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Avon Catchment Council

Report for IWM006 Surface Water Management and Self Sufficiency -

Analysis of the Regional Water Demand

May 2007

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Executive Summary

Presented is an assessment of regional water demand from the Water Corporation and Integrated Water Supply Scheme (IWSS), commonly know as the “Scheme”. The subsystem of the IWSS that services a large proportion of the Avon River Basin is known as the Goldfields and Agricultural Water Supply (G&AWS) Scheme. The following assessment includes an analysis of potential alternative water supplies in addition to the cost of water within the Avon Region. The objective of undertaking the assessment was to provide recommendations to the Avon Catchment Council for informing priorities for investment and in setting targets for reduced reliance on the Water Corporation Scheme.

Assessment of Regional Demand

The Water Corporation of Western Australia supplies drinking quality water to areas of rural Western Australia including parts of the Avon River Basin (ARB) through the Scheme.

The Water Corporation Scheme comprises 9,642 km of pipe network including 658 km of main trunk pipe extending between Mundaring and Kalgoorlie. The majority of reticulated pipe network use is located north of the Great Eastern Highway and west of Merredin. Mundaring Weir is the major source of supply to the Agricultural and Goldfields Regions. A number of other local water sources are used to supplement supply within the IWSS, at a local scale.

Of the estimated 27 GL/year delivered through the Mundaring to Kalgoorlie pipeline, approximately 11 GL/year is consumed within the Avon River Basin.

Approximately 61% of water delivered through the Water Corporation IWSS within the ARB is consumed within towns, and the remaining 38% is used on-farm. Stand pipes and community water supplies, transport infrastructure and the mining industry account for the remaining 1%.

Approximately 42% of the water delivered through the Water Corporation IWSS is used for residential purposes, with an additional 9% used primarily by Local Government Authorities (LGAs) in providing services, maintaining infrastructure and on parks and gardens. Water used for industry and commercial purposes accounts for a further 7% of water used within the region.

Approximately 10% of all water sourced from the Water Corporation IWSS within the Avon River Basin is used within the town of Northam, and 43% of water is used within seven shires including the town of Northam, and the shires of Northam, Merredin, York, Wongan – Ballidu, Mundaring, and Cunderdin.

Assessment of Alternative Water Supplies

Dams are commonplace throughout the ARB, primarily used for watering of livestock and domestic garden use. For the most part, correctly designed dams and their catchments can be used as a satisfactory direct replacement for the Water Corporation IWSS, if the intended use is agricultural or ex-house domestic.

In general, dams provide a comparatively inexpensive alternative to the reticulated supply network. However, capital costs associated with developing alternative water supplies are likely to be a significant barrier to adoption.

Previous surveys undertaken within the Avon River Basin have highlighted that a significant percentage of dams in the Avon River basin are likely to be substandard, and will be unable to cope with potential changes in rainfall patterns. This is exacerbated by the fact that relatively few professionals within the ARB are capable of effectively designing farm water storages at an enterprise scale.

Future water demands for agricultural enterprises may be influenced by climate change. Change in rainfall patterns may present significant challenges for self-sufficient water supplies on-farm, potentially resulting in a trend towards a smaller number of large, strategic, on-farm water supplies, with pipe networks, tanks and troughs providing a more flexible means of distributing water throughout the property.

Many landholders rely solely upon the Scheme for high quality requirements (domestic consumption and spray use).

Appropriately-sized and configured rainwater tanks appear to provide the best opportunity for replacing consumption of Water Corporation IWSS water for household use and crop spraying. However, there is a proportionally greater cost per kilolitre associated with the installation of rainwater tanks compared to dams.

There is potential for rainwater tanks to be used in towns to reduce scheme consumption. The main problem associated with rainwater tanks is the lack of coincidence between periods of high rainfall and periods of peak water demand, which necessitates the installation of relatively large storages. In addition, collection and distribution of rainwater within the household often requires additional guttering and plumbing, and a change in attitude toward water use. Predictions associated with climate change also potentially reduce the reliability of roof runoff and therefore rainwater supplies, thus increasing the required tank volume for a given reliability.

Stormwater is considered to represent a water resource that has potential for proliferation within the region. Some towns in the Avon Basin have previously implemented stormwater use systems that have proved to be both economic and effective.

Groundwater supplies may be more reliable than surface water supplies because they are often not impacted by short-term fluctuations in rainfall and generally, are not directly influenced by evaporation.

The zone of ancient drainage, located east of the Meckering line, has been a predominantly flat, internally drained landscape for more than 30 million years. Whilst it contains significant palaeochannels, (up to 70 m in thickness) these generally have very large salt stores, and therefore, fresh water is only associated with surficial sediments, granite rock fractures and hillside seeps. Significant low salinity groundwater resources within the region are considered to be restricted to remnant palaeochannels located within the narrow strip between the Meckering Line and the Darling Scarp.

Issues associated with supply quality, quantity, pricing policy and reliability may present potential barriers to adoption.

Relatively few groundwater resources are used to supplement town water supplies, as the proximity of reliable water supplies to towns within the Avon River Basin is limited by the underlying hydrogeology of the region. However, the towns of Quairading and Brookton both utilise groundwater resources to supplement town water supplies.

A number of potentially innovative developments have recently been trialled as alternative water supplies, including portable desalination plants. Technically, these options have some way to progress and as such are not yet economically viable. Consequently, they have not been considered in detail in this report.

Cost of Water

Water delivered to the Avon River Basin through the Water Corporation IWSS is charged to the consumer at a price, which is less than the cost of delivery. The State Government of Western Australia pays the Water Corporation a Community Service Obligation (CSO) payment, which forms a subsidy for delivering water to country areas.

For the purposes of this assessment, it has been assumed that the recurrent costs of delivering water within the ARB via the Water Corporation IWSS are $5.00/kL.

For residential water users, the first 350 kL sourced from the Scheme is the same for all households within Western Australia, charged at approximately 58c/kL. As household consumption increases above 350 kL, then remote areas are charged a premium over the price charged to city customers.

The installation of rainwater tanks, and re-use of grey water represents the primary opportunity for reducing residential water use. Costs associated with the installation of a rainwater tank, guttering, pressure pump and plumbing would likely outweigh savings through reduced Water Corporation charges.

The cost of developing alternative water supplies for commercial enterprises in the ARB is generally too high to produce a positive NPV for the investment when current IWSS pricing arrangements are considered. This is likely to present a significant barrier to reform in many cases.

Local Government Authorities are significant "commercial" users within the ARB, accounting for approximately 8.8% of the water accessed from the Water Corporation Scheme. Approximately half of the water used by Local Government Authorities is used for irrigation of parks, gardens and ovals. There is potential for reduced reliance on the Water Corporation IWSS through the collection and utilisation of storm water. The infrastructure required is much less per volume of water saved when compared to residential or agricultural water users within the region.

Economies of scale associated with Local Government Projects result in a greater financial incentive for them to proceed with investment in alternative water supplies when compared to private or other commercial consumers. The Water Corporation charges a farmland connection fee of $152.30 per service and a flat consumption rate of 95.1 c/kL.

Analysis indicates that at both a paddock and property scale, the cost of accessing water from the Water Corporation IWSS is significantly less than developing alternative on-farm water supplies. The real cost of delivery of water incurred by the Water Corporation is similar to the cost of establishing alternative on-farm water supplies. The economic implications of current IWSS pricing policy need to be reviewed if a significant state-wide reduction in the reliance on Water Corporation supplies is to be achieved.

Potential increases in investment for development of alternative supplies may result from the requirement to upgrade a specific section of the pipe network, particularly where the integrity of the pipe network is threatened by an external factor, such as salinity.

Capital investment in developing alternative water supplies to the Water Corporation IWSS, does not guarantee self-sufficiency. In periods of extreme drought, on-farm water supplies may fail, requiring the presence of alternative emergency water supplies.

Analysis of costs supports a cost share arrangement of 50% as an incentive payment to encourage the development of alternative water supplies to the Water Corporation IWSS. Whilst this does not represent a break-even for most projects, a 50% subsidy is likely to provide a significant incentive for landholders to develop alternative water supplies.

Targets

The ACC Investment Plan requires the setting of targets for reduced water consumption from the Water Corporation IWSS within the region by 2007 (**W3 MAT 4.1**).

The targets for reduced consumption presented below are considered those likely to result directly from investment by the Avon Catchment Council. Underlying trends in water use within the Avon River Basin, or water savings resulting from other investment programs have not been considered in the setting of these targets.

It is recommended that residential and commercial water users within the Avon River Basin should not be targeted for ACC investment. This recommendation is primarily based on the poor economics and technical complexities associated with the development of alternative water supplies for these users.

Based on the assumption that all resources for the project are directed towards reducing on-farm reliance on the Water Corporation IWSS, and that only landholders with access to the Water Corporation IWSS are engaged within the project, then a preliminary target for reduced Scheme usage of 30,000 kL in three years is recommended.

The specific advantage of working with Local Government Authorities within the Avon River Basin is that they represent much larger individual water users, than do other potential target users within the region. Assuming that resources from within this project are directed towards engaging Local Government Authorities in developing stormwater re-use systems, then a preliminary target of 60,000 kL in three years is recommended.

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1. Introduction

1.1 Background

GHD were contracted by the Avon Catchment Council to deliver the 2005 - 2008 Investment Project: Surface Water Management and Self-Sufficiency IWM006.

This project includes elements associated with improving self-sufficiency for water use within the Avon River Basin, and reducing reliance on the Water Corporation Water Supply Scheme (IWSS) or “Scheme”.

Presented is an analysis of the regional water demand within the Avon River Basin, with particular emphasis on water delivered through the Water Corporation Scheme. The analysis is presented in four sections including:

1. Analysis of Regional Water Demand
2. Assessment of Alternative Supplies
3. Cost of Water
4. Benchmarks and Targets

1.2 Relevant Management Action Target

The Management Action Target relevant to this project component is:

> ***W3 MAT 4.1*** *The volume of water used annually for farm and town supply from reticulated schemes is identified within 30 Local Area Plans and targets for reduced use are set by 2007.*

1.3 Analysis of Demand

The aim of this component is to assess the extent of reticulated water used within the Avon River Basin (ARB) at a region wide scale.

The analysis included collation of existing Water Corporation data, for the region within an historic, current and predicted use framework.

A relatively high level assessment of demand was undertaken, focusing on the geographical distribution of water within the catchment. In addition, an analysis of the activities influencing water use within the ARB was also conducted. An additional level of assessment may be required to develop detailed targets at a sub catchment or local area planning scale.

More detailed analysis of water use has been undertaken at a subcatchment scale, through planning activities associated with this project, in addition to strategic assessment undertaken by the Farm Water Planning Scheme (Department of Environment, 2005). These assessments provide an important insight into the potential opportunities and constraints associated with achieving targets for increased self-sufficiency and reduced reliance on the reticulated supply network.

1.4 Assessment of potential alternative water supply sources for the ARB

Identification of potential water sources as an alternative to reliance on Water Corporation reticulated supplies is essential to achieving the outcomes of **W3 MAT 4.1**.

The assessment of alternative water supply options was undertaken based on water use trends within the ARB, and outcomes associated with planning activities undertaken within other components of the ACC Surface Water Management and Self-Sufficiency Project.

A methodology for assessing the extent of self-sufficiency at an enterprise level was developed using guidelines published by the Department of Water (Farm Water Advisory Committee).

1.5 Benchmarks and Targets

This report focuses on presenting the information and the outcome of investigations, necessary to develop targets for reduced reliance on the Water Corporation scheme, as described within the Avon Catchment Council Management Action Target ***W3 MAT 4.1****.*

Setting targets for reduced reliance on the Water Corporation Scheme requires a detailed understanding of potential drivers and barriers to change. Development and execution of strategies to achieve these targets requires reflection upon these drivers and barriers to adoption of alternative water sources.

Information presented in this report forms a platform to enable the development of a strategy for reducing reliance on the Water Corporation Scheme. The report may influence subsequent investment through the ACC Surface Water Management and Self-Sufficiency Project - IWM006.

2. Analysis of Regional Water Demand

2.1 Water Corporation Supply Regions

GHD undertook an analysis of water use from the Water Corporation Integrated Water Supply Scheme (IWSS) within the Avon River Basin. The analysis included:

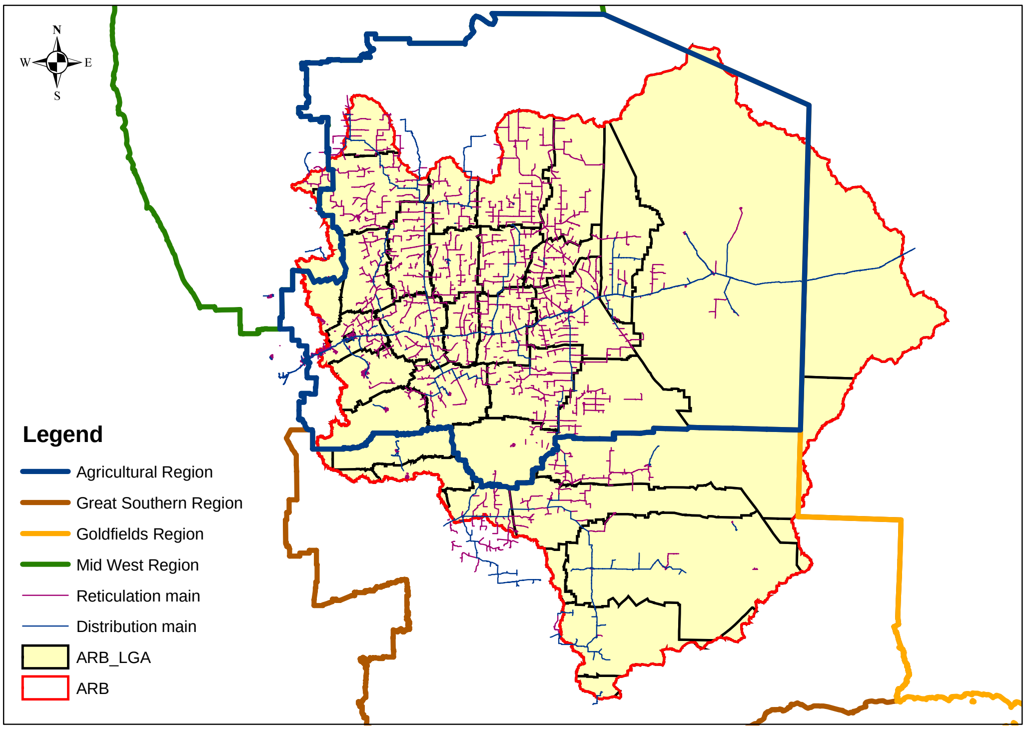
- Assessment of volumes of usage at a Local Government Area (LGA) scale.
- Determination of the distribution of the supply network.
- Assessment of strategic reticulated supplies.

The Water Corporation of Western Australia supplies drinking quality water to areas of rural Western Australia including parts of the Avon River Basin (ARB) through its IWSS. For a large proportion of the ARB the IWSS is known as the Goldfields and Agricultural Water Supply Scheme (G&AWS). The overall IWSS supplies water to 1.5 million of the 1.9 million people living in Western Australia. Water is sourced from multiple groundwater and surface water catchments.

The IWSS service area encompasses towns in the South West, metropolitan Perth and, through the Goldfields Pipeline from Mundaring Weir to towns and farmlands in the Central Wheatbelt out to Kalgoorlie/Boulder. The IWSS rural service area is divided into regions based upon geographic location. Parts of the following IWSS regions fall within, and service the ARB:

- Agricultural
- Great Southern
- Midwest
- Goldfields.

