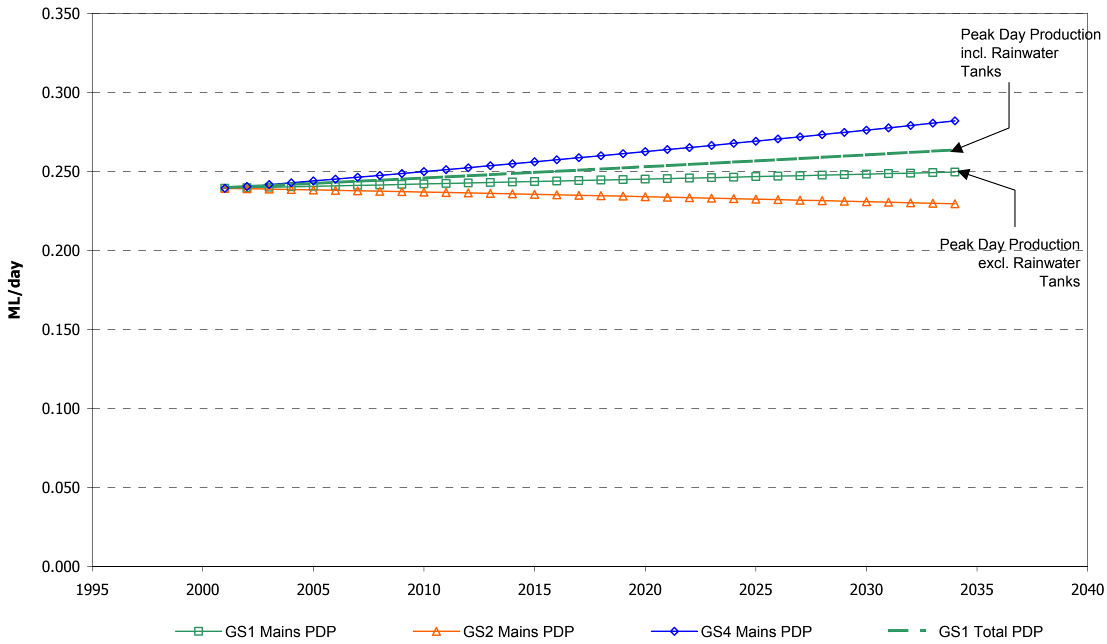


Figure 3-10: Peak Day Production Rainwater Tank Attenuation

As a part of this study, rainwater tank modelling has been conducted for an average house in the village of Bonalbo. Much of the site-specific information was obtained through a household survey conducted as part of the study. The average lot size in Bonalbo was discovered to be very large at 985 m^2 and the average roof size was around 200 m^2. The details of the modelling results are included in Section 2.5.4 (page 38).

As the results showed, rather than being used solely to supplement outdoor garden watering, as has been the case in the past, rainwater tanks are now being used for indoor uses such as toilet flushing and for laundry. Although the NSW Health Department does not recommend the use of rainwater for potable purpose where there is a reticulated water supply, there are many cases of rainwater being used for potable purpose. Bonalbo is one such case, where rainwater has been adopted as the main potable supply. As seen in Figure 3-9, rainwater has been employed by a majority of residents for drinking water purposes and some residents have employed rainwater for other indoor uses such as dishwashing, clothes washing and to a lesser extent showering and toilet flushing. A fair proportion of Bonalbo residents also use their rainwater tanks for outdoor uses such as hand held irrigation of plants and car washing. The adoption of rainwater has essentially been due to the poor quality of the mains supply.

In this study roofwater harvesting using rainwater tanks was modelled as a supplementary source of supply for mains water. That is, when available, the harvested roofwater is used first with mains water meeting the residual demand. It was modelled for the existing residential development within the village. It was found that the harvested roofwater from a 4.5 kL tank could potentially yield about 58 kL in an average rainfall year, which is about 14% of the total average demand of a typical residential house. There are currently 10% of residential houses in Bonalbo that do not have a rainwater tank. Rainwater tank installations in these houses would serve little purpose in providing an extra water source for irrigation. However the provision of rainwater tanks with trickle feed for indoor uses in these houses and all new developments would reduce the peak day and peak instantaneous demand on the main supply system, attenuating the level to which excessive draw-down in the local reservoir is observed.

Analysis indicates that in Bonalbo village there are benefits in installing rainwater tanks for indoor usage in all new developments and in existing homes, particularly those which do not yet harvest roof water. All existing rainwater tanks' operation can be optimised to accommodate the new potable water supply system. The use of harvested rainwater for indoor water use such as toilet flushing, laundry and showering is recommended. A cost benefit analysis of water savings versus extra plumbing costs is recommended.

In any case experience elsewhere is that some householders are willing to invest in a rainwater tank system because of the environmental benefits, even though the cost may be higher than any savings in their bills for reticulated water supply. There are no impediments to the installation of rainwater tank systems in the Kyogle Council Local Environment Plan. A number of NSW councils have recently adopted development control plans supporting the installation of rainwater tanks as an integral part of the water sensitive urban design concept, particularly in new sub-divisions. This is because of the benefits the whole concept provides in attenuating peak flows and reducing stormwater runoff in addition to the average annual and peak water supply demand and production reductions.

Other benefits include reduced stormwater inflow into sewer system potentially resulting in smaller pipes and reduced overflow problems, lower energy cost for the scheme and more operational flexibility to manage the regional water scheme including the ability to respond to system failures. Unfortunately due to the current lack of knowledge and information, it is difficult to quantify these benefits in dollar value.

Downstream benefits can be achieved through detention, which holds stormwater temporarily in tanks, but allows it to slowly flow to the drainage system. Alternatively, it can involve retention, which holds rainwater for reuse on site. Retention of rainwater allows for its reuse for outdoor use such as gardening and washing cars. When integrated with household plumbing and by using a pump, a rainwater tank can also supply water for other uses.

While it is recognised that some consumers may also wish to use rainwater for all domestic purposes, including drinking, cooking, bathing and in hot water systems, in urban areas access to a reticulated potable water supply remains the most reliable source of drinking water for the community. In these areas NSW Health supports the use of rainwater tanks for all non-potable uses, such as garden watering, and car washing. The collection of rainwater conserves the potable water supply and helps to reduce stormwater. The use of rainwater tanks for drinking purposes is not recommended where a reticulated potable water supply is available.

A number of plumbing devices need to be used to ensure supply and to integrate tanks with existing plumbing, while other technical means can improve the quality of rainwater stored in tanks. These include:

- mains water trickle top-up systems for dry periods;
- backflow prevention devices;
- first-flush separation devices,
- Enviroflow or Smartflow (or equivalent) roof gutters;
- litter and mosquito proofing;
- water filtration devices and
- ultra violet disinfection units (where potable applications are envisaged).

Water Sensitive Urban Design (WSUD)

In its broadest context water sensitive urban design encompasses all aspects of urban water management as part of the design process for development. WSUD is a consideration of the opportunities and linkages between urban design, landscape, architecture, and water management. In the planning stages, water use can be optimised and opportunities for on-site water harvesting and re-use can be considered and the best options developed.

Water sensitive urban subdivision and building design, which better controls the flow and retention of stormwater in the urban landscape, can reduce garden water and landscape water needs at little or no extra cost. Combining elements of WSUD with rainwater tanks connected to the roof guttering will provide enhanced reduction in stormwater runoff from the urban block. Some of the principles of good water sensitive urban design are contained in DIPNR's (formerly Planning NSW) Sustainable Urban Settlement Guidelines for Regional NSW. WSUD utilises many of the other tools discussed below such as rainwater tanks, effluent reuse and stormwater management.

WSUD is the practice of the temporary storage of stormwater on the urban allotment, which reduces the peak flow velocity and volume that leaves the site. The flow velocity and volume are reduced by installations such as providing natural infiltration, surface storage and infiltration into aquifers. Not only are there benefits to the street drainage system by incorporating elements of WSUD into the construction of new developments, but also pollutant and nutrient loads are reduced.

While still a novel concept, new subdivisions that have incorporated the ideas of WSUD into the design are being trialled by various Councils around Australia. Brisbane City Council in conjunction with the CSIRO has conducted a study into the financial, social and environmental benefits of a number of innovative water services to an urban development, of which water sensitive urban design is one. Wyong Shire Council have approved the design of new subdivision in Warnervale that utilised the ideas such as rainwater tanks, grassed swales and subsoil infiltration drains, rather than conventional stormwater pipe drainage practices. A subdivision at Figtree Place in Newcastle has been constructed with many features of water sensitive urban design, including underground rainwater tanks and gravel-filled infiltration trenches and has been designed such that stormwater runoff from the site has virtually been eliminated.

Analysis into the costs involved with the Figtree Place development showed that a saving of 1% of the construction costs was realised when compared against the costs associated with traditional drainage systems. This cost saving equated to $959 on a per dwelling basis.

Council, as the determining authority for new developments in the area, is in an ideal position to maximise water sensitive urban design opportunities. This could potentially be achieved through the use of Council's development control plans.

Shortlisting of Local Water Supply Sources

Based on analysis and the above conclusions, it is recommended that the following two local supply opportunities be shortlisted and be used in the bundling process when developing integrated water management options. The local supply shortlisted options are;

- Roofwater harvesting in the Bonalbo village; and
- WSUD with rainwater tanks in all new developments and existing dwellings not currently harvesting roofwater.

3.3.2 Regional Water Supply Sources

There are three regional water sources available to meet the urban water needs of Bonalbo village. These sources include:

- The local Peacock Creek source and existing off-stream storage (Bonalbo Dam);
- The existing unutilised regional bore sources (Bonalbo and Old Bonalbo); and
- Water carting and rainwater tank top-up

As discussed earlier in this report, the existing local creek has inadequate water to meet the Bonalbo village urban demands. Council's existing license condition allows extraction from Peacock Creek and it is likely that any changes to license conditions from the water sharing plan development process would decrease Council's ability to extract water when needed. However with opportunities for regional water supply expansion such as increasing pump extraction capacity and benefit from the existing underutilised bore water sources the unrestricted village demands of Bonalbo may be met. In the extreme case that the village demands may not be met then the drought strategy will be in force.

Peacock Creek and Bonalbo Dam

The existing regional water supply system draws water from Peacock Creek and pumps to an off stream storage. The water is then chlorinated and reticulated throughout the village. Past hydrology studies have concluded that the existing 3 L/s capacity of the extraction pump is not sufficient to capture the fast-response time and large flows experienced within Peacock Creek. Appendix A shows the Peacock Creek historical discharge flows and levels.

In September 1998, Department of Commerce issued the Strategy Study Report (Report No. 97113) on the Bonalbo Water Supply Augmentation Concept Study. Based on the investigations by Department of Commerce and Kyogle Council it was confirmed that the existing water supply scheme failed in providing reliably distributed water that meets the Australian Drinking Water Guidelines. On this basis other water supply options were investigated and local bores assessed for their water quality.

It was concluded that the difference between the existing and potential regional water sources is their quality. Appendix N contains detailed comparative discussion of the water quality and the type of treatment processes that may be required to meet the Australian Drinking Water Guidelines (ADWG). In summary the analysis indicates the following:

- Untreated water from the existing bores is inferior in overall quality than the creek/dam source.
- Both the creek and bore water sources would require basic filtration to meet ADWG. It is expected that even after the basic filtration the creek/dam water would be more palatable than the bore water, due to the lower levels of dissolved solids in the river water. To reduce the dissolved solids of the bore water, an additional capital, operation and maintenance intensive treatment process unit, including coagulation, flocculation and filtration will be required.

Regional Groundwater Sources

Assessment of the groundwater potential in the Bonalbo regional area was conducted at a desktop level in partnership with DIPNR. All correspondence with DIPNR has been attached in Appendix O and the following discussion summarises the outcomes of the desktop assessment.

DIPNR's Groundwater Data System is a database of known bores, sustainable yields, water quality and bore log details in NSW including bores within the Bonalbo area. Council has advised that there are a number of wells around the village. Wells are included within the definition of a bore. There are four bores located around the village of Bonalbo consisting of two bores and two excavations for which no information on bore quality, yield or construction has been supplied to DIPNR.

DIPNR's database has identified two bores located on a property two kilometres to the east of Old Bonalbo, which have a yield of 4 L/s and 4.5 L/s. It should be noted that there is a dis-used live stock dip site to the east of these two sites. Most of the other bores are either very low yielding or too saline for drinking purposes (perscomm. Rumpf, 2004). It is evident that the deeper bores tend to contain fresher water, possibly due to the intersection of differing geological units. If any investigations were to be undertaken in the Old Bonalbo area, it is suggested that the test bores be drilled to the east of the town to a minimum depth of 40 m (perscomm. Rumpf, 2004).

Figure 3-11 shows a map of the Old Bonalbo area with DIPNR's suggested test drilling locations in order of preference (1,2,3). The locations and order of preference have been based on; information provided for other bores, proximity to town, and road reserves. In May 2004 Council initiated testing of the 13 L/s bore identified as preference 1. The results are shown and discussed further in Appendix N.

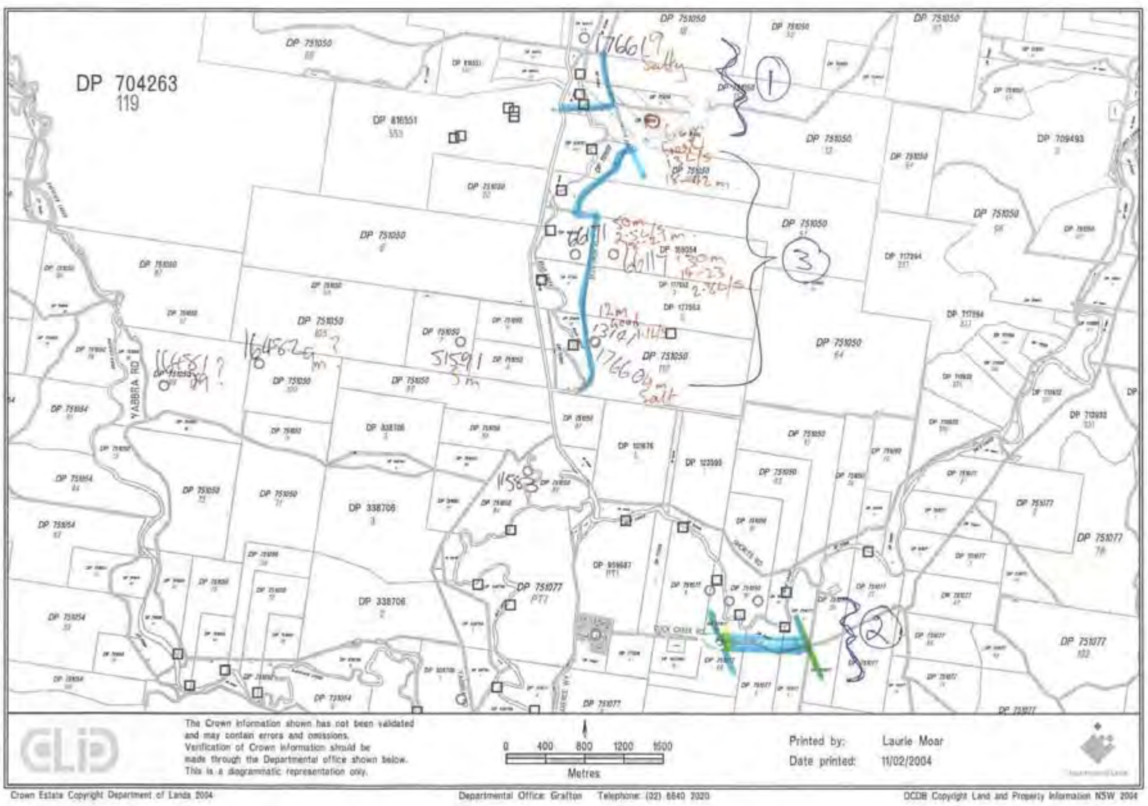


Figure 3-11: Map of Old Bonalbo showing Groundwater Potential

Based on the information of bores around Bonalbo within the same geology, it would be considered a greater risk to explore for water supplies from groundwater for both yield and water quality (salinity), however as above, there may be potential from bores drilled to a depth greater than 40m. It has been reported that in December 2003 a local driller installed a bore that was at a depth of 60m and yielding 12 L/s. Examination of DIPNR's database shows a NNW running trend of higher yielding bores with one bore producing 13 L/s (Drilled in Nov 2003). This bore was tested for water quality over a 7day regular pumping regime in May of 2004.

There are 4 bores located around the township of Bonalbo consisting of 2 bores and 2 excavations for which no information has been supplied to the Department.

Figure 3-12 is a map of the Bonalbo area, showing DIPNR's suggested test drilling locations. The locations and order of preference have been based on; an extension of the NNW high yield trend extended from Old Bonalbo to the north and road reserves.

In another effort to locate potential groundwater sources, a survey of local residents was undertaken requesting any information that residents had on the location of wells, springs or bores. None of these surveys were returned with useful information.

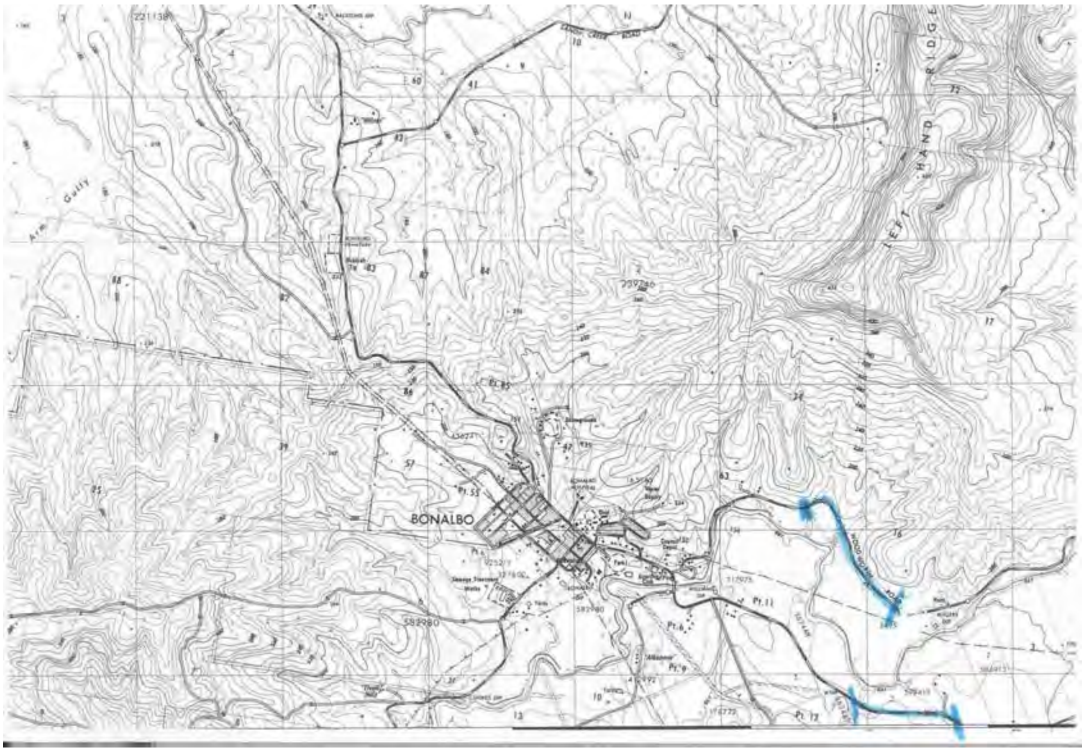


Figure 3-12: Map of Bonalbo showing Groundwater Potential

DIPNR has stated that their recommendations for Bonalbo groundwater potential should not be acted upon without first undertaking a field inspection of the prospective sites. DIPNR envisages that a 1-day field trip with a Council representative and a DIPNR Hydrogeologist would be required for both Old Bonalbo and Bonalbo.

Water Carting and RWT Top-up

As Bonalbo receives a low average annual rainfall, a supplementary local water supply option particularly during drought periods is water cartage. Typically demand is high during these periods and rainwater tanks are unable to supply demand from the roof water previously harvested and held in storage. As previously stated an analysis of roof water systems for Bonalbo indicates that there is limited potential to supply household internal and/or external needs in a drought year. Therefore as a supplementary source water carting and rainwater tank top-up is a potential water supply, which is available to the community. However the cost of water carting can be relatively high compared with other supply sources. Council could offer a rebate to the community for water carting and filling of domestic water tank purposes.

Drought relief for country towns is available through assistance from the New South Wales Government to local water utilities. Where water cartage is recommended as the most economical measure to adopt, the Minister for Energy, Utilities and Sustainability may pay a subsidy for the quantity required to be carted for essential purposes (determined to be 95L/person/day). Typically water-carting costs can be in excess of $0.75 per km for the truck's operation plus the price of the water per kL.

Shortlisting of Regional Supply Sources

Based on analysis and the above conclusions, it is recommended that the following three local supply opportunities be shortlisted and be used in the bundling process when developing integrated water management options. The regional supply shortlisted options are;

- The local Peacock Creek source and existing off-stream storage (Bonalbo Dam);
- The existing unutilised local bore sources (Bonalbo and Old Bonalbo); and
- Water carting as part of the Drought Strategy (only)

3.3.3 Integrated Water Supply Opportunities

In view of the varying water quality between the regional sources, a number of source combinations could be developed to meet the water supply requirements of Bonalbo. The following six water source opportunities are available to the village of Bonalbo:

1. Peacock Creek water supply and supplementary bore supply for single scheme to supply internal and external use,
2. Peacock Creek water supply and supplementary bore supply for single scheme to supply RWT for internal and external use with Demand Management,
3. Rainwater tanks and water cartage for outdoor and toilet use, Peacock creek treated water supply for all other end-uses including Demand Management,
4. Rainwater tanks and water cartage for potable use, Peacock creek water supply for non-potable use including Demand Management,
5. Rainwater tanks for outdoor and toilet use (no water cartage), Peacock creek treated water supply for all other end-uses and toilet use when RWT = 0, including Demand Management and
6. Rainwater tanks for outdoor and toilet use (no water cartage), combined Peacock creek and bore water treated water supply for all other end-uses and toilet use when RWT = 0, including Demand Management.

A seventh opportunity was also considered and later removed. It consisted of treated bore water supply for potable use and rainwater tanks with untreated Peacock creek water mains top-up for non-potable use including demand management. The details of the opportunity are included in Appendix P.

Opportunities 1 to 6 are described in the following section. Please note that all the numbers on the demand for water, rainwater tank top-up and cartage are based on the 2001 demand without added demand management measures (for example mandating water efficient shower heads).

Opportunity 1: Peacock Creek water supply and supplementary bore supply for single scheme to supply internal and external use

This is a "traditional" opportunity, where the water collection and distribution infrastructure is not modified above the basic requirements in order to meet water quality and annual demand. The treatment infrastructure will require upgrading to a Water Filtration Plant (WFP) so that the water meets the ADWG, especially the guidelines for taste and odour. The peak day demand in this opportunity would increase from 0.24ML/day to 0.27ML/day, requiring a water filtration plant capacity of 0.27ML/day.

The secure yield of Peacock Creek has been established as being between 25ML – 60ML per annum. This uncertainty gives rise to the assumption that the lower limit of the secure yield be adopted as the potential annual supply from Peacock Creek. This requires that a supplementary supply be sourced to meet the future annual average unrestricted demand of 52ML/annum for the village of Bonalbo (the current unrestricted annual average demand is 50ML/day). The prospective supplementary supply is a bore identified by DIPNR in their groundwater survey. The bore water will be transferred by pipe and discharge into the dam and will be required to provide a supplementary supply of 27ML/annum and an average sustainable yield of at least 1.0 L/s over a 24-hour pumping day. The peak day supply of the scheme is reliant on the storage in the dam and reservoir. This opportunity has the potential to more fully utilise the water extraction permits that the Council currently has by accessing ground water sources that are currently underutilised.

