TECHNICAL NOTE 3

POTABLE WATER DEMAND AND EFFLUENT PRODUCTION

ORANGE CITY COUNCIL IWCM

PREPARED FOR:

ORANGE CITY COUNCIL

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GEOLYSE

POSTAL ADDRESS PO BOX 1963 ORANGE NSW 2800
LOCATION 154 PEISLEY STREET ORANGE NSW 2800
TELEPHONE 02 6393 5000 **FACSIMILE** 02 6393 5050
EMAIL ORANGE@GEOLYSE.COM **WEB SITE** WWW.GEOLYSE.COM

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Cover Photos:

Main – Suma Park Dam spillway (Source: OCC)

Top – Suma Park Reservoir (Source: Kerry Fragar)

Middle 1 – Stormwater harvesting batch pond (Source: Kerry Fragar)

Middle 2 – Orange STP Trickling Filter (Source: OCC)

Bottom – Harvested stormwater discharging to holding pond (Source: Martin Haege)

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Orange City Council's Integrated Water Cycle Management

Integrated Water Cycle Management (IWCM) is a 30 year strategic planning tool that enables Orange City Council to manage urban water services in a holistic manner and in accordance with best management practice. It brings together water supply, sewerage and stormwater within a catchment context, identifies current and potential future issues relating to planning and service delivery and examines how these issues can best be addressed.

IWCM Evaluation Study

The IWCM Evaluation Study lists all urban water service targets and identifies all the issues relating to planning and service delivery for urban water supply, sewerage and stormwater over the next 30 years. It examines what issues:

- can be addressed by existing or formally adopted actions and capital works – the Business as Usual scenario; or
- remain to be addressed in the IWCM Strategy.

Technical Notes

The IWCM Evaluation Study is supported by a number of Technical Notes that provide detailed supporting information and analysis. Findings from the technical work are presented in the relevant sections of the IWCM Evaluation Study.

Technical Note 1: IWCM Targets and Community Objectives

This Technical Note details the relevant targets and community objectives for the delivery of urban water services for Orange City Council.

Technical Note 2: Orange Water Resources

This Technical Note presents details of the various water resources considered by Orange City Council to provide long term water security including: surface water, stormwater, rainwater, groundwater, treated effluent, regional supplies and other solutions. It defines secure yield and how it relates to long term water security. It also includes an analysis of how climate change may impact on the secure yield.

Technical Note 3: Potable Water Demand and Effluent Production

This Technical Note describes the assessment of future potable water needs and effluent production for Orange and the villages of Lucknow and Spring Hill. Demand projections are based on consideration of historical demand, demand drivers and demand management.

Technical Note 4: Typical Residential Bill Analysis

This Technical Note defines what the Typical Residential Bill (TRB) is and details the modelling undertaken to determine the TRB and the impact of current and proposed actions and capital works.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
BAU	Business as usual
CVO	Cadia Valley Operations
D/S	Downstream
DEUS	Department of Energy, Utilities and Sustainability
DoP	Department of Planning
DPWS	Department of Public Works and Services
EA	Emergency Authorisation issued under Section 22A of the *Water Act 1912*
ERP	Estimated Residential Population
GPT	Gross Pollutant Trap
GL	Gigalitre (1,000 megalitres)
ha	Hectares
IPR	Indirect potable reuse
IWCM	Integrated Water Cycle Management
kL	Kilolitre (1,000 litres)
kWhr	Kilowatt hour
L	Litre (1,000 millilitres)
LGA	Local Government Area
L/s	Litres per second
LEP	Local Environmental Plan
mg/L	Milligrams per litre
m^3/hr	Cubic metres per hour
mL	Millilitre
ML	Megalitre (1 million litres or 1,000 kilolitres)
ML/day	Megalitres per day
m	Metre
mm	Millimetres
NOW	NSW Office of Water
NPV	Net Present Value
OCC	Orange City Council
pa	Per annum
REF	Review of Environmental Factors
STP	Sewage Treatment Plant (works)
TBL	Triple bottom line (environmental, social and economic)
TRB	Typical Residential Bill
µg/L	Micrograms per litre
U/S	Upstream
UV	Ultraviolet
WTP	Water Treatment Plant (works)
WWTP	Wastewater Treatment Plant (or STP)

Introduction

1.1 SCOPE OF TECHNICAL NOTE 3

This Technical Note describes the assessment of future potable water needs and effluent production for Orange and the villages of Lucknow and Spring Hill. Demand projections are based on consideration of historical demand, demand drivers and demand management.

1.2 REPORT STRUCTURE

This report is structured as follows:

- **Section 2** provides an outline of the methodology used to assess current and future potable water demand;
- **Section 3** provides background information and forecasts of potable water demand and effluent production for Orange; and
- **Section 4** provides background information and forecasts of potable water demand and effluent production for Lucknow and Spring Hill.

Methodology

2.1 INTRODUCTION

This section provides an outline of the methodology used to develop potable water demand and effluent generation forecasts for Orange and the villages of Lucknow and Spring Hill.