Figure 2-1 Map showing ARB and IWSS geographic supply regions



2.2 Water Corporation "Mains"

Water is transported to regional areas via an extensive pipeline network known as the "Mains" supply. There are two categories of Mains:

- *Distribution Mains:* Major pipelines that form the backbone of the Scheme network that distribute water throughout the ARB. They consist of trunk, distribution and bore mains of varying diameters, which are the primary arterial skeleton of the network.
- *Reticulation Mains:* Minor pipelines that supply water to individual connections throughout the ARB. They generally branch off from the Distribution Mains, and create an extended secondary and tertiary delivery network hierarchy to a range of individual properties.

A summary of the length of the pipe network and a map highlighting the area of distribution of Scheme water is presented below.

Figure 2-2 Map showing location of Distribution and Reticulation Mains throughout the ARB

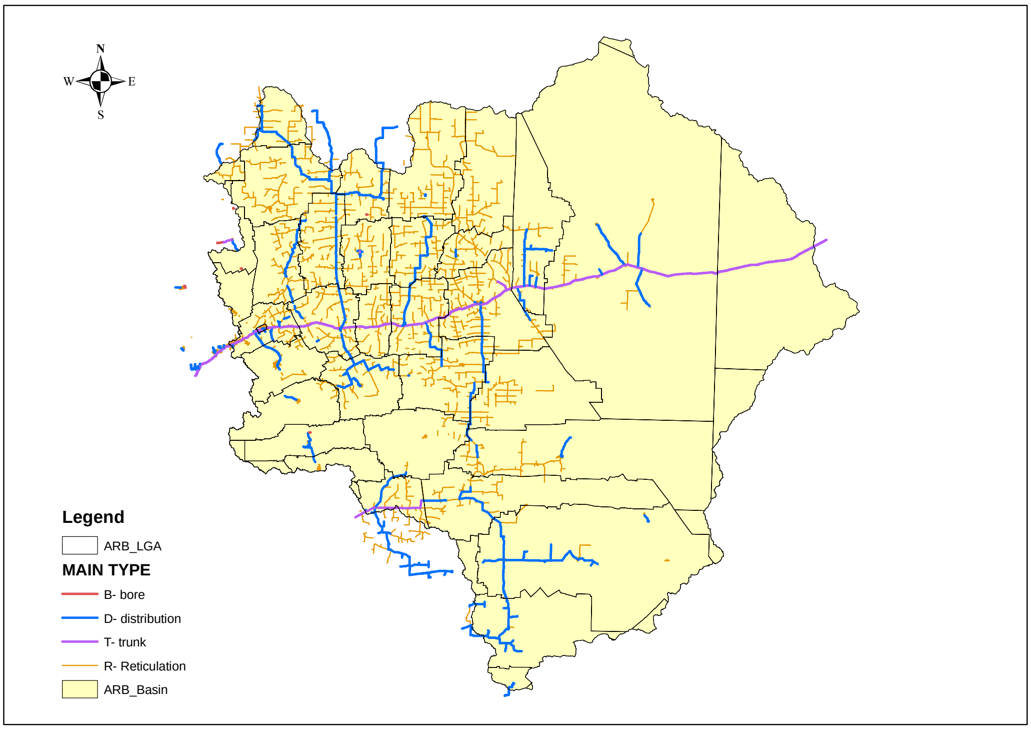


Table 2-1 Summary Water Corporation "Mains" Pipe Network throughout ARB

Main Type	Main Class	Length (km)
Distribution	B- bore	11.4
	D- distribution	1,821
	T- trunk	638
Reticulation	R- reticulation	7,172
Total Water Corporation Mains		**9,642**

2.3 Water Corporation Supply Sources

Water distributed to the ARB via the IWSS comes from a variety of sources, however Mundaring Weir is the major source of supply to the Agricultural and Goldfields Regions. Wellington Dam is the major source of supply to the Great Southern Region.

The Perth to Kalgoorlie (Goldfields) pipeline forms the primary arterial stem from which other mains branch off, to distribute water throughout the region.

A range of other local sources is used to supply the IWSS. They are generally opportunistic supplies used to supplement the local area supply to reduce the reliance on the major sources. Local supplies are not necessarily connected to the "Mains" network, but are still operated by the Water Corporation. In some cases isolated communities, such as Lake King, are completely reliant on local water resources, as they are not serviced by the IWSS.

Local supply sources include:

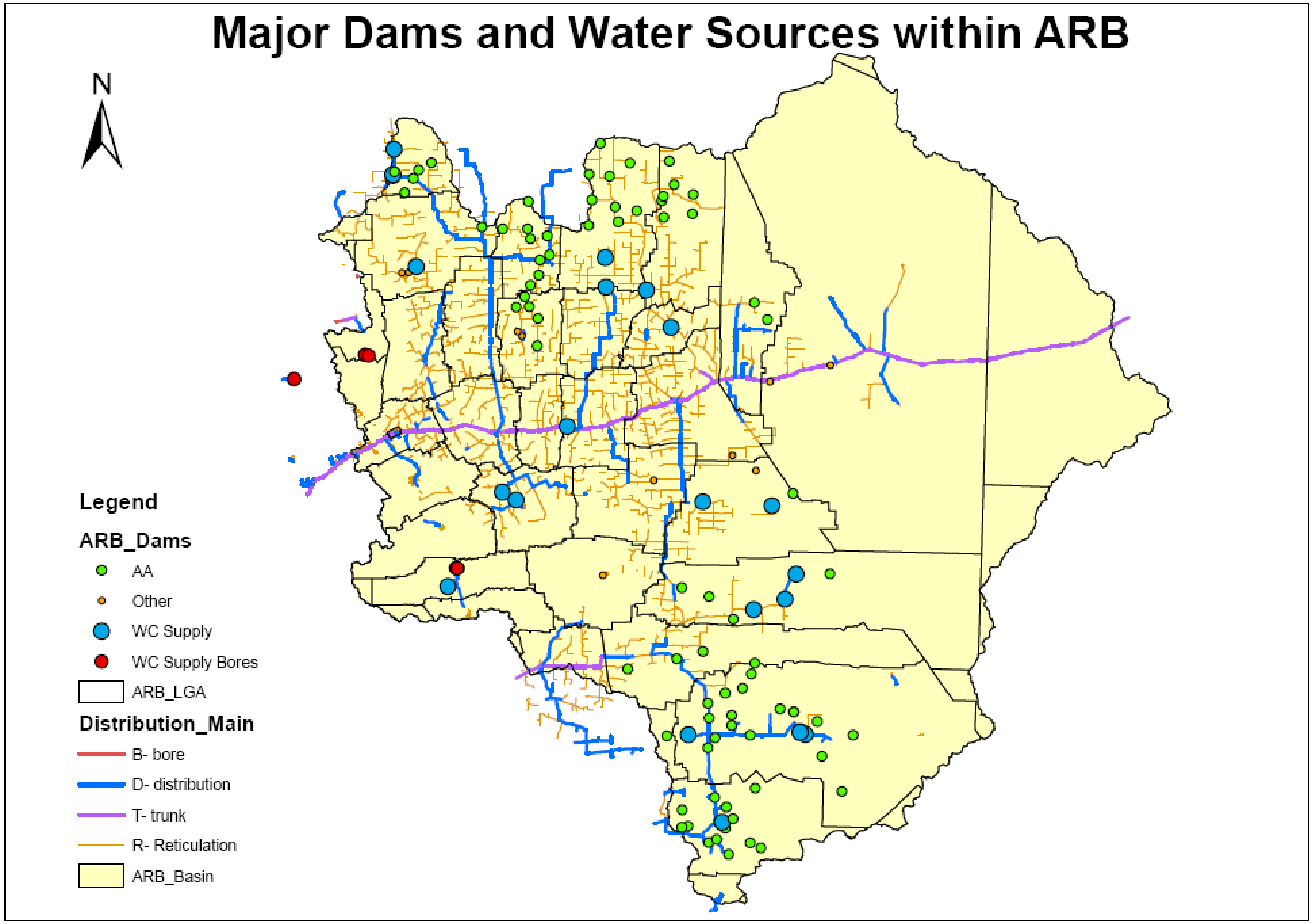
- Dams with granite outcrop catchments;
- Dams with artificially constructed catchments;
- Dams collecting overland flow from natural catchments and waterways; or
- Production bores accessing groundwater of adequate quality.

In addition to the Mains distribution network, strategic community water supply facilities exist throughout most of the dryland agricultural area. They include stand-alone strategic supplies that provide sources of emergency water to "water deficient" areas, as well as non-strategic Agricultural Area (AA) Dams within the catchment. These community water supplies cater for a broad spectrum of community water uses, from emergency drinking water for livestock to supplementary water supplies for rural towns.

The function of these community assets includes:

- The improvement of town water supplies;
- The watering of playing fields and town gardens;
- The provision of water for emergency use by farm livestock when on-farm supplies fail; and
- Provision of emergency public water supply capacity at public standpipes.

Figure 2-3 Map showing location of water supply sources throughout ARB



Revenue earning water sources, including the IWSS, are operated and managed by the Water Corporation. Stand-alone community water supplies, including strategic supplies used by landholders during extreme drought conditions, are generally not revenue earning and are funded by Local Government or the Department of Water through the Rural Water Plan.

An objective of the Rural Water Plan (RWP) is to develop a more adequate and reliable network of off-farm strategic community water supplies. According to the objectives of the RWP, community water supplies should have the following attributes:

- Be managed and maintained by the community;
- Be available to the community as an emergency water supply when the surrounding area is declared “water deficient”;
- Be able to supply at least 20 adjacent farms.

(Department of Environment, 2005)

2.4 Patterns of Usage

An assessment of the pattern of usage within the ARB was undertaken to ascertain the distribution of water use across a range of categories. These categories were developed to reflect the socio-economic framework of the region.

Water Corporation use over 190 categories for describing connections within the Avon River Basin.   In undertaking the analysis, the 190 categories were amalgamated into 10 broad categories, considered to provide a more meaningful analysis of water use patterns within the region for this level of assessment.

The analysis included the total number of connections and consumption volume in kilolitres for each of the adopted categories. The results of this analysis are presented in Table 2-2 and Table 2-3.

Table 2-2 Trend of Water Corporation consumption via Category - ARB

Category Description	Annual Consumption (kL)											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Accommodation Services	347,240	276,428	297,450	323,926	277,717	313,726	418,697	309,803	352,998	368,503	383,191	399,645
Commercial	289,653	283,160	294,859	313,359	284,604	288,051	312,840	270,212	272,913	294,897	300,610	288,762
Farms	4,784,642	4,519,428	4,496,191	4,959,893	4,426,396	3,811,619	4,511,995	3,992,017	4,073,124	4,238,755	4,481,155	4,098,576
Industrial	609,286	605,264	548,815	523,846	503,252	484,831	428,242	291,402	313,480	377,055	438,635	429,283
Mining	29,348	40,746	67,284	26,517	16,502	17,282	15,532	3,794	4,374	7,486	1,371	310
Parks, Gardens, Reserves & Recreation	592,923	582,678	542,354	638,972	536,235	449,331	541,271	492,685	509,073	504,004	501,284	429,435
Residential	4,677,199	4,701,889	4,890,523	5,541,999	4,888,308	4,666,199	5,600,266	4,498,020	4,604,622	4,897,153	4,865,273	4,616,157
Services, Infrastructure & Amenities	535,002	516,414	516,539	600,377	512,585	515,973	623,844	434,728	445,707	469,912	460,987	470,362
Stand Pipes, Community Water Supplies	64,679	51,594	53,125	87,870	67,148	42,724	65,714	59,194	78,151	53,227	80,304	55,596
Transport Infrastructure	3,319	4,063	5,812	6,206	5,778	5,263	7,426	6,605	6,380	7,284	7,668	7,488
Grand Total	**11,933,291**	**11,581,664**	**11,712,952**	**13,022,965**	**11,518,525**	**10,594,999**	**12,525,827**	**10,358,460**	**10,660,822**	**11,218,276**	**11,520,478**	**10,795,614**

Source: Water Corporation sales data

Table 2-3 Summary of Water Corporation consumption via Category - ARB

Category	Average Annual Consumption (kL)	%
Residential	4,870,634	42.5
Farms	4,366,149	38.1
Parks, Gardens, Reserves & Recreation	526,687	4.6
Services, Infrastructure & Amenities	508,536	4.4
Industrial	462,783	4.0
Accommodation Services	339,110	3.0
Commercial	291,160	2.5
Stand Pipes, Community Water Supplies	63,277	0.6
Mining	19,212	0.2
Transport Infrastructure	6,108	0.1
Total	**11,453,656**	**100**

Source: Water Corporation sales data

The total water use within the Avon River Basin sourced from the Water Corporation IWSS is approximately 12 GL/year, almost one half of the estimated 27 GL delivered through the Perth to Kalgoorlie pipeline each year.

Approximately 43% of the water delivered through the Water Corporation IWSS is used for residential purposes, with an additional 9% used primarily by LGAs in providing services, maintaining infrastructure, and parks and gardens. Water used for industry and commercial purposes accounts for a further 7% of water used within the region.

Thus, approximately 61% of water used within the ARB occurs within town settlements. The remaining 38% of water delivered through the Water Corporation IWSS is used on-farm. Standpipes and community water supplies, transport infrastructure and the mining industry account for approximately 1% of the total water used from the Water Corporation Scheme.

The breakdown of water used on farm between domestic, crop spraying and/or reticulated. Stock consumption is not reported by the Water Corporation. A better understanding of the volume of water used annually for stock supply, and the distribution of this water throughout the region is important in developing strategies for reduced reliance on the Water Corporation IWSS.

An important outcome of the analysis is that approximately 9% of water use from the Water Corporation Scheme is used by LGAs in managing and maintaining infrastructure, parks and gardens etc. The towns of Northam, Merredin and Quairading have implemented storm water collection and re-use predominantly on parks and gardens.

There is an opportunity to reduce the volume of water sourced from the Water Corporation IWSS, by working with other LGAs to develop integrated storm water harvesting and re-use systems within towns.

2.4.1 Local Government Area (LGA) summary

Further analysis was undertaken to determine consumption trends at an LGA scale in order to provide input into local area plans developed by ACC within the ARB.

The analysis provides an overview of usage patterns within the Region. This information is important in identifying geographical priorities for within the region, and also for setting meaningful targets for reduced supply to local government.