The water supply reservoir may require enlarging to provide for peak day demand supply and a minimum service pressure of 12m head will be required across the existing reticulation. Other parts of the water services infrastructure identified as being issues will be upgraded to comply with OHS & S Standards. In addition to the water being more palatable, it will also reduce the generation of sewerage odours and corrosion of the sewerage assets. This opportunity does not rely on rainwater harvesting in rainwater tanks or incorporate their use into the scheme operation. A diagram of this opportunity is included in Figure 3-13.

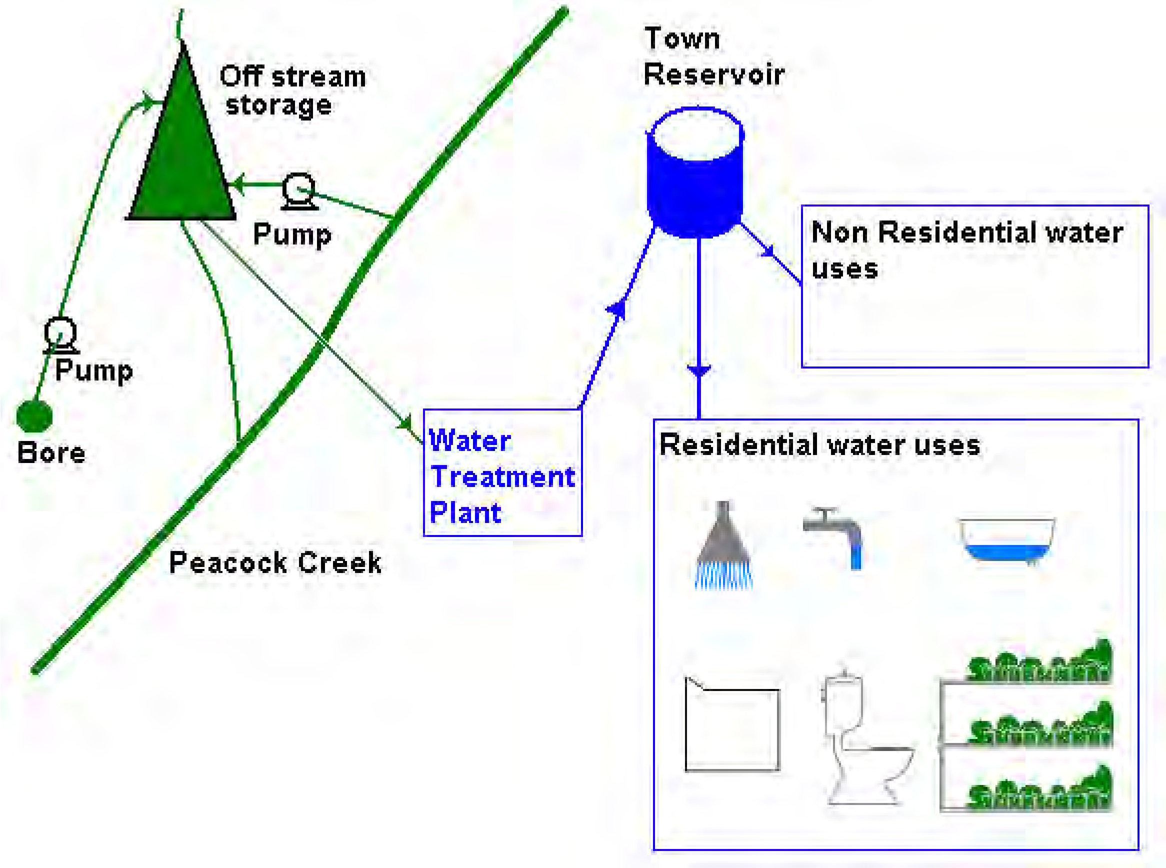


Figure 3-13: Diagram of integrated water supply opportunity 1

Opportunity 2: Peacock Creek water supply and supplementary bore supply for single scheme to supply RWT for internal and external use with Demand Management

The WFP will be required to provide for a peak day supply of 0.20ML/day. The existing water reticulation will be used to top up the existing household's rainwater tank. This operation sees the rainwater tank become a mini-service reservoir and will allow the peak day demand on the dam, WFP, water supply reservoir and reticulation to be reduced from 0.24ML/day to 0.20ML/day. This occurs by the action of the rainwater tanks attenuating the peak day demand. The attenuation is limited, due to the inclusion of rainwater tanks as mini-service reservoirs in the existing water supply. This option sees that roof water runoff will not be captured in the household water tank and will be diverted to the stormwater system, to protect the quality of the treated and filtered potable water and follow DOHs recommendation. Ownership and maintenance of the household water tank will become an issue for Council.

The water supply reservoir will not require enlarging and a minimum service pressure of 5m head will be required across the existing reticulation, in order to top up the household water tank. Each tank will provide the necessary storage for fire fighting requirements.

Further the inclusion of a medium to high impact demand management program will reduce the annual water supply production to 41ML/year and reduce the peak day demand from 0.24ML/day to 0.21ML/day (employing a low impact demand management program) or 0.19ML/day (employing a medium to high impact demand management program). This has the potential for downsizing of the treatment plant and future water supply infrastructure, also probably allowing a decrease in capital and operating costs.

The prospective supplementary local bore supply will be required to provide up to 16ML/annum to the dam, with an average supply of 0.5 L/s. The peak day supply of the scheme is reliant on the storage in the dam and reservoir. This opportunity has the potential to more fully utilise the water extraction permits that the Council currently has by accessing ground water sources that are currently underutilised and by maximising the use of the existing rainwater tank in each premises.

Other parts of the water services infrastructure identified as being issues will be upgraded to comply with OHS & S Standards. In addition to the water being more palatable, it will also reduce the generation of sewerage odours and corrosion of the sewerage assets. This opportunity does not rely on rainwater harvesting. A diagram of this opportunity is included in Figure 3-14.

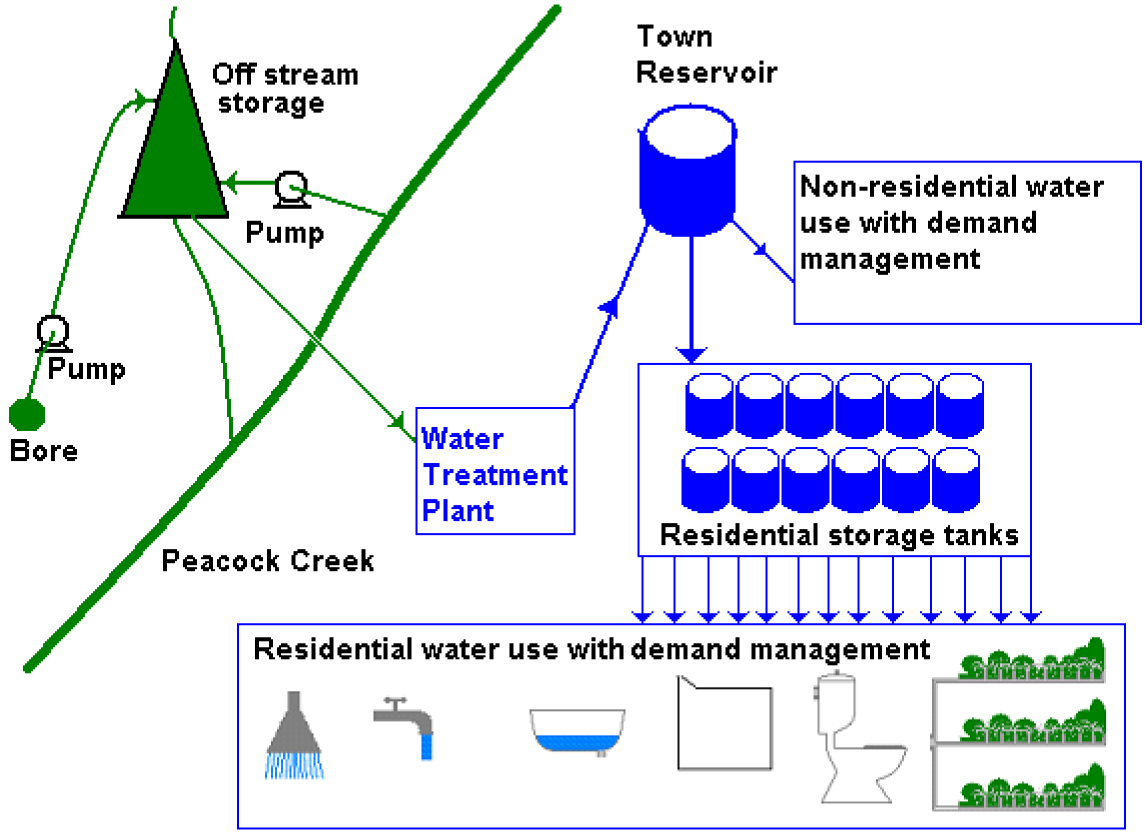


Figure 3-14: Diagram of integrated water supply opportunity 2

Opportunity 3: Rainwater tanks and water cartage for outdoor and toilet use, Peacock creek treated water supply for all other end-uses including Demand Management.

It is proposed that this opportunity utilises rainwater harvesting and the rainwater tank to supply toilet and garden watering. Modelling has identified that for an average size tank, only 1/3 of this demand will be supplied from the rainwater tank. A shortfall of approximately 82kL will require water carting in an average year and 175kL in a drought year. There is no mains top-up provided from the potable water supply scheme. Essentially this means that garden watering becomes a consumer choice and a user pays end-use. It makes Council's provision of the potable water supply scheme more equitable between the residents of Bonalbo and passively regulates the water usage by only supplying those end-uses with the least variability on a per person or household basis.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-10 that the annual average demand from toilet and garden watering for all user categories is 20ML/annum. It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-8 that the average annual demand of all other indoor end-uses for all water user categories including a medium to high impact demand management program is 22.5ML/annum.

Since the proposed potable water supply scheme is required to supply 28.5ML/annum (including approximately 6ML/year UFW), the existing system may not require a supplementary supply and can potentially rely on the lower limit secure yield of Peacock Creek at 25ML/annum. The shortfall may be supplied by carting 3.5ML/year of potable water to top-up the town reservoir. This means that the additional capital and operating costs associated with the operation of a bore may be avoided. Further the peak day demand of the scheme reduces to approximately half of that expected in Opportunity 2 to 0.08ML/day. A diagram of his opportunity is included in Figure 3-15.

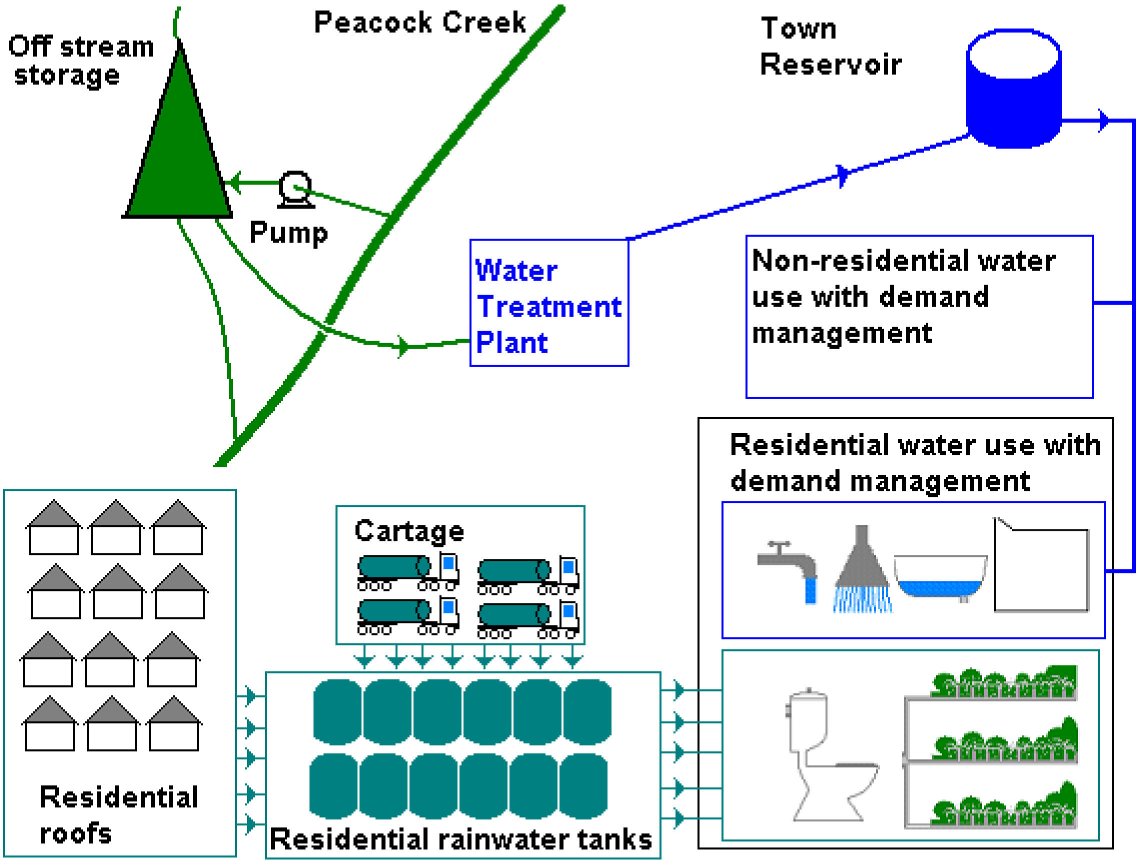


Figure 3-15: Diagram of integrated water supply opportunity 3

Table 3-4 contains the probable cartage demands for water, when the tank is used to supply water for irrigation and toilet flushing for all private residences as well as the probable cartage demands for water to supply water for irrigation, toilet flushing and clothes washing. The assumptions behind these calculations are that every dwelling has 250m^2 of irrigated garden and has 200m^2 of roof area connected to the tank, as a consequence, if the connected roof area is increased or the garden area decreased, the cartage requirements would be lower. It is also assumed that the carted water delivered is only sufficient for the days supply. This is the most efficient way to fill the tanks as it allows maximum space in the tank for any rain that does come, but has the most expensive cartage requirements. These results show that:

- The tanks can provide a significant proportion of the water required, but are not reliable with out some form of top up,
- The use of rainwater for clothes washing increases the amount of rainwater used and
- In dry years, the size of the tank has little impact on the demand as there are few times where a tank of any size is at capacity.

- Depending on the tank size and the level of end-use the longest period of continuous carted water use varies between 92 days to 126 days.

Table 3-4: Opportunity 3 Water Cartage

			Units	Tank Size (kL) 4.5	10	22
Tank to garden and toilet	Average Year	Days carted water is used	Days/ year	101	75	47
		Volume Cartage	ML/year	10.1	7.3	4.8
		Volume of roof water provided	ML/year	7.2	10.0	12.5
		Volume of reticulated potable water supplied	ML/year	25.2		
	Drought Year	Days carted water is used	Days/ year	200	188	169
		Volume Cartage	ML/year	20.8	18.4	15.4
	Longest period of carted water use		Days	124	118	92
Tank to garden, toilet and laundry	Average Year	Days carted water is used	Days/ year	123	93	64
		Volume Cartage	ML/year	12.8	9.9	7.0
		Volume of roof water provided	ML/year	8.9	11.8	14.7
		Volume of reticulated potable water supplied	ML/year	20.8		
	Drought Year	Days carted water is used	Days/ year	229	216	199
		Volume Cartage	ML/year	24.6	22.3	19.3
	Longest period of carted water use		Days	126	118	99

Opportunity 4: Rainwater tanks and water cartage for potable use, Peacock creek water supply for non-potable use including Demand Management.

It is proposed that this opportunity utilises rainwater harvesting and the rainwater tank to supply drinking, laundry and showering. Modelling has identified that for an average size tank, only 45% of this demand will be supplied from the rainwater tank. A shortfall of approximately 73kL will require water carting in an average year and 165kL in a drought year. There is no mains top-up provided from the potable water supply scheme. Essentially this means that drinking, laundry and showering is reliant on roofwater harvesting and water carting. There is no provision for a treated reticulated water supply in this opportunity and requires only chlorine dosing and a dam aerator rather than a WFP. Council's provision of a non-potable water supply scheme is similar to the existing supply and shall only provide for toilet and garden watering in this opportunity.

The returned surveys showed that a majority of Bonalbo households already use tank water for drinking. This opportunity requires the installation and expansion of the household tanks and the Council to check the installation and co-ordinate the maintenance of the tanks (for example ensuring that screens are working and that the tank is cleaned out on a regular basis). Preferably this could occur through the inclusion of mandatory installation of a rainwater tank to all existing and new developments through Council's development control plan (DCP). This opportunity would also mean that Council would essentially own the tanks as part of the water supply system. Council could achieve ownership by offering residents a rebate or free tank service and maintenance arrangement. The 10% of existing developments, which do not currently have a rainwater tank, will require installation, correct sizing and appropriate end-use connection. Associated costs of tanks and plumbing would need to be accounted in the overall scheme cost.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-10 that the annual average demand from toilet and garden watering for all user categories is 20ML/annum. It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-8 that the average annual demand of all other indoor end-uses for all water user categories including a medium to high impact demand management program is 22.5ML/annum.

Since the proposed non-potable water supply scheme is required to supply 26ML/annum (including approximately 6ML/year UFW), the existing system will not require a supplementary supply and can rely on a secure yield at Peacock Creek of 25ML/annum. This means that the additional capital and operating costs associated with the operation of a bore may be avoided. The peak day demand of the non-potable scheme becomes approximately 0.13 ML/day. A diagram of this opportunity is included in Figure 3-16.

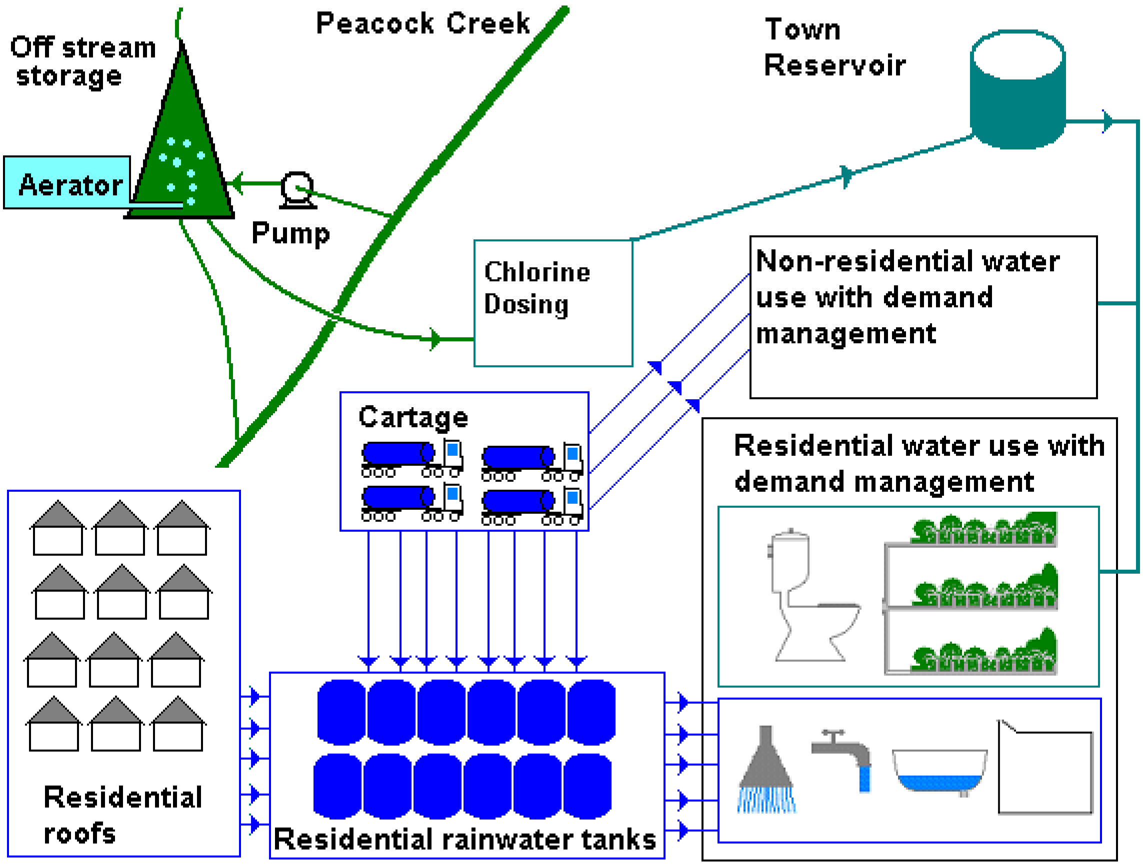


Figure 3-16: Diagram of integrated water supply opportunity 4

Table 3-5 contains the probable cartage demands for water, when the tank is used to supply water for all internal uses apart from toilet flushing as well as the probable cartage demands for water to supply water for internal residential uses excluding toilet flushing and clothes washing. The assumptions behind these calculations are that every dwelling has 200m^2 of roof area connected to the tank, as a consequence, if the connected roof area is increased or the efficiency of the appliances, the cartage requirements would be lower. It is also assumed that the carted water delivered is only sufficient for the days supply. This is the most efficient way to fill the tanks as it allows maximum space in the tank for any rain that does come, but has the most expensive cartage requirements.

Table 3-5: Opportunity 4 cartage

<table>
<tr><th colspan="3" rowspan="2"></th><th rowspan="2">Units</th><th colspan="3">Tank Size (kL)</th></tr>
<tr><th>4.5</th><th>10</th><th>22</th></tr>
<tr><td rowspan="7">Non-potable to garden and toilet, tank to other uses</td><td rowspan="4">Average Year</td><td>Days Cartage</td><td>Days/ year</td><td>188</td><td>139</td><td>100</td></tr>
<tr><td>Volume Cartage</td><td>ML/ year</td><td>11.9</td><td>8.9</td><td>6.4</td></tr>
<tr><td>Volume of roof water provided</td><td>ML/year</td><td>13.3</td><td>16.3</td><td>18.7</td></tr>
<tr><td>Volume of reticulated non-potable water supplied</td><td>ML/year</td><td colspan="3">17.3</td></tr>
<tr><td rowspan="2">Drought Year</td><td>Days Cartage</td><td>Days/ year</td><td>279</td><td>260</td><td>260</td></tr>
<tr><td>Volume Cartage</td><td>ML/year</td><td>17.9</td><td>16.7</td><td>16.7</td></tr>
<tr><td colspan="2">Longest period of continuous carting</td><td>Days</td><td>136</td><td>125</td><td>103</td></tr>
<tr><td rowspan="7">Non-potable to garden, toilet and laundry, tank to other uses</td><td rowspan="4">Average Year</td><td>Days Cartage</td><td>Days/ year</td><td>160</td><td>109</td><td>68</td></tr>
<tr><td>Volume Cartage</td><td>ML/year</td><td>8.4</td><td>5.7</td><td>3.6</td></tr>
<tr><td>Volume of roof water provided</td><td>ML/year</td><td>12.3</td><td>15.0</td><td>17.1</td></tr>
<tr><td>Volume of reticulated non-potable water supplied</td><td>ML/year</td><td colspan="3">17.3</td></tr>
<tr><td rowspan="2">Drought Year</td><td>Days Cartage</td><td>Days/ year</td><td>250</td><td>223</td><td>207</td></tr>
<tr><td>Volume Cartage</td><td>ML/year</td><td>13.4</td><td>11.9</td><td>11.1</td></tr>
<tr><td colspan="2">Longest period of continuous carting</td><td>Days</td><td>134</td><td>121</td><td>93</td></tr>
</table>

A number of conclusions can be drawn from Table 3-5, including that:

- The tanks can provide a significant proportion of the water required, but are not reliable with out some form of top up,
- The higher demand than option 3 increases the volume of cartage required and the volume of roof water provided,
- The use of rainwater for clothes washing (rather than the non-potable supply) increases the amount of rainwater used,
- In dry years, the size of the tank has little impact on the demand as there are few times where a tank of any size is at capacity, and

- Depending on the tank size and the level of end-use the longest period of continuous carted water use varies between 93 days to 136 days.

Opportunity 5: Rainwater tanks for outdoor and toilet use (no water cartage), Peacock creek treated water supply for all other end-uses and toilet use when RWT = 0, including Demand Management.