2.2 INPUT DATA

A potable water demand analysis was conducted for the water supply system for city of Orange and the villages of Lucknow and Spring Hill. The purpose of this assessment was to:

- provide an assessment of the current potable water demand, allowing for the influence of climate;
- forecast future potable water demand over the next 50 years under medium and high growth scenarios[1];
- investigate the effect of various demand management scenarios on potable water demand; and
- assess the present and future potable water demand with respect to current treatment capacity.

Data available for undertaking the demand analysis is provided in **Table 2.1**.

Table 2.1 – Water demand analysis input data

Data	Source	Description
Production records	OCC	Orange water production records from 1 January 1992 to 31 Dec 2010 supplied as bulk raw water to the Water Treatment Plants (WTPs). Lucknow and Spring Hill water production data records from 1 July 1998 to 31 December 2010 as bulk water from the bores.
Population data	ABS	Orange population data was obtained from census data and the ABS website http://profile.id.com.au/Default.aspx?id=262&pg=210&gid=10&type=enum Population data for Lucknow and Spring Hill obtained from ABS census data http://www.abs.gov.au/websitedbs/d3310114.nsf/home/census+data
	OCC	• Proportion of population supplied with water = 94% (Orange) • Proportion of population supplied with sewerage = 88% (Orange) • Assumed 100% of Spring Hill and Lucknow village population suppled with water and sewerage • Adopted Orange annual population medium growth rate = 0.8%pa • Adopted Orange annual population high growth rate = 1.1%pa • Adopted lower bound of zero growth for Spring Hill and Lucknow • Adopted upper bound of 0.8%pa population growth for Spring Hill and Lucknow
Climate data	SILO drill data	Daily rainfall, evaporation and temperature data for Orange from 1 January 1970 to December 2007, supplemented with data from Orange Airport AWS from January 2008 to December 2010.
Consumption records	OCC	Customer consumption within various categories obtained from the Concept Study (MWH, 2007).
Demand management	OCC	• Details of water management strategies already in place were obtained from OCC. • Future demand management measures derived in consultation with OCC

[1] The IWCM planning period is 30 years. However Council's strategy for water supply adopts a 50 year planning period and analysis of water supply options has been based on a 50 year analysis. Comment is made where required as to how options perform over the 30 year IWCM planning period.

2.3 ASSESSMENT OF CURRENT WATER DEMAND

The DEUS Water Demand Trend Tracking and Climate Correction software (v10) (DEUS, 2002) was used to assess historical water production data for Orange and the villages of Lucknow and Spring Hill. Results of this assessment were used to estimate the current unrestricted water demand.

Data used to inform this assessment is described in **Table 2.1**.

2.4 ASSESSMENT OF FUTURE WATER DEMAND

2.4.1 MODEL

The DEUS Demand Management Decision Support System (DSS) version S1.1 (DEUS, 2006) was used to forecast water production and evaluate demand management measures.

2.4.2 DEMAND FORECAST

2.4.2.1 Baseline Demand

Baseline demand forecast assumes no demand side management measures are in place. It provides a worse case demand scenario.

2.4.2.2 Impact of Demand Management Measures

Following on from the outcomes of the historical water production and baseline consumption analysis, a number of demand management measures built into the DSS model were evaluated to assess their impact on total and peak water demand.

Three combinations of demand management measures were assessed using the DSS model (refer **Table 2.2**). As described below, each combination builds on the previous level. The assumptions for each level of demand management are summarised in **Table 2.3**.

Table 2.2 – Demand management scenario levels

Level	Description	Options included in the DSS model
1	Low level demand management	Baseline[1] plus: • National water efficient labelling scheme (WELS) • Community education programs • Residential showerhead retrofit program • Fixture code – taps and showers on all new developments; this represents the fixture efficiency component required by BASIX • Non-residential water audits
2	Medium level demand management = Business as Usual	Level 1 plus: • Alternative water supply to dual reticulation area • Permanent water conservation measures
3	High level demand management	Level 2 plus: • Conservation pricing for residential users

(1) The adopted baseline per capita water demand accounts for water savings achieved through Council's leak and pressure reduction program completed in 2009. Therefore no demand management scenario included the loss management option available in DSS.