Table 2-4 Summary of Water Consumption (IWSS) - LGA within ARB

Local Government Authority	Connections	Annual Consumption (kL)											
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
SHIRE OF BEVERLEY	641	200,520	203,146	193,922	226,431	189,625	180,740	228,756	175,840	194,636	211,782	204,947	196,793
SHIRE OF BROOKTON	382	174,498	162,156	154,408	172,022	154,389	149,399	193,626	157,534	157,877	160,695	164,855	162,293
SHIRE OF BRUCE ROCK	839	429,677	383,410	385,781	447,291	375,880	322,286	392,138	327,816	332,913	351,635	362,440	313,063
SHIRE OF CHITTERING	360	106,467	101,171	106,289	124,810	109,514	109,574	126,282	114,822	124,489	132,060	127,568	122,031
SHIRE OF CORRIGIN	601	220,983	221,309	221,450	242,739	223,570	204,883	235,151	190,551	177,185	209,106	207,509	182,609
SHIRE OF CUNDERDIN	914	444,739	451,346	420,929	496,257	427,545	393,160	472,144	382,748	403,755	449,308	441,076	400,773
SHIRE OF DALWALLINU	567	327,886	310,507	303,572	332,130	297,753	258,994	322,050	292,592	294,447	281,595	300,722	299,174
SHIRE OF DOWERIN	724	379,891	369,897	394,985	418,485	384,340	344,734	410,787	349,510	343,428	374,391	373,506	355,025
SHIRE OF DUMBLEYUNG	12	2,879	4,340	3,013	3,289	3,650	4,017	5,140	4,315	6,315	4,408	4,044	3,674
SHIRE OF GOOMALLING	591	279,544	294,840	298,080	309,723	280,472	237,010	272,859	225,363	242,014	269,836	258,365	247,598
SHIRE OF KELLERBERRIN	1,017	562,502	448,917	481,236	509,740	430,756	376,140	433,310	348,168	354,668	375,308	382,251	357,864

Local Government Authority	Connections	Annual Consumption (kL)											
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
SHIRE OF KENT	111	22,947	33,713	31,031	34,639	35,503	35,260	57,253	41,939	58,082	50,312	60,189	50,841
SHIRE OF KONDININ	553	179,107	175,859	201,251	209,870	189,444	178,088	221,743	185,331	199,469	211,690	224,312	198,279
SHIRE OF KOORDA	480	260,153	255,890	277,060	286,094	262,629	210,829	252,406	231,281	194,568	211,405	229,769	216,644
SHIRE OF KULIN	542	204,158	193,561	199,532	226,128	202,386	184,101	219,527	196,043	222,689	212,269	252,934	199,736
SHIRE OF LAKE GRACE	675	191,509	190,971	197,058	215,573	221,639	221,873	286,276	233,046	258,517	251,256	286,265	252,886
SHIRE OF MERREDIN	2,236	874,147	853,037	909,411	988,321	895,561	811,154	908,978	787,276	755,387	803,516	834,454	739,880
SHIRE OF MOORA	35	2,059	1,575	1,807	2,548	8,927	10,364	13,318	15,397	17,207	15,267	17,448	15,477
SHIRE OF MOUNT MARSHALL	590	246,626	228,656	223,304	251,728	241,667	195,074	208,106	208,987	209,990	206,854	227,380	217,792
SHIRE OF MUKINBUDIN	515	243,366	236,436	236,436	262,012	218,132	201,382	254,291	212,686	225,453	220,354	231,119	217,234
SHIRE OF MUNDARING	738	311,909	301,688	330,047	373,411	323,268	352,123	510,054	362,366	419,494	448,128	460,103	454,530
SHIRE OF NAREMBEEN	509	222,988	207,284	222,149	262,723	226,474	182,939	207,118	173,695	201,193	202,577	227,700	204,664
SHIRE OF NARROGIN	48	29,916	33,998	25,721	34,162	32,253	27,543	34,413	24,644	30,938	34,727	31,041	28,372
SHIRE OF NORTHAM	1,771	1,088,219	1,092,816	1,025,833	1,100,511	1,008,884	939,680	1,011,140	722,738	778,387	864,566	931,898	918,954

Local Government Authority	Connections	Annual Consumption (kL)											
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
SHIRE OF NUNGARIN	328	161,103	141,401	143,086	178,013	139,069	119,405	128,105	122,806	109,173	119,295	124,399	103,678
SHIRE OF PINGELLY	528	193,097	185,518	168,633	197,751	181,054	163,384	208,046	173,799	171,585	188,080	178,615	178,223
SHIRE OF QUAIRADING	716	302,928	291,394	281,575	332,524	277,076	254,263	292,456	231,301	256,799	260,286	264,375	248,872
SHIRE OF SWAN	270	107,886	113,449	111,499	117,500	120,137	136,870	135,831	124,852	116,070	105,794	135,084	125,118
SHIRE OF TAMMIN	387	237,655	239,531	232,993	248,654	208,645	194,699	211,174	183,490	182,060	211,921	228,414	219,965
SHIRE OF TOODYAY	615	179,663	179,283	168,066	206,871	176,843	179,786	222,749	173,504	192,399	218,086	206,521	201,598
SHIRE OF TRAYNING	594	280,239	258,568	271,666	289,502	260,535	228,875	249,880	216,769	198,249	213,344	225,423	215,775
SHIRE OF VICTORIA PLAINS	57	23,222	21,996	23,125	22,714	20,317	19,008	21,066	18,394	19,631	18,644	20,041	21,312
SHIRE OF WAGIN	11	8,205	7,178	6,543	9,582	8,369	10,601	11,188	9,095	9,520	8,827	10,073	9,233
SHIRE OF WESTONIA	262	110,935	111,173	114,705	118,703	104,788	78,786	109,956	92,932	93,822	95,601	105,662	98,014
SHIRE OF WICKEPIN	637	323,916	344,054	299,327	353,232	327,380	303,287	380,951	330,746	330,726	356,984	341,253	310,723
SHIRE OF WONGAN-BALLIDU	1,030	568,268	543,966	605,171	629,379	555,356	508,647	563,357	489,910	467,747	525,674	506,194	518,849
SHIRE OF	641	284,160	271,936	290,494	309,179	275,636	244,949	279,990	242,131	242,361	243,387	258,200	240,477

Local Government Authority	Connections	Annual Consumption (kL)											
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
WYALKATCHEM													
SHIRE OF YILGARN	871	492,031	504,234	531,610	544,742	454,818	389,584	447,147	375,774	383,243	356,017	378,545	345,819
SHIRE OF YORK	1,619	512,791	484,347	494,177	604,892	513,180	505,694	645,889	544,520	590,316	614,753	594,676	549,815
TOWN OF NORTHAM	3,153	1,113,511	1,103,405	1,105,053	1,302,895	1,130,836	1,105,296	1,318,159	1,042,584	1,071,347	1,103,539	1,078,456	1,028,571
TOTAL ARB	**27,170**	**11,906,300**	**11,557,956**	**11,692,028**	**12,996,770**	**11,498,300**	**10,574,481**	**12,502,810**	**10,337,295**	**10,638,149**	**11,193,277**	**11,497,826**	**10,772,228**

Source: Water Corporation sales data

There are a total of 27,000 connections to the Water Corporation IWSS, within the ARB. Approximately 5,000 of those are located within the Town and Shire of Northam, and a further 3,000 connections within the shires of York and Merredin. It is estimated that these four LGAs account for approximately 30% of total water use within the ARB.

The water used per connection ranges between 380 and 478 kL/year, with an average of 420 kL/year, analysed on a per shire basis within the ARB. Where shires include substantial towns, including York, Toodyay, Merredin, Pingelly, Corrigin and Beverley, water use per meter was generally below 370 kL/year. This tends to reflect the fact that a significant proportion of water (approximately 60 to 70%), sourced from the Water Corporation IWSS in the region, is used within towns. Standard household water consumption used by Water Corporation in price setting is 350 kL/year.

Water use per connection within shires dominated by farm use, was generally between 400 and 600 kL/year. Assuming that there are between three and six connections per farm, agricultural enterprises potentially use between 5 and 10 times the volume of water compared to non-farming residences.

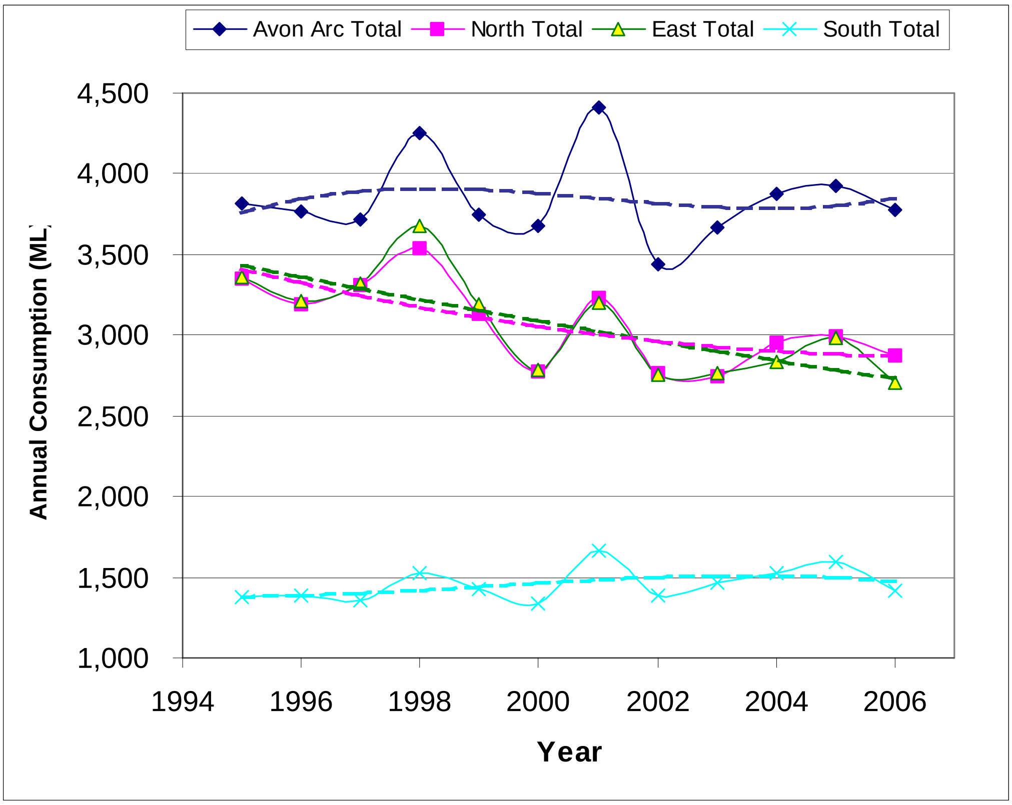
In terms of volumetric savings, the greatest potential benefit may be achieved by engaging LGAs in developing strategies for reduced water use within towns. In particular, integrated town water re-use systems present a significant opportunity to reduce the volume of water sourced from the Water Corporation Scheme.

2.4.2 Water use trends 1994 – 2006

Water demand from the Water Corporation IWSS for the ARB was analysed for the period 1994 – 2006.Figure 2-4 shows trends for this period across various parts of the ARB.

Water demand from the Water Corporation IWSS within the ARB, appears to fluctuate, apparently responding to annual rainfall. Overall there appears to be a downward trend in water demand from the Water Corporation IWSS.

Figure 2-4 Trend of annual water consumption within ARB as a comparison by spatial area



Source: Water Corporation sales data

The analysis indicates an increase in residential demand for water within the Avon Arc, and in particular within the towns of Toodyay, York, Chittering, and Mundaring. There also appears to be a declining trend in water demand within small wheatbelt towns including: Goomalling, Mukinbudin, Pingrup (Kent), Quairading, Trayning and Southern Cross (Yilgarn).

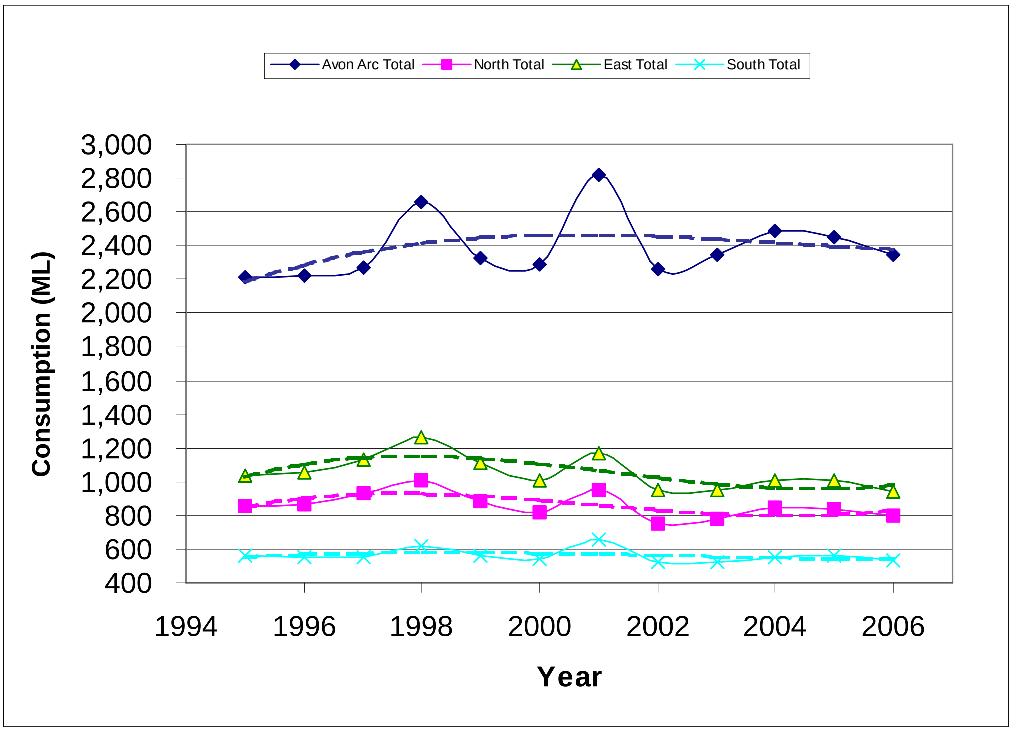
Approximately 50% of residential water demand occurs within the towns of Northam, Merredin, Mundaring, York and Toodyay, of which Merredin is the only one with a declining demand for water. Although residential demand appears to vary according to annual rainfall, there appears to be no significant trend in the volume of residential water demand, however important spatial trends in water demand are emerging within the region.

Figure 2-5 illustrates that there has been a declining trend in residential water use within towns in the southern, eastern and northern areas of the ARB. This is likely to be indicative of the population decline in the areas. However the substantial increase, approximately 10%, in residential water use in the western Avon Arc area of the basin is likely to be indicative of the shift in population, as people move to towns like Northam, York and Toodyay.

Similarly, Figure 2-6 gives a comparison of residential water use in ARB towns between the periods 1995 - 1997 and 2004 – 2006. Out of the 35 towns only 12 showed an increase in residential Scheme water consumption.