It is proposed that this opportunity, as in Opportunity 3 utilises rainwater harvesting and the rainwater tank to supply toilet and garden watering. Modelling has identified that for an average size tank, only 1/3 of this demand will be supplied from the rainwater tank. A shortfall of approximately 87kL will occur in an average year and 173kL in a drought year. There is no mains top-up provided from the potable water supply scheme, however the toilet will have a solenoid valve or RainBank configuration (Appendix Q) which would connect the toilet to the mains supply in the event that the storage level in the rainwater tank being drawn down so much that it cannot supply the toilet flushing. Essentially this means that garden watering is limited by the rainwater harvesting. It makes Council's provision of the potable water supply scheme more equitable between the residents of Bonalbo and passively regulates the water usage by only supplying those end-uses with the least variability on a per person or household basis. A Council DCP will be required to mandate the installation of the RainBank instrumentation and associated plumbing. Current estimates put the RainBank at about $400, the pump at about $600, and the installation at about $200.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-10 that the annual average demand from toilet and garden watering for all user categories is 20ML/annum. The annual average demand from toilet flushing with cistern displacement device for all user categories is 4.8ML/annum. We can estimate that one quarter of the mains top-up for the rainwater tank with toilet and garden watering end-uses is allocated to toilet flushing, that is 3.2ML/annum is supplied from the mains top-up, leaving 1.6ML/annum supplied from the rainwater tank.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-8 that the average annual demand of all other indoor end-uses for all water user categories including a medium to high impact demand management program is 22.5ML/annum. Therefore mains supply is increased to 24.1ML/annum.

Since the proposed potable water supply scheme is required to supply 30.1ML/annum (including approximately 6ML/year UFW), the existing system may require a supplementary supply based on the lower limit secure yield of Peacock Creek being 25ML/annum. This means that there would be regular restrictions placed on customers and a risk that cartage would be necessary. Further the peak day demand of the scheme would be about to 0.1ML/day. A diagram of this opportunity is included in Figure 3-17.

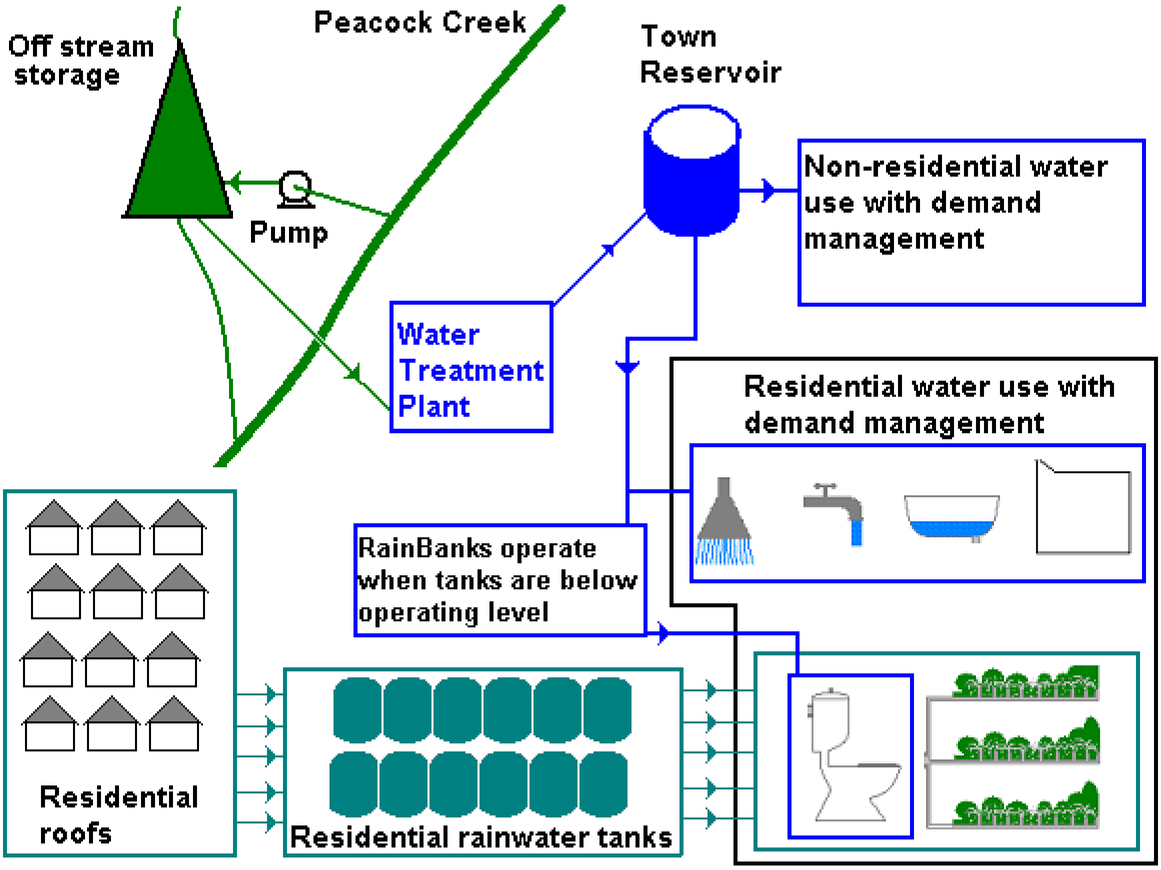


Figure 3-17: Diagram of integrated water supply opportunity 5

Table 3-6 contains the probable tank top up demand for water, when the tank is used to supply water to the toilet and garden and the volume of water that would be used to supply toilet flushing if the RainBank was to be installed. As in opportunity 3, it is assumed that each dwelling has 250m^2 of irrigated garden and has 200m^2 of roof area connected to the tank. Please note that when the RainBank is in operation, there is no water available for use in the garden.

Table 3-6: Opportunity 5 tank top up and bypass

<table>
<tr><th colspan="3" rowspan="2"></th><th rowspan="2">Units</th><th colspan="3">Tank Size (kL)</th></tr>
<tr><th>4.5</th><th>10</th><th>22</th></tr>
<tr><td rowspan="5">Tank to garden and toilet – No RainBank</td><td rowspan="3">Average Year</td><td>Days top up</td><td>Days/ year</td><td>110</td><td>84</td><td>54</td></tr>
<tr><td>Volume top up</td><td>ML/ year</td><td>11.3</td><td>8.4</td><td>5.7</td></tr>
<tr><td>Volume of roof water provided</td><td>ML/year</td><td>7.97</td><td>10.9</td><td>13.5</td></tr>
<tr><td rowspan="2">Drought Year</td><td>Days top up required</td><td>Days/ year</td><td>211</td><td>193</td><td>178</td></tr>
<tr><td>Volume Top up</td><td>ML/year</td><td>22.5</td><td>20.1</td><td>17.2</td></tr>
<tr><td rowspan="7">Tank to garden and toilet – with RainBank</td><td rowspan="4">Average Year</td><td>Days RainBank draws on main supply</td><td>Days/ year</td><td>110</td><td>84</td><td>22</td></tr>
<tr><td>Volume of mains water through RainBank</td><td>ML/year</td><td>1.74</td><td>1.33</td><td>0.860</td></tr>
<tr><td>Volume of roof water provided</td><td>ML/year</td><td>7.97</td><td>10.9</td><td>13.5</td></tr>
<tr><td>Volume of irrigation not provided</td><td>ML/year</td><td>9.56</td><td>7.09</td><td>4.86</td></tr>
<tr><td rowspan="3">Drought Year</td><td>Days RainBank draws on main supply</td><td>Days/ year</td><td>110</td><td>84</td><td>54</td></tr>
<tr><td>Volume of mains water through RainBank</td><td>kL/year</td><td>3.21</td><td>2.97</td><td>2.54</td></tr>
<tr><td>Volume of irrigation not provided</td><td>ML/year</td><td>19.3</td><td>17.2</td><td>14.62</td></tr>
</table>

The most important conclusion that can be formed from the results in Table 3-6 is that the RainBank has the capacity to significantly reduce the demand for water, but will result in effectively a total ban on irrigation for large parts of the year.

Assuming that the cost of treated water for Bonalbo is the same as for Kyogle (86c/kL), in an average year, the rainwater provided by the tank would be worth about $72.10 and the irrigation water not provided would be worth about

Opportunity 6: Treated water supply from Petrochilos Dam for potable use,rainwater tanks for toilet flushing and outdoor use with back-up from reticulated supply, and a bore/s for raw water supply to Petrochilos Dam including Demand Management.

It is proposed that this opportunity is based on opportunity 5. The two changes are the addition of an aerator to the reservoir and the augmentation of the water supply through the use of bore water. The aerator will help produce a more treatable water through a reduction in the concentration of iron and manganese in the water. The use of the bore will reduce the use of restrictions and provide a more secure supply than opportunity 5.

During parallel work on the design of a new water treatment plant for Bonalbo, a 0.3ML per day (during warmer weather, less during cooler weather when the temperature is under 15^{o}C as the treatment processes do not function as efficiently) plant was designed on the basis of Commerce's September 1998 Strategy Report.

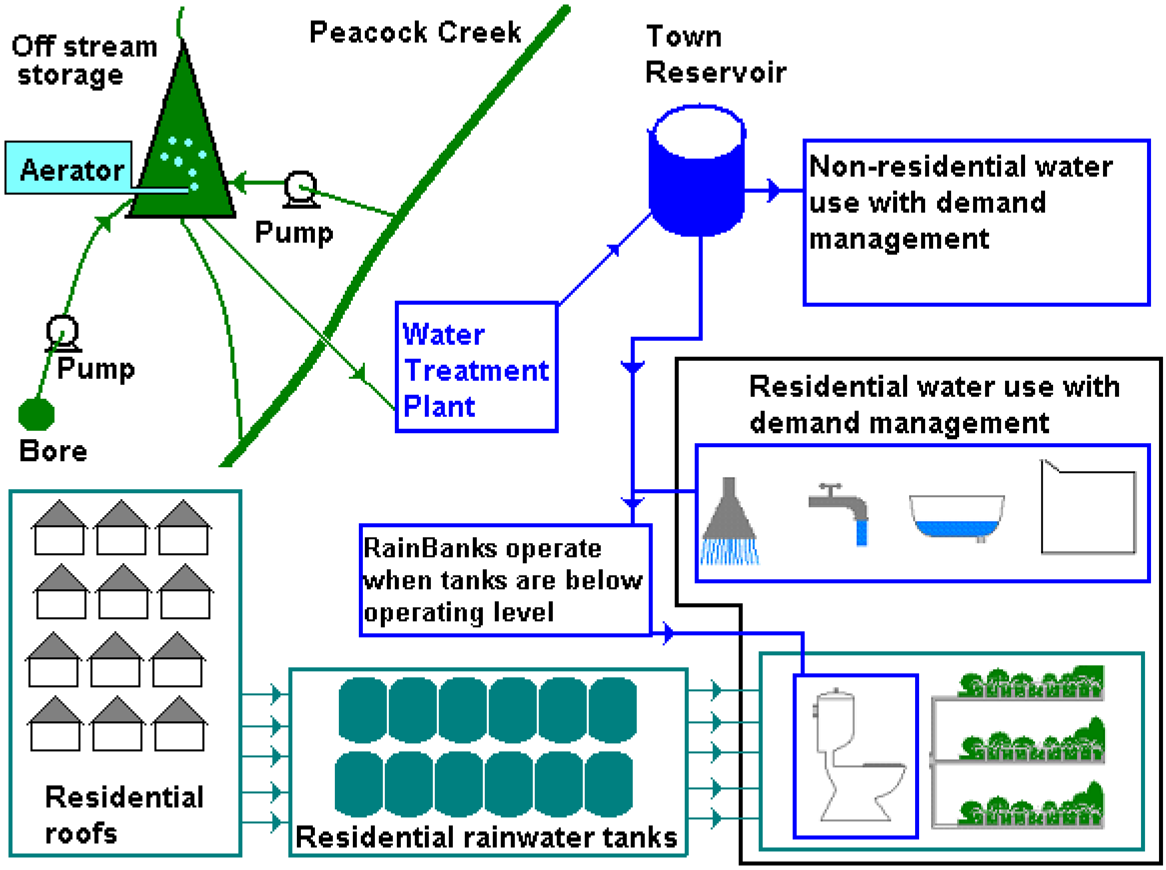


Figure 3-18: Diagram of integrated water supply opportunity 6

Comparison of Integrated Water Supply Opportunities

A Triple Bottom Line Assessment of six (6) potential integrated water supply opportunities available in Bonalbo is undertaken below in Table 3-7. It should be noted that there are potentially other integrated opportunities available, however those most logical and effective are assessed below.

Table 3-7: TBL Assessment of Integrated Water Supply Opportunities

	Opportunity					
		2	3	4	5	6
FUNCTIONAL						
'Treatability' and Palatability of water	3	3	3	2	3	3
Sustainability of Supply	3	3	2	1	1	3
Maintenance and Operational Constraints	2	2	1	1	2	2
Site Location	2	2	3	3	3	2
Sub-total	*10*	*10*	*9*	*7*	*9*	*10*
Rank	1	1	4	6	4	1

	Opportunity					
	1	2	3	4	5	
TECHNICAL						
Degree to which option is technically challenging	1	1	2	2	3	2
Further technology required to treat water source	1	1	1	3	1	1
Interference with other services on route	1	1	2	2	3	1
Subject to pricing of other authorities	3	3	2	2	3	3
Ability to be expanded	2	3	1	1	0	3
Potential for further treatment units	2	2	2	0	2	2
Sub-total	*10*	*11*	*10*	*10*	*12*	*12*
Rank	4	3	4	4	1	1
ENVIRONMENTAL						
Extent of construction impacts	1	1	2	3	2	1
Improved environmental protection of Peacock Creek catchment	1	2	2	3	2	2
Minimises water extractions and protects low flows	3	2	1	1	0	2
Minimises green house gases	0	2	1	1	3	1
Vulnerability of water resource(s)	2	2	1	1	0	2
Sub-total	*7*	*9*	*7*	*9*	*7*	*8*
Rank	4	1	4	1	4	3
SOCIAL						
Improved relationship between water users	1	2	3	2	3	3
Improve security of town water supply	2	2	1	1	1	3
Improve the quality of drinking water	2	2	2	1	2	3
Improves reputation of Council	3	3	2	2	1	3
Protects public health	3	3	3	1	3	3
Sub-total	*11*	*12*	*11*	*7*	*10*	*15*
Rank	3	2	3	6	5	1
POLITICAL						
Approval process	2	3	2	2	3	2
Better business and development opportunity	2	2	2	1	0	3
Inter-government agency collaboration	2	2	2	2	3	2
Sub-total	*6*	*7*	*6*	*5*	*6*	*7*
Rank	3	1	3	6	3	1

	Opportunity					
	1	2	3		5	6
ECONOMI						
Cost rating based on equivalent bulk supply rate or comparative security of supply	2	2	0	1	3	2
Improve the performance of the assets	2	2	2	1	2	3
Provide services that are equitable and affordable	2	2	0	1	3	2
Improve efficiency ratios	2	2	1	1	0	3
Sub-total	*8*	*8*	*3*	*4*	*8*	*10*
Rank	2	2	6	5	2	1
TOTAL	52	57	49	42	52	62
Overall Rank	**3**	**2**	**5**	**6**	**3**	**1**

The ranking in the balanced score card suggests that if in the future the existing water supply quality is enhanced the preferred integrated water supply source for the village of Bonalbo would be to develop Opportunity 6. The above ranking is only the view of one of the Commerce engineers, and a better outcome/approach would be to conduct the above analysis collectively by relevant stakeholders.

On the basis of this assessment a preliminary costing of the tank component of the 10 000L tank option of opportunity 6 has been undertaken. This shows that the closest tank size is 2000Gallons or 9100L and the cost of the tank is about $1400 delivered to Bonalbo (the difference between a steel or plastic tank is negligible), the cost of the RainBank is about $1200 and the other costs come to about $1000 (including plumbing, power supply and a concrete slab for the tank), giving a total cost of about $3600 per dwelling.

3.4 Opportunities for Urban Water Harvesting and Reuse

The following water supply sources have been considered for potable and non-potable water supply in Bonalbo village.

Urban water harvesting and reuse sources considered for non-potable use:

- Greywater;
- Reclaimed water; and
- Stormwater and WSUD

The coarse screening process shown in Appendix J was undertaken to select opportunities for further analysis and consideration. The outcomes of this screening process together with the main reasons for their scoring and decision for further consideration are summarised in Table 3-3 below. The scoring of supply sources is based on three levels of acceptance (High – H, Medium – M and Low – L) for four considered categories: Social Acceptance, Environmental Acceptance, Economic Acceptance and Regulatory Acceptance. Any supply source scoring two or more Low – L for considered categories has not been considered as a potential Water Supply Opportunity.

Table 3-8: Urban Water Harvesting and Reuse Screening Summary

Non-Potable Supply Source	Average Scoring	To be considered further	Reason
Greywater	M	Yes	Potential for local supply and use on household gardens
Reclaimed Water	H	Yes	Existing regional supply. Potential to be incorporated and harnessed further. Potential for a local on-site sewage reuse.
Stormwater (WSUD)	H	Yes	Existing regional supply. Potential to be incorporated and harnessed further. Potential for a local on-site stormwater reuse.

The feasibility of the shortlisted local water supply source opportunities and regional supply source opportunities is evaluated in isolation in the following subsections. The outcome of the feasibility analysis would then be used in assessing the source opportunities' benefits for inclusion within integrated water management options.

3.4.1 Effluent Reuse Opportunities

Regional Wastewater Reuse

The current effluent reuse scheme supplies gravity reticulated tertiary treated effluent to the Schools agricultural plot (located next to the Sewerage Treatment Plant) and the Golf Course. All storage dams are bunded and do not take in stormwater so they have no overflow systems constructed (other than dam wall overtop in the case of an extreme storm event). Any discharge from the Sewerage Treatment Plant to a natural waterway is via the Authorised Discharge Point located on the southern boundary of the Sewerage Treatment Plant site. This gully then flows to Peacock Creek just downstream of town.

The combined volume of effluent currently reused on each site is approximately 11 ML (2002/03) and 14 ML (2003/04), both representing 100% reuse of total effluent produced. Any surplus of treated effluent (for example that experienced during particularly wet years when irrigation demand is low) is designed to discharge through the EPA Authorised Discharge Point. Currently the Golf Club is proposing to extend to irrigate fairways as well as tees and greens.

Previous reports list the estimated re-use as 3 ML for the golf club, and 10 ML for the school agricultural plot. This was prior to the construction of the reuse scheme, and some expansion has been done since. The areas involved in the irrigation of lands with treated effluent are 1.5 ha of grazing pasture and 2.7 ha of various crops at the School and 11 ha of the Golf Course. The Golf Course is expected to irrigate on fairways only in extreme dry weather, (so say 5% of 11 ha) and irrigated on the greens and tees all year round. This equates to roughly 5ha of urban open space area that requires irrigation.

The effluent from the Bonalbo sewage treatment plant is being treated to a standard suitable for a range of beneficial urban, agricultural and environmental applications. The benefits currently being realised include enhanced resource recycling, savings on treated water for non-potable uses, potential reduction in costs of fertilisers, reduced discharges resulting in better environmental water quality, and reduced freshwater diversions from streams.

There is a range of re-use options currently employed and some available for expansion should the increase in the production of sewage be such that there is a surplus of water available for reuse. These options includw:

- Agricultural reuse;
- Non-potable domestic reuse;
- Urban open space reuse; and
- Environmental reuse.

Kyogle Council has provided both the Bonalbo Golf Club and the Public School Agricultural Block with treated effluent for reuse as irrigation. A study into further potential local and regional level reuse will identify and maximised the opportunistic land based reuse opportunities. In view of the high cost associated with the regional schemes that maximise the reuse potential, Council has been focussing on the existing local opportunities already involved such as the golf course and agricultural reuse at close proximity to the sewage treatment plant.

The NSW Health Department does not presently support indirect and direct potable reuse. Groundwater recharge is also not an option at this stage.

Residential On-Site Sewage Reuse

The design, installation and operation of domestic on-site sewage management systems are regulated under New South Wales legislation. Under this legislation, approval is needed for the installation, construction or alteration of an on-site sewage management system. Local Governments such as Kyogle Council are responsible for the issuing of these approvals. Specific requirements for on-site sewage management approvals, including performance standards, have been set out by the NSW government and the application process ensures that the system installed by a resident will meet the requirements, delivers the best chances of operating trouble free and aims to be without risk to health or the environment.

Recently, Kyogle Council has prepared *Standard Plans for Sewage Management System and Effluent Disposal Area.* All applications to install an on-site management system are expected to comply and adhere to the above plans. Otherwise applicants are required to complete a Kyogle Council *Application to Install and/or Construct, Alter or Operate a Non-standard Sewage Management System and Effluent Disposal Area* and submit an accompanying report containing all required details for consideration and approval.

Reclaimed water should only be used for the following end-uses

- Residential garden Irrigation;
- Toilet Flushing;
- Car Washing;
- Pathway and wall washing;
- Fire fighting;
- Water bodies for passive recreation not involving water contact; and
- Ornamental water bodies.

Reclaimed water is not permitted for use with the following purposes:

- Drinking, cooking or kitchen use;
- Bath, showers, hand basins or personal washing;
- Clothes washing;
- Swimming pools;

- Water contact recreation (e.g. playing under the sprinkler); and
- Irrigation of crops that are consumed by humans without processing or cooking.

Residential On-site Greywater Reuse

Domestic greywater is a component of wastewater and includes the water from baths, basins, showers, kitchen and laundry but excludes toilet water (blackwater). Greywater contains less nutrients and pathogens than blackwater. There is potential for individual households to divert greywater for use in garden irrigation. On-site greywater use has the potential both to reduce freshwater needs and to reduce sewage flows. The following figures are given for an average potential for a house in Sydney with a higher occupancy rate than in Bonalbo.

Table 3-9: Percentage of wastewater generated in an average house (3.5 people)

Wastewater source	Total wastewater		Total grey water	
	% Total	Litres per day	% Total	Litres per day
Toilet	32	186	-	-
Hand basin	5	28	7	28
Bath/shower	33	193	48	193
Kitchen	7	44	11	44
Laundry	23	135	34	135
Total	100	586	100	400

Source: NSW Health 2000 Greywater Reuse in Sewered Single Domestic Premises

As shown in Table 3-9, household greywater typically represents a total of 68% of household wastewater. In 2003/04 water year, Council's total levied baseload wastewater was estimated to be 25,355 kL (see Table 2-12). This roughly equates to 535 L/day of wastewater production per household. Therefore the average amount of greywater currently produced from a typical household in Bonalbo is estimated to be 365 L/day. This should be considered as a potential local water supply and if harnessed as a non-potable supply could substitute up to 35% of the unrestricted total household average daily demand or roughly 75% of a household's external average daily demand.

Household greywater is biologically active and can contain significant levels of bacteria and other pathogens, which may increase if the greywater is stored for lengthy periods without treatment. For this reason, health authorities prefer sub-surface irrigation methods with immediate discharge from household appliance and fittings to the subsurface system. A hazard with untreated greywater systems is the potential for clogging of subsurface systems by soaps and oils in the greywater. However, domestic grey water can be used to water gardens and if treated appropriately, flush toilets and wash clothes. By using greywater, the following advantages are seen:

- Reduce water bills;
- Use less water resources;
- Help save money on the cost of new or upgraded water and sewer infrastructure;
- The benefits of increased yield in droughts;
- The economic benefits of freeing up peak day capacity in the Bonalbo system to serve other users;

- Provide garden water benefits to householders, particularly during droughts;
- The environmental benefits of reduced freshwater abstraction from the bores or creek; and
- The environmental benefits of reduced reclaimed water discharges.

Some disadvantages exist as follows:

- The main disadvantage to most households is the cost of installing and maintaining the greywater system.
- Most systems require a fair degree of control i.e. they need to be designed for the number of occupants, the system can fail if left unattended and the type of cleaning products used in your home will determine how the water can be used.
- There is the potential for pollution and health effects as the greywater contains impurities and micro–organisms that are derived from household and personal cleaning activities. Because it contains pathogenic microorganisms and other materials, greywater is considered to have health and pollution impacts. It is therefore necessary to install suitable equipment.