Table 2.3 – Demand management options and assumptions

Option	Assumptions[1]	
	Market Penetration	**Potable Water Savings**
Implementation of national water efficient labelling scheme (WELS) 2005 saw the introduction of a mandatory Water Efficiency Labelling Scheme (WELS) for toilets, washing machines, shower roses, taps, urinals and dishwashers.	Assumed to impact on residential customers only; increase the uptake of efficient washing machines by 5% and low flow showerheads by 15%. No impact assumed on toilets because the level of participation in the existing voluntary scheme is high.	Based on average use reductions of: • 20% for taps; • 30% for dishwashers; • 30% for washing machines; and • 30% for efficient showerheads.
Community education programs Council would provide materials, training and technical assistance to implement a comprehensive ongoing community education program.	20% of all customers in each category influenced by the community education effort.	Water savings vary dependent on the customer category and end use.
Residential showerhead retrofit program Upon request, a Council approved plumber would install a retrofit kit in existing single family residential housing. The kit would include a low-flow shower head.	15% of customers over a three year period.	• Based on average use volumes for each type of shower; and • 5% of participants in the program are free-riders.
Fixture code – taps and showers on all new developments. The fixture efficiency component of the NSW Government BASIX program will be implemented.	90% of new residential accounts complying.	20% reduction in use in showers, taps and sinks and outdoor use.
Non-residential water audits This measure allows for water audits for non-residential customers.	10% of non-residential customers participating.	• 10% saving in non-leakage consumptions per customer • 75% reduction in customer leakage - but saving only lasts two years
Dual Reticulation for New Subdivisions All new subdivisions to be fitted with dual reticulation systems with recycled water to be used for toilet flushing and irrigation.	Medium growth – 70% of all new residential developments. High growth – 45% of all new residential developments. Refer to **Section 3.3.3**.	70% reduction in targeted end uses. Refer to **Section 3.3.3**.
Permanent water conservation measures Council would introduce a water use regulation that would: • prohibit irrigation during the times of the day with the highest evaporation; • mandate the use of a trigger nozzle when washing cars; and • prohibit irrigation that fell on hard surfaces or hosing down of footpaths or driveways.	50% of all customers would adhere to the regulation.	10% reduction in external use in participating customers.
Conservation pricing for residential users Council would introduce a water pricing policy that would increase the water consumption charge as water supplies dropped below critical levels.	All customers would be affected.	• 10% saving in external use • 5% saving in internal use • Price elasticity for external use is -0.2 • Price elasticity for internal use is -0.05

Source: (1) DEUS (2006) with any modifications noted

2.4.3 PEAK DAY WATER PRODUCTION

The peak day water demand is calculated in the DSS model using a peak to average ratio derived from actual water production data. The daily water production data shows that the peak day to climate corrected daily demand ratio is approximately 2.2:1 for Orange (refer to **Section 3.2.2**) and 2.1:1 for Lucknow and Spring Hill (refer to **Section 4.2.1**).

2.5 ASSESSMENT OF EFFLUENT PRODUCTION

The DSS model includes an estimate of the forecast effluent production based on the potable water demand and data relating to the split between internal and external water use.

The DSS model calculated the percentage of internal residential use as 62% with the overall percentage of internal use being around 65%. This agrees well with analysis of six years of water production and effluent generation data for Orange (2005 to 2010) that shows an average of 65% of the potable water produced ends up as treated effluent. This ranges from around 45% to 50% when there are no or low level restrictions to about 85% on level 5 restrictions due to the reduced level of outdoor use. The data used to derive this relationship are shown on **Figure 1**.