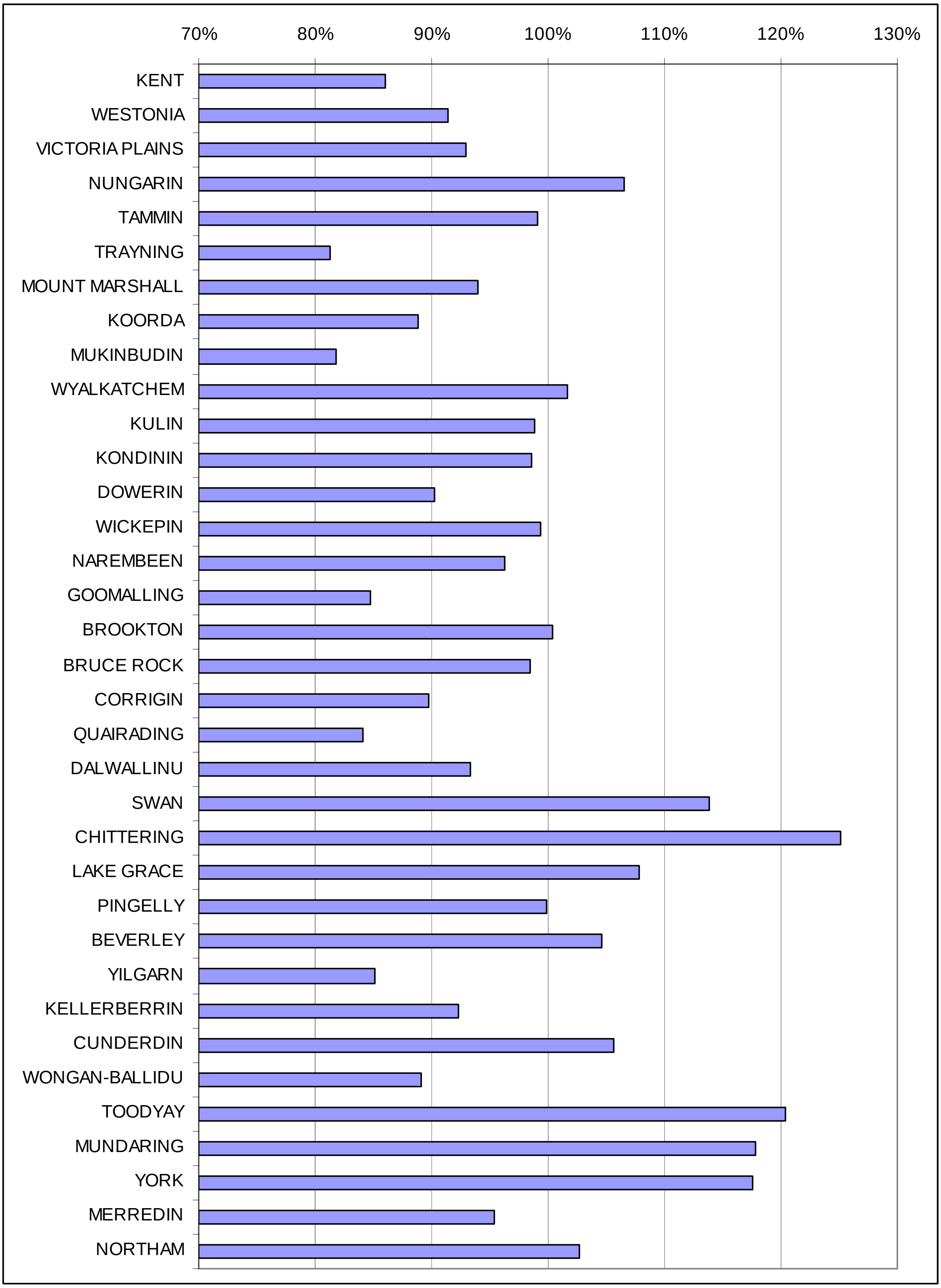
Perhaps this could be recast: There has been a general demographic shift with people leaving rural areas for employment in Perth and major regional centres. The current mining boom has also been a significant driver of mobility for certain groups. With increased land prices in the major centres there is now a prospect of a reverse trend within the Avon Arc: many of its towns offer an alternative, convenient lifestyle within an hour of metropolitan Perth, and with significantly more affordable real estate.

Figure 2-5 Residential Water use within the ARB 1994 - 2006



Source: Water Corporation sales data

Figure 2-6 Residential Water Demand with Avon Shires for the period 2004 – 2006 expressed as a percentage of water demand for the period 1995 – 1997 usage.

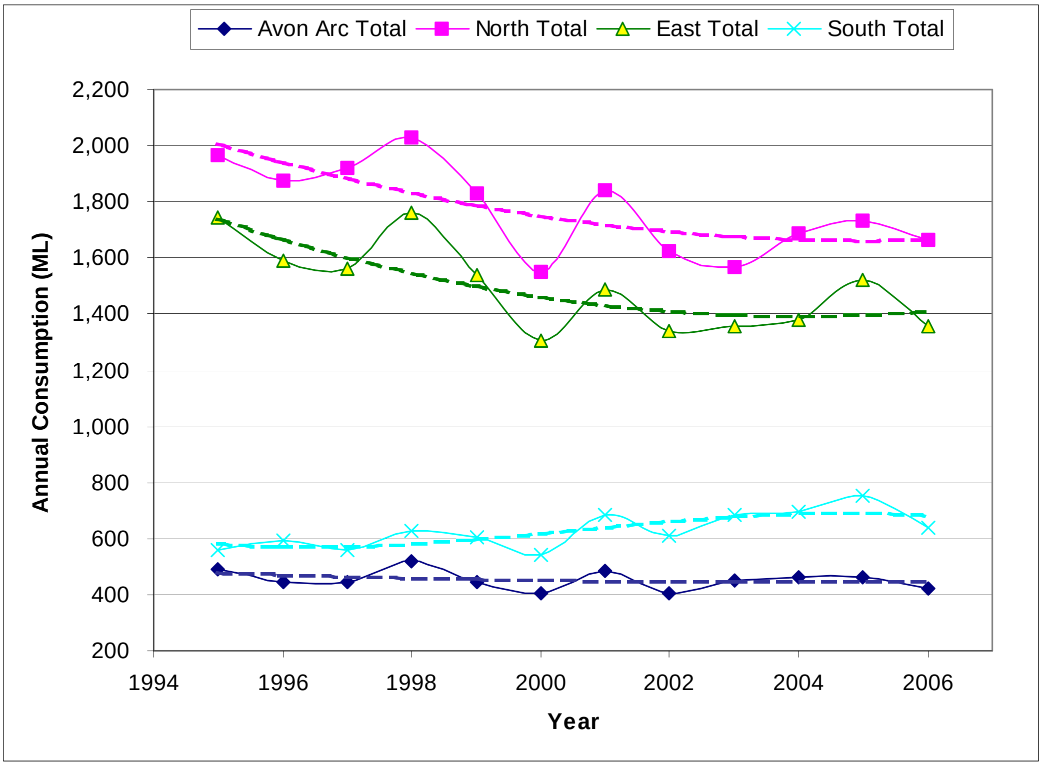


Source: Water Corporation sales data .

The analysis of trends in agricultural water demand is presented in Figure 2-7. The analysis indicates a reduction in agricultural demand for water within the ARB for the period 1994 - 2006. This reduction in demand is most significant in the north and eastern areas of the ARB, experiencing approximately 22% reduction in demand for the period of analysis. A reduction in demand (12%) in western areas of the ARB occurred for the period 1995 - 2002.

The southern areas of the ARB experienced a slight reduction in agricultural water demand for the period 1995 - 1998, followed by a gradual increase in demand for water, appearing to level off in 2005. The slight increase in water demand within the southern part of the region after 2000 reflects extensions to the pipeline in the Lake Grace Shire. When Lake Grace is removed from the analysis, agricultural water demand within the south area of the ARB stabilizes after 2000.

Figure 2-7 Agricultural Water Use trends with the ARB 1994 – 2006



Source: Water Corporation sales data

It is considered that a reduction in sheep numbers within the region is the most likely reason for the reduced agricultural water demand.

Since the early 1990s the Australian sheep flock size has experienced a reduction of approximately 40% (ABARE, 2007). This has coincided with a 60% reduction in the value of wool production from the wheatbelt region of Western Australia (WDC 2003). Whilst no specific figures associated with sheep numbers within the region are available, the very significant reduction in the wool production within the region indicates a significant reduction in sheep numbers.

Assuming that 80% of agricultural water demand is consumed by domestic stock, a 35% reduction in the ARB flock size for the period 1993 – 2003 would have resulted in an 840 ML annual reduction in water demand. The reduction in agricultural water used within the ARB for the period 1994 – 2006 is approximately 850 ML.

Table 2-5 Trend in Australian Sheep Flock Size and World Sheep Production

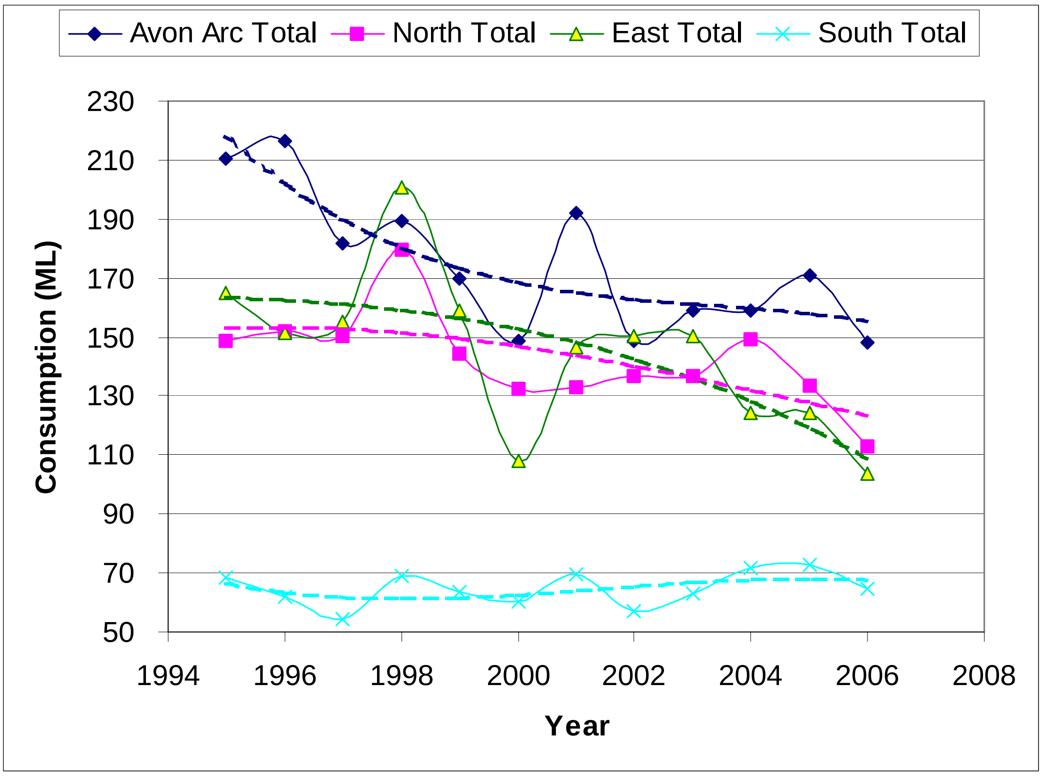
	1983	***1993***	***2003***
Australian Sheep Numbers (million)	135	133	94
World Production - Sheep (Mt)	6.1	6.9	7.6

Source: ABARE www.abareconomics.com/australiancommodities/htm/sheep.html

Since 1990 there has been a 25% increase in world sheep production and ABARE are predicting an increase in the Australian flock size by 4% by 2010 (ABARE, 2007). It is possible that increases in the flock size within the ARB, responding to international demand for sheep products, will result in an upward trend in agricultural water demand within the region.

There appears to be a general declining trend in minor categories of the water demand within the ARB, including demand by LGAs (Parks, Gardens Reserves and Recreation), Industry and Services. This is partially offset by a steady increase in water demand for accommodation services within the region post-2000.

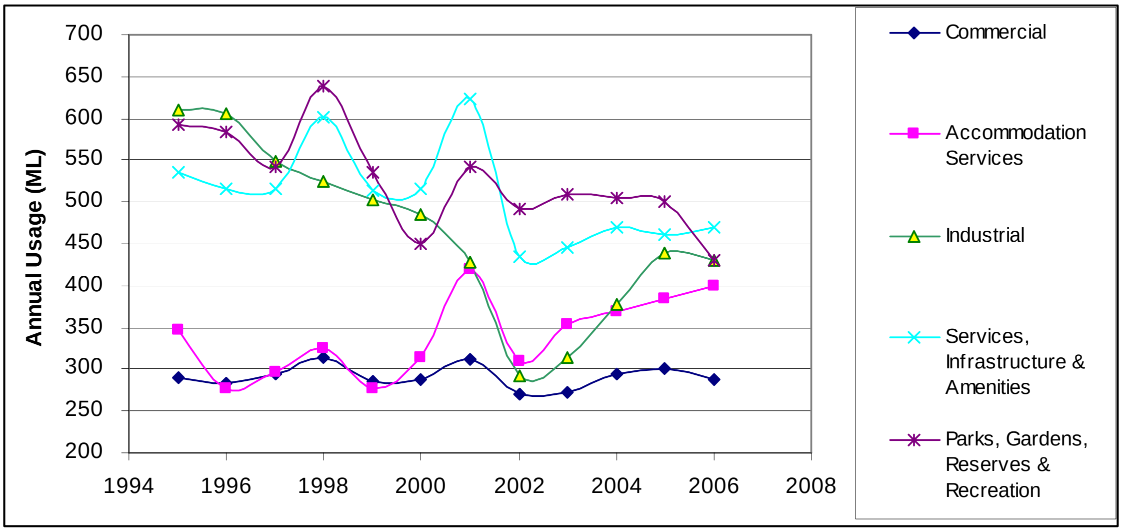
Figure 2-8 Shire water use trends 1994 - 2006



Source: Water Corporation sales data

It should be noted that the Wundowie Abattoir accounts for between approximately 50 and 70% of “Industrial” water consumed within the ARB with a maximum consumption of over 400 ML in 1996 and 1997. In Figure 2-9 it should be noted that when the consumption of the abattoir dropped to just over 100 ML in 2002 and 2003 the whole “Industrial” usage for those years dropped significantly. It appears that the consumption of this abattoir largely influences the “Industrial” annual water usage.

Figure 2-9 Water Demand by Category for ARB (Excluding Residential, Agricultural)



Source: Water Corporation sales data

In summary, there has been a 10% reduction in water demand for the period 1995 – 2006 within the ARB, principally influenced by reduction in agricultural water demand. This reduction also mirrors the reduction in residential consumption in the eastern and northern areas of the wheatbelt largely due the changing population distribution within the region, as more people leave the more isolated areas and relocate to the metropolitan area. The growth of Avon Arc towns, with their increased appeal as preferred places to live, is likely to result in an increase in residential demands in those particular towns.

3. Assessment of Alternative Water Supplies

In developing targets for reduced reliance on the Water Corporation IWSS, an assessment of potential alternative supplies is required. Without a comparable, cost-effective alternative, it is difficult to imagine how significant reductions in water usage can be achieved. For the purposes of this report, the definition of an alternative water supply is one that may be used as a direct replacement for Water Corporation supplied water. Thus, an alternative water supply must be of suitable quality, cost and reliability to replace that currently being delivered from the Water Corporation Scheme.

The assessment of alternative water sources attempts to identify opportunities and barriers to adoption. The objective of this section is to discuss issues associated with the adoption of alternative water sources in context of the following criteria.

1. Water Quality.
2. Supply Reliability.
3. Availability and Quantity of Supply.

Costs associated with developing alternative supplies are discussed in Section 4 of this report.

Conventional sources of water are considered likely to have the highest rate of adoption because they are relatively low maintenance, have a lower capital cost and are tried and tested. These sources include:

– Dams with improved catchments,
– Rainwater Tanks collecting runoff from shed and house roofs,
– Bores and Soaks.

3.1 Dams

Dams have been used extensively throughout the ARB for irrigation of livestock and domestic garden use. The quality of water required for livestock and irrigation is not as high as for human consumption. For the most part, correctly designed dams with dedicated catchments can be used as a direct replacement for Scheme supply if the intended use is agricultural or ex-house domestic.

For dams to be reliable and provide an acceptable replacement supply they must have adequate capacity and a suitable catchment area, capable of yielding sufficient runoff volumes to meet demand. Regular de-silting, the addition of improved catchments and the construction of silt traps can greatly improve the reliability of farm dams. Roaded catchments enhance the runoff potential of a dam's catchment area by reducing the runoff threshold. Consequently, a dam with an improved catchment is likely to receive inflow from a greater proportion of rainfall events and a greater magnitude of inflow from each episode.

Assuming a runoff threshold of 10 mm, a rule of thumb for dam sizing in the ARB is approximately 1000 m^3 of storage and 1 hectare of roaded catchment for every 100 head of sheep. If an average key dam is between 4,000 and 5,000 m^3, a key dam could service approximately 400 – 500 head of sheep. This takes into account both stock consumption and evaporation losses. This analysis has been undertaken using the last 35 years of rainfall with the ARB. However, potential changes to rainfall patterns associated with climate change would affect the reliability of dams designed on the above basis.