A house with greywater treatment needs to be plumbed to separate the greywater from the blackwater. Treatment is still required for the black water, which may range from a composting toilet to a connection to a reticulated sewerage system. The use of greywater systems on areas connected to the reticulated supply can reduce the hydraulic loads on the sewerage system and sewage treatment plant. Greywater in sewered areas need to consider the NSW Health policy "greywater reuse in sewered single domestic premises" (2000).

The cost effectiveness of residential greywater reuse technologies is still in the developmental stage. A typical on-site domestic greywater reuse system can cost $5,000–$10,000. It is recommended that Council monitor future developments for possible emergence of suitable technology for local conditions and consider implementation in all new developments.

3.4.2 Shortlist of Effluent Reuse Opportunities

It is important to recognise that the requirements on the effluent quality are different for each end use and therefore the need to provide a quality product that is acceptable to that end use. Whilst technology is available to produce effluent of highest purity devoid of any contaminants, for most markets this purity is not warranted. At Bonalbo the opportunities for reuse include the following:

- the urban open space;
- residential non-potable;
- agricultural; and
- environmental.

Agricultural and Urban Open Space

As seen in the Figure 3-19, there are a number of open space areas in Bonalbo that are being and could be watered with treated effluent. Areas include the public parks and gardens, median strips, school grounds, golf course, the showground and the sports oval. Currently 95% of the treated effluent is reused for irrigation at the Golf Course and Public School Agricultural Plot. There are currently no other reuse projects and analysis indicates that at present there is no large-scale opportunity for industrial reuse. Other potential reuse irrigation areas have been identified such as the showground and sporting field. A projected expansion in population will see an increase in sewage and allow an allocation of the treated effluent to be used at these sites. Council could investigate the provision of a new effluent reuse reticulation system to irrigate these areas in preparation for the predicted population growth. If all these open space areas were opportunistically irrigated with effluent then up to 90% of annual flow and 100% of dry weather flows could be reused. The minimum urban open space potential irrigation area identified below is 22 ha.

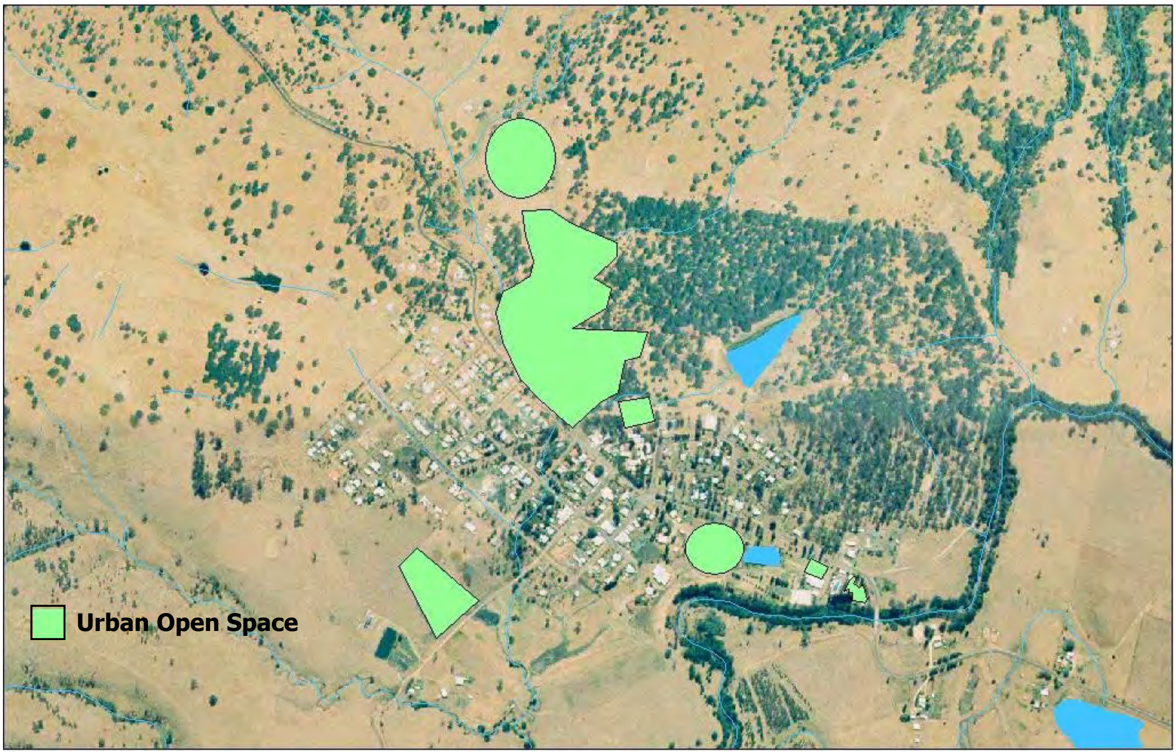


Figure 3-19: Bonalbo Urban Open Space

Residential Non-Potable Reuse

There is a potential for residential reuse systems to be included within a DCP for new developments. The quality of reclaimed water used for residential non-potable purposes needs to comply with *NSW Guidelines for Urban and Residential Use of Reclaimed Water* and the Kyogle Council *Standard Plans for Sewage Management System and Effluent Disposal Area*. The reclaimed water could be used for garden watering and toilet flushing. It is estimated that the current wastewater volume produced per household per day is 535 L, of which 170 L is estimated to be blackwater. Residential On-Site Sewerage Management Systems and On-site Greywater Management Systems can be employed to reduce sewage flows and reduce river and groundwater extractions.

Environmental Reuse

At Bonalbo there are two types of environmental reuse opportunities. These include:

Opportunity 1: Environmental release for downstream users

The effluent could be treated to a suitable high quality and released to Peacock Creek. As there are a number of downstream users, Council could obtain environmental credit to offset against water supply extraction under the Water Management Act. However, the guidelines governing these environmental credit systems are currently being drawn-up.

Opportunity 2: Environmental reuse for rehabilitation of natural or constructed wetlands

Council could investigate the potential of installing a constructed wetland downstream of the effluent and stormwater discharge points, upstream of Peacock Creek. Since stormwater flows are very intermittent at Bonalbo, providing effluent to such a project would ensure the sustainability of the wetland and possibly enhance the eco-tourism potential and educational value of the area, as wetlands in general provide a number of passive social and environmental benefits. The wetland would essentially act in polishing any tertiary treated effluent before being discharged to the natural environment.

3.4.3 Stormwater Harvesting and Reuse Opportunities

Historically stormwater management has focussed on diverting the runoff away from the urban areas as fast as possible. Little recognition has been paid to utilising this resource or protecting the quality of the stormwater discharging to receiving waters. Kyogle Council is yet to have a formal Urban Stormwater Management Plan (SWMP) for the village of Bonalbo. Such a document should identify the existing stormwater issues and give measures to minimise stormwater impacts, which incorporate source control as well as remedial end-of-pipe management options. These measures would include the encouragement of educational measures, land use planning and development control, site auditing, a review of management practices and implementation of structural options. A major source control measure often omitted from a SWMP, is water sensitive urban subdivision design achieved through policies, development control plans and building codes. Both WSUD and the measures noted in a SWMP have benefits of reduced water supply demands, reduced stormwater impacts on environmental water quality and potential to provide new/enhanced natural habitats (for native flora and fauna) or aesthetic features in urban environments (artificial water bodies).

Currently the majority of stormwater in the Bonalbo urban catchment is diverted into two natural detention basins. The village is founded on undulating land on one bank of Peacock Creek. All stormwater drains from the urban catchment through the existing stormwater network and discharges into two detention basins on the downstream side of the village. The are two main opportunities which exist and where stormwater runoff could be further harvested and reused.

Regional Stormwater Reuse

Preliminary calculations for Bonalbo village rainfall conditions indicates that the 100 ha urban catchment draining to a water quality control retention basin might yield up to 71 ML of water for open space irrigation in a year of average rainfall and little potential in a drought year. Stormwater quality may be expected to be poorer than that of roof water. For garden watering and toilet flushing, the physical quality of stormwater is likely to be adequate without additional treatment. It may be necessary to provide disinfection to achieve an acceptable bacteriological quality for residential reuse.

Council should be supplementing the effluent water irrigation reuse at the School Agricultural Plot and Golf Course with the stormwater harvested within detention basins. A detention basin at the Golf Course and downstream of the Sewerage Treatment Plant would have dual benefits. Firstly it helps to prevent downstream flooding and attenuate potential erosion caused by high flow velocities, and secondly the stormwater captured in the detention basin would be used for irrigating the agricultural plot and Golf Course, thereby maintaining the productivity and green appeal of the two sites. The estimated requirement and allocation of water for irrigation at the School and Gold Course is 55 ML per year. This figure is based on an application rate of 3 mm/m^2/day. Currently they receive only 14 ML per year. The deficit can be supplemented by the harvesting of stormwater runoff collected from the Bonalbo urban footprint.

There is a stormwater detention basin adjacent to the bowling club and sports oval which assists the irrigation of both sites. It is thought that this basin is not used to its full potential and the extent of its use can be expanded.

Further and as previously discussed, an option for Council is to divert the majority of the stormwater runoff from the village into a constructed wetland. The use of effluent when required could enhance this concept in order to provide nutrients and sustain plant growth. Council could investigate the potential of installing a constructed wetland downstream of the effluent and stormwater discharge points, upstream of Peacock Creek. Environmental reuse would ensure the sustainability of the wetland and possibly enhance the eco-tourism potential and educational value of the area, as wetlands in general provide a number of passive social and environmental benefits. The wetland would essentially act in polishing any polluted stormwater and tertiary treated effluent before being discharged to the natural environment.

Water Sensitive Urban Design (WSUD) – On-site Stormwater Reuse

As already discussed, water sensitive urban design encompasses all aspects of urban water management as part of the design process for development. In the planning stages, water use can be optimised and opportunities for on-site water harvesting and re-use can be considered and the best options developed.

Water sensitive urban subdivision and building design, which better controls the flow and retention of stormwater in the urban landscape, can reduce garden water and landscape water needs at little or no extra cost. Combining elements of WSUD with rainwater tanks connected to the roof guttering will provide enhanced reduction in stormwater runoff from the urban block. WSUD utilises many of the other tools discussed below such as rainwater tanks, effluent reuse and stormwater management.

WSUD is the practice of the temporary storage of stormwater on the urban allotment, which reduces the peak flow velocity and volume that leaves the site. The flow velocity and volume are reduced by installations such as providing natural infiltration, surface storage and infiltration into aquifers. Not only are there benefits to the street drainage system by incorporating elements of WSUD into the construction of new developments, but also pollutant and nutrient loads are reduced.

Section 3.3.1 discusses WSUD further as a stormwater harvesting opportunity and its reuse potential at an allotment scale. Council, as the determining authority for new developments in the area, is in an ideal position to maximise water sensitive urban design opportunities. This could potentially be achieved through the use of Council's development control plans.

3.4.4 Shortlist of Stormwater Opportunities

Based on analysis and the above conclusions, it is recommended that the following four local harvesting and reuse opportunities be shortlisted and be used in the bundling process when developing integrated water management options. The local shortlisted options include;

- Urban Open Space at the Golf Course, bowling green, showground; and sports oval
- Residential non-potable (through WSUD)
- Agricultural
- Environmental

Agricultural and Urban Open Space

As seen in the Figure 3-19, there are a number of open space areas in Bonalbo that are being and could be watered with treated effluent. Areas include the public parks and gardens, median strips, school grounds, golf course, the showground and the sports oval. Currently 100% of the treated effluent is reused for irrigation at the Golf Course and Public School Agricultural Plot. The estimated requirement and allocation of water for irrigation at the School and Gold Coarse is 55 ML per year. This figure is based on an application rate of 3 mm/m^2/day. Currently they receive only 14 ML per year. The deficit can be supplemented by the harvesting of stormwater runoff collected from the Bonalbo urban footprint.

Other potential reuse irrigation areas have been identified such as the showground and sporting field. A projected increase in population will see an increase in stormwater flow due to an increase in impervious surfaces with new development. The increase in stormwater flows may be harnessed and if captured may be used at these sites. Council could investigate the provision of a new stormwater reuse reticulation system to irrigate these areas in preparation for the predicted expansion in population growth.

As previously discussed the minimum agricultural and urban open space potential irrigation area is 22 ha.

Residential Non-Potable Reuse

There is a potential for residential reuse systems to be included within a DCP for new developments. The quality of harvested stormwater used for residential non-potable purposes needs to comply with *Australian Runoff Quality Draft (ARQ), 2003*. The harvested non-roof stormwater could be used for garden watering and toilet flushing. Using the Rainfall-runoff modelling in BASIX-stormwater (*BASIX Draft, 2004*) it is estimated that the current average non-roof stormwater volume produced per allotment per average rainfall year is estimated to be between 200 kL - 315 kL. A proportion of this runoff can be harnessed and reused on-site. This may aid in reducing river and/or groundwater extractions for garden and lawn watering and toilet flushing.

Environmental Reuse

At Bonalbo there are two types of environmental reuse opportunities. These include:

Opportunity 1: Environmental release for river health

The stormwater could be captured in a detention basin and then released to Peacock Creek in a controlled manner to avoid high flow velocities and potential erosion and creek water turbidity downstream.

Opportunity 2: Environmental reuse for rehabilitation of natural or constructed wetland

Council could investigate the potential of installing a constructed wetland downstream of the effluent and stormwater discharge points, upstream of Peacock Creek. Since stormwater flows are very intermittent at Bonalbo, providing effluent to such a project would ensure the sustainability of the wetland and possibly enhance the eco-tourism potential and educational value of the area, as wetlands in general provide a number of passive social and environmental benefits.

4 REVIEW OF DROUGHT MANAGEMENT STRATEGY

A review of the drought management strategy has been undertaken. The review concluded that it complies with the recommendations outlined in this long term water supply and drought strategy. The changes that Commerce recommends are in relation to the use of milk tankers for transporting water and the closing of Bonalbo School.

It is recommended that if milk tankers are used to transport water, multiple warnings should be given to all people in the town, as there is a small minority of the population who are severely allergic to milk. This would enable any people with this allergy to secure an alternate water supply (for example getting their household water tank filled with water using a water tanker rather than a converted milk tanker and installing appropriate plumbing to allow the house to be supplied exclusively by the tank).

It is also recommended that the discussions to be undertaken prior to the closing of the school be made more explicit. It is felt that this is especially important given that the pupils coming from the surrounding area will also be coming from severely drought effected areas and attendance at school will enhance the opportunity for the prevention of drought related health problems in the students and their families.

GLOSSARY OF TERMS

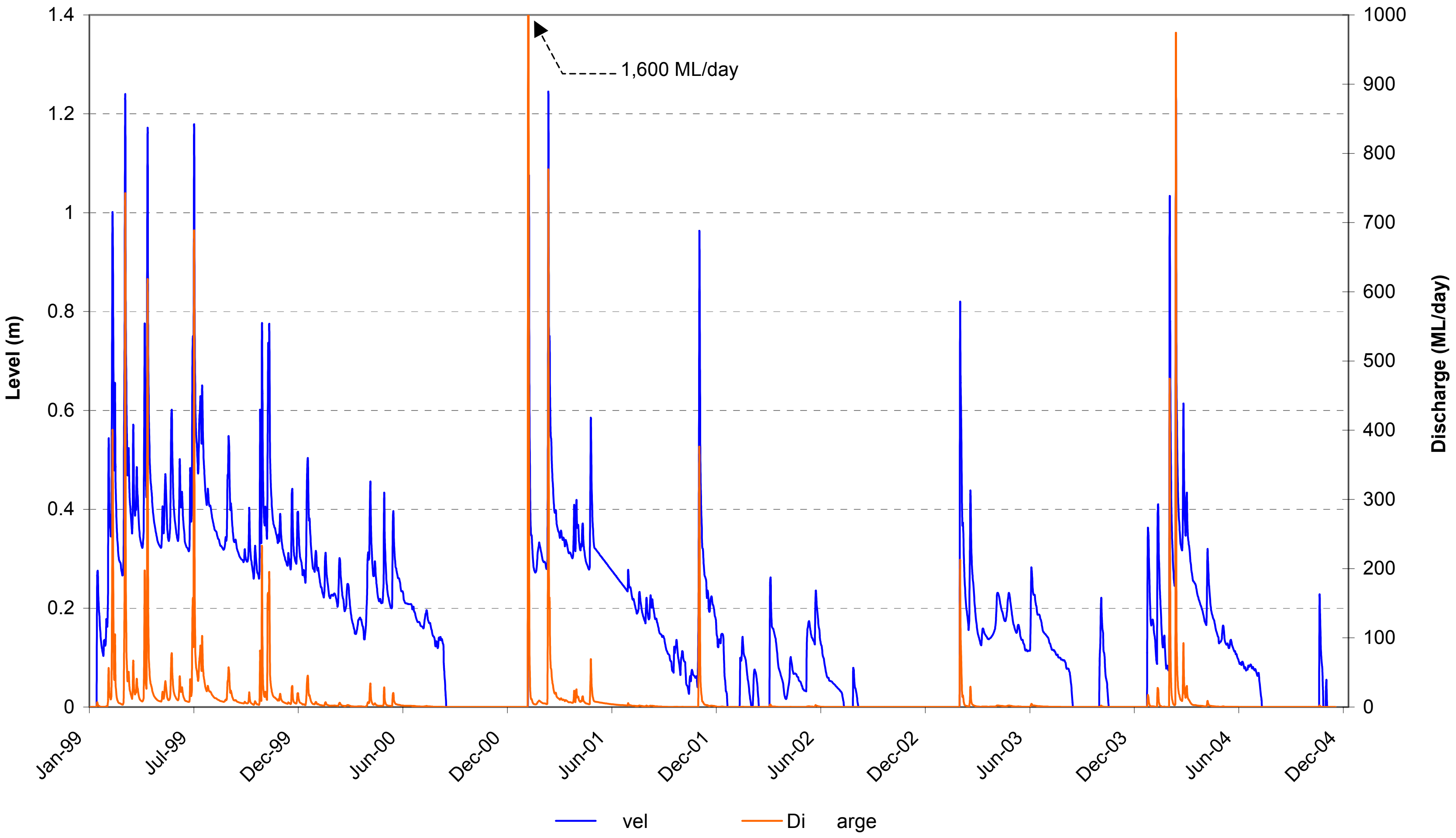
Australian Height Datum (AHD)	A system of control points for height based on a network of levelling measurements which covered the whole of Australia and which was fitted to mean sea level as measured at tide gauges distributed around the Australian coast, over the period 1968-1970. (mAHD = m - 1.065)
Average Recurrence Interval (ARI)	The average time duration between occurrences of a given magnitude of storm or flood.
Catchment	The area drained by the streams or watercourses down to the point at which the dam is located.
Dam	Any man made barrier, temporary or permanent, including appurtenant works that does or could impound, divert or control water, other liquids, silts, debris or other liquid-borne material.
Dwelling	A dwelling is a building or structure in which people live. This can be a building, such as a house; part of a building, such as a flat; or it can be a caravan or tent, humpy or park bench. Houses under construction, derelict houses, vacant tents, or converted garages are not counted in the census.
Farm Dams Policy	Introduced on January 1st 1999 creating basic rights for landholders to capture and use surface water on their properties up to a limit specified as the Maximum Harvestable Right Dam Capacity (MHRDM).
Full Supply Level (FSL)	The level of water surface when the reservoir is at maximum operating level, excluding periods of flood discharge.
Harvestable Right	The amount of surface water a property owner is entitled to before requiring a water license for additional surface water access.
Height of Dam	Normally this is the difference in level between the natural bed of the stream or watercourse and the crest measured at the downstream toe of the dam. If the dam is not across a stream, channel or watercourse, the height will be between the lowest elevation of the outside limit of the dam, and the top of the dam. (See definition "Top of Dam".)
Greywater	Grey water is the liquid waste from domestic fixtures (not including toilets) such as baths, showers, hand basins and laundry facilities.

Maximum Harvestable Right Dam Capacity (MHRDC)	Useful benchmark as to the volume of surface water that can be captured and used in farm dams without detrimental environmental impacts (ie, the sustainable level of water use). Generally adopted as the maximum volume of surface water that can be utilised by rural residential developments for a non-potable water supply. Determined by multiplying the area of the property by a regional coefficient contained on maps published by DLWC as part of the Farm Dams Assessment Guide.
Non-Potable	Water not-suitable for human consumption.
Potable	Water suitable for human consumption.
Rural Residential Development	The subdivision of land in rural and non-urban areas into smaller blocks for the purpose of creating residential living areas in a rural environment, often resulting in the intensity of the use of natural resources in the area, particularly water resources.
Stormwater retention	Harvesting stormwater on-site for reuse
Unregulated catchments	Catchments which are not part of a major irrigation system (ie. They do not contain major irrigation dams, which allow control of the stream flows for irrigation purposes, but they may contain dams, which supply urban areas or private irrigators).
Water Hardness	Total hardness is usually defined as the sum of Calcium and magnesium hardness in mg/L as $CaCO_3$ and it can also be differentiated into carbonate and non-carbonate hardness. ADWG recommend that good quality is between 60 to 200mg/L $CaCO_3$. Between 200 and 500mg/L of hardness can cause scaling in plumbing fixtures and excessive soap consumption.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
COAG	Council of Australian Governments
DCP	Development Control Plan
DEUS	Department of Energy, Utilities and Sustainability
DLWC	Department of Land and Water Conservation
DIPNR	Department of Infrastructure Planning & Natural Resources
DPWS	Department of Public Works and Services
EPA	Environmental Protection Authority
ha	Hectares
KC	Kyogle Council
kL	Kilolitres (1 000 litres)
kL/d	Kilolitres per day
kL/a	Kilolitres per annum
L	Litre
L/d	Litres per day
LGA	Local Government Area
MEU	Ministry of Energy and Utilities
ML	Megalitres (1 000 000 litres)
ML/d	Megalitres per day
ML/year	Megalitres per year
NPV	Net present value
NSW	New South Wales
RWT	Rainwater tank
STP	Sewerage Treatment Plant
TBL	Triple bottom line
UFW	Unaccounted for water
WM Act	Water Management Act
WTP	Water Treatment Plant
WSUD	Water Sensitive Urban Design

Appendix A - Peacock Creek Flow and Discharge Levels (Jan 1999 – December 2004)



Appendix B – Integrated Water Supply Triple Bottom Line Assessment Criteria

To establish the business objectives and related assessment criteria for the future management of the Bonalbo water supply, a number of literature sources were consulted. They include the following: 1999/00 Strategic Business Plans for Water Supply and Sewerage and the Kyogle Council 2003/04 Management Plan were consulted. The Integrated Catchment Management Plan for the Upper North Coast Catchment 2002 - Catchment Blueprint incorporates the area of Bonalbo and has set numerous objectives and target dates. These objectives have been included within the Strategy Assessment Criteria. Table A-1 below outlines the assessment criteria and measures that would achieve full compliance with each assessment criterion.