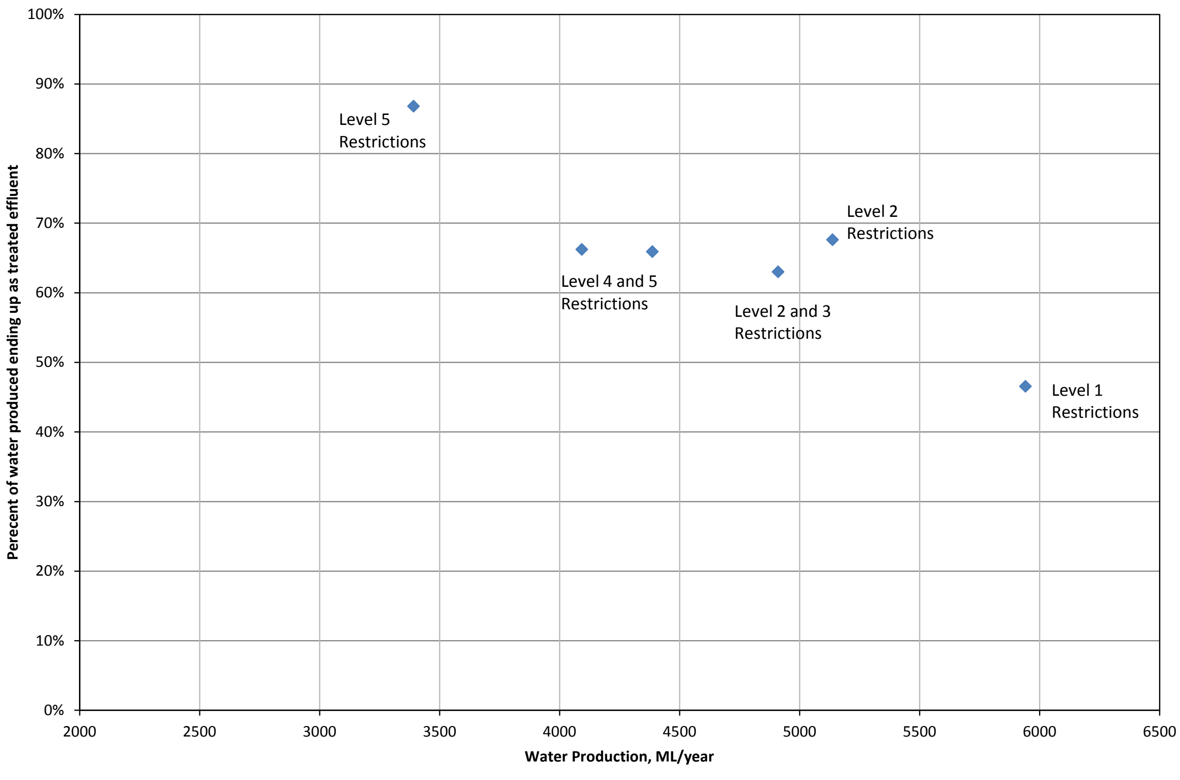


Figure 1: Relationship between water produced and treated effluent generation

Orange

3.1 POPULATION

3.1.1 POPULATION AND POPULATION SERVED

The Estimated Resident Population (ERP) for the City of Orange as produced by the Australian Bureau of Statistics (ABS) is provided in **Table 3.1**. The annual change in population has varied, with low to negative growth from 2001 to 2006 followed by high growth from 2007. The average annual growth over the ten year period is 0.8% pa.

Table 3.1 – Estimated Resident Population, Orange City Council

Year (ending 30 June)	Estimated Residential Population	Annual Population Change	% Change
2001	36,999	--	--
2002	37,066	67	0.2%
2003	37,126	60	0.2%
2004	36,956	-170	-0.5%
2005	36,970	14	0%
2006	37,108	138	0.4%
2007	37,525	417	1.1%
2008	38,158	633	1.7%
2009	38,646	488	1.3%
2010	39,261	615	1.6%
2011	40,062	801	2.0%

Source: http://profile.id.com.au/Default.aspx?id=262&pg=210&gid=10&type=enum

The data in **Table 3.1** is the Local Government Area (LGA) population. Not all residents receive water and sewerage services. Analysis completed in the Concept Study provided the following results (MWH, 2007):

- 94% of the population served with water; and
- 88% of the population served with sewerage.

The proportion of population served was assumed to remain constant for the water demand and wastewater production forecasting. Therefore the forecast of population served will be in line with the population forecast.

3.1.2 POPULATION GROWTH

Several future population projections have been prepared for the City of Orange as summarised below:

- *Orange Sustainable Settlement Strategy* (Parsons Brinkerhoff, 2004) – included medium and high growth projections of 0.8% pa and 1.1% pa respectively;
- *OCC Business Centre Strategy Review Study* (Leyshon Consulting, 2005) – adopted an average growth of 0.57% pa for the period 2006 to 2016;
- *CENTROC Population Projections* (Western Research Institute, 2008) – included assessment of population drivers and provided projections for high, medium and low growth scenarios. The average growth rates for the period 2011 to 2031 were:
  - Scenario A (high) – 1.26% pa

- Scenario B (medium) – 0.84% pa
- Scenario C (low) – 0.46% pa (this was the scenario adopted for the Centroc study (MWH, 2009));

- Department of Planning population projections (2005 update); and
- *Orange Sustainable Settlement Strategy Update* (Draft) (Newplan, 2010) – included a review of published projections and determined that the medium and high growth projections adopted in the 2004 study (Parsons Brinkerhoff, 2004) of 0.8% pa and 1.1% pa respectively were appropriate, with the starting population adjusted to the ABS figure recorded in 2008.

A comparison of these projections is provided in **Table 3.2**.

Table 3.2 – Recent published resident population projections

Source	2006	2011	2016	2021	2026	2031
ERP (ABS – refer **Table 3.1**)	37,108					
Parsons Brinkerhoff (2004) – High Projection	39,079	41,276	43,597	46,048		
Parsons Brinkerhoff (2004) – Medium Projection	38,503	40,068	41,696	43,391		
Leyshon (2005) – 2021 to 2031 extrapolated	38,350	39,515	40,593	*41,763*	*42,967*	*42,206*
CENTROC – High	-	39,749	45,138	49,576	50,552	51,108
CENTROC – Medium	-	38,786	41,992	44,539	45,352	45,880
CENTROC – Low	-	38,015	39,349	40,508	41,189	41,690
Department of Planning (2005 update)	-	39,040	40,240	41,570	42,910	44,150
Department of Planning (2008 update)	-	38,200	39,200	40,200	41,000	41,600
Newplan (2009) – High Projection	-	39,259	41,466	43,797	46,260	48,860
Newplan (2009) – Medium Projection	-	38,910	40,492	42,137	43,850	45,632
Average all sources	**38,260**	**39,282**	**41,376**	**43,353**	**44,260**	**45,141**
Minimum all sources	**37,108**	**38,015**	**39,200**	**40,200**	**41,000**	**41,600**
Maximum all sources	**39,079**	**41,276**	**45,138**	**49,576**	**50,552**	**51,108**

Based on the projections derived in the previous studies, Orange City Council has adopted the following long term population growth assumptions for the IWCM Evaluation Study:

- Medium growth rate – 0.8% pa
- High growth rate – 1.1% pa

These growth rates are consistent with the *Orange Sustainable Settlement Strategy Update* (Newplan, 2010). Updated population projections based on these growth rates using the ERP figure for 2009 as a starting point are provided in **Table 3.3** and illustrated in **Figure 2**.