3.1.1 Implications of Climate Change

Assuming the worst case scenario for climate change, resulting in a 20% reduction in rainfall in the ARB over the next 20 to 30 years (CSIRO 2004), a range of trends within agriculture may be expected. For instance, it is likely that there will be increased reliance on stock within the agricultural enterprise, reduced stocking rates, longer periods between runoff events, more intense storm events, and increased evaporation. This will require on-farm storages to have greater capacity to deal with:

- *Changes in rainfall trends*
- *Changes to water distribution within the enterprise to account for changes in stocking density*
- *Overall increase in the water demand at an enterprise level*

It is also possible that movement away from grazing in the more marginal sections of the Scheme will occur resulting from potential land retirement, rural restructuring and ecosystem services tendering.

Historically, many farmers have used a relatively large number of small to moderate size dams distributed around the property as the primary means of providing stock water supplies. Disadvantages of a range of dams spread around the property include a high relative evaporation potential per volume of storage, low flexibility in responding to changing spatial and volumetric water needs across the property, and relatively low reserve storage. These disadvantages are likely to be exacerbated by the impacts of climate change, which may significantly reduce the reliability of small to medium-size farm dams.

It is possible that storages of between 4,000 - 5,000 cubic metres will not be sufficient to cope with projected trends associated with climate change. Increasing the capacity of individual farm dams may not be the most viable means of dealing with water demands within the future.

A more effective strategy in light of risks associated with potential climate change may be the construction of a single or a small number of large strategic storages 10,000 – 20,000 m^3 and the installation of solar pumps, pipes, small storage tanks and troughs. Large storages, assuming they have well-developed, effective catchments, provide the greatest means of ensuring security of supply during drought conditions, and tanks and troughs provide the most flexible means of distributing water throughout the property.

In order to fully gain the advantages of larger storages revised property planning using land capability (land class fencing) and water management objectives, may be required. A property planning requirement at the farm enterprise level may become a prerequisite for allocation of public funds to water development and ecosystem services tendering projects.

In general, dams provide a comparatively inexpensive alternative to the reticulated supply network. However, capital costs associated with developing alternative water supplies are likely to be a significant barrier to adoption. Issues associated with costs are developed further in Section 4 of this report.

3.1.2 Re-use of Stormwater

There is potential for towns within the ARB to upgrade and improve their drainage infrastructure to maximise the collection and storage of runoff from the impervious areas of townsites (with particular emphasis on Cooperative Bulk Handling (CBH) receival sites). Collected water can be used as part of an integrated water management system within the town. Such uses include:

- Irrigation of parks, gardens, town ovals and bowling greens
- Non-potable residential use such as toilet flushing
- Residential gardens
- Commercial and industrial non-potable use

Stormwater is considered to present a relatively underdeveloped water resource within the region. In many cases, runoff is directed out of the town and discharged into nearby creeks and watercourses. Storm water is a valuable resource that sometimes contributes to further environmental and agricultural problems such as groundwater recharge, flooding, erosion, sedimentation, waterlogging and salinity.

There appears to be significant opportunity within the ARB to work with LGAs to develop stormwater re-use systems similar to those that have been implemented in a range of towns within the region. Section 5.4 explores the potential for the expansion of water re-use schemes in towns in the ARB and details existing schemes that are currently in operation in the region.

3.1.3 Summary

The key issues that need to be considered when assessing the value of dams with improved catchments are:

- The suitability of the soil to seal and form a non-leaky dam that is not at risk of becoming saline from the intrusion of shallow, salty watertables;
- The provision of an adequately sized and properly constructed roaded catchment or other improved catchment (i.e. granite outcrop, sealed road or buildings like wheat bins) to assist in harvesting runoff generated from rainfall events;
- The size, number and location of dams to meet required demand and to fit with other similar resources (i.e. groundwater);
- Their cost of implementation, especially when compared to the Scheme supply, where available;
- The ability to maintain a supply of adequate quality, free from contamination.

Surveys of catchments in the ARB indicate that a large percentage of dams are not considered reliable (reliability is based on frequency of drying and on the dam water quality). The *South East Newdegate and Lake Magenta North Catchment Group Farm Water Supply Planning Project* (conducted by Laing and Associates, 2005) found that of 297 dams visited in the catchments, 144 (48%) were classed as unreliable.

Prout and Dodd (2004) found that in the Wallatin and O'Brien catchments, (near Kellerberrin, 250 km east of Perth) many dams were generally constructed a long time ago, were silted, had insufficient catchment area or were becoming saline.

These surveys highlight that appropriate design and construction of farm dams and town dams alike, is critical in terms of water quality and reliability of supply. A significant percentage of dams within the ARB are likely to be substandard and will not be able to cope with potential changes in rainfall patterns. This is exacerbated by the fact that there are few suitably trained professionals within the ARB capable of effectively designing farm water storages and associated distribution systems at an enterprise scale. In addition, contractors generally do not possess the range of skills required to provide integrated water management solutions at an full enterprise scale. This scenario has perhaps been exacerbated by Government agencies moving away from investment in the skills required for soil and water conservation planning services, over the last two decades.

3.2 Rainwater Tanks

3.2.1 Tanks on Farm

Many landholders within the ARB rely solely upon the Water Corporation Scheme for high quality water requirements (domestic consumption and spray use). Upgrading infrastructure to provide sufficient storage for collecting roof runoff has the potential to produce a supply with a comparable reliability and quality to the Scheme.

Tanks and associated infrastructure can be established to collect runoff from the roofs of farm buildings. Many properties throughout the ARB, not connected to Scheme, use rainwater tanks as their primary in-house and crop spray supply.

The advantage of harvesting rainfall from shed and house roofs is that they generally have a runoff threshold of only 1 to 2 mm; they do not rely on high rainfall intensity to generate runoff. They therefore provide an opportunity for relatively reliable catchment of runoff water.

Appropriately sized and configured rainwater tanks appear to provide the best opportunity to replace scheme water consumption for household use and crop spraying. The configuration of tanks and infrastructure will be unique for each property, depending on the distribution of buildings and specific water needs. However, with careful planning, a system can be designed, to provide a self-sufficient supply for most scenarios.

The key issues that need to be considered when assessing the value of rainwater tanks are:

- Their contribution towards achieving a self-sufficient water supply;

- Availability and suitability of on-property building infrastructure available to harvest runoff generated from rainfall on roofs;
- Cost of implementation, especially when compared to Scheme supply (where this is available); and
- The ability to maintain a supply of adequate quality, free from contamination.

Optimisation of tank sizes for the particular needs of individual properties can be undertaken, provided the following parameters are known:

- Estimated volume of consumption.
- Historic daily rainfall data, with consideration for projected changes in rainfall patterns.
- Estimation of runoff thresholds.
- Effective roof catchment area.

There is a proportionally greater cost per kilolitre associated with the installation of rainwater tanks compared to dams. The initial purchase of the tank, roof guttering, possibly a pressure pump and the cost of incidental plumbing will generally lead to a higher cost for rainwater tank supply. This issue is explored further in Section 4 of this report.

3.2.2 Rainwater Tanks in Towns

There is potential for rainwater tanks to be used in towns to reduce Scheme consumption. As residential consumption accounts for approximately 50 per cent of all Water Corporation IWSS water consumed within the ARB, even relatively small savings at a residential level may have a significant impact on the total volume of water used. Whilst there is there is insufficient roof area on most houses to provide a completely self-sufficient supply, there is potential for rainwater tanks to complement and reduce Scheme consumption.

Opportunities for the use of tank water in towns include:

- Toilet flushing.
- Washing Machine use.
- Drinking water (if sufficient quantity is available).

Tanks on in-town residential houses will vary in size to suit the consumption demands, available block space and roof catchment area of individual households.

The average person uses approximately 58 kL of water per year and a standard residential garden uses approximately 180 kL/year. For a house containing four people, (approximate annual consumption of 400 kL) the collection and storage of rainwater roof runoff in tanks has the potential to provide 20% of total household requirements.

There is a range of barriers associated with the use of rainwater tanks for town water supply. Foremost is that the period of highest rainfall is generally out of phase with the period of highest water demand. This necessitates the installation of a relatively large storage to provide adequate capacity during dry periods.

Additionally, collection and distribution of rainwater within the household requires guttering and plumbing, and a change in attitude toward water use.

Climate change is expected to result in a reduction in rainfall in the ARB, potentially reducing the reliability of water supplies dependent on roof runoff.

3.3 Groundwater

Good groundwater supplies are generally more reliable than surface water supplies because they are not so directly impacted by short-term fluctuations in rainfall and are generally not directly influenced by evaporation. The potential storage present in groundwater sources means they are not as susceptible to failing in dry periods as surface water supplies. This is not always the case for smaller groundwater sources associated with hillside seeps that are generally reliant on winter recharge.

The zone of ancient drainage, located east of the Meckering line, has been a predominantly flat, internally drained landscape for more than 30 million years. It is estimated that only approximately 50,000 years is required for significant salt store to accumulate within the landscape. As a consequence, even though the area east of the Meckering line contains significant palaeochannels (up to 70 m in thickness), these channels generally have an enormous salt store. Therefore, freshwater is generally only associated with surficial sediments, granite rock fractures and hillside seeps.

Infill sediments in the area associated with the Darling Scarp have largely been destroyed during geological activity associated with the development of the Scarp itself. As a result, significant low salinity groundwater resources within the region are considered to be restricted to remnant palaeochannels located within the narrow strip between the Meckering Line and the Darling Scarp.

Significant, low salinity groundwater resources are dealt with in more detail in a report to the ACC entitled: Assessment of Low Salinity Groundwater Resources within the Avon River Basin (GHD 2006). For the purposes of this report, discussion is limited to small volume groundwater resources associated with fractured rock aquifers, hillside seeps and surficial aquifers, as significant, low salinity groundwater resources within the region are rare.

3.3.1 On Farm

Soaks associated with surficial aquifers can be developed at a relatively low cost; however, deep bores require significantly more investment, including costs associated with investigation. Investigation may be relatively expensive, there is no guarantee of a return and to some degree, the yield of the asset is uncertain. Development of surficial and fractured rock aquifers can result in a reduction in water quality over time due to intrusion of saline aquifers.

The groundwater associated with sandy soils high in the catchment overlaying relatively impermeable bedrock, clays or ironstone are considered to be a relatively underdeveloped water resource within the region. These water resources are relatively cheap and simple to develop, and provide an alternative for a supply, particularly in areas where soils are not suitable for the construction of dams.

Identifying and developing groundwater resources of this nature generally requires a moderate level of expertise, however there are relatively few Landcare professionals within the region who have well developed skills in this area.

Groundwater development in the ARB is largely opportunistic and site specific, and the large areas of saline aquifers within the region present additional complications.

Locating opportunistic sources of adequate quality groundwater in the ARB can be relatively complicated and in some cases requires local knowledge.

The key issues that need to be considered when assessing the potential value of groundwater resources include:

- Their contribution towards achieving a self-sufficient water supply;
- The initial investigations and assessment required prior to the resource being developed;
- The location, quality and quantity of potential resources available and their ability to meet required demand and fit with other similar resources;
- The long-term reliability of the source;
- The extra infrastructure that may be required to distribute water to other locations across the property;
- Their cost of implementation, compared to the use of Scheme supply where this is available; and
- The ability to maintain a supply of adequate quality that is free from contamination.

Bores and soaks are commonplace in the ARB. The current cost of installing a bore can be prohibitive particularly when compared to the cost of drawing from the Water Corporation Scheme. Additional issues associated with supply quality, quantity and reliability may also be seen as potential barriers to adoption.

3.3.2 Town Water Supplies

Relatively few groundwater resources are used to supplement town water supplies, as the proximity of reliable water supplies to towns within the Avon River Basin is limited by the underlying hydrogeology of the region.

The town of Quairading has 3 water supply dams that collect and harvest storm water which is used and reticulated to the school, bowling club and community oval. In addition to this, the dams provide capacity for an emergency water supply.

A bore field located to the east of the Quairading townsite on the Bruce Rock Road was established in approximately 1950, however a fire in 2000 destroyed much of the infrastructure. Two bores have been re-cased and new pumps installed since the 2000 fire are currently operational and being used to supplement the above-mentioned town water supply. Financial assistance to undertake this work was sourced from the National Water Initiative funding program.

The Happy Valley bore field is managed by the Water Corporation and provides supplementary water resources for the town of Brookton. This facility currently consists of two production bores that draw water from a locally recharged, shallow, semi-confined aquifer. The bores are used to meet increased demand during summer, usually operating between November and April.

Happy Valley comprises soils that are valley infill deposits of sandy colluvium and alluvium, which are of Tertiary to Quaternary age. These sands are recharged from direct rainfall infiltration through valley sediments and from run-off and through flow from nearby slopes. Groundwater flows towards streamlines and discharges into swampy areas at the base of the valley. The town water supply bores draw groundwater from the sandy deposits on the northern side of the valley, where the aquifer is semi-confined. The bores are approximately 15 metres deep.

At present, there are no plans to extend the Happy Valley borefield, as surface water resources appear to be able to adequately meet future demand.

Opportunities to further develop groundwater supplies to supplement town water supplies are considered to be relatively limited within the ARB.

3.4 Alternative Water Supplies

A number of potentially innovative developments have recently been trialled as alternative water supplies, including portable desalination plants. By-and-large they are too expensive to be considered for significant adoption. These options are considered novel and technological advances may make them more affordable in the future, but currently they are not economically feasible and thus, they have not been considered in detail here.

4. Cost of Water

The key driver influencing the level of adoption of alternative water supplies is the capital investment for establishing alternative supplies, when compared to the cost of accessing water from the Water Corporation IWSS. An assessment of the cost of alternative water supplies in comparison to scheme water is presented in this section.