Table B-1: Triple Bottom Line Assessment Criteria

FUNCTIONAL	
'Treatability' and Palatability of water	Options that allow water to be easily treated with minimal water quality improvement barriers
Sustainability of Supply	Options that include a source that is highly sustainable in the long term providing flexibility for future augmentation
Maintenance and Operational Constraints	Options that allow assets to be easily maintained with good access, low OHS issue (Travel Time) and Council has influence over operation
Site Location	Site location is secure and unlikely to be damaged by natural disasters or vandalised
TECHNICAL	
Degree to which option is technically challenging	Options that are of minimal technical challenge or more cost effective in implementation and operation
Further technology required to treat water source	Options that do not require further associated costs in treatment
Interference with other services on route	Options that require minimal interference with other services along the route
Subject to pricing of other authorities	Options that incur minimal water supply charges and/or require minimal license approvals from authorities other than KC
Ability to be expanded	Options that have potential to be expanded without incurring large costs and being too technically challenging
Opportunity for other treatment units	Options that allow newer or other forms of treatment to be added or replace within the process train

ENVIRONMENTAL	
Extent of construction impacts	Options that have minimal construction impacts on the environment
Improved environmental protection of Yass River catchment	Options that improve environmental protection of the Peacock Creek catchment through increased environmental flows and a more sustainable sharing of water resources
Minimises water extractions and protects low flows	Options that reduce water extractions and protect low flows in the environment

Minimises green house gases	Options that minimise energy consumption, reduce green house gases and associated environmental pollution
Vulnerability of water resource(s)	Options that are adequately protected, and future impacts and sources of pollution are identified
SOCIAL	
Improved relationship between water users	Options that improve the relationship between water users in the Peacock Creek catchment and neighbouring water authorities
Improve security of town water supply	Options that reduce the potential for water restrictions
Improve the quality of drinking water	Options that increase the quality of the potable water supply including land management and treatment technologies
Improves reputation of Council	Options that enhance the reputation of Council as a service provider to the residents under its jurisdiction
Protects public health	Options that improve and protect public health
POLITICAL	
Approval process	Options that have no significant impediments for the development of the source
Better business and development opportunity	Options that increase business and develop opportunities in the Kyogle Council urban areas and rural areas
Inter-government agency collaboration	Options that strengthen relationships between inter-governmental authorities

FINANCIAL	
Cost rating based on equivalent bulk supply rate or comparative security of supply	Options that require minimal cost for the same security of supply
Minimise the impact of future infrastructure on current ratepayers	Options that consider inter- and intra-generational equity
Improve the performance of the assets	Options that increase existing assets design life and/or operate more efficiently
Provide services that are equitable and affordable	Options that consider equity and affordability issues, particularly in relation to small communities
Improve efficiency ratios	Options that improve the operational efficiency of assets and service delivery

Underpinning these objectives is the need to conserve, efficiently use, reclaim and recycle urban water to improve economic and community outcomes whilst minimising environmental impacts. This is otherwise known as the Triple Bottom Line (TBL) and recognises that human quality of life depends not only on economic values, but also on the social systems and ecosystems in which we exist. Our existence should aim to value the standards of ecologically sustainable development (ESD), in order to use, conserve and enhance community resources so that ecological processes and total quality of life are not compromised, but rather at the very least maintained, for present and future generations.

Appendix C – DEUS Best Practice Management of Water Supply and Sewerage Guidelines

The Guidelines were released in May 2004 and sets the requirements that Local Water Utilities must meet in order to be eligible for the payment of a dividend from the surplus of their water supply or sewerage business. The guidelines are designed to aid the water utilities in running businesses that are environmentally and economically sustainable and conform to National Competition Policy.

There are 6 main criteria that must be complied with. They are:

1 The completion and maintenance of a strategic business plan,

2 A financial plan including pricing, developer charges and liquid trade waste approvals,

3 Demand management,

4 Drought management

5 Performance reporting and

6 Integrated Water Cycle Management.

Compliance is with these criteria is demonstrated through:

- The commissioning of an independent compliance audit report,
- The provision of an unqualified financial audit report for all water supply and sewerage businesses that the utility runs and
- The presentation of a council resolution that was made at a meeting open to the public that states that the utilities have achieved "substantial compliance" with each of the 6 criteria listed above.

Strategic Business Plans

Strategic Business Plans provide a framework that aids utilities in meeting customer and government expectations in terms of accountability, service provision and efficiency. The main components of the plans are:

1 An operating environment review – this is a review of the current and forecast: demands for service, maintenance requirements, service levels and regulatory requirements,

2 An asset management plan - this is a set of plans that detail the operation, maintenance, decommissioning, augmentation and replacement of assets that will be required to meet the serviced communities future demands, security and service levels,

3 A selection of key performance indicators – these are specific service standards that those using the services provided by the utility can expect as well as standards of legislative compliance and economic standards,

4 A customer service plan outlining the facilities and assets necessary to provide the required level of customer service (including response time and accessibility of information, feedback and payments services),

5 Detailed level of service indicators based on the key performance indicators and other factors that can be used to assess the precise level of service being provided to customers and

6 A Human Resources Plan that details the utilities policies and strategies associated with the recruitment of new staff, the work and pay conditions for staff and redundancy, retirement and firing of staff along with a long term staffing level strategy.

Financial Plans

The financial plans indicates how the Utility will finance the provision of services that meet the required levels of service in a way that ensures the long term viability of the business, while aiming to achieve the lowest stable residential bills.

Factors that must be considered are the costs associated with:

1 The operation, maintenance and administration of the utility,

2 The replacement of assets and

3 The augmentation of assets to provide sufficient capacity into the future, and

4 The provision of dividends to the Council.

As well as these factors, best practice pricing of services requires that:

1 The costs of service provision must be recovered with an appropriate return on infrastructure investment.

2 Customers are charged at a rate relative to their usage (i.e. they pay based on consumption not just a single access charge).

3 The pricing structure complies with reforms to National Competition Policy and the policies of the Council of Australian Governments.

4 Are simple for customers to understand and easy for the Utility to implement and administer.

5 Takes into account the social implications of increasing charges on "vulnerable" customers including pensioners, and

6 Where possible it supports government policy objectives in relation to regional development, employment and public health and welfare.

7 For residential customers, less than 25% of revenue should come from the access charge, with the rest coming from the usage charge and for non-residential customers, no more than 50% of the revenue shall come from the access charge.

8 For all residential customers, a step price increase (expressed as an excess water charge) of at least 50% for all water consumed over a threshold volume (of at least 450kL/a) shall be charged.

9 All customers shall be billed at leats 3 times per year (preferably every quarter) to increase customer awareness of their water usage through their spending.

10 In situations where non-residential customers are charged at a rate less than the actual costs associated with the provision of services (with the remainder being made up by residential customers) the utility should develop strategies that lead to the complete recovery of all the costs within 5 years.

11 It is recognised that water consumption varies with weather and therefore revenue is more variable under a tariff scheme that is closely lined to consumption. Therefore it is recommended that a revenue fluctuation reserve of up to 10% of annual turnover be established to help utilities cope in years where water use is lower than average due to conditions that are wetter than average or drought years where water restrictions reduce sales.

12 Each residential tenement connected to the sewerage system shall be charged the same access charge and non-residential customers shall be charged an amount for the estimated volume they discharged to the sewer together with an access charge based on

the relative capacity requirements that their loads place on the system relative to residential customers.

13 For non-residential customers, there is an extra fee on top of the non-residential sewerage charge that is the liquid trade waste charge. This charge must cover the costs associated with the inspection and re-inspection of premises, an excess mass charge for premises discharging more than 20 kL/day and the issuing of approvals for all premises discharging trade waste.

14 For all new developments, all costs (both current and expected) in excess of the those associated with providing services to existing customers shall be charged as an upfront lump sum in accordance with the "Developer Charges Guidelines for Water Supply, Sewerage and Stormwater" (DLWC, 2002).

15 If there are pre-existing binding agreements on tariffs, they must be replaced with best practice tariffs as soon as is legally practicable and must disclose the number of such contracts in a council meeting open to the public and add a notice to this effect in its Statement of Compliance.

Demand Management

Appropriate Demand Management is an essential tool in the process of ensuring efficient use of water resources and improving environmental outcomes as required by the *Water Management Act 2000*. Cost-effective demand management has the ability to significantly reduce the social, economic and environmental impacts associated with the provision of water and sewerage services.

DEUS recognises that the first step to introducing demand management is to meter all customer usage so that the current timing and uses of the water can be understood. Subsequent measures that should be examined include:

- Active intervention through a number of measures including:
  - Retrofit programs for fittings and appliances,
  - Rebates for the installation of rainwater tanks,
  - Effluent and stormwater re-use programs,
  - The implementation of water efficiency targets for new development (including the BASIX program that will become compulsory in rural areas in July 2005) and for specific types of renovation,
- Water pricing reform,
- Community education,
- Effluent and stormwater reuse, and
- Water loss and leakage reduction.

A system for the review of these measures every two years so as to ensure that there is an appropriate level of investment in the maintenance and upgrading of both the utility's and the customers' equipment.

Drought Management

A comprehensive drought management strategy must be available for implementation when necessary and to give guidance on the triggers for various components of the strategy.

Performance Reporting

The completion of a comprehensive annual report is mandated by National Competition Policy and strongly endorsed by a number of other organisations. The annual report is important for ensuring public accountability and is a useful tool for assisting utilities in:

- Checking that performance is improving,
- Examining trends in performance indicators and
- Benchmarking performance against similar utilities.

Integrated Water Cycle Management

Integrated Water Cycle Management (IWCM) integrates the management of water supply, sewerage and stormwater services over catchments, with due regard to other water management plans. IWCM is a method used in identifying, address and respond to water management problems so that development is economically, environmentally and socially sustainable in the long term. The main components of the IWCM are:

1 A concept study that defines the catchment issues (eg. flood plain management and acid sulfate or saline soils that may impact on the location of particular structures), water resources issues (eg. access changes mandated by the *Water Management Act 2000*) and urban water issues (eg system deficiencies) that exist in the catchment,

2 The compilations of studies that include detailed analysis of the issues and strategies to manage the issues and finally

3 The adoption of a long term strategy that integrates the provision of water supply, sewerage and stormwater services.

Appendix D – Literature Review

Strategic Business Plan for Water Supply and Sewerage 1999/00, DPWS

The strategic business plans were prepared for inclusion in the 2003/04 Council Management Plan as required by The Local Government Act 1993. Each strategic business plan has a long-term (20 years) strategic approach focussing on the review of the whole operating environment of the particular service. DLWC has made Strategic Business Plans a prerequisite for the provision of financial assistance to Councils. The plans are effective in communicating scheme information to stakeholders and demonstrate that the scheme is being well managed. The plans detail scheme augmentation options and future issues and concerns relevant to Council water supply and sewerage systems. Their relevance to this report is very appropriate. Options and issues discussed in the plans have been reviewed and evaluated herein.

Integrated Catchment Management Plan for the Upper North Coast Catchment 2002 - Catchment Blueprint

The Blueprint summarises the issues in the Landscape type that includes Bonalbo and the Peacock Creed catchment as

- Soil degradation and erosion.
- Water quality and riparian zone decline.
- Stream bank erosion and sedimentation.
- Disruption of fishing and oyster industries and estuarine environment, flood plain habitat degradation.
- Weeds.
- Vegetation - effects of wildfire and vegetation management.
- Expansion of rural residential development.
- Point source pollution."

The main objectives are summarised as:

A. Human population impacts managed through effective land-use planning that minimises future land-use conflict over our diminishing natural resources. This land-use planning requires active community participation to incorporate the spiritual and cultural values of the whole community, including indigenous peoples.

B. The retention and restoration of our wildlife habitats, to protect our biodiversity from threatening processes and to secure diverse and resilient eco-systems.

C. Our land managed in accordance with land capability in order to prevent further degradation, to ensure appropriate land-use and to rehabilitate the environmental attributes of our land's resources.

D. Achieve water quality throughout the catchments and within receiving estuarine and marine waters that meets both human and environmental requirements.

E. A community with adequate resources and capacity to implement best land management practices and ensure the effective stewardship [care and management] of our environment.

Kyogle Council 2003/04 and 2004/05 Management Plans

Used to source current and previous water pricing policies.

Kyogle Council Urban Stormwater Management Strategy, May 2002

Whilst this report provided some generic stormwater objectives for the Kyogle Local Government Area, it is predominantly aimed at the Kyogle Urban area, not the village of Bonalbo.

Bonalbo Water Supply Augmentation Strategy Report, Sept 1998, DPWS

Review of the Water Supply only, and proposed strategy at the time. The recommendations relating to this report relating to water source augmentation were not affordable and have not been implemented by Council. This lack of identification of a cost effective solution for the long term water supply led to the production of the current investigation report.

Bonalbo Water Supply Augmentation – Bonalbo Water Treatment Plant Concept Design Report, July 2004 Department of Commerce

Details the requirements for the proposed Water Filtration Plant utilising the Petrochillos Dam for raw water supply.

Kyogle Shire Water Supply & Sewerage Schemes Safety Audits, Oct 1996 DLWC

Identified outstanding works relating to OH&S provisions at all Councils water and sewerage sites. The findings of this report were incorporated into the 1998 Strategy.

Appendix E – Legal Instruments

Legislation

The following section contains the legislation that is relevant to this project at the moment, please check before relying on any information in this section as legislation is continuously changing.

Catchment Management Authorities Act 2003

The objectives of the Catchment Management Authorities Act 2003 are to:

- to establish authorities for the purpose of devolving operational, investment and decision-making natural resource functions to catchment levels,
- to provide for proper natural resource planning at a catchment level,
- to ensure that decisions about natural resources take into account appropriate catchment issues,
- to require decisions taken at a catchment level to take into account State-wide standards and to involve the Natural Resources Commission in catchment planning where appropriate,
- to involve communities in each catchment in decision making and to make best use of catchment knowledge and expertise,
- to ensure the proper management of natural resources in the social, economic and environmental interests of the State,
- to apply sound scientific knowledge to achieve a fully functioning and productive landscape,
- to provide a framework for financial assistance and incentives to landholders in connection with natural resource management.

The Act is administered by the Minister for Natural Resources.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* is the principal planning instrument in NSW, and it specifies the environmental considerations in all development activities. It also governs the procedures of all proposals that have an effect on the environment. Its objectives are to encourage the proper management of natural and man-made resources, the orderly use of land, the provision of services, and the protection of the environment.

Independent Pricing and Regulatory Tribunal Act 1992

Under the *Independent Pricing and Regulatory Tribunal Act 1992*, the Independent Pricing and Regulatory Tribunal (IPART, previously Government Pricing Tribunal) was set up to determine and advise prices and pricing policies for government monopoly services.

The Tribunal currently has powers to set prices for Sydney Water, Hunter Water and Gosford and Wyong Councils. This includes service usage charges and developer contributions.

The Tribunal does not intend, in the near term, to regulate prices for water supply and sewerage services in country NSW. Instead it has recently released Pricing Principles for Local Water Authorities, which sets out pricing recommendations for councils to adopt in the pricing of their services.

Local Government Act 1993

Council delivers water supply services to its residents via authority delegated under the *Local Government Act 1993*. The Minister for Sustainable Natural Resources administers the parts of this Act dealing with water supply and sewerage.

The Act confers service functions on councils. These include the provision, management and operation of water supply works, sewerage works, facilities and their operation. The Act provides Council with broad powers to carry out their functions, and as a 'Council may do all such things as are supplemented or incidental to, or consequential on, the exercise of its functions' (section 23 of the Act).

Some parts of the Act relating specifically to water supply and sewerage are listed below:

- Section 60 –DEUS provides approval for water supply and sewerage works
- Section 64 – developer charges (under this section of the Act, a council may use the relevant provisions of the Water Supply Authorities Act to obtain water supply and sewerage developer charges)
- Section 68 – Council approval of plumbing works
- Section 634-651 – water supply, sewerage and drainage offences, and
- water, sewerage and drainage regulations which cover matters from the 'old' ordinance 45 and 46.

The role of the Minister for Natural Resources includes matters such as construction of works, handover and vesting of work, approval of dams and treatment plants, direction to councils concerning dams and treatment plants, action during emergencies, and the appointment of an administrator.

Native Vegetation Act 2003

The Native Vegetation Act 2003 aims:

a) To provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and

b) To prevent broad scale clearing unless it improves or maintains environmental outcomes, and

c) To protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and

d) To improve the condition of existing native vegetation, particularly where it has high conservation value, and

e) To encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation,

all in accordance with the principles of ecologically sustainable development.

Occupational Health and Safety Act 2000

The *Occupational Health and Safety Act 2000* details Council's responsibilities to ensure health, safety and welfare of employees and others at places of work. All schemes operational activities are impacted on by this Act.

Protection of the Environment Operations Act 1997

The objectives of this Act are as follows:

- to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development,
- to provide increased opportunities for public involvement and participation in environment protection,
- to ensure that the community has access to relevant and meaningful information about pollution,
- to reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following:
    - pollution prevention and cleaner production,
    - the reduction to harmless levels of the discharge of substances likely to cause harm to the environment,
    - the elimination of harmful wastes,
    - the reduction in the use of materials and the re-use or recycling of materials,
    - the making of progressive environmental improvements, including the reduction of pollution at source,
    - the monitoring and reporting of environmental quality on a regular basis,
- to rationalise, simplify and strengthen the regulatory framework for environment protection,
- to improve the efficiency of administration of the environment protection legislation,
- to assist in the achievement of the objectives of the Waste Avoidance and Resource Recovery Act 2001.

Public Health Act 1991

The *Public Health Act 1991* consolidates previous Acts relating to public health and provides for the prevention of the spread of disease.

The Act is administered by the Minister for Health.

Under Section 14 of the Act, the Director-General or any authorised officer of the Department of Health may inspect sewerage works where the Director-General deems it necessary in the interest of public health. The Director-General may report to the Minister for Sustainable Natural Resources whenever any danger to public health could be removed or diminished. The Minister may then take appropriate action.

Public Works Act 1912

The *Public Works Act 1912* provides the authority for the Public Works Department to construct sewerage and water supply works within the Council's area.

The powers of the Minister of Public Works are likely to be transferred to the Minister for Commerce. The new NSW Department of Commerce was created on 2nd April 2003 comprising all the former Departments of Fair Trading and Industrial Relations, the Office of Information Technology from the former Department of Information Technology and Management and the Department of Public Works and Services.

Rivers and foreshores Act 1948

This act will be repealed shortly and replaced with the Water Management Act 2000. It covers the assessments necessary for riverside works.

Soil Conservation Act 1938

The objective of the *Soil Conservation Act 1938* is the conservation of soil resources and farm water resources and the mitigation of erosion and land degradation.

The Act is administered by the Minister for Natural Resources.

Water Act 1912

The *Water Act 1912,* administered by the Minister for Natural Resources, covers matters such as water rights licences and water allocation.

Water Management Act 2000

The water management act will come into force shortly. The objects of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:

- to apply the principles of ecologically sustainable development, and
- to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and
- to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:

  (i) benefits to the environment, and

  (ii) benefits to urban communities, agriculture, fisheries,

  industry and recreation, and

  (iii) benefits to culture and heritage, and

  (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,

- to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,
- to provide for the orderly, efficient and equitable sharing of water from water sources,
- to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,
- to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,
- to encourage best practice in the management and use of water.

Water Supply Authorities Act 1987

The *Water Supply Authorities Act 1987* is the legal instrument for levying developer charges. The relevant provisions were amended in 1993 as part of the Consequential Provisions of the Local Government Act.

The Act states that in calculating the amount levied on development, Council may take into account the value of existing and projected works, which will serve the development.

Key Agencies

The key agencies responsible for the administration of these legal instruments and each agency's responsibilities are listed below:

Department of Energy, Utilities and Sustainability

- providing subsidies under Country Towns Water Supply and Sewerage Schemes Program
- Local Government Act 1993 section 60 approvals for water supply and sewerage schemes and infrastructure including trade waste discharge to sewer
- Water and sewage treatment plant approval for rural water utilities

Department of Environment and Conservation

- Pollution regulators and licensing authority
- Development concurrence approvals for pollution mitigation facilities under the *Protection of the Environment Operations Act 1997*
- Licensing of sewerage systems, including STPs and effluent reuse schemes
- Pollution reduction programs
- River water quality objectives
- Funding of stormwater quality objectives.
- Issue, manage and enforce all licences to release pollutants including water pollution.
- Have issued interim water quality and river flow objectives that should be considered

Department of Infrastructure Planning and Natural Resources

Natural resource (river flow, groundwater and land) management

Kyogle Council

- Planning, development and ongoing operation of the water, sewerage and stormwater systems schemes
- Owners of the physical water infrastructure assets
- Local area and infrastructure management and planning approvals under the *Local Government Act 1993*
- Funds maintenance and upgrading of physical water infrastructure assets.

Department of Health

- Protection of public health under the *Public Health Act 1991.*

Department of Infrastructure Planning and Natural Resources

- Planning approvals under Environmental Planning and Assessment Act 1979.

Department of Local Government

- Policy and legislative framework for local government.

Murrumbidgee Catchment Management Board – will change shortly

- River flow and quality objectives
- Development of water sharing plans.
-

Non-key Agencies

The non-key agencies and their responsibilities are discussed below.

Work Cover Authority – Workplace and employee safety.

NSW Fisheries – Protection of the fishing industries and aquatic systems under *Fisheries Management Act 1994*. – issue licences for dredging and reclamation works

NSW National Parks and Wildlife Service – Manages land in Bonalbo's water catchments, specifically the Richmond Range National Park.

NSW Agriculture – Provides advice on protection and management of agricultural resources and advice on effluent irrigation schemes.

Appendix F – DIPNR Correspondence

MEMORANDUM

TO	Jeremy Black
CC	
DATE	29 September 2003
FROM	Matthew Renshaw
SUBJECT	Provision of Daily Rural Demands for Peacock Creek and Gorge Creek catchments

NSW Department of Commerce
McKell Building
2-24 Rawson Place
Sydney NSW 2000
Telephone 02 9372 8877
Facsimile 02 9372 7070
TTY 1300 301 181
ABN 54 625 095 406
www.commerce.nsw.gov.au

Jeremy,

Re: our conversation on Friday 26th September, the Department of Commerce would like to formally request the services of your DIPNR section, to aid in obtaining rural demand data for modelling and estimation of the secure yield of the Bonalbo Water Supply.

We have daily recorded stream flow data for Peacock Creek (204043) and Gorge Creek (204044) for the following dates:

Station 204043 (area=44 km^2): 25/03/1960 to present

Station 204044 (area=41 km^2): 20/04/1960 to 06/06/1985.

We would like the following:

1. Actual upstream rural demand data (including irrigation, stock and domestic, riparian rights and industry) for the same period (1960 to present or whatever is available) to calibrate the streamflow model.
2. Rural demand estimation on daily time scale at the town water intake from 1890 to present for the infinite case, assuming no limitation on the resource (i.e. catchment of stations 204043 and 204044 and for the catchment between gauging stations and the Town Water Supply intake).
3. Any access restrictions that you might have that might be applicable to this catchment, so that it can be used in our model of the TWS.
4. A brief report outlining assumptions used in the modelling

We realise that high priority work within your Department may take priority over this work request. However, please note that the acquisition of this irrigation data is on the critical path for completion of our work. In terms of our priorities we need Item 1. as soon as possible, followed by items 2. & 3. and Item 4. within reasonable time after 2. & 3.

Please inform us of any progress in allocation of resources, capabilities/limitations in data provision and scheduled dates of delivery. If you have any queries, please do not hesitate to contact Roshan on 9372 7871 or his mobile on 0409 785 013 myself on 9372 7810.

Kind Regards

Matthew Renshaw

Strategic Urban Planner, Water Services

From: "Jeremy Black" Jeremy.Black@dipnr.nsw.gov.au

To: "Matthew Renshaw" matthew.renshaw@commerce.nsw.gov.au

Date: Tuesday, 28 October 2003 9:26:18

Subject: Bonalbo Water supply

Matthew,

As requested, please find attached report following the verbal advice.

Sorry for delay in replying to initial request.

Regards

Jeremy Black

Resource Analysis Manager

North Coast Region

ph (02) 66 402010

mob (0411) 449 747

Department of
Infrastructure, Planning and Natural Resources

Summary Report: Surface Water Licences Upstream of Bonalbo Water supply Extraction

There are 3 existing licences recorded in the Licence Administration System.

License	Purpose	Stream	Area (Ha)	Crop	Annual Allocated Volume (ML)
30SL042968	Irrigation	Peacock	10	Perennial Pasture	15
30SL043056	Irrigation	Gorge	24	Perennial Pasture	36
30SL066257*	Farming	Gorge	NA	Dairy Wash-down	5

*On April 26 2005, a check (by Commerce) of the water access licence register <http://www.wma.dipnr.nsw.gov.au/wma/ConversionSearch.jsp?selectedRegister=WaterActLicense> showed that "The licence 30SL066257 was not converted and is in any case no longer valid."

The Volumetric Conversion survey records show no response from licence holders and they were consequently given the minimum conversion rate for the determination of annual volume. This may indicate the license holders are not currently using the licenses.