Note that **Table 3.3** provides the projections at five year intervals as well as the odd years used in **Table 3.2** for direct comparison with the previous population projections.

Table 3.3 – Medium and high population growth scenarios, City of Orange

Year	Estimated Residential Population	
	Medium Projection 0.8% pa	High Projection 1.1% pa
2009	38,685 (1)	38,685 (1)
2010	38,994	39,111
2011	39,306	39,541
2015	40,579	41,309
2016	40,904	41,764
2020	42,229	43,632
2021	42,567	44,112
2025	43,945	46,085
2026	44,297	46,592
2030	45,731	48,676
2031	46,097	49,212
2035	47,590	51,413
2040	49,524	54,304
2045	51,537	57,357
2050	53,632	60,581
2055	55,812	63,988
2060	58,080	67,585

(1) Population projection based on 2009 ERP published in 2010. The 2009 ERP published in 2011 (see Table 3.1) had 39 less people but the difference was so insignificant that the projections were not altered

Figure 2: Population projections, City of Orange – 2010 to 2060

3.2 EXISTING WATER DEMAND

3.2.1 MONTHLY HISTORICAL DEMAND

The monthly water tracking model developed for the concept study (MWH, 2007) was updated with production and climate data to the end of December 2010. The climate corrected 12 month trend is shown in **Figure 3** along with the observed and predicted monthly demand. The water restriction regime since January 2003 and implementation of user pay water pricing are also indicated.

The climate corrected 12 month trend clearly shows the impact of the user pay pricing system and water restrictions on demand. Seasonal variation in water demand is still evident under Level 1 to 3 water restrictions, but is much less with Level 5 restrictions under which outdoor use is not permitted. The observed increase in monthly demand in the warmer months is much less since the introduction of user pay pricing.

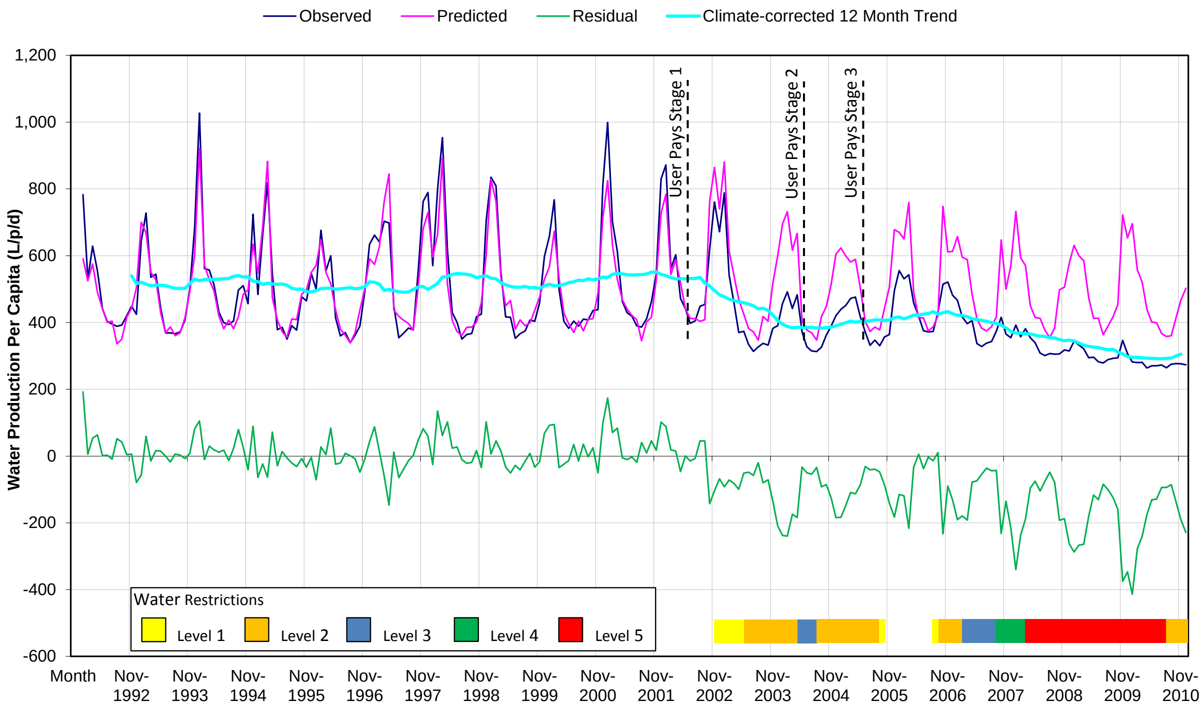


Figure 3: Regression analysis – monthly analysis for Orange

3.2.2 DAILY HISTORICAL DEMAND

The daily water tracking model developed for the concept study (MWH, 2007) was updated with production and climate data to the end of December 2010. The observed and climate corrected daily production from January 1993 to December 2010 is shown in **Figure 4**. The water restriction regime since January 2003 and implementation of user pay water pricing are also indicated.