4.1 Subsidies

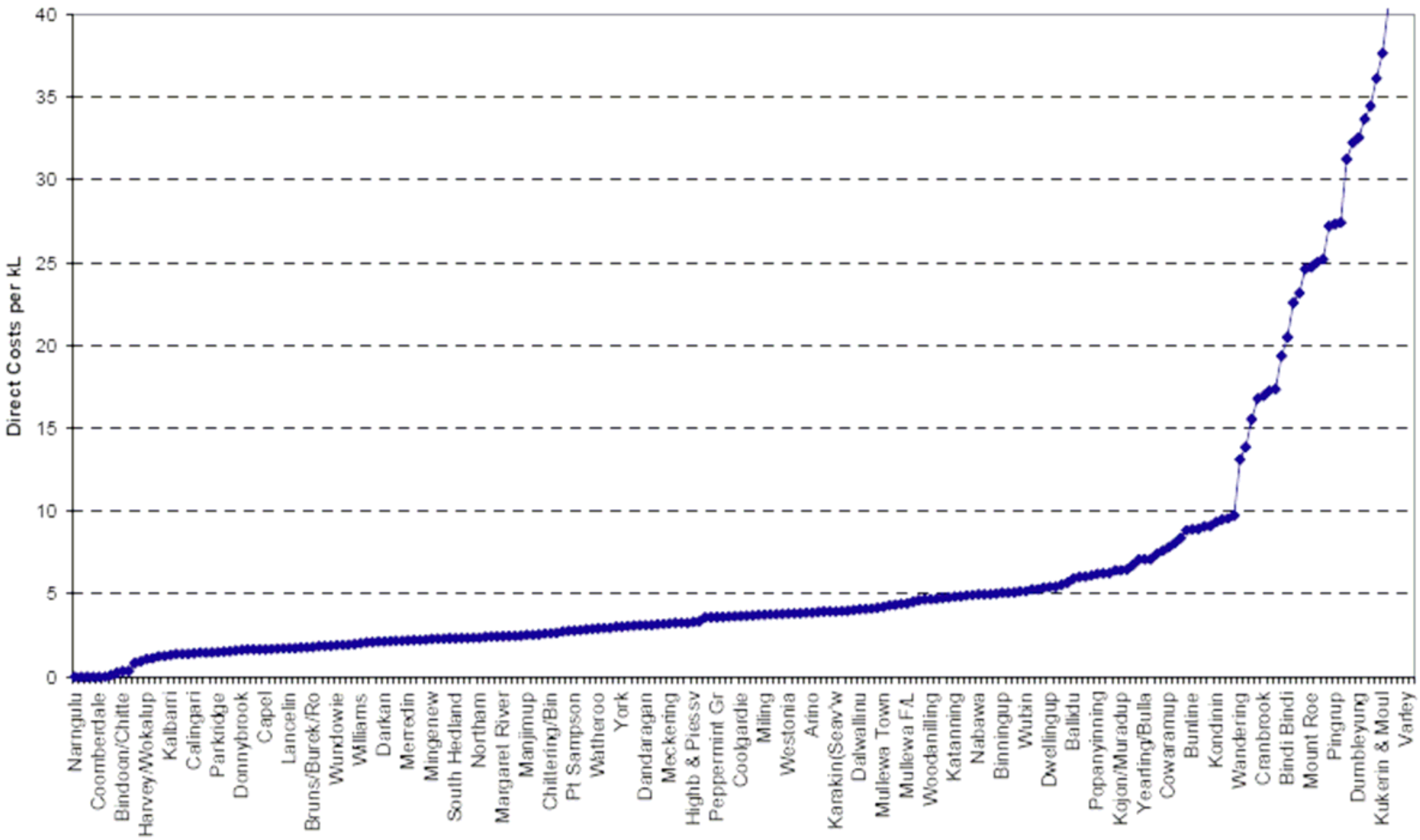
Water delivered to the Avon River Basin through the Water Corporation IWSS is charged to the consumer at a price less than the cost of delivery. The State Government of Western Australia pays the Water Corporation a “Community Service Obligation” (CSO) payment, which forms a subsidy for delivering water to country areas.

The Water Corporation undertook an assessment of the cost of delivering water to Kalgoorlie in 2000. It was estimated that the cost of delivery was approximately $4.50 / kL, equivalent to around $6.75 in today’s terms - indexed at 7% to account for the significant increase in the price of fuel since 2000.

In June 2006 a representative from Water Corporation estimated the cost of delivering water to farmland in the Northam area as being between $5 and $10 per kL. These costs are considered to be approximate but do include costs associated with operating and maintaining the network infrastructure. However, it is not clear whether the costs associated with managing the infrastructure network has been projected to include increasing costs associated with impacts of salinity on the network.

The following chart (Figure 4-1) presents the direct cost of supplying water to various towns throughout regional Western Australia, not all of which are located in the ARB. Direct costs include pumping costs, the cost of reading meters and maintenance but do not take account of the capital cost of the pipeline and associated infrastructure. This chart indicates that there is a large range of costs associated with the delivery of water to rural Western Australia.

Figure 4-1 Direct Costs of Water Supply ($ / kL) to Rural Western Australia (Source: Economic Regulation Authority of Western Australia)



In light of the aforementioned discussion with the Water Corporation, and from Figure 4-1, it has been assumed that the average cost of delivering water to the Avon River Basin is $7.50 /kL. This includes the cost of maintaining the network infrastructure, which may need to remain in place to provide water to other users, or for the provision of emergency supplies. For the purposes of this assessment, it has been assumed that the recurrent costs of delivering water are $5.00/kL (66.67 % of the total cost). This value is used to calculate the annual cost saving per kL associated with any reduced consumption from the Water Corporation IWSS.

4.2 Residential

An annual service charge is paid on all residential properties that have access to Water Corporation services, including properties that are vacant land. This charge is **$152.30** for the 2005/06 year.

A range of charges apply to WA towns, partially reflecting the cost of supplying water to particular towns, with the range of charges outlined in Table 4-1. Charges also reflect the volume of water used for each year. Refer to the Water Corporation website for a more detailed breakdown of the price of water to different areas of the ARB.

Table 4-1 Water Corporation Residential Charges for Country Customers 2005/06

Volume of Usage (Kilolitres)	Water Corporation Charges ($/kL)		
	Country		City
	Lower cost	Upper cost	
0-150	$ 0.43	$ 0.43	$ 0.43
151-350	$ 0.69	$ 0.69	$ 0.69
351-450	$ 0.85	$ 0.88	$ 0.93
451-550	$ 0.85	$ 1.35	$ 0.93
551-750	$ 1.23	$ 1.78	$ 1.23
751-1150	$ 1.56	$ 3.01	$ 1.23
1151-1550	$ 2.24	$ 6.01	$ 1.53
1551-1950	$ 2.58	$ 6.98	$ 1.53
over 1950	$ 3.00	$ 7.89	$ 1.53

Source: Water Corporation, 2005 c & d

Country residential water charges are the same as those in Perth, provided consumption remains below 350 kL/year. However, high water use within country towns is charged at a premium. At low consumption levels, residential charges for water in country towns are highly subsidised. However, for water use over 1,950 kL/year the price of water more closely reflects the actual cost of delivery.

The primary opportunity for reducing reliance on reticulated scheme for town residential supply is associated with the installation of rainwater tanks, and the use of grey water. The use of rainwater tanks is discussed in Section 3.2.2. As an example, installation of a 34 kL rainwater tank could reduce the volume of usage from the Scheme by around 95 kL/year, assuming:

1. A roof area of 250 square metres,
2. An annual rainfall of 390 mm,
3. A daily water consumption of 320 L (which is the equivalent daily consumption of 2 people) and
4. The tank is used only to supplement the scheme, not to replace it, meaning the tank runs dry on occasion and does not provide a completely reliable supply.

Costs and savings associated with the above example are presented in Table 4-2 below. In summary the capital costs associated with the installation of an appropriate rainwater tank are approximately $6,000 (consisting of $4000 for a 34 kL tank and an additional $2,000 for miscellaneous costs). This equates to approximately 8.5 times more than the actual cost saving to the end user and roughly equivalent to the cost of delivery incurred by the Water Corporation (both cost savings are based upon a Net Present Value analysis of the saving over a ten year period).

Table 4-2 Costs and Savings Associated with Residential Rainwater Tanks

	NPV $/20 year (Discount rate 5%)
Saving to Consumer (95kL @ *57c/kL)	$ 700
Saving for Water Corp (95kL @ $5.00 /kL)	$ 6,100
Cost of Works (Year 1)	$ 6,000

* Average cost of the first 350 kL of Scheme usage.

Additional barriers to the adoption of rainwater tanks for residential water use include, additional guttering and plumbing required and potential negative impacts of climate change on reliability. Success of similar schemes in other states would suggest that, assuming the right balance of incentive and education, barriers to adoption could be removed in WA.

Despite perceived barriers to adoption, the use of rainwater tanks as a means of partial substitution for Scheme water use may present opportunities for some residential customers, particularly those with a particularly high water demand. In cases where domestic water demand exceeds 1,550 kL/year, the cost of installing rainwater tanks would be economically viable in areas of the region where charges exceed $5/kL for Scheme water (refer Table 4-1).

In areas near to the periphery of the scheme where the cost of delivery is greater than $5/kL, such as Varley, Pingrup and Kondinin, it is potentially economically viable for the Water Corporation to subsidise the installation of rainwater tanks as a means of reducing water demand.

Re-use of shower grey water for toilet flushing offers an interesting comparison to the collection, storage and use of rainwater. A four-person household is estimated to use approximately 80 kL/year in showering and between 60 – 80 kL/year in toilet flushing. The cost of installing a small holding tank, pressure pump and plumbing to re-use shower grey water for toilet flushing is dependent on the nature of construction of the house, however, in some cases, it is likely to be substantially less than that associated with the installation of rainwater tanks.

Whilst neither of these two alternative water management options appear to be entirely economic given the current cost of water, collection of roof run-off and re-use of shower grey water potentially offer avenues for significant savings in the use of Scheme water. If the cost of water to the end user were to increase to better reflect the cost of delivery, then the water management options described above may become more economic.

4.3 Commercial and LGA

An annual service charge of $152.30 is applied to all commercial properties that have access to the Corporation's water main. An additional charge is applied to commercial properties based on the size of the water meter.

Table 4-3 Charges for country commercial property meters

Meter Size (millimetres)	Price ($)		Meter Size (millimetres)
Country		Metropolitan	
15, 20	$ 461.90	$ 461.90	20
25	$ 721.70	$ 721.70	25
30	$ 1,039.30		
35, 38, 40	$ 1,848.00	$ 1,848.00	40
50	$ 2,887.00	$ 2,887.00	50
70, 74, 80	$ 7,390.00	$ 7,390.00	80
100	$ 11,548.00	$ 11,548.00	100
140, 150	$ 25,982.00	$ 25,982.00	150
		$103,928.00	300
		$ 141,457.00	350

Source: Water Corporation, 2005 a & b

Commercial charges for country commercial customers range between:

– $0.85 -- $1.38 / kL (total consumption <300 kL / year).

– $1.48 -- $2.85 / kL (total consumption >300 kL / year).

The extent to which commercial properties can substitute alternative water supplies for Scheme supply would need to be assessed on a case-by-case basis. However, the economics of developing alternative water supplies are similar to that for residential properties, in that the relatively low price of water is likely to present a significant barrier to adoption in most cases.

Local Government Authorities are a significant commercial user within the ARB, and according to Water Corporation records, approximately 440,000 kL/year are applied to parks and gardens within the region. Assuming a cost of $1.38 per kL, the average cost to LGAs within the region for watering parks and gardens is approximately $20,000 per year.

Assuming that LGAs were able to supply 50% of water requirements for parks and gardens through the implementation of storm water re-use systems, on average, LGAs in the region could save approximately $10,000/year, or $80,000 over ten years, when discounted at 5%. The cost saving to the Water Corporation, assuming a cost of delivery of $5.00/kL, would be $1.1 million/year, or $8.1 million in 10 years, when discounted at 5%.

On the basis of this assessment, there appears to be significant scope to develop storm water re-use systems for towns within the region. Investigation will need to be undertaken at an individual shire level to further ascertain opportunities for pursuing storm water re-use opportunities.

Some towns within the region, including Northam, Merredin and Quairading, have previously successfully implemented storm water re-use systems. Refer to section 5.4.1 and Appendix B for an overview of stormwater and wastewater re-use in rural Western Australia.

4.4 Farmland

There is a special definition for farmland in the Water Corporation by-laws: farmland includes; pasture, grazing and dairy. Some agricultural enterprises including horse studs, piggeries and market gardens are classified as commercial and charged at commercial rates.

Water Corporation charges for water delivered to farmland connections are $152.30 per service connection and a flat rate of 95.1 c/kL.

Some farms access water from standpipes to supplement on farm supplies. The Water Corporation provides standpipes in country regions, which are connected to the Water Corporation IWSS. Standpipes are operated by LGAs who hold an account with the Water Corporation. The Shires set their own charges for water supplied from this source.

Water on farm is used primarily for three purposes: domestic use, crop spraying, and the watering of stock.

4.4.1 Stock Irrigation

Sheep within the Avon River Basin consume approximately 1 kL/head/year.

Capital costs and savings for replacing Water Corporation IWSS with alternative supplies, both at a paddock and property scale, are presented in Table 4-4. At a paddock scale, it is assumed that a 5,000 m^3 dam, with a 5 ha roaded catchment is capable of replacing Water Corporation Scheme for 500 sheep.

Analysis of costs and savings for the property scale, assume a typical herd size of 3,500 sheep, estimated to consume 3,500 kL/year, and that the landholder has 6 connections to the Water Corporation IWSS.

It is assumed that the landholder is charged water at a rate of $0.95/kL, and the cost of delivery incurred by the Water Corporation is $5.00 kL/year.

The analysis indicates that at both paddock and property scale, the cost to the landholder of accessing water from the Water Corporation IWSS is cheaper than developing alternative on-farm water supplies. When considering the actual cost of delivery of water incurred by the Water Corporation, then developing alternate water supplies would be economic, when considering a 20 year return period.

Table 4-4 Costs and Savings Associated with Replacing Water Corporation IWSS with on-farm supplies.

	$/20year NPV (Discount rate 5%)		
	Saving to Consumer	Saving to Water Corp	Cost of Works – Alternate water supplies.
Paddock Scale *(500 sheep)* *Assumes: 500kL/year & 1 connection.*	$8,050	$32,000	$25,000*
Property Scale *(3,500 Sheep & #6 connections)*	$54,500	$225,000	$80,000 – $200,000
Morbinning Catchment *(part property scale for 10 landholders)*	$73,100	$220,000	$160,000

* *Assumes sheep use two dams due to a crop/ pasture rotation.*

Assumes replacement of the Scheme supply - resulting in savings of connection costs.

Also presented in Table 4-4 are costs and potential savings associated with a range of water self-sufficiency projects developed with landholders within the Morbinning Catchment, during a planning exercise associated with the ACC - Surface Water Management Self-Sufficiency Project IWM006, in 2006. When considering the cost of capital works within the Morbinning Catchment, the break-even cost of water was approximately $2.20 / kL, when considering a saving of 6,000 kL/year and a 20 year return period.

The analysis indicates that there is currently little financial incentive for landholders to reduce their reliance on the Water Corporation IWSS given the current cost of water. However, if the cost to the farmer of water delivered through the Water Corporation IWSS was to increase to more closely reflect the actual cost of delivery, then developing alternative water supplies will become more economic, particularly nearer to the periphery of the Water Corporation IWSS.

It is possible that other market-based instruments can be used to create leverage for landholders to develop alternative water supplies. These mechanisms could include subsidies, offsets, conservation credits and education. Market-based instruments that capture external costs and collateral benefits are therefore believed to have a potential role within the water industry at a statewide level.

Another approach, based on supply management, might be for the Water Corporation to reduce the rate of supply or access at individual connections, to facilitate better management of peak demand within the water supply system. If this were to occur, landholders may need to invest in on-farm storage to ensure they have sufficient supplies for peak usage during autumn. It is considered that such a development would improve the benefit-cost ratio of developing alternative water supplies, however it is unlikely that developing alternative supplies would become cost-effective under the current pricing arrangements.

The analysis indicates that a subsidy of 50% - 70% is required for landholders to break even when considering developing alternatives to accessing water from the Water Corporation IWSS.

In summary, there appears to be limited financial incentive currently for landholders to move away from using the Water Corporation IWSS. However, potential increases in the cost of water, in addition to a trend towards the need for increased investment in infrastructure resulting from a reduced rate of supply, may result in increased financial pressures for landholders to develop alternative supplies. It should be further noted that an equitable solution to the reliance problem would necessarily involve significant policy reform across all levels of government.

4.4.2 Crop Spaying

It is considered that a reasonable proportion of on-farm water use from the Water Corporation IWSS, is for the purpose of crop spraying. Crop spraying requires good quality water, with little suspended material. In the Morbinning catchment for instance, approximately 30% of all water sourced from the Water Corporation IWSS is for crop spraying.