There are also two outstanding applications for new licenses:

2 Ha of perennial pasture, which may be, allocated 9 ML per annum.

2 Ha of perennial pasture, which may be, allocated 13 ML per annum.

Both applications may be refused.

The probable maximum annual volume for all licenses would be 78 ML or approximately 0.20 ML/d during August through February and a further 0.01 ML/d all year for dairy wash-down.

We are unable to provide any estimate of Basic Rights use (formerly known as riparian rights). If you were able to determine the number of properties having river frontage, use the following table to calculate an estimate of annual volumes.

Property Size (Ha)	Annual Basic Rights Volume (ML)
< 10	0.5
10-100	1.0
100-200	1.8
> 200	3

Jeremy Black

Resource Analysis Manager

North Coast Region

From: "Matthew Renshaw" Matthew.Renshaw@commerce.nsw.gov.au

To: "Jeremy Black" jeremy.black@dipnr.nsw.gov.au

Date: Tuesday, 28 October 2003 2:34:49

Subject: Re: Bonalbo Water Supply

Jeremy,

Thank you for your memo and prompt response. Additionally to clarify, we would appreciate your assistance with the following:

1) In regards to the three existing licenses, is it possible to determine their location in relation to the stream gauges (ie. upstream of the gauging stations, or between the gauging stations and the Bonalbo off stream storage intake)?

2) Similarly for the two outstanding license applications, on which creek will they be situated and where are they in relation to the stream gauges?

3) Is it suitable to assume that downstream irrigators would get their water extraction from the catchment area downstream of the Bonalbo river intake?

4) A description of the land use in both catchments including the characteristic of the catchments (eg, steep, %forested, farms, etc)

5) Any information on water extraction for stock and domestic use, any industrial water consumers in the catchment (and their licensed annual and daily entitlements)

6) Your best estimate of the riparian diversions

7) Any knowledge of farms dams upstream of the intake works., etc do they take water from the river or bores or combination of the two, or do they just capture surface runoff? Are the bores connected to the river system and if so is there any regulation on their extraction through annual entitlements for bores in each subcatchment?

To your knowledge, if any of the above queries are discussed in published reports, could you please reference them or direct me as to obtaining a copy.

Your quick response would be appreciated.

Kind Regards

Matthew Renshaw

Strategic Urban Planning

Sustainable Water Solutions

From: "Jeremy Black" jeremy.black@dipnr.nsw.gov.au

To: "Matthew Renshaw" Matthew.Renshaw@commerce.nsw.gov.au

Date: 28/10/03 3:18pm

Subject: Re: Bonalbo Water Supply

Comments below. I can't answer some of them for you so I have referred to our Access Licensing Unit for clarification. Probably take a few days for a response, all a little busy today.

JB

>>> "Matthew Renshaw" <Matthew.Renshaw@commerce.nsw.gov.au> 10/28/03 02:34pm >>>

Jeremy,

Thank you for your memo and prompt response. Additionally to clarify, we would appreciate your assistance with the following:

1) In regards to the three existing licenses, is it possible to determine their location in relation to the stream gauges (ie. upstream of the gauging stations, or between the gauging stations and the Bonalbo off stream storage intake)?

Trying to get a map for you.
But aren't the Bonalbo supply off-take and gauge in the same place. I know of only one other gauge (204048) on Peacock Crk which is upstream of them all. License 42968 may even be below the water off-take so may need to be discounted. Licencing Unit checking. They initially just searched our database on stream names.

2) Similarly for the two outstanding license applications, on which creek will they be situated and where are they in relation to the stream gauges?

referred to licencing unit

3) Is it suitable to assume that downstream irrigators would get their water extraction from the catchment area downstream of the Bonalbo river intake?

referred to licencing unit

4) A description of the land use in both catchments including the characteristic of the catchments (eg, steep, %forested, farms, etc)

referred to licencing unit

5) Any information on water extraction for stock and domestic use, any industrial water consumers in the catchment (and their licensed annual and daily entitlements)

None

6) Your best estimate of the riparian diversions

Have no access to property layer but would be very small eg < 0.01 ML/d

7) Any knowledge of farms dams upstream of the intake works., etc do they take water from the river or bores or combination of the two, or do they just capture surface runoff? Are the bores connected to the river system and if so is there any regulation on their extraction through annual entitlements for bores in each subcatchment?

referred to licencing unit

To your knowledge, if any of the above queries are discussed in published reports, could you please reference them or direct me as to obtaining a copy.

no but referred to licencing unit

Appendix G – ABS Census Data Confidentiality Randomisation

In response to the census data conflict between Cdata and information provided by council and the Australian Bureau of Statistics (ABS) in regards to the Bonalbo queries, the discrepancies have found to be a result of 'confidentiality randomisation'.

Confidentiality randomisation (or 'Introduced Random Error') is the result of the Census and Statistics Act (1905), where it is illegal to release any information collected under this Act (such as data gathered from the census) that would make it possible to identify any individual or group. For example, in the case of Bonalbo, due to the low population, it would be very easy to find a flat that was attached to a shop (especially if there was only one in the town). Due to the flat [attached to the shop] being easily recognised, census data cannot release this information. To get around this, a random number of either 0 or 3 will replace the 1. This also occurs if there were two flats attached to shops in the same town. This obviously affects the information presented as a whole particularly because this is such a small population.

It is almost impossible to get the exact amount if there are categories in the count that contain a 1 or 2, and no reliance should be placed on records that have such data (ie a 0 or 3).

The above example is certainly the case for the age, population and dwelling data for Bonalbo and was also confirmed by a Cdata technical officer (Simon). Although the random error tries to minimise the discrepancies between small amounts of data, this has a detrimental effect on a small and localised population.

Due to discrepancies that were found in census data for Bonalbo, it was necessary find the most accurate result. After speaking to Simon (who is a technical officer for the Australian Bureau of Statistics (ABS)) on the 10th of March, we both discovered that Cdata has the potential to expel misleading information. This is due to the 'introduced random error'.

The introduced random error involves the ABS making adjustments to data in order to hide the identity of individuals or groups. Where there is a '1' or '2' in a field, these figures are randomly changed to either a '0' or '3'. As a result of this, it was also discovered that the same information obtained from different sections of Cdata might be completely different. (ie. The total population obtained from the 'Age' category will have a different number to the total population gathered from the 'dwelling' section, even though they are representing the same data from the same place). At the time, the technical officer did not know this and had to receive further assistance to help solve the problem.

Simon advised on the correct data to use for each query, but could not be absolutely sure that the figures were 100% correct. In the Bonalbo case a discrepancy in the population figures totalled at least 10 persons. To be conservative we have assessed the Bonalbo 2004 starting population as being a total of 347 people.

Appendix H – Photos

Water Supply Scheme

Photo I: Peacock Creek Weir Pool and Pump Station Intake

Photo II: Pump Station 1 – Pump Well

Photo III: Pump Station 1 Switchboard

Photo IV: Bonalbo Dam

Photo V: Bonalbo Dam Off-take Trunnion

Photo VI: Bonalbo Water Supply Pumping Station No.2

Photo VII: Hypochlorination System housed in building adjacent to PS 2

Photo VIII: Pump Station No. 2 Delivery Pumps (Duty & Standby)

Photo IX: Pump Station No. 2 Switchgear

Photo X: Reinforced Concrete Service Reservoir

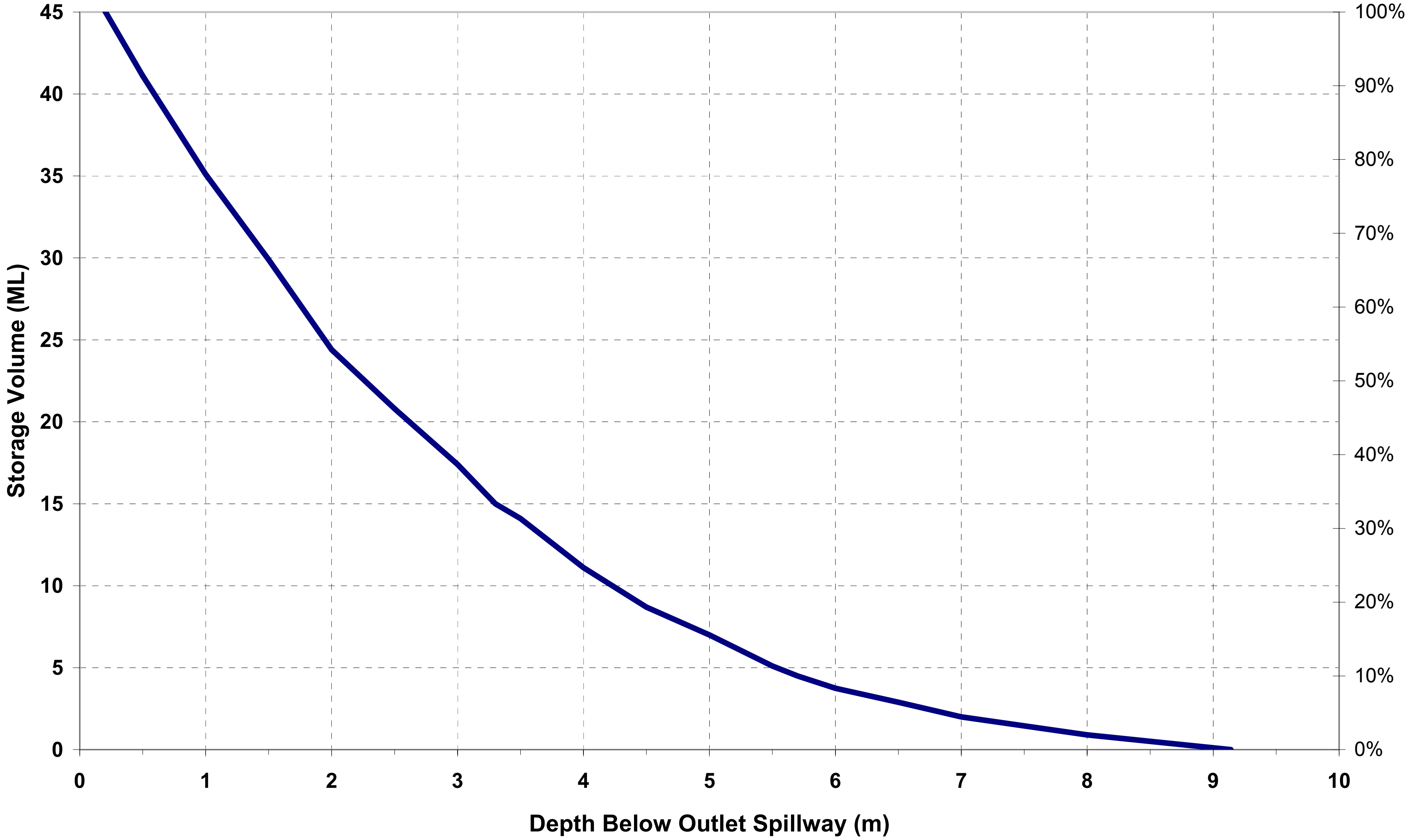
Photo XI: Rainwater Polytank and Concrete In-ground Tank Configuration

Photo XII: Corrugated Iron Tank

Photo XIII: Polytank at School

Photo XIV: Fibreglass tank

Appendix I – Bonalbo Dam Storage versus Depth Relationship Curve



Appendix J – Water Sources and Opportunities

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
Potable Water Sources - existing scheme							
ROOF WATER - currently majority of water for potable uses	showering	**H**	**H**	**L**	**M**	✓	Quality could be improved through first flush devices.
	RWT survey concludes that all types of end-uses are connected, dependant upon tenement. Widely varied end-use connectiion.	It is estimated that currently 90% of residents voluntarily use RWTs as their main potable water supply.	Potential to mitigate and reduce downstream flow-on effects.	For RWTs to be eligible for subsidy they have to be treated as mini service reservoirs. Council would need to own, operate and maintain the tanks and the pressure pumps	Not recommended by NSW Health if there is an existing connection to a reticulated potable supply.	Large potential for inclusion in a DCP, mandating that all tenements have a RWT. Potential for rebate.	Viable average yield = 1242mm/year x 150m^2 roof area x 85% capture rate (first flush and evap, gutter capture) x 50% of time tank near full, allowing overflow = 80 kL/year (as a rough estimate) - toilet, laundry and garden
SURFACE WATER - Peacock Creek and Petrochilos om local catchment	showering	**H / L**	**M**	**H**	**M**	✓	chlorinated and reticulated as the current supply - it is regarded as a non-potable supply
		Dependant on whether treated or not. Water quality in dam is occasionally high in turbidity, colour and iron. Peacock Creek has coliform problems.		Upgrade of Pump station to increase capacity **> $32,000** A Water Filtration Plant has been proposed with a capacity of 0.3ML/day to supply a potable source from Peacock Creek **> $1,100,000** + Dual reticulation 6.2km of pipework **> $620K** for entire network	Assessed as a high risk dam.	Transfer capacity at Peacock Creek extraction point is not sufficient to capture large flows.	Petrochilos Dam is only small (47ML) and the opportunity for natural die-off of pathogens could be expected to be less than for a larger dam with longer residence time.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
Potable Water Sources - not currently in use							
GREYWATER	water and showering	**L**	**M**	**H**		×	
		Not acceptable to the community	Treatment before use	Infrastructure Cost	Unacceptable to NSW Health		
GROUNDWATER	Drinking water and showering	**M**	**H**	**H**		✓	
			Sustainable Yield and Water Quality not known	Estimated at **$0.6M - $0.8 M** transfer from Old Bonalbo (12.2km - 16.1km) existing bores (as identified in DIPNR desktop survey)	NSW Health regulation for potable water (ADWG), Requires treatment before use, DIPNR license and limit on extraction		Would require a 3L/s bore to supply entire peak day demand = 0.23ML/day @ 100mm mPVC pipe Site 1 = 16.1km Site 2 = 12.2km Site 3 = 14.5km
RECLAIMED WATER	Drinking water and showering	**L**	**M**	**H**		×	
Direct potable		Unacceptable to community	Need to ensure sustainability	Infrastructure Cost	Unacceptable to NSW Health		
Indirect potable (aquifer recharge)		Greater drought security	Need to ensure sustainability	Infrastructure Cost	DEC, Health and DIPNR Regulations		
SEA WATER	Drinking water and showering		**-**	**-**	**-**	×	
STORMWATER	Drinking water and showering	**M**	**M**	**H**	**L**	×	proportion of the village's safe yield has come from local runoff. There is the potential for contamination
				Contaminants will not be removed by Membrane Filtration and require additional treatment that the community can't afford	Unacceptable to NSW Health		First flush is a problem. Can be contaminated with herbicides, pesticides, paints, chemicals and petrochemicals, litter and sediment.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
SURFACE WATER - Toonumbar Dam	Drinking water and showering	**L**	**L**	**H**	**L**	×	The dam has a total storage volume of 11,000 ML
		Community cannot afford transfer of water from Toonumbar	Toonumber National Park and State Forest	**> $1.5 M** transfer > **$1.1 M** treatment	The park contains two World Heritage listed rainforests, the Murray Scrub and the Dome Mountain Forest. These forest contain significant areas of subtropical and temperate rainforest and are listed with other nearby National Parks such as the Border Ranges and Lamington National Parks as part of the World Heritage Central Eastern Rainforest Reserve of Australia		Toonumbar Dam is located roughly 20km from Bonalbo on the other side of the Richmond Range, through a State Forest and Toonumber National Park.
SURFACE WATER - Woodenbong and Urbenville	Drinking water and showering	**L**	**L**	**H**	**H**	×	
		Community cannot afford transfer of water from Woodenbong or Urbenville	Yabbra State Forest	**> $3.0 M** transfer > **$1.1 M** treatment			Urbenville is located roughly 37km from Bonalbo on the other side of Yabbra State Forest
SURFACE WATER Kyogle	Drinking water and howering	**L**	**L**		**H**	×	
		Community cannot afford transfer of water from Kyogle	Toonumber National Park and State Forest	**> $4.5 M** transfer > **$1.1 M** treatment			Kyogle is located roughly 45km from Bonalbo on the other side of the Richmond Range, through a State Forest and Toonumber National Park.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
SURFACE WATER - Clarence River	Drinking water and i	**L**	**L**	**H**	**H**	×	
		Community cannot afford transfer of water from Clarence River	Yabbra National Park and Yabbra State Forest	**> $0.7 M** transfer **> $1.1 M** treatment			Clarence River is located roughly 14km from Bonalbo
Non-Potable Water Sources - existing scheme							
SURFACE WATER - Peacock Creek and Petrochilos Dam Runoff from local catchment	For all uses	**H**	**H**	**L**	**M**	✓	Water from Peacock Creek is chlorinated and reticulated as the current supply - it is regarded as a non-potable supply
	Parks and Gardens	**H**	**H**	**L**	**H**	✓	Majority of parks and oval already watered with stormwater and reclaimed water
	Agricultural	**H**	**H**	**L**	**H**	✓	Wastewater reuse already in use at school agricultural block, and golf course, potential for other users
				Upgrade of Pump station to increase capacity **> $32,000** + Dual reticulation 6.2km of pipework **> $620K** for entire network	Assessed as a high risk dam.	Transfer capacity at Peacock Creek extraction point is not sufficient to capture large flows.	Petrochilos Dam is only small (47ML) and the opportunity for natural die-off of pathogens could be expected to be less than for a larger dam with longer residence time.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
Non-Potable Water Sources - not currently in use							
GREYWATER	For all uses		**M**	**H**	**L**	✓	Treated prior to use
	Parks and Gardens	**H**	**H**	**L**	**H**	✓	Majority of parks and oval already watered with stormwater and reclaimed water.
	Agricultural	**H**	**H**	**L**	**H**	✓	Wastewater reuse already in use at school agricultural block, and golf course, potential for other users.
		Acceptable to the community			Acceptable to NSW Health	Large potential for inclusion in a DCP, mandating that all tenements have a greywater reuse. Potential for rebate.	Potential for use of treated greywater on Household gardens.
GROUNDWATER	For all uses	**M**	**H**	**H**		✓	
	Parks and Gardens	**H**	**H**	**H**	**M**	✓	Potential for stand-pipe and transfer of water to tanks to water household gardens.
	Agricultural	**H**	**H**	**H**	**M**	✓	Borefield at Old Bonalbo (10km). Preliminary desktop surveys have shown that some bores have up to 13L/s yield.
				Cost of pipeline form Old Bonalbo **> $0.8M** + Dual reticulation 6.2km of pipework **> $620K** for entire network	DIPNR license and limit on extraction		Yield and water quality not fully known

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
RECLAIMED WATER	For all uses	**H**	**H**	**L**	**H**	✓	100% reuse employed on golf course, school agricultural block, and for road construction - i.e. no discharge to Peacock Creek
	Parks and Gardens	**H**	**H**	**L**	**H**	✓	Potential for stand-pipe and transfer of water to tanks to water household gardens.
	Agricultural	**H**	**H**	**L**	**M**	✓	
				Further potential for use at showground (Pipeline = 1.4km) **= $70K**	Bonalbo sewerage scheme was constructed in the early 60s. The effluent reuse scheme at Bonalbo was completed in 2002/03 resulting in the removal of the EPA Pollution Reduction Program requirements from the plant.		
SEA WATER	For all uses	-	-	-		×	Not available
STORMWATER	For all uses	**H**	**H**	**M**	**H**	✓	Anecdotally, a significant proportion of the village's safe runoff. There is the potential for contamination
	Parks and Gardens	**H**	**H**	**L**	**H**	✓	Potential for stand-pipe and transfer of water to tanks to water household gardens.
	Agricultural	**H**	**H**	**L**	**M**	✓	
		A dual reticulation/supply is a possibility	Difficult to harvest. 100% reuse of currently harvested stomwater	Dual reticulation 6.2km of pipework **> $620K** for entire network			First flush is a problem. Can be contaminated with herbicides, pesticides, paints, chemicals and petrochemicals, litter and sediment.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
SURFACE WATER - Toonumbar Dam	For all uses	**L**	**H**	**H**			The dam has a total storage olume of 11,000 ML
		Community cannot afford transfer of water from Toonumber	Toonumber National Park and State Forest	**> $1.5M**	The park contains two World Heritage listed rainforests, the Murray Scrub and the Dome Mountain Forest. These forest contain significant areas of subtropical and temperate rainforest and are listed with other nearby National Parks such as the Border Ranges and Lamington National Parks as part of the World Heritage Central Eastern Rainforest Reserve of Australia		Toonumbar Dam is located roughly 20km from Bonalbo on the other side of the Richmond Range, through a State Forest and Toonumber National Park.
SURFACE WATER - Woodenbong and Urbenville	For all uses	**L**	**L**	**H**	**H**	×	
		Community cannot afford transfer of water from Woodenbong or Urbenville		**> $3.0M** transfer			Urbenville is located roughly 37km from Bonalbo on the other side of Yabbra State Forest
SURFACE WATER - Kyogle	For all uses	**L**	**L**	**H**	**H**	×	
		Community cannot afford transfer of water from Kyogle	Toonumber National Park and State Forest	**> $4.5 M** transfer **> $1.1 M** treatment	As above		Kyogle is located roughly 45km from Bonalbo on the other side of the Richmond Range, through a State Forest and Toonumber National Park.

Water Sources	End Uses	Social Acceptance	Environmental Acceptance	Financial Cost ($)	Regulatory Acceptance	Shortlist as Opportunity	Comments
SURFACE WATER - Clarence River	For all uses	**L**	**L**	**H**	**H**	×	
		Community cannot afford transfer of water from Clarence River		**> $0.7 M** transfer			Clarence River is located roughly 14km from Bonalbo

Appendix K – Education Programs

Water conservation educational programs aim to show the importance and worth of water and through this process bring about behavioural and cultural change the consumption habits of consumers. In the past 5 years Kyogle Council has implemented a small water conservation and education program throughout the community. The challenge to Council in the future will be to raise and maintain awareness of water conservation issues in the community and develop them into a sustained change in the behavioural patterns of water use.

School Education

As part of its Schools Water Conservation and Protection Program Council should:

- take high school students through its Sewage Treatment Plant and Water Treatment Plant as a way of educating students to be more aware of how and when they use water.
- Answer any requests for information on water consumption and usage in the shire and distribute information packs and borrow out educational videos to high school students to assist them in their Science/Geography curriculum.
- Conduct colouring competitions inviting primary school students to express their views on water.
- Reach all schools in the shire regarding water conservation issues through an educational program.
- Take an active role in National Water Week each year, including taking part in primary school expos each year.
- Invite the high school to create a water jingle to assist Council in raising the community's awareness of water conservation issues.

Community Education

As part of its community education program council should:

- Conducted numerous interviews with local media regarding water conservation.
- Conduct radio and newspaper competitions encouraging the community to provide ideas and solutions to water conservation issues.
- Provide numerous displays in community centres and shopping malls highlighting water conservation issues.
- Hold Open Days at Petrochilos Dam site promoting water conservation
- Act as keynote speakers at local community group meetings to discuss water conservation and field questions.
- Conduct a random survey across the Shire to assess the community's awareness of water conservation issues.
- Produce fliers and brochures driving home the water conservation message including 10 Easy Ways to Save Water and Money
- Produce a brochure on the Shire's water supply.
- Regularly distribute press releases and advertisements covering water conservation issues.
- Produce and air a jingle to encourage water conservation.

Further Education Programs

The water conservation issues that need to be raised in an educational program are currently heightened by the on-set of drought that currently exists within the Kyogle LGA and other areas of NSW. The challenge for Council is to ensure that whilst increasing awareness it needs to be translated into a lasting behavioural change of customer's patterns of water use. Options that are available to Council to develop a water conservation message are to deliver the message through the educational campaign, include increasing community involvement at a local level, target specific groups within the community for specially tailored sessions and promote the Standards Australia Water Conservation Rating and Labelling Scheme for water using appliances.

Members of the community may have many valid suggestions for programs to run at a local level. Allowing for the provision of these suggestions to be aired and implemented gives greater ownership and involvement for members of the community. Builders and plumbers are one group that could be included in a specifically tailored education session regarding how to best implement and the benefits of water saving measures. The personal contact that builders and plumbers have with home-owners provides an extra means of spreading the message into the community.