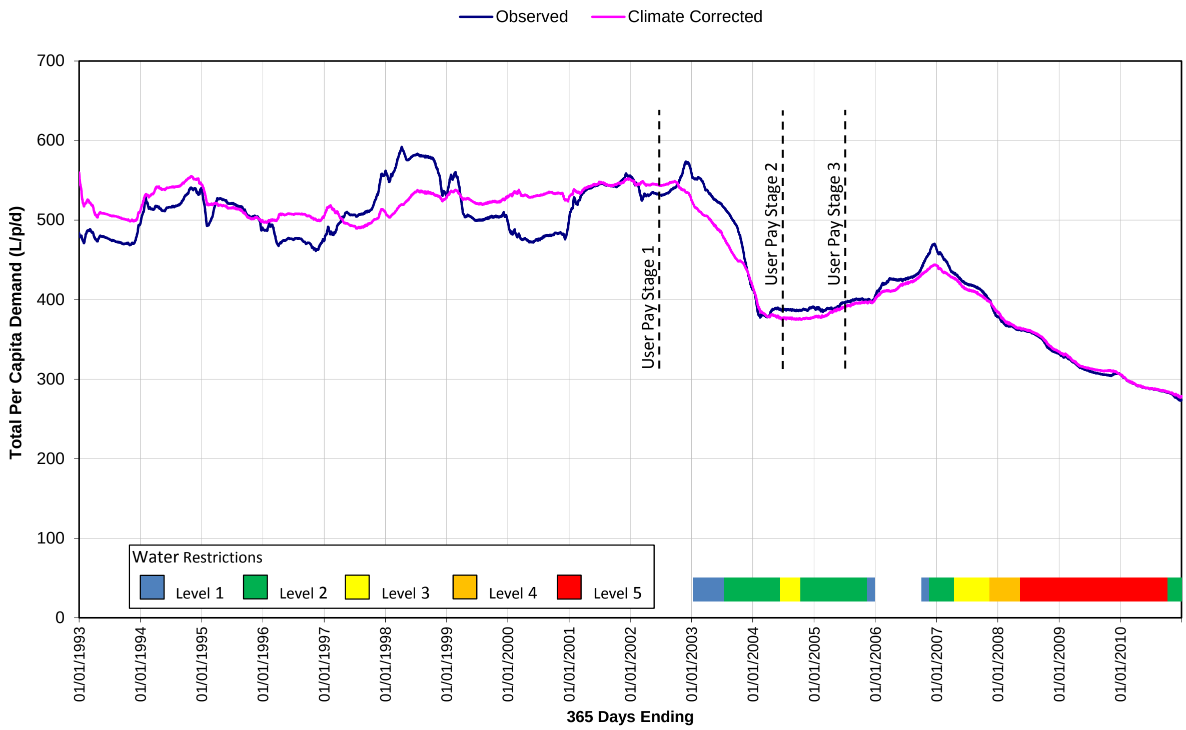


Figure 4: Observed and climate corrected demand - Orange

Prior to the introduction of user pay pricing, the climate corrected per capita water production ranged from 490 L/p/d to 555 L/p/d. This dropped markedly following the introduction of Stage 1 user pay in July 2002 falling to around 380 L/p/d just prior to the Stage 2 user pay system being introduced in July 2004. However water demand through this period was also reduced by a water restriction regime that commenced with Level 1 in January 2003 and gradually increased to Level 3 in June 2004. Interestingly, the Stage 2 user pay scheme did not appear to have a significant effect on water demand.

The climate corrected water demand remained at around 380 L/p/d through to the end of 2005 before starting to increase as water restrictions were eased and then lifted at the start of December 2005. The climate corrected daily production increased to 445 L/p/d before a new water restriction regime, that commenced in October 2006 and rose to Level 5 in May 2008, reduced demand to 278 L/p/d by the end of 2010.

The climate corrected daily production shows the effect of climate on water production which is represented by the difference between observed and climate corrected data shown in **Figure 4**. The climate correction takes into account climatic factors and corrects the water production data so that underlying trends can be observed. For example, through 1998, it was slightly hotter than the long term average and water production was slightly increased. Conversely, through 2000 the temperature was slightly lower than average, and the observed water production was less than the climate corrected data.

The difference between the observed and corrected data is less when water restrictions are in place as restrictions have the greatest impact on external water use, which is highly climate dependant.

The daily production data, without correction for service reservoir fluctuations, shows that the peak day to climate corrected daily demand ratio is approximately 2.2:1.

3.2.3 BASELINE DEMAND

A climate corrected current per capita demand is required as the starting point for baseline demand estimates. The Concept Study (MWH, 2007), using data to December 2006, adopted a baseline per capita demand of 467 L/p/d. This was based on the climate corrected average for the 12 months after the Stage 1 user pay system was introduced. Level 1 water restrictions were in place for half of this period.

The CENTROC study (MWH, 2009) extended the analysis for Orange to include water production data through to the end of 2008 and adopted a baseline demand of 435 L/p/d. This represented the per capita climate corrected demand at the end of 2006 following a period with no water restrictions and with Stage 3 user pays. The total annual demand from this per capita daily demand and the population served with water at the time was 5,590 ML/year.