Water use for crop spraying varies between seasons and is a function of a landholder's cropped area. For the purpose of the analysis, an operation that crops 3,000 ha, with four spray applications per year, at a rate of 50 L per hectare is considered. The total water used in crop spraying on this property would be 600 kL/year.

It is estimated that the cost per kilolitre of establishing roof harvesting and tank storage of rainwater is approximately $75/kL in the year of expenditure, which is equivalent to $5.85/kL over 20 years, when discounted at 5%. For the above example, the landholder would need to outlay approximately $45,000 to achieve self-sufficiency in crop spraying.

Table 4-5 Costs and Savings Associated with Replacing Water Corporation IWSS with On-Farm Water Supplies for Crop Spraying

	NPV (20 year) *(Discount rate 5%)*		
	Saving to Consumer	Saving to Water Corp	Cost of Works
Crop Spraying (600 kL/year)	$ 9,275	$ 38,500	$ 45,000

4.4.3 Summary

There is currently little financial incentive for landholders within the ARB to develop self-sufficient water supplies as an alternative to the Water Corporation IWSS, because the cost of developing alternative water supply is greater than the price charge by the Water Corporation ($ 0.95/kL).

The analysis undertaken indicates that the break even for replacement of stock supplies through the construction of dams and associated roaded catchments is approximately $2.20 /kL. The break even for replacing water supplies for crop spraying, using tank storage, is approximately $5.85 /kL. The analysis assumes to return period of 25%, with a discount rate of 5%.

The cost of delivery of water within the ARB ranges between $1 - $40 /kL, however most the cost of delivery for most areas within the region is between $1 - $10/kL. In areas near to the periphery of the scheme network, the cost of delivery of water exceeds the cost of developing alternative water supply.

Further investigation into the full costs of delivery of water through the Water Corporation IWSS water may highlight additional opportunities for the development of alternative water supply. Assessment of other market-based instruments may also prove beneficial in leveraging investment into the development of alternative water supplies, however detailed assessment of such instruments is considered beyond the scope of this report.

A potential driver for investment in the development of alternative supplies may result from the requirement to upgrade a specific section of the network, particularly where the pipe network is threatened by an external factor such as salinity. The Water Corporation is currently undertaking an asset audit of the reticulated pipe network. At present there is little or no additional information available to further develop this component of the investigation.

It should be noted that capital investment in developing alternative water supplies to the Water Corporation IWSS, does not guarantee self-sufficiency. In periods of extreme drought, on-farm water supplies may fail, requiring the presence of alternative emergency water supplies.

In the eyes of many landholders, the Water Corporation IWSS provides a secure, reliable and high quality supply.

It is possible that other market-based instruments can be used to create leverage for landholders to develop alternative water supplies. These mechanisms could include subsidies, offsets, conservation credits and education. Market-based instruments that capture external costs and collateral benefits are therefore believed to have a potential role within the water industry at a statewide level.

Analysis of costs and savings associated with replacing water sourced from the Water Corporation IWSS indicates that a subsidy of 50% - 70% is required to ensure that development of alternative paddock - farm scale water supply projects break even.

There appears to be limited financial incentive currently for landholders to move away from using the Water Corporation IWSS. However, potential increases in the cost of water, in addition to a trend towards the need for increased investment in infrastructure resulting from a reduced rate of supply, may result in increased financial pressures for landholders to develop alternative supplies. It should be further noted that an equitable solution to the reliance problem would necessarily involve significant policy reform across all levels of government.

5. Recommendations for Targets

There are benefits associated with reduced reliance on the Water Corporation IWSS in rural and regional areas within the Avon River Basin (ARB). Foremost is the responsible management of a valuable resource. Reducing consumption from the Water Corporation Scheme supply may be viewed as a social responsibility, to conserve water for drier years.

The ACC Investment Plan requires the setting of targets for reductions in reticulated water consumption by 2007 (**W3 MAT 4.1**). It is considered that the setting of targets for a reduction in scheme usage forms a vital component of a strategy for reducing reliance on IWSS supplies throughout the region.

The "real" cost associated with the supply of water to the ARB via the Water Corporation IWSS is greater than the "actual" price charged to the end consumer. If reliance on the Water Corporation IWSS can be reduced, there is potential economic saving for the Government of Western Australian.

The development of alternative water supplies can reduce the potential impacts of possible failure in the Water Corporation IWSS. A failure resulting from deliberate or accidental damage to the IWSS pipeline network and associated infrastructure, or an extended dry period that necessitates a reduction in supply to regional locations, may have a devastating impact on some rural communities. Investment in private water infrastructure will benefit landholders by protecting them from disruption to the Water Corporation IWSS and will benefit authorities by reducing pressure on large public water resources.

In setting targets for reduction in reliance on the Water Corporation IWSS, the economics of establishing alternative supplies must be considered as the primary driver. As a result, it is considered that the level of adoption will be commensurate with the level of investment made available through funding programs run by the Department of Water and the Avon Catchment Council.

As the incentive program run by the Department of Water excludes funding to landholders currently connected to the Water Corporation IWSS, it is considered that targets associated with reduced consumption should be directly linked to the level of investment provided by the Avon catchment Council.

The following discussion considers potential reductions in water sourced from the Water Corporation IWSS within the context of residential, commercial, agricultural and local government authorities.

5.1 Residential

Approximately one third (4.97GL/year) of all water used within the Avon River Basin sourced from the Water Corporation IWSS, is used for town residential water supplies. Of this, approximately 1.01 GL/year is used for residential purposes within the town of Northam.

Average household usage is considered to be approximately 350 - 400 kL/year, approximately half of which is used for in-house domestic purposes and the other half is used on gardens. Typically, the Water Corporation consider garden usage to be discretionary, with the majority of water-wise campaigns directed at reducing garden usage.

Whilst grey water re-use and collection of roof runoff in rainwater tanks potentially offer a 50% reduction in in-house usage, economics and technical issues limit the practicality of implementing these water management options. The costs associated with collecting roof runoff and storage in rainwater tanks may be up to 15 times that associated with sourcing water from the Water Corporation IWSS.

It is considered that residential water use within the Avon River Basin should not be targeted for investment within the ACC Surface Water Management and Self-Sufficiency Project IWM 006. Therefore, it is recommended that the target for reduction in the water sourced from the Water Corporation IWSS for residential purposes be zero.

5.2 Commercial and Industrial

Approximately 7% of all water sourced from the Water Corporation IWSS within the Avon River Basin is used for commercial or industrial purposes.

The relatively low cost of water sourced from the Water Corporation IWSS is believed to present a significant barrier to the adoption of alternative water resources for the majority of commercial and industrial enterprises within the ARB. Engaging commercial and industrial enterprises in developing alternative water sources to the Water Corporation IWSS is likely to be difficult and time-consuming.

Commercial and industrial users are not considered to be a target of the ACC Surface Water Management and Self-Sufficiency Project, and therefore it is recommended a target for reduction in the water sourced from the Water Corporation IWSS for commercial purposes, be zero.

5.3 Agricultural

Approximately 32% of water sourced from the Water Corporation IWSS within the Avon River Basin is used on-farm, for either domestic or agricultural purposes. Planning activities undertaken within subcatchments have indicated that a significant proportion of this water is used for in-house, garden and crop spraying. However, a large number of landholders throughout the region also use water sourced from the Water Corporation IWSS for irrigation of stock.

At the current cost of water, there is a financial barrier associated with the development of alternative water supplies to the Water Corporation IWSS. It is estimated that the cost of developing alternative water supplies is generally between 3 and 5 times the cost of accessing water from the Water Corporation IWSS. A 50% subsidy, offered as a grant to landholders developing alternative water supplies is offered through the ACC Surface Water Management Self-Sufficiency Project.

If water savings associated with potential works developed during planning for self-sufficiency within the Morbinning catchment are considered typical, then a saving of approximately 10,000 kL/year could be expected given the current level of investment offered by ACC. This represents less than a 0.1% saving to the total volume of water used within the region.

The total water saving that can be achieved by focusing on reductions in water use on-farm, is limited by the number of landholders that can be engaged within this project. Assuming that all resources for the project are directed towards reducing on-farm reliance on the Water Corporation IWSS, and that only landholders with access to the Water Corporation IWSS are engaged by the project, then a target of 30,000 kL in three years is recommended.

5.4 Local Government Authorities

Local Government Authorities use approximately 8.8% of all water sourced from the Water Corporation Scheme within the region. Municipal water consumption by shires on parks, gardens, reserves and recreation areas throughout the Avon Basin accounts for around 4.5 % of the total Scheme water use in the catchment. The sum total of water applied to town parks and gardens is in the order of 440 ML per year.

The rate of water application on public open space is largely governed by temperature and the amount of rainfall received in a given year. Climate change is expected to result in increased average temperatures and reduced rainfall. This change may mean an even greater volume of water will be required to irrigate town gardens in future.

Numerous councils employ wastewater and stormwater re-use programs to lessen their reliance on Water Corporation Scheme water. Stormwater re-use involves the collection of rainfall runoff either from the town itself, or from a specifically constructed catchment area. Wastewater re-use involves the recycling of grey water and sewage. Wastewater is treated and often shandied with stormwater or Scheme water prior to use on council gardens.

In order to obtain an overview of the general opinion of rural shires to water resource management and to assess the prevalence of wastewater and stormwater re-use in the Avon Catchment, telephone interviews were conducted with a number of shire council Chief Executive Officers (CEOs). These conversations indicated that municipals within the Avon Basin are incredibly aware of their water usage, actively try to limit consumption and seek alternatives to Scheme water. CEOs display a high level of water awareness, with most expressing an interest in the state of their respective towns' water supply. The Community Water Grants Scheme was often mentioned and many shires had applied for such grants with varying degrees of success. A number of shires appeared to have a structured plan for furthering their self-sufficiency, their final objective being to eliminate their Scheme consumption for parks, gardens and ovals. Statements such as "we wish to drought proof the town" and "we hope never to use Scheme water on shire gardens again" were common sentiments of CEOs.

Whilst the intentions of CEOs were for the most part, incredibly positive, they often raised funding as the primary barrier to further water infrastructure development. However, the success of the community grants (both in terms of the number of applications lodged and the potential water saving) indicates that when they are provided with some financial impetus, local governments are proactive in pursuing water infrastructure development. Some 165 water grants were approved in Western Australia in the first round of funding, which provided an investment totalling around $5M. With a total of $200M of federal funding committed over five years, round two of the community water grants scheme is currently underway with a new round three announced in April. 2007. A number of shires have indicated their intention to apply for funding in this round.

5.4.1 Overview of Wastewater and Stormwater Use Within the Avon Basin

Information regarding the prevalence of water re-use in towns in the Avon River Basin is relatively sparse. Details of water re-use were sourced from the Water Corporation, by phone surveys with shire CEOs and by referring to the successful community water grant applications.

The Water Corporation provided the data contained in Table 5-1, (see over) concerning water re-use within the Avon River Basin. This table presents the water volumes provided by the Water Corporation to rural shires since 2002. This information only details treated wastewater that is provided to rural shires by the Water Corporation but does mention, for example, that Wyalkatchem, Mukinbudin and Kellerberrin integrate treated wastewater and captured stormwater.

A number of other towns within the ARB capture stormwater for use in the drier months and use this source as their primary supply for town gardens. The first round of Community Water Grants were announced in March 2006 and numerous towns in the ARB took advantage of this funding to improve their water supplies. Appendix B presents the towns that have to date made successful applications for Community Water Grant funding. Only projects that make specific applications for water infrastructure relating to stormwater or wastewater re-use have been included in Appendix B. A number of rural towns also made successful first round applications to fund other water saving projects, such as the installation of subsurface irrigation systems or the addition of rainwater tanks to roofs.

Appendix B highlights three important observations:

1. Shires and rural towns are interested in water management and are active in investing in storm and wastewater infrastructure if a co-contribution is offered. This is evidenced by the fact that 25 shires received backing for such projects in the March round of funding. More unsuccessful applications may have been made, which would not be indicated in Appendix B.
2. The Commonwealth government views the funding of Shire water infrastructure as an important undertaking. The total value of the March investment in these schemes in rural Western Australia exceeded $880,000.

3. The volume of water that can be saved by using alternative water supplies for town garden watering is significant. The 25 projects detailed in Appendix A will result in an estimated saving of some 295 ML / year. Using an average cost of delivery to the Water Corporation of $5 per kilolitre, this will potentially save in the order of $1.475M per annum. Subsequently, the state government's community service obligation (paid to Water Corporation to account for the disparity between delivery cost and the final price paid by the customer) will be reduced by a similar amount. This saving could possibly be reinvested to initiate additional work into water infrastructure.

Table 5-1 Treated Wastewater Volumes Provided to Shires by the Water Corporation (Source: Water Corporation)

WWTP	Recipient of re-use water	Type of re-use:	Contracted Re-use Volume (ML/d)	Actual Volume provided 2002/03 (ML/annum)	Actual Volume provided 2003/04 (ML/annum)	Actual Volume provided 2004/05 (ML/annum)	Actual Volume provided 2005/06 (ML/annum)	Comments
Northam	Town of Northam	Municipal re-use	No MOU in place yet	125.5 (estimated)	139.2 (estimated)	100.1 (estimated)	101.8 (estimated)	The Town of Northam re-uses 100% of summer discharges from the plant. Treated Wastewater is discharged to river in Winter months.
Merredin	Shire of Merredin	Municipal re-use	.28ML/d	84	94.2	85	98.8	Project to commence to construct infrastructure to take 100% reuse
Wongan Hills	Shire of Wongan/Ballidu	Municipal re-use	.13ML/d	35.6	39.1	44.8	46.9	Project completed to ensure 100% of treated wastewater is provided to the Shire for re-use. Shire constructed additional storage dam to increase storage.
Wyalkatchem	Shire of Wyalkatchem	Municipal re-use	.04ML/d	11	14.3	18.3	19.8	Shire re-uses treated wastewater from the wastewater treatment plant. Project commenced to ensure 100% of Treated Wastewater is pumped to the Shire for reuse. Shire has extended their storage dam to increase capacity.
Kellerberrin	Shire of Kellerberrin	Municipal re-use	0.110ML/d	31.2	29.3	34.6	36.6	Project to ensure 100% of treated wastewater is provided to the Shire for re-use was completed 06/04. Earthworks undertaken at time to ensure stormwater was captured more efficiently.
Narembeen	Shire of Narembeen	Municipal re-use	0.08ML/d	22.8	22.6	29.6	35.2	Shire re-uses treated wastewater from the wastewater treatment plant. MOU signed. Project to be started to ensure 100% of Treated Wastewater is pumped to Shire for reuse.
Corrigin	Shire of Corrigin	Municipal re-use	0.08ML/d	24.1	19.9	20.8	28.2	Project completed to ensure 100% of treated wastewater is provided to the Shire for re-use.
Mukinbudin	Shire of Mukinbudin	Municipal re-use	0.05ML/d	13.1	15.9	14.7	16.7	Project completed to ensure 100% of treated wastewater is provided to the Shire for re-use. Earthworks carried out to improve capture of stormwater.
Wundowie	Shire of Northam	Municipal re-use	0.08ML/d		0	40	42.1	Project completed to ensure 100% of treated wastewater is provided to the Shire for re-use
York	Shire of York	Municipal re-use	0.08ML/d		14.8	16.5	20.8	Water Corporation provides 100% of treated wastewater to the Shire for re-use.

Conversations with shire CEOs also indicated that towns have implemented stormwater re-use programs of their own initiative. Often stormwater capture systems were implemented decades ago, which serves to highlight the fact that rural areas have been conscious of their water supply and consumption for some time. This awareness stems not only from a desire to manage a valuable, finite resource but also from a desire to make financial savings. One CEO stated that his town spent almost $21,000 per year irrigating the football oval.