Council staff can also be targeted for special education sessions that cover water saving practices both at work and in the home. This will have the benefit of directly reducing Council's water use but will also provide a positive example to friends and neighbours of staff members into water conservation measures. Tourists and holiday-makers are another group that Council could target with a specific education campaign. As the greatest influx of tourists generally occurs during the period of peak demand and hottest weather, wasteful water usage practices exhibited by this group may have a significant detrimental effect on demands.

Council can increase the awareness of customers and the quality of information available to them by promoting the Standards Australia Water Conservation Rating and Labelling Scheme for water using appliances. This national initiative is designed to provide an easy to understand rating system for the efficiency of domestic water using fixtures. The scheme provides each appliance with a rating of either 'A', 'AA' or 'AAA' in a scale of increased water efficiency. This allows customers to make more informed decisions when purchasing water-using appliances.

To provide a well run, coordinated education program that will change consumer water usage over time will require an investment in resources from NSC. Ideally a coordinator would be employed to manage the education program, or otherwise hire consultants with marketing and PR experience in running similar programs. Having a NSC staff member manage the education program and the overall demand management strategy would provide better control and results. An estimate of the costs involved would be an annual up front cost of $50,000 for the first few years of the program followed by $20,000 per annum in subsequent years.

Appendix L – Water Efficiency Data – Market Washing Machine Review

Front Loading Clothes Washing Machines

Brand	Model	Capacity (kg)	Water Used (L)	Price ($)	Litres/kg Load	Rating	Size
Miele	Novotronic W828	5.0	61	1,799	12.2	AAAA	Up to 5.5 kg
Kleenmaid	TX 728A	5.0	58	1,999	11.6	AAAA	Up to 5.5 kg
Whirlpool	AWM 5100	5.5	57	999	10.4	AAAA	Up to 5.5 kg
Ariston	Margherita 2000 AB95	5.5	87	1,099	15.8	AAA	Up to 5.5 kg
Simpson	Enviro 100 45S100C	5.5	77	849	14.0	AAAA	Up to 5.5 kg
Asko	Quattro W6011	6.0	63	1,799	10.5	AAAA	6kg to 7kg
Bendix	Aquaria Splendida B1253X	7.0	73	1,599	10.4	AAAA	6kg to 7kg
Bosch	WF02430AU	6.0	75	2,399	12.5	AAAA	6kg to 7kg
Whirlpool	6th Sense AWM 8121	7.0	60	1,249	8.6	AAAAA	6kg to 7kg
LG	Intellowasher WD-1074FHB	7.0	95	1,299	13.6	AAAA	6kg to 7kg
Westinghouse	Mastermimnd LF711C	7.0	95	1,049	13.6	AAAA	6kg to 7kg
AEG	Lavamat W830-W	6.0	72	1,599	12.0	AAAA	6kg to 7kg
Maytag	Neptune MAH3000AAW	8.0	109	2,749	13.6	AAAA	Over 7.5kg
Overall Average		**6.2**	**76**	**1,394**	12.2		
AAA Average		5.5	87	1,099	15.8	AAA	
AAAA Average		6.2	76	1,649	12.2	AAAA	
AAAAA Average		7.0	60	1,249	8.6	AAAAA	

Top Loading Clothes Washing Machines

Brand	Model	Capacity (kg)	Water Used (L)	Price ($)	Litres/kg Load	Rating	Size
Simpson	Esprit 550 36S550K	5.5	117	649	21.3	AA	Up to 5.5 kg
Fisher & Paykel	Pride MW511	5.5	127	780	23.1	AA	Up to 5.5 kg
Hoover	500MB	5.0	118	599	23.6	AA	Up to 5.5 kg
Fisher & Paykel	Excellence GW511	5.5	133	896	24.2	AA	Up to 5.5 kg
NEC	NW-452	4.5	145	549	32.2	A	Up to 5.5 kg
Fisher & Paykel	Intuitive Eco IW711	7.0	149	1,228	21.3	AA	6kg to 7kg
Fisher & Paykel	Excellence GW611	6.5	154	1,007	23.7	AA	6kg to 7kg
Hoover	600MB	6.0	120	699	20.0	AA	6kg to 7kg
Simpson	Encore 605 35S605K	6.0	122	725	20.3	AA	6kg to 7kg
Whirlpool	6ALBR6245JQ	6.0	123	849	20.5	AA	6kg to 7kg
LG	Turbo Drum WF-T653A	6.5	164	879	25.2	AA	6kg to 7kg
Samsung	Triflow SW65ASP	6.5	153	749	23.5	AA	6kg to 7kg
Fisher & Paykel	Intuitive Eco IW711	8.0	177	1,362	22.1	AA	Over 7.5kg
Fisher & Paykel	Excellence GW711	7.5	168	1,118	22.4	AA	Over 7.5kg
Samsung	Triflow SW95ASP	9.5	192	1,099	20.2	AA	Over 7.5kg
Hitachi	SF-H800PX	8.0	180	999	22.5	AA	Over 7.5kg
Whirlpool	6ALSR7244JQ1	7.5	159	949	21.2	AA	Over 7.5kg
Simpson	Enduro 801 22S801K	8.0	185	1,099	23.1	AA	Over 7.5kg
LG	Turbo Drum WF-T953A	9.0	180	1,379	20.0	AA	Over 7.5kg
Hoover	750LC	7.5	189	849	25.2	AA	Over 7.5kg
Hoover	800RLC	8.0	186	999	23.3	AA	Over 7.5kg
Simpson	Esprit 750 22S750K	7.5	194	849	25.9	AA	Over 7.5kg
Overall Average		**6.9**	**156**	**923**	22.9	AA	
Below 7kg Average		5.9	135	801	23.2	AA	
Above 7kg Average		8.1	181	1,070	22.6	AA	

Appendix M – Kyogle Council Water and Sewerage Charges

The following is an extract from the Kyogle Council 2004/05 Management Plan – Revenue Policy

Water Charges

The charging structure is based on a two-tiered system as follows:

(a) An annual availability/access charge which applies to each property receiving a water supply service (including private line connections) and to each property to which a service connection is available; and

(b) A consumption based charge for each kilolitre of water consumed.

The proposed increase in Water Charges for 2004/2005 is 3%.

CHARGE	NUMBER OF PROPERTIES	RATE PER UNIT OR ANNUAL CHARGE	ANTICIPATED YIELD
Availability/Access Charges			
Vacant Property Charge	121	75.00	9,075
20 mm connection	1,668	175.00	291,900
25 mm connection	33	273.50	9,026
32 mm connection	18	448.00	8,064
40mm connection	20	700.00	14,000
50mm connection	13	1,093.75	14,219
80mm connection	0	2,800.00	0
100mm connection	0	4,375.00	0
100mm connection (fire service)	0	0.00	0
Total	**1,873**		**346,284**
Water Consumption Charge		$1.00 per 1,000 litres (Minimum account of $5.00 per billing period applies)	441,000

Sewerage Charges

(a) Residential Sewerage charges incorporate a uniform charge for each property.

The proposed increase in Sewerage Charges for 2004/2005 is 15%.

CHARGE	NUMBER OF PROPERTIES	RATE PER UNIT OR ANNUAL CHARGE	ANTICIPATED YIELD
Sewerage Annual Charge	1,468	474.00	695,832

(b) Non Residential sewerage charges are to be charged as per the formula:

$$(AC + C \times UC) \times SDF$$

where:

AC = An annual availability/access charge ($).

C = Customer's annual water consumption (kL)

UC = Sewerage Usage Charge ($/kL)

SDF = Sewerage Discharge Factor (i.e. the ratio of a customer's estimated volume discharged in the sewerage system to the customer's total water consumption). Refer Appendix A.

CHARGE	RATE PER UNIT OR ANNUAL CHARGE
Availability/Access Charges	
20 mm connection	175.00
25 mm connection	273.44
32 mm connection	448.00
40mm connection	700.00
50mm connection	1,093.75
80mm connection	2,800.00
100mm connection	4,375.00
100mm connection (fire service)	0.00
Total	
Sewer Usage Charge	$0.82 per kL

Note: Non-Residential and Trade Waste Charges are subject to a Minimum charge equivalent to the residential sewerage charge ($474).

5. Trade Waste Charges:

Council has introduced cost-reflective trade waste fees and charges in 2004/2005 to comply with DEUS Pricing Guidelines.

These fees and charges apply to ALL liquid trade waste dischargers and are determined with reference to the levels of pre-treatment (e.g. appropriately sized and maintained grease traps) and excess mass charges for wastes exceeding normal acceptance limits.

The trade waste fees and charges are in addition to the Non-Residential sewerage bills.

(a) Liquid trade waste charges for 2004/2005 for dischargers requiring nil or minimal pre-treatment are to be charged as per the formula:

$$A + I$$

where:

A = Annual trade waste fee ($)

I = Re-inspection fee ($) (where required)

Annual Trade Waste Fee	$66.00
Re-inspection fee	$62.00

Note: Non-Residential and Trade Waste Charges are subject to a Minimum charge equivalent to the residential sewerage charge ($473).

(b) Liquid trade waste charges for 2004/2005 for dischargers requiring prescribed pre-treatment are to be charged as per the formula:

$$A + I + (C \times UC \times TWDF)$$

where:

A = Annual trade waste fee ($)

I = Re-inspection fee ($) (where required)

C = Customer's annual water consumption (kL)

UC = Trade Waste Usage Charge ($/kL)
TWDF = Trade Waste Discharge Factor (i.e. the ratio of a customer's estimated volume discharged in the sewerage system to the customer's total water consumption). Refer Appendix A.

Annual Trade Waste Fee	$66.00
Re-inspection fee	$62.00
Usage fee for trade waste dischargers with appropriate prescribed pre-treatment	$1.00/kL
Usage fee for trade waste dischargers without appropriate prescribed pre-treatment	*$1.00/kL

***** This charge is to gradually increase to around $11/kL. It has been set at the same rate as dischargers with appropriate prescribed pre-treatment for 2004/2005 in order to give those customers who are required to have pre-treatment a period of grace to get appropriate pretreatment devices installed, before they are charged heavily for not having pre-treatment.

Note: Non-Residential and Trade Waste Charges are subject to a Minimum charge equivalent to the residential sewerage charge ($473).

(c) Liquid trade waste charges for 2004/2005 for large dischargers (over about 20kL/d) and industrial waste are to be charged as per the formula:

$$A + I + EMC$$

where:
A = Annual trade waste fee ($)
I = Re-inspection fee ($) (where required)
EMC = Total Excess Mass Charges ($)

Annual Trade Waste Fee	$443.00
Re-inspection fee	$62.00
Excess mass charges	per Appendix B

Note: Non-Residential and Trade Waste Charges are subject to a Minimum charge equivalent to the residential sewerage charge ($473).

Appendix N – Water Source Water Quality Comparison

The main deficiency of the existing water supply scheme is the poor quality of dam water especially with respect to colour, turbidity, manganese, aluminium, and total dissolved solids. Preliminary water quality tests of the proposed bore water supply source actually exhibit poorer levels of water quality than the dam.

A summary table of the average results of the Bonalbo Dam water quality in comparison to the bore water quality report is given below in Table K-I.

Table K-I Water Supply Water Quality

Parameter	Bonalbo Dam 2003	Bo 2004	Old Bonalbo Bore 2004
Algae (cells/mL)	42	52	
Alkalinity as CaCO3 (mg/L)	121	125	123
Aluminium (dissolved) (mg/L)	0.037	0.020	0.27
Chlorop	3	3	
Colour (Apparent) Pt-Co	100	60	582.0
Gross Alpha (mBq/L)	9	17	
Gross Beta (mBq/L)	13	20	
Hardness as CaCO3 (mg/L)	159	158	66
Iron (dissolved) (mg/L)	0.11	0.13	0.45
Manganese (dissolved) (mg/L)	0.03	0.05	0.13
Non Filterable Residue (mg/L)	4	4	5
pH	7	7.42	7.14
Total Aluminium (mg/L)	0.071	0.051	0.035
Total Dissolved Solids (mg/L)	447	451	411
Total Iron (mg/L)	0.28	0.28	4.97
Total Manganese (mg/L)	0.14	0.14	0.14
Total Nitrogen (mg/L)	0.10	0.1	0.21
Total Phosphorus (mg/L)	0.04	0.11	0.15
True Colour (Pt-Co)	39	29	111
Turbidity (NTU)	3	2.3	56

The above table shows that the Colour and Turbidity are very high in comparison to the Bonalbo Dam water. A large proportion of this colour and turbidity could be reduced by the precipitation of the high iron and manganese contents out of solution.

The water treatment plant would be required to produce treated water to the requirements in Table K-II.

Table K-II- Treated Water Quality Requirements

Parameter	Target
True Colour	< 15 Pt-Co (up to 25 units accepted if no chemicals are used)
Turbidity	< 0.5 NTU 100% of the time < 0.3 NTU 90% of the time
pH	7.2 to 8.0
Total Iron	< 0.1 mg/L
Total Manganese	< 0.05 mg/L
Total Aluminium	< 0.2 mg/L
Free Chlorine	0.25 - 1.0 mg/L
Odour and Taste	Unobjectionable
Giardia cysts and Cryptosporidium oocysts removal: minimum 3 log	
E Coli , Coliforms, and Faecal Coliforms (Count/100mL) = 0	

The plant will be designed for producing 0.3 ML/day of treated water that meets the above specified water quality requirements when water temperature is above 15°C. A 25% reduction in production would be accepted during winter months when the water temperature is below 15°C.

As a minimum the water will have to be treated to remove and/or reduce Turbidity, Colour, Iron, Manganese, Aluminium, Coliforms, Faecal Coliforms and E. Coli, algae cells, and possibly some heavy metals and also should be able to remove Giardia cysts and Cryptosporidium.

Conventionally a treatment plant will possibly have the following process units to produce filtered water at Bonalbo that complies with the Australian Drinking Water Guidelines:

(i) Flocculation,

(ii) Coagulation and Sedimentation,

(iii) Filtration,

(iv) Disinfection,

(v) Chemical dosing,

(vi) Powdered activated carbon (PAC) for algal toxin removal,

(vii) Waste water handling and disposal.

There are a number of treatment plant designs that incorporate all or some of the above treatment processes but offer significant variations in layout and capital and operating costs. The broad classifications are:

1. Conventional treatment plants: Plants that will cover all the above treatment steps in order and usually in dedicated units in the plant eg flocculation chamber, coagulation/sedimentation chamber etc. These units can be constructed in single or combined structures. The water retaining structures are mostly constructed from reinforced concrete and the building is of masonry construction. Conventional treatment plants cannot be guaranteed to remove Giardia and Cryptosporidium without the extensive use of chemicals such as chlorine or ozone which in large quantities may produce unwanted by-products.

Waste water from these plants is usually directed to sludge drying beds or lagoons.

Conventional plants have high capital and operating costs as highly skilled operators and many chemicals are used. However, these plants offer relatively low maintenance costs.

2. Package treatment plants: A miniaturised conventional plant. In this plant the whole process of treatment may be combined in a single steel or fibreglass structure. Packaged plants usually have higher loading rates on the coagulation/sedimentation and filtration units. This is to make them pre-assembled and easily transportable.

Capital costs of package plants are lower than conventional plants but maintenance costs are usually higher. Again highly skilled labour is required.

3. Membrane filtration plants: These plants that utilise semi-permeable membranes to separate suspended solids, colloids, bacteria, and all other particles greater than 0.03-0.05 micron in size. Membrane filtration in recent years has become more affordable in Australia and worldwide as advancements in membrane production and module design have been made and as competition increased with more suppliers coming into the market.

Unlike conventional and packaged systems, membrane filtration system capital costs per volume of treated water do not escalate rapidly as plant sizes decrease. This factor makes membrane filtration ideal for small plants. The other factor that distinguishes the membrane technology from conventional technology is the simplicity of operation.

Another important factor that has led to a wider acceptance and reliance on membrane filtration is the more stringent water regulations introduced in recent years in regards to disinfection by products, Giardia and Cryptosporidium outbreaks, and expected more requirements for the removal of dissolved contaminants from the water.

In recent years Department of Commerce have recommended more membrane filtration plants for small systems and communities and Department of Land and Water Conservation and most clients have supported this approach. For membrane filtration process the membrane designer will determine the required chemicals, chemical dosages, process requirements, and the design parameters.

Bonalbo Dam Water Quality (2004)

PARAMETER	GUIDELINES	DATE SAMPLED AND RESULTS															
		07/01/04	12/3/03	26/3/03	16/4/03	30/4/03	14/5/03	28/5/03	25/6/03	16/7/03	13/8/03	27/8/03	10/9/03	24/9/03	15/10/03	12/11/03	**AVERAGE**
Algae (cells/mL)	<1000	100	10	10	10	10	10	10	10	10	100	100	100	100	100	100	**52**
Alkalinity as $CaCO_3$ (mg/L)	No guideline	158	123	115	120	115	118	115	120	119	121	126	123	130	130	141	**125**
Aluminium (dissolved)	0.2	0.012	0.01	0.016	0.012	0.011	0.012	0.07	0.026	0.01	0.005	0.021	0.043	0.006	0.039	0.013	**0.020**
Chlorophyll a (ug/L)	No guideline	3.0	2	3	5	3	5	2	2	3	<5	2.5	3	3	1	1.0	**3**
Colour (Apparent) Pt-	15	40	84	49	101	133	103	83	55	60	44	38	28	33	29	23	**60**
Gross Alpha (mBq/L)	100	<5	7		21	21	18	<5	<5	<5	<5	<5	<5	<5	<5	19.0	**17**
Gross Beta (mBq/L)	500	<10	<10		14	<10	<10	34	15	15	<10	<10	<10	<10	<10	<10	**20**
Hardness as $CaCO_3$ (mg/L)	200	162	142	144	139	149	193	160	158	153	150	165	174	189	144	153	**158**
Iron (dissolved)	-	<0.01	0.05	0.11	0.41	0.36	0.07	0.08	0.05	<0.01	0.1	0.13	0.07	<0.01	0.08	0.07	**0.13**
Manganese (dissolved)	-	<0.01	<0.01	<0.01	0.01	0.03	<0.01	0.08	0.11	<0.01	0.03	0.02	0.04	<0.01	0.06	<0.01	**0.05**
Non Filterable Residue	No guideline	3	5	3	3	5	4	5	<1	2	1	4	<1	6	<1	2	**4**
pH	6.5-8.5	7.47	7.85	7.83	7.07	7.16	7.3	7.28	7.27	7.36	7.22	7.28	7.52	7.6	7.42	7.68	**7.42**
Total Aluminium	-	0.03	0.058	0.07	0.05	0.036	0.033	0.06	0.034	0.07	0.053	0.057	0.069	0.027	0.099	0.022	**0.051**
Total Dissolved Solids (mg/L)	500	553	470	443	430	432	444	440	451	289	450	452	463	465	484	498	**451**
Total Iron (mg/L)	0.3	0.36	0.23	0.18	0.51	1	0.32	0.29	0.09	0.11	0.19	0.23	0.14	0.12	0.24	0.25	**0.28**
Total Manganese	<0.05	0.09	0.05	0.06	0.25	0.62	0.14	0.15	0.12	0.11	0.06	0.08	0.08	0.09	0.13	0.11	**0.14**
Total Nitrogen (mg/L)	3	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	0.032	0.1	0.2	<0.1	0.05	<0.1	<0.1	<0.01	0.2	**0.1**
Total Phosphorus	No guideline	0.67	0.02	<0.05	<0.05	0.06	0.04	0.025	<0.05	0.02	0.15	0.025	0.02	<0.05	<0.05	<0.05	**0.11**
True Colour (Pt-Co)	15	23	47	41	47	52	37	27	21	29	20	25	15	15	18	18	**29**
Turbidity (NTU)	<1	2.1	3.35	2.9	2.6	2.27	2.27	3.94	1.5	1.7	1.5	1.3	1.9	2.4	1.8	2.7	**2.3**

Bonalbo Dam Water Quality (2003)

PARAMETER	GUIDELINES	DATE SAMPLED AND RESULTS														
		26/2/03	12/3/03	26/3/03	16/4/03	30/4/03	14/5/03	28/5/03	25/6/03	16/7/03	13/8/03	27/8/03	10/9/03	24/9/03	15/10/03	AVERAGE
Algae (cells/mL)	<1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<100	<100	<100	**42**
Alkalinity as $CaCO_3$ (mg/L)	No guideline	125	123	115	120	115	118	115	120	119	121	126	123	130	130	**121**
Aluminium (dissolved)	0.2	0.23	0.01	0.016	0.012	0.011	0.012	0.07	0.026	0.01	0.005	0.021	0.043	0.006	0.039	**0.037**
Chlorophyll a (µg/L)	No guideline	4	2	3	5	3	5	2	2	3	<5	2.5	3	3	1	**3**
Colour (Apparent) Pt-	15	557	84	49	101	133	103	83	55	60	44	38	28	33	29	**100**
Gross Alpha (mBq/L)	100	8	7		21	21	18	<5	<5	<5	<5	<5	<5	<5	<5	**9**
Gross Beta (mBq/L)	500	11	<10		14	<10	<10	34	15	15	<10	<10	<10	<10	<10	**13**
Hardness as $CaCO_3$ (mg/L)	200	162	142	144	139	149	193	160	158	153	150	165	174	189	144	**159**
Iron (dissolved) (mg/L)	-	0.03	0.05	0.11	0.41	0.36	0.07	0.08	0.05	<0.01	0.1	0.13	0.07	<0.01	0.08	**0.11**
Manganese (dissolved)	-	<0.01	<0.01	<0.01	0.01	0.03	<0.01	0.08	0.11	<0.01	0.03	0.02	0.04	<0.01	0.06	**0.03**
Non Filterable Residue (mg/L)	No guideline	15	5	3	3	5	4	5	<1	2	1	4	<1	6	<1	**4**
pH	6.5-8.5	7.84	7.85	7.83	7.07	7.16	7.3	7.28	7.27	7.36	7.22	7.28	7.52	7.6	7.42	**7**
Total Aluminium	-	0.28	0.058	0.07	0.05	0.036	0.033	0.06	0.034	0.07	0.053	0.057	0.069	0.027	0.099	**0.071**
Total Dissolved Solids (mg/L)	500	550	470	443	430	432	444	440	451	289	450	452	463	465	484	**447**
Total Iron (mg/L)	0.3	0.29	0.23	0.18	0.51	1	0.32	0.29	0.09	0.11	0.19	0.23	0.14	0.12	0.24	**0.28**
Total Manganese	<0.05	0.06	0.05	0.06	0.25	0.62	0.14	0.15	0.12	0.11	0.06	0.08	0.08	0.09	0.13	**0.14**
Total Nitrogen (mg/L)	3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.032	0.1	0.2	<0.1	0.05	<0.1	<0.1	<0.01	**0.10**
Total Phosphorus	No guideline	0.01	0.02	<0.05	<0.05	0.06	0.04	0.025	<0.05	0.02	0.15	0.025	0.02	<0.05	<0.05	**0.04**
True Colour (Pt-Co)	15	147	47	41	47	52	37	27	21	29	20	25	15	15	18	**39**
Turbidity (NTU)	<1	13	3.35	2.9	2.6	2.27	2.27	3.94	1.5	1.7	1.5	1.3	1.9	2.4	1.8	**3**

CLIENT:	Kyogle Council	REPORT No:	0405 - 07592
ADDRESS:	PO. Box 11 Kyogle NSW 2474	DATE SAMPLED:	07-May-04
CONTACT:	Mr Graham Kennett	DATE REPORTED:	24-May-04
		No. of SAMPLES:	1

Test Method: Analysis results apply to the sample as received.