In 2009, Orange City Council undertook a major leak and pressure reduction program. These works have been audited and found to have saved 500 ML/year of unaccounted for water (refer to **Appendix A**). Applying this annual water saving to the water consumption at the end of 2006 results in a per capita daily demand of 404 L/p/d.

The period from December 2005 through to October 2006 is the only period of observed data that has no restrictions under the user pay water pricing system. It is considered to be the best estimate of current unrestricted demand. Prior to the leak and pressure reduction program, the per capita demand was 435 L/p/d. This reduces to 404 L/p/d once the water savings from the leak and pressure reduction program are accounted for. Therefore the adopted baseline per capita water demand was set at 404 L/p/d in 2010 which equates to an annual demand of 5,403 ML/year.

3.2.4 CONSUMPTION DATA

Sectoral demands derived from data for the concept study (MWH, 2007) were retained for this current study. This was based on consumption data for the 2001 to 2005 financial years and was split into eight sectors:

- Residential;
- Rural residential;
- Commercial;
- Industrial;
- Rural/environmental protection;
- Public use;
- Parks and open space; and
- Unknown and other.

Adjustments were made for data anomalies with the final analysis showing that water consumption is dominated by the residential sector with both the commercial and industrial sectors also having a significant influence (refer to **Table 3.4** and **Figure 5**).

Table 3.4 – Water consumption by sector

Category	Average Consumption 2001-2005 (1) ML/a	Average Breakdown %	Number of Accounts 2010
Residential	2,792	70.0%	14,130
Rural Residential	131	3.3%	412
Commercial	457	11.5%	1,148
Industrial	368	9.2%	436
Rural/Environmental Protection	89	2.2%	19
Public use	31	0.8%	142
Parks and Open Space	119	3.0%	66
Unknown and other	1	0%	0

Source: (1) MWH (2007) Table 0-3

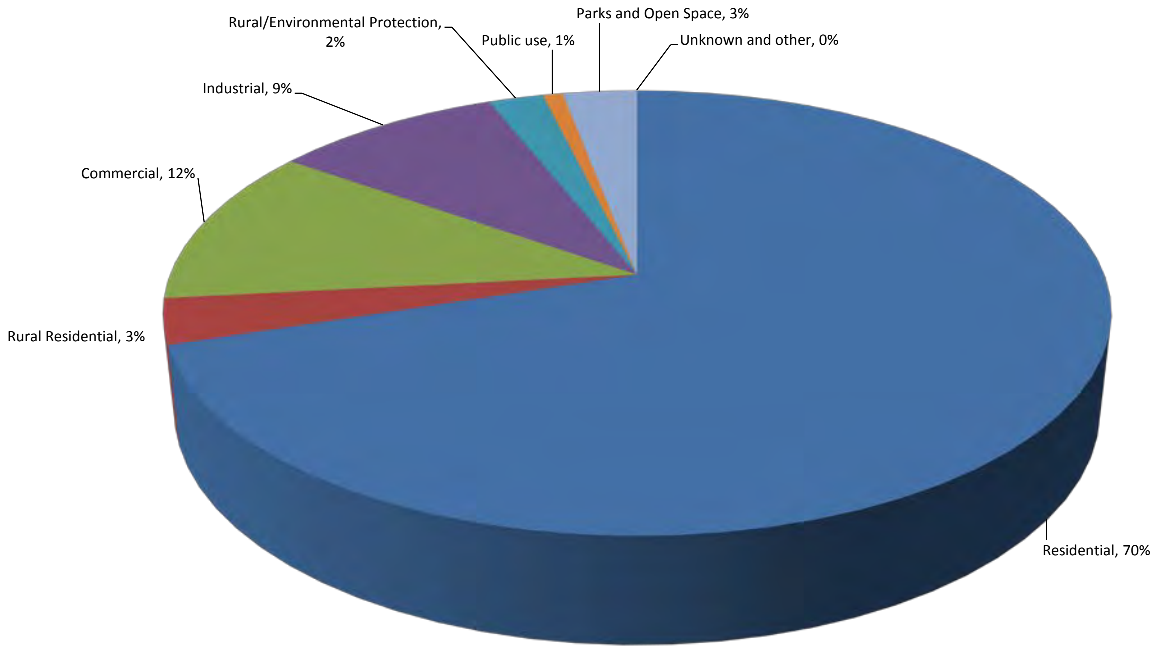


Figure 5: Average breakdown of water consumption by sector

3.2.5 MAJOR USERS

The top 20 water users for 2009-2010 are listed in **Table 3.5** along with their consumption and ranking for 2004-2005 if they were in the top 20 at that time. In 2009-2010 the top 20 users accounted for 371 ML or 9.6% of the annual water consumption. It is noted that the total annual water consumption in 2009-2010 was low due to water restrictions (3,872 ML).