CEOs highlighted a number of barriers to the implementation of stormwater and wastewater re-use projects. Foremost was the issue of funding. Despite presenting a future financial saving, water infrastructure requires an up front capital investment that many towns are incapable of making. Although community water grants were introduced to share the burden of this investment, CEOs suggest that in some circumstances, an initial investment must be made by the town in order to produce an application (for example, to engage a consultant to detail an infrastructure project). Given that an application may prove unsuccessful, any money spent on supporting such a submission would be considered a waste.

However, one town's water infrastructure project displayed how an innovative combination of funding can produce a highly successful outcome. The concerned town obtained a $32,000 Community Water Grant, received $20,000 from the Water Corporation and contributed around $8,000 from its own funds. Thus, a venture with a total value of around $60,000 that involved three parties was made possible. The project involved the expansion of an existing town dam to allow the capture of more stormwater and to enable the town's wastewater to be integrated into this source, after it had been treated to an acceptable level.

An investigation of the viability of investment into town water supplies for the irrigation of gardens and reserves also shows the targeting of funds to local government in a positive light. As an example, one town in the wheatbelt received a grant for around $45,000 that proved to be the catalyst for a project valued at $82,000. This project is forecast to save 14,100 kL of Scheme water annually, that would otherwise have been used to irrigate the town oval. Based upon a 10-year investment horizon, this places the cost of the provision of water at around $0.83 per kilolitre (assuming a 7% discount rate). This compares favourably to the $1.48 -- $2.85 that would be charged for Scheme water. Under these circumstances, there are multiple financial beneficiaries; the Shire benefits from reduced Water Corporation usage and the State Government benefits from a reduced Community Service Obligation payment.

The financial and practical viability of investment in town-scale water supplies for parks and gardens appears to be driven by 3 factors:

1. *Ability of shires to invest in large-scale works* – Rural towns have a larger proportion of their income available for investment in infrastructure than, for example, farming enterprises. The infrastructure provided by a shire affords benefits to a wide range of people and as a result, there is an expectation that shires will invest in such assets.

2. *Close proximity of the water source to the point of use* – Generally, a town water supply is located close to the area it will be used. This means that distribution costs are kept to a minimum. In a farm situation, water may be pumped a similar distance but it is usually a lesser volume, meaning distribution costs per unit volume are higher.
3. *Relatively low water quality requirements* – The end use of the water supply does not necessitate stringent water quality controls. Therefore, the capture and storage system that needs to be constructed is not as expensive as if water was being provided for domestic consumption.

In terms of providing the greatest reduction in Scheme usage, it appears that working with towns to provide alternative water supplies for irrigation of parks and gardens creates a better value investment than a co-investment with farmers. Potentially, funds could be targeted at local government level, rather than at farm enterprise level.

The specific advantage of working with Local Government Authorities within the Avon River Basin is that they represent much larger individual water users, than do other potential target areas within the region. For instance, an average local government authority within the Avon River Basin may use in the order of 30,000 kL/year for irrigating parks, gardens and cited recreational infrastructure that could be replaced by re-use of stormwater run-off.

Whilst the actual water savings associated with developing projects for re-use of stormwater within towns of the Avon River Basin is less well-developed than those for on-farm usage, it is considered that savings of 20,000 kL/year may be a reasonable target.

Assuming that resources from within the ACC Surface Water Management Self-Sufficiency Project are directed towards engaging Local Government Authorities in developing stormwater re-use systems, a target of 60,000 kL in three years is recommended as a preliminary target.

5.5 Summary of Recommendations

It is recommended that investment through the ACC Surface Water Management Self-Sufficiency Project not be directed towards residential and commercial users of water from the Water Corporation IWSS, principally due to perceived difficulties in engaging these user groups, compounded by financial barriers to adoption of alternative water sources.

It is considered that Local Government Authorities represent the primary target as a user group when considering opportunities for reduced reliance on the Water Corporation IWSS. Development of stormwater harvesting/re-use systems within the Avon River Basin may present an opportunity to achieve a target for reduced consumption of 60,000 kL or more in three years.

Reduced reliance on the Water Corporation IWSS by the farming community within the Avon River Basin also provides opportunities for investment by the ACC, through the Surface Water Management and Self-Sufficiency Project. However, individual landholders represent relatively small individual water users when compared with local government. The number of landholders that can be engaged within this project will limit potential targets for reduction in water sourced from the Water Corporation IWSS. It is estimated that a target for reduced IWSS consumption associated with provision of on-farm water supplies associated with the ACC Surface Water Management and Self-Sufficiency Project would be in the order of 30,000 kL over three years.

6. References

ABARE, 2007, www.abareconomics.com/australiancommodities/htm/sheep.html Accessed January 2007.

Department of Environment, October 2005, *Western Australian Water Plan Implementation 1995 –2005*.

Laing, I. 2005, *South East Newdegate and Lake Magenta North Catchment Groups, Farm Water Supply Planning Project, February - March 2005,* A report prepared for Department of Environment and Rural Water Advisory Committee

Prout, A. & Dodd N. 2004, *Wallatin Catchment Demonstration Initiative - Farm Water Supply Planning, Kellerberrin,* Prepared for Department of Environment and Rural Water Advisory Committee.

Water Corporation, 2005a, *Commercial Charges for Country Customers*, www.watercorporation.com.au Accessed 14/06/2006

Water Corporation, 2005b, *Commercial Charges for Metropolitan Customers*, www.watercorporation.com.au Accessed 14/06/2006

Water Corporation, 2005c, *Residential Charges for Country Customers*, www.watercorporation.com.au Accessed 14/06/2006

Water Corporation, 2005d, *Residential Charges for Metropolitan Customers*, www.watercorporation.com.au Accessed 14/06/2006

Wheatbelt Development Commission (2003). Wheatbelt Economic Perspective. Department of Local Government and Regional Development, West Australian.

http://www.wheatbelt.wa.gov.au/

Appendix A

Successful Community Water Grants to Rural Towns for Stormwater and Wastewater Re-use

Project ID	Application Title	Applicant	Project Description	Approved Funding (exl GST)
1028	Provision of Floating Cover for Tin Dam and Minimising Evaporation	Shire of Dundas	This project will minimise evaporation from the Tin Dam, Norseman, by installing a floating cover to provide a barrier between the water and the environment. This will allow the dam to retain as much stormwater as possible, which in turn will be used to irrigate community facilities and gardens. This project will save 13.3ML of water each year.	$45,454.55
1068	Installation of Self-Sufficient Water Supply for Community Facilities, Dandaragan, WA	Danaragan Youth Places and Spaces	This project involves the installation of a rainwater tank to supply water to community facilities at Dandaragan that are currently not connected to town water supply. This project will provide the community buildings with a self-sufficient water supply and prevent the need to cart in treated water. By saving 40kL of water each year it is hoped that this effort will encourage other community groups to undertake similar projects.	$2,954.55
1169	WA College of Agriculture - Narrogin Water Efficiency Project	Western Australia College of Agriculture Narrogin	This project involves installation of tanks to collect rainwater from buildings at the Western Australia College of Agriculture, Narrogin. Collected water will be used to irrigate gardens and reticulate an on-site farm. These changes will save 15.9ML of water each year.	$40,340.91
1172	Dunn Rock Water Conservation Project	Dunn Rock Community Association	This project will re-use stormwater to service the Dunn Rock Tennis Club Community Association, residents and volunteer fire brigades. The water will be used to service public toilets, irrigate a sports ground and gardens and be available for stock water and emergency fire suppression. The project will invole the installation of pumps that will transfer captured stormwater run-off from roads and a bulk grain storage facility. These changes will save 40.0ML of water each year.	$38,135.45
1607	Esperance Enhanced Filtration of Treated Effluent Scheme	Shire of Esperance	This project will reduce the consumption of fresh groundwater used to maintain sporting grounds and public open spaces within the Esperance Township. Currently, council mixes treated effluent wastewaters with fresh groundwater for irrigation purposes. The proposed filtration system will improve treated wastewater quality, reducing the volume of groundwater to be used in irrigation of these areas. This project will save 0.8ML of water each year.	$37,300.82

1666	Surface water management, Dowerin, WA	Shire of Dowerin	This project will use stormwater from the town catchment to irrigate the school oval, public sporting areas, open spaces and public gardens within the Shire of Dowerin. Stormwater will be directed into a cross-slope waterway and a dam on the Dowerin Field Day site. These changes will save 6.0ML of water each year.	$30,954.55
1671	Recycling water for re-use at Merredin Regional Community Leisure Centre	Shire of Merredin	This project will save water by combining a hockey and football oval into one and by converting two grass bowling greens with synthetic greens at Merredin Regional Community Leisure Centre. In addition, run-off irrigation water from the oval and greens will be collected and re-used to water the oval and council parks and gardens. These changes will save 27.7ML of water each year.	$45,454.55
2011	Water harvesting from the town, Goomalling,WA	Shire of Goomalling	This project will re-use stormwater to irrigate community sporting ovals within the Shire Of Goomalling. The stormwater will be stored in a newly constructed dam. This project will save 4.0ML of water each year.	$7,322.73
2163	Shire of Williams Water Re-use Scheme	Shire of Williams	This project will re-use treated wastewater to irrigate the community playing fields within the Shire of Williams. This project includes the establishment of a tank designed to store treated wastewater to be used to water the Shire's main recreation oval, relieving the necessity of utilising scheme water to irrigate the oval over the summer months. This project will save 16.065ML of water each year.	$27,381.82
2355	Saving and Recycling Rainwater by Enlarging Wyalkatchem Catchment Dam	Shire of Wyalkatchem	This project will re-use run-off to irrigate the recreation oval, tennis courts and bowling green within the Shire of Wyalkatchem. An existing dam will be extended to increase run-off storage capacity. In the future, run-off will also be used to irrigate the town's gardens. This project will save 0.2ML of water each year.	$28,181.82
2908	Water Treatment Project	Great Southern Grammar School Inc	This project will re-use stormwater to irrigate school playing fields and a newly created water wise garden at Great Southern Grammar School, Albany. The water wise garden will be designed to maximise stormwater absorption, aiming to decrease levels of the water table. Water will be treated on-site and stored until required for irrigation. This project will save 0.5ML of water each year, and a total of 5 hectares will be revegetated.	$45,454.55

3035	Great Southern Regional Cattle (GSRC) Saleyards Water Re-use Project	Shire of Plantagenet	This project will re-use stormwater in daily operations at Great Southern Regional Cattle Saleyards, within the Shire of Plantagenet. Rainwater will also be collected by tanks to be used for daily operations. In addition, the storage capacity of the existing dam will be increased to store the increased level of water being harvested. This project will save 10.0ML of water each year.	$36,146.36
3288	Construction of Dam and Equipment to Irrigate Playing Fields	Shire of Carnamah	This project will provide the Carnamah Community with increased water storage capacity and availability for the town and Shire of Carnamah. Dams will be constructed to store water that will supply community sporting ovals, grounds and a school oval. These measures will also reduce salinity further downstream. This project will save 8.5ML of water each year.	$45,454.55
3443	Water Harvesting to Drought Proof the Bruce Rock Townsite	Shire of Bruce Rock	This project will improve water efficiency within the Bruce Rock Shire by repairing a broken water catchment and using stormwater to irrigate the town's public gardens and oval. This will be achieved by repairing an existing dam and pumping stormwater run-off to the main town dams. These changes will save 3.4ML of water each year.	$26,059.09
3468	Geraldton Wetland Sanctuary - Lake Liner Project	Development Institute of Geraldton Grammar Incorporated	This project will provide the lining for an eco-lake that will be used to reticulate the grounds of the Geraldton Grammar School. These works will reduce the demand on existing groundwater and community water resources reduced by approximately 40 per cent. This project will save 13.28ML of water each year.	$45,454.55
3742	Newdegate Stormwater Harvesting and Effluent Reycling Project	Shire of Lake Grace	This project will re-use stormwater and treated effulent to irrigate ovals within the Shire Of Lake Grace. Stormwater will be collected in a dam and the treated effulent in a storage tank prior to redirection to the ovals. This project will save 25.0ML of water each year.	$44,320.00
3875	Effluent and Rainwater Oval Reticulation	Eastern Goldfields Hockey Association Inc	This project will re-use treated effluent to irrigate a grassed hockey oval at the Eastern Goldfields Hockey Grounds. A water tank and connections to the City's effluent reticulation system will be installed, as well as piping connections from the stadium roof to the new tank. This project will save 7.0ML of water each year.	$40,500.00

4064	Mukinbudin Sports Grounds - Recycled and Rainwater Project	Shire of Mukinbudin	This project will re-use greywater and rainwater to irrigate the sports reserve and the artificial turf on the bowling green and tennis courts at Mukinbudin Sports Grounds. This will be achieved by using recycled water from the Mukinbudin Wastewater Treatment Plant to irrigate natural grass areas. A rainwater tank will be installed, and harvested water used on artificial turf surfaces and within the sports pavilion. This project will save 36.0ML of water each year.	$45,236.36
5421	Installation of Water Efficient Devices	Spalding Park Golf Club Inc	This project involves installation of tanks to collect run-off water from the carpark of the Spalding Park Golf Club. The collected water will be used to irrigate surrounding vegetation and gardens and will relieve the pressure currently placed on sourcing bore water for these needs. This project will save 40ML of water each year.	$10,832.73
5615	Reticulate Treated Wastewater to Golf Course	Shire of Irwin	This project will re-use treated effluent to irrigate the Dongara Golf Course greens. A water efficient irrigation system will be installed to be used in conjunction with the stormwater, and existing bore water. This project will save 7.0ML of water each year.	$45,454.55
6054	Installing Efficient Systems Using and Reusing Water, Perkins Beach WA	Camp Kennedy	This project will improve water efficiency at Camp Kennedy, Perkins Beach, by implementing a range of water saving initiatives. These include installation of more efficient toilets and a reduction in use during dishwashing and clothes washing. Additionally, greywater will be used to irrigate a sporting field and a tank will be installed to collect rainwater for various uses around the camp. These changes will save 0.248ML of water each year.	$27,636.36
6059	Installation of water supply pipeline to reticulate Sportsground Tambellup WA	Shire of Tambellup	This project will install a water supply pipeline to irrigate the sports grounds at Tambellup. Water will be pumped from an existing dam, which will be gravity fed to holding tanks at the oval. This project will save 4.6ML of water each year.	$45,454.55
6064	Railway Dam Reticulation Project, Bencubbin WA	Shire of Mt Marshall	This project will save water by collecting water run-off from the Railway Dam, Bencubbin. The collected water will be used to irrigate the town oval, town gardens and nursery, and provide water for the regional aquatic centre. These changes will save 14.1ML of water each year.	$45,281.82

6582	Recycling Water for use on the Sports Grounds - Wagin WA	Shire of Wagin	This project will re-use stormwater run-off to irrigate the sports grounds at Wagin. Water will be collected by a drainage network using sub-surface culverts. Water will then be pumped to a holding dam which supplies the recreation complex. This project will save 0.75ML of water each year	$26,263.64
9019	Proposed Recyclable Water Supply Source for Geraldton Foreshore	City of Geraldton	This project will re-use storm water to irrigate the foreshore within the Geraldton Shire. Storm water will be collected from an industrial site, and will be used to recycle and recharge a freshwater lens that overlays a brackish groundwater aquifer. Flow controls will be installed on each bore depending upon specific irrigation requirements. This project will save 14.0ML of water each year.	$45,454.55

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