SAMPLE ID. Old Bonalbo Groundwater-Lot 12 DP751050
Sample No. 001

PARAMETER	Method No.	PQL	Unit	Result
Alkalinity (as CaCO3)	2320B	1	mg/L	123
Aluminium (Dissolved)	3113	0.001	mg/L	0.027
Ammonia-N	4500-NH3	0.005	mg/L	0.2
BOD	5210-B	2	mg/L	< 2
Calcium	3113	0.1	mg/L	11.0
Color Apparent	6.18	0.7	Pt-Co	582.0
E.Coli	9223	1	MPN/100mL	< 1
Electrical Conductivity	2510 B	1	uS/cm	642
Hardness (as CaCO3)	2340-B	1	mg/L	66
Iron (Dissolved)	3111	0.01	mg/L	0.45
Magnesium	3113	0.1	mg/L	9.3
Manganese (Dissolved)	3111	0.01	mg/L	0.13
Non Filterable Residue	2540 D	1	mg/L	5
pH	4500-H B	0.1		7.14
Total Aluminium	3111	0.001	mg/L	0.035
Total Coliforms	9223	1	MPN/100mL	1
Total Diss. Solids	1030-E	1	mg/L	411
Total Iron	3030 E	0.01	mg/L	4.97
Total Manganese	3030 E	0.01	mg/L	0.14
Total Nitrogen	4500-N	0.01	mg/L	0.21

Notes:

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D. Surkitt
Laboratory Manager
NATA Signatory

Page 1 of 2

CLIENT:	**Kyogle Council**	**REPORT No:**	**0405 - 07592**
ADDRESS:	PO. Box 11 Kyogle NSW 2474	**DATE SAMPLED:**	**07-May-04**
CONTACT:	Mr Graham Kennett	**DATE REPORTED:**	**24-May-04**
		No. of SAMPLES:	**1**

Test Method: Analysis results apply to the sample as received.

SAMPLE ID. Old Bonalbo Groundwater-Lot 12 DP751050
Sample No. 001

PARAMETER	Method No.	PQL	Unit	Result
Total Phosphorus	4500-P B	0.05	mg/L	0.15
True Colour	6.18	0.7	Pt-Co	111.0
Turbidity	2130-B	0.01	NTU	56.0

End of Results for Old Bonalbo Groundwater-Lot 12

Notes:

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NATA accreditation does not cover microbiological analysis

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Laboratory Manager
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ABN: 81 383 023 77

NSW Department of Commerce

Appendix O – DIPNR Groundwater Assessment

From: **"Chris Rumpf"** Chris.Rumpf@dipnr.nsw.gov.au

To: Matthew.Renshaw@commerce.nsw.gov.au

Date: **Wednesday, 11 February 2004 10:29:29**

Subject: **Re: Bonalbo Water supply strategy**

Matt, Roshan

Assessment as requested (please see attached)

Call me if you have any questions.

Regards

Chris

Desktop Groundwater Assessment of Old Bonalbo – Bonalbo (superceded)

Old Bonalbo

There are only 2 bores on the Departments database showing yields over 1L/s being 4 and 4.5 litres per second.

These bores are located on a property approximately 2km to the east of Old Bonalbo

Most of the other bores are either very low yielding or too saline for drinking purposes.

Looking at a blurred copy of the Warwick geology map it is extrapolated that the geology of the area is dipping slightly to the east on an approximately north south strike.

It is evident that the deeper bores tend to contain fresher water, possibly due to the intersection of differing geological units.

It should be noted that there is a dip site to the east of the above mentioned high yield bores.

If any investigations were to be undertaken in this area, it is suggested that test bores be drilled to the east of the town to a minimum depth of 40m.

Bonalbo

There are 4 bores located around the township of Bonalbo consisting of 2 bores and 2 excavations for which no information has been supplied to the Department on.

Therefore based on the information of bores around Old Bonalbo within the same geology, it would be considered a greater risk to explore for water supplies from groundwater form both yield and water quality (salinity), however as above, there may be potential form bores drilled to a depth of greater than 40m.

From: **"Matthew Renshaw"** Matthew.Renshaw@commerce.nsw.gov.au

To: **"Chris Rumpf"** Chris.Rumpf@dipnr.nsw.gov.au

Date: **Wednesday, 11 February 2004 10:48:55**

Subject: **Re: Bonalbo Water supply strategy**

Hi Chris,

Thanks for the information.

Can I infer that there is greater risk, but more potential for groundwater supply by drilling bores of greater than 40m depth in Bonalbo?

Is there a similar dip (weaker geology) as through Old Bonalbo running through Bonalbo village or nearby?

Can you suggest a region/area where test bores might be drilled?

Will call to discuss.

Kind Regards

From: **"Chris Rumpf"** Chris.Rumpf@dipnr.nsw.gov.au

To: Matthew.Renshaw@commerce.nsw.gov.au

Date: **Wednesday, 11 February 2004 5:12:23**

Subject: **Re: Bonalbo Water supply strategy**

Matt

Please see attached as requested

Regards

Chris

Desktop Groundwater Assessment of Old Bonalbo - Bonalbo

Old Bonalbo

Examination of the Departments database shows a north north west running trend of higher yielding bores with one bore producing 13L/s (Drilled in Nov 2003).

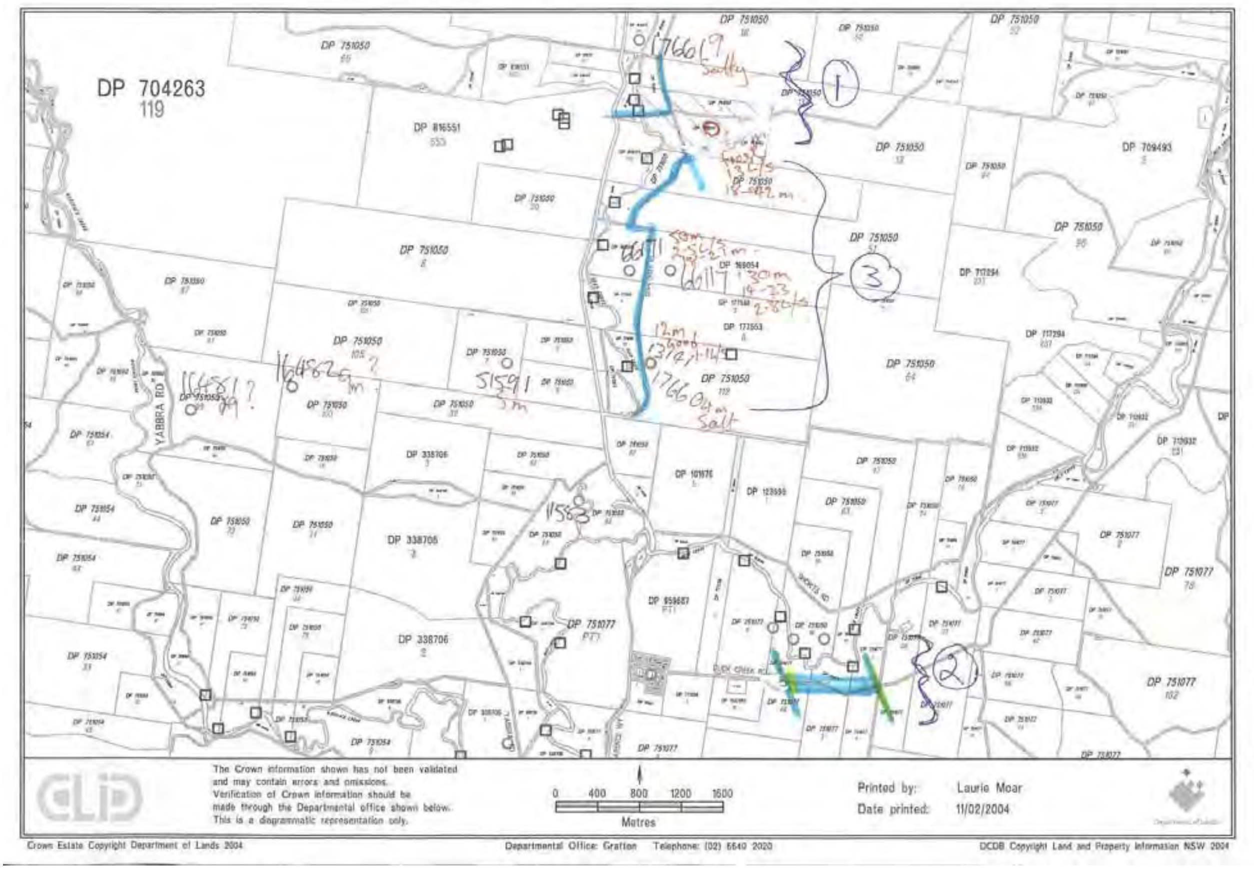
Most of the other bores are either very low yielding or too saline for drinking purposes.

Looking at a blurred copy of the Warwick geology map it is extrapolated that the geology of the area is dipping slightly to the east on an approximately north south strike.

It is evident that the deeper bores tend to contain fresher water, possibly due to the intersection of differing geological units.

It should be noted that there is a dis-used live stock dip site to the east of the some of the high yielding bores directly to the east of Old Bonalbo.

Attached is a map of the Old Bonalbo area. Shown on this map are the suggested test drilling locations in order of preference (1,2,3). The locations and order of preference have been based on; information provided in other bores, proximity to town, and road reserves.



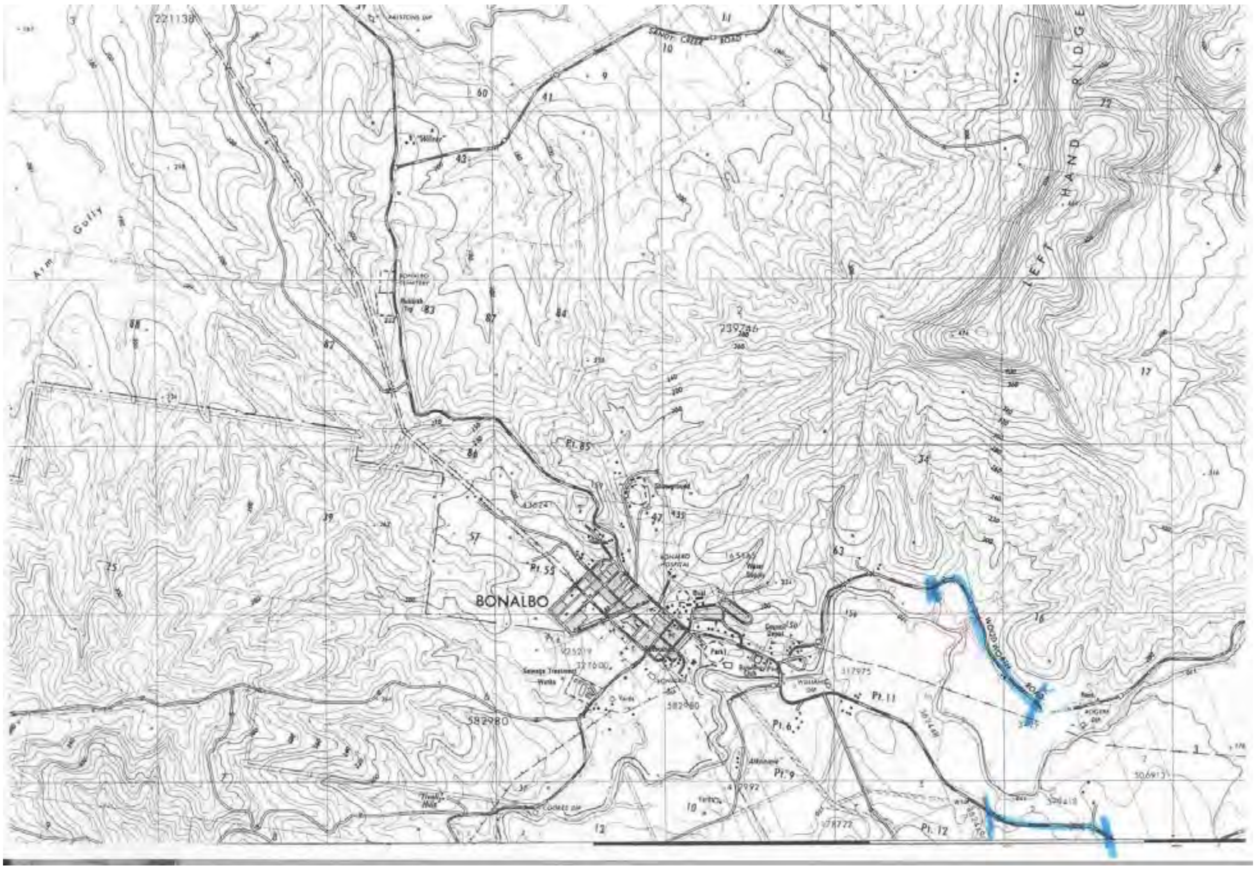
It must be noted that these recommendations should not be acted upon without first undertaking a field inspection of the prospective sites. Should you require an Hydrogeologist from this Department to undertake this, it is envisaged that a 1 day field trip would be needed for both Old Bonalbo and Bonalbo. If you would like to discuss this further, please call Jeremy Black on (02) 6640 2010.

Bonalbo

There are 4 bores located around the township of Bonalbo consisting of 2 bores and 2 excavations for which no information has been supplied to the Department.

Therefore based on the information of bores around Old Bonalbo within the same geology, it would be considered a greater risk to explore for water supplies from groundwater form both yield and water quality (salinity), however as above, there may be potential form bores drilled to a depth of greater than 40m.

Attached is a map of the Bonalbo area. Shown on this map are the suggested test drilling locations. The locations and order of preference have been based on; an extension of the north north west high yield trend extended from Old Bonalbo to the north and road reserves.



It must be noted that these recommendations should not be acted upon without first undertaking a field inspection of the prospective sites. Should you require an Hydrogeologist from this Department to undertake this, it is envisaged that a 1 day field trip would be needed for both Old Bonalbo and Bonalbo. If you would like to discuss this further, please call Jeremy Black on (02) 6640 2010.

Appendix P – Opportunity 7

Opportunity 7: Treated Bore water supply for potable use and rainwater tanks with untreated Peacock creek water mains top-up for non-potable use including Demand Management.

This opportunity again requires improved water treatment to meet ADWG but has the advantage that the water used for non-potable use does not require restriction or treatment and that the volume of water to be treated is reduced from Opportunity 1. The potable water supply would consist of treated bore water and the non-potable supply would be provided through the existing reticulation system and supplied from the dam and Peacock Creek.

This opportunity requires a dual reticulation. The new pipework will feed the potable reticulation and the existing pipework will feed the non-potable reticulation. Downsizing of the treatment plant would allow a decrease in capital and operating costs. These funds could be used to install a new reticulation system.

Similar operation of a rainwater tank as in Opportunity 3 will be employed to supply toilet and garden watering. Modelling has identified that for an average size tank, only 1/3 of this demand will be supplied from the rainwater tank. A shortfall of approximately 82kL in an average year and 175kL in a drought year will be supplied by a non-potable mains top-up from the existing reticulated supply. Essentially this means that garden watering is restricted by the dam storage levels and not as previously proposed in Opportunity 3, the supply available in the rainwater tank. It makes Council's provision of the non-potable water supply scheme less equitable between the residents of Bonalbo.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-10 that the annual average demand from toilet and garden watering for all user categories (including swimming pool filling) is 26ML/annum (including approximately 6ML/year UFW) as it will be supplied through the existing reticulation. The non-potable supply can rely solely on the lower limit secure yield of Peacock Creek at 25ML/annum.

It has been calculated from the demand modelling and it can be cross-checked with and approximated by using Table 2-8 that the average annual demand of all other indoor end-uses for all water user categories is 22.5ML/annum.

The peak day demand of the potable scheme would be approximately 0.10ML/day, requiring a bore capacity and WFP capacity of 1.3L/s or 0.1ML/day. A diagram of this opportunity is included in Figure 1.

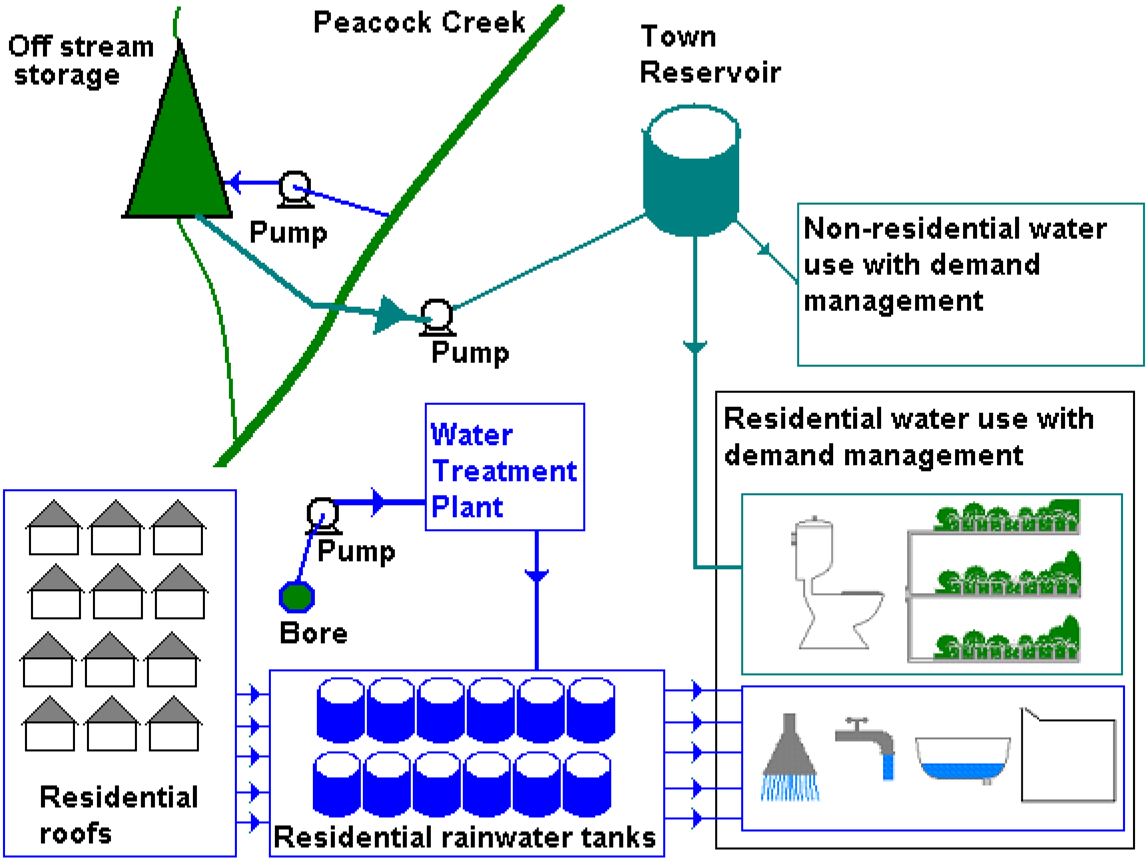
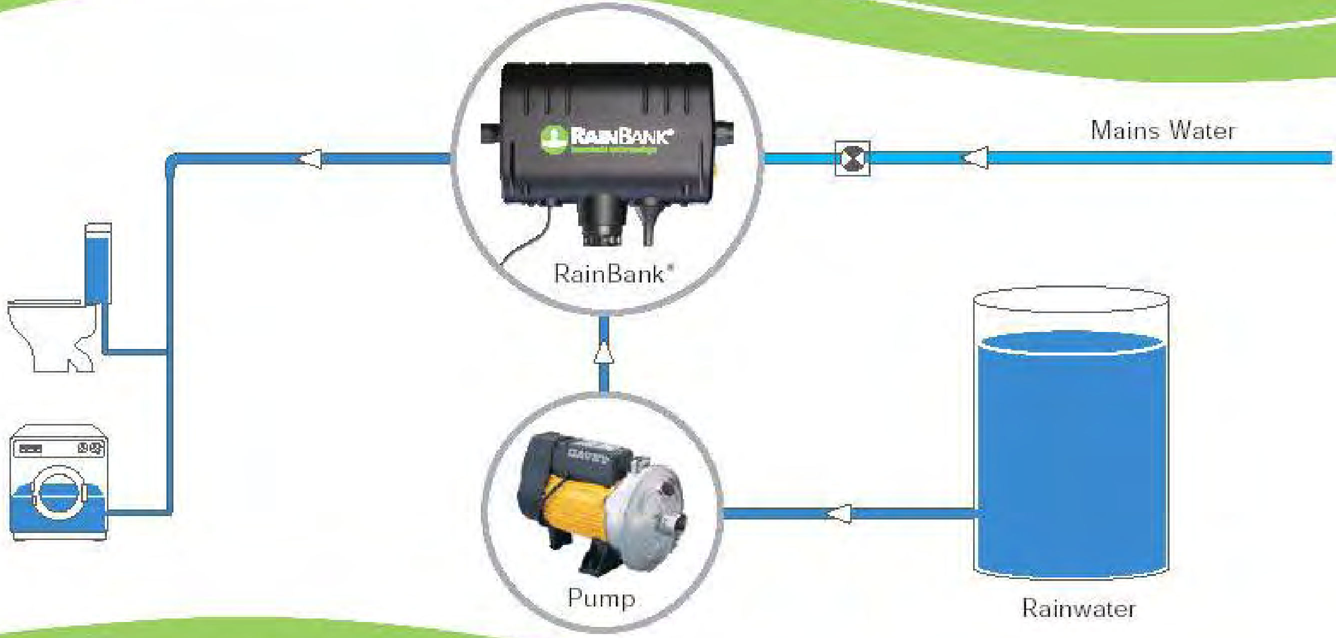


Figure 1 - Diagram of integrated water supply opportunity 7

Appendix Q – RainBank brochure



FEATURES AND BENEFITS

- Environmentally friendly.
- Automatically switches between rainwater and mains water supply.
- Provides water saving benefits of up to 40%.
- Incorporates easily with new and existing buildings.
- Unique technology with patent pending.
- Provides seamless mains back-up in the event of no rainwater or electrical interruptions.
- No double handling of mains water.
- Adaptable to existing pumps and rainwater tanks.
- Built-in backflow protection valve for added safety.
- Can be mounted on pump or on nearby wall.
- Watermark approval license IPC 20009
- No adjustment necessary.
- Simple to install.

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Produced by Davey Products; Australia's leading designer and manufacturer of water transfer pumps and pressure systems for the rural, domestic, industrial, pool and spa markets, RainBank® is an automatic controller for rainwater harvesting.
Incorporated into the design of new homes or retrofitted to existing properties, RainBank® controls the water supply for toilet and laundry applications by automatically switching the water source from the domestic mains to rainwater when a demand is sensed and rain water is available in the storage tank.
RainBank® is the first product to use rainwater as the water supply for toilet and laundry in metropolitan areas and control it automatically. It can save up to 40 per cent of a households drinking quality water which is normally used in these applications thereby helping conserve Australia's' precious water reserves.

Typical Domestic Water Usage

Water saving

RainBank® allows households in metropolitan and regional areas to replace up to 40 per cent of their drinking quality water usage in toilets and washing machines with rainwater. Actual savings will depend on local rainfall, roof area and size of tank.

Seamless and convenient

RainBank® does the thinking for you by automatically switching the water source from the domestic mains to the rainwater supply stored in the tank whenever a toilet is flushed or a washing machine used. If the rainwater supply is depleted at any time or in the case of a power failure, RainBank® automatically supplies mains water as the back up.

Environmentally friendly

RainBank® only operates the pump to pressurise the rainwater when required. Energy costs are minimised as there is no double handling or re-pressurising of the mains water. Daily power consumption figures for a pump and RainBank® system supplying toilet cisterns in a three person dwelling is the equivalent to the operation of a reverse cycle 2,400W air conditioner for 3 minutes a day.

Easy to install

RainBank® can be incorporated into the design of new homes or retrofitted to existing properties. It is easy to install as either a complete system of pump and controller, or as a controller added to an existing pressure pump and tank installation. It is normally mounted on top of the pump; however its design also allows remote mounting onto a wall or nearby location.

Safe

RainBank® has achieved the requirements of Standards Australia's draft Technical Specification ATS 5200.466—2004, for Rainwater tank connection devices.
RainBank® also complies with AS 3500, AS4020 and features Water Mark approval license number IPC20009, for connection to a drinking water supply.

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More information on RainBank® is available by visiting. www.davey.com.au/rainbank

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