In 2004-2005 the top 20 water users consumed 519 ML (MWH, 2007) or about 9.7% of the annual water consumption (5,363 ML). The 2009-2010 data shows a 28% reduction with the largest reductions coming from:

- Central West Linen Service (Health Support Linen Service) – 113.6 ML down to 68.6 ML (40% reduction);
- Electrolux – 47.4 ML down to 9.6 ML (80% reduction);
- Orange City Council (Cook Park) – 35 ML down to 9.6 ML (73% reduction) through the introduction of water recycling; and
- TAFE – 14 ML down to 7.5 ML (46% reduction).

This data highlights the effectiveness of the water saving programs implemented by these customers.

Table 3.5 – Major potable water users 2009-2010

Rank	Customer	Consumption	2004-2005 [1]	
		2009-2010 kL	Consumption kL	Rank
1	Health Support Linen Services	68,575	113,639	1
2	Bloomfield Hospital	55,632	65,034	2
3	Charles Sturt University	41,919	27,024	6
4	Greater Western Area Health Service	37,323	19,287	9
5	Appledale Processors Co-Operative Limited	23,786	25,190	8
6	The Uniting Church of Australia – Kinross School	14,856	17,620	10
7	Kinross School Trust	13,297	12,986	14
8	Orange Ex-Services Club Limited	11,916	-	-
9	Styrotec Pty Limited	11,490	-	-
10	Electrolux Home Products Pty Limited	9,627	47,403	3
11	Orange City Council – Cook Park	9,589	34,971	4
12	Wontama Retirement Village	9,146	13,355	13
13	Fitness Perfection	8,693	-	-
14	Orange City Council - Showground	8,454	-	-
15	Canobolas Caravan Park Pty Limited	8,440	-	-
16	Reg Prop SP 31035,57250,75426	8,370	-	-
17	Registered Proprietor SP 67170	8,213	8,689	20
18	Department of TAFE	7,546	13,963	11
19	Perpetual Limited	7,412	8,723	19
20	Orange City Council – Botanic Gardens	7,119	-	-

Source: (1) MWH (2007) Table 0-4

3.2.6 UNACCOUNTED FOR WATER

The Concept Study discusses data issues associated with quantifying the annual unaccounted for water (UFW). The consumption is underestimated and the production is overestimated, hence the calculated UFW was quite high and not representative of the system losses and unmetered properties alone. For the purposes of modelling in the Concept Study it was assumed that the UFW was 20% (MWH, 2007).

As discussed above, Orange City Council undertook a major leak and pressure reduction program in 2009 that has saved 500 ML/year; this would have been a component of the UFW. This would reduce the UFW to about 10% which is a typical allowance for leakage and unmetered activities. This lower value was used for water demand forecasting in the Evaluation Study.

3.3 FUTURE WATER DEMAND

3.3.1 BASELINE WATER PRODUCTION FORECAST

The DEUS Demand Management Decision Support System (DSS) version S1.1 was used to provide a water production demand forecast and evaluation of demand management measures. Baseline demand was determined using:

- an average per capita water production volume (climate corrected) of 404 L/p/d (refer to **Section 3.2.3**); and
- a population served with water of 36,654 in 2010.

The baseline demand takes into account the impact of the user pay pricing structure and system loss management as these measures are factored into the starting per capita demand. It does not include any demand side management measures. It therefore provides a worst case demand scenario.

The most significant future demand driver for OCC over the next 50 years is population growth. Annual growth rates of 0.8% pa (medium growth) and 1.1% pa (high growth) have been used for demand forecasting.

Baseline potable water forecasts at 10 year intervals are summarised in **Table 3.6**.

Table 3.6 – Orange forecast water demand – baseline

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	404	404	404	404	404	404
Average Annual (ML/a)	Medium: 0.8%pa	5,403	5,851	6,336	6,862	7,431	8,048
	High: 1.1%pa	5,403	6,028	6,724	7,502	8,369	9,337
Peak Day Water Demand (ML/d)	Medium: 0.8%pa	32.5	37.6	41.9	46.0	49.8	54.0
	High: 1.1%pa	32.5	38.8	44.5	50.4	56.2	62.7

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

3.3.2 LOW LEVEL DEMAND MANAGEMENT

The low level demand management measures include:

- User pay pricing structure;
- BASIX compliance;
- Community education/public awareness campaigns;
- Showerhead exchange program;
- Non-residential water audits;
- Water restriction implementation; and
- System loss management.

The assumptions used to assess the market penetration and demand reduction potential of these options are provided in **Table 2.3**.

Potable water forecasts at 10 year intervals for the low level demand management scenario are summarised in **Table 3.7**. It shows that the potable water demand in 2040 could be reduced by around 5% from the baseline case; or by about 350 to 390 ML/annum.

Peak day water demand remains within the capacity of the existing Icely Road water treatment plant (38 ML/day) for the medium growth rate until about 2025; reaching a peak of 44 ML/day in 2040. Under the high population growth the peak day water demand reaches 38 ML/day in around 2022.

Table 3.7 – Orange forecast water demand – low level demand management

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	404	386	384	383	382	381
Average Annual (ML/a)	Medium: 0.8%pa	5,403	5,595	6,028	6,509	7,035	7,612
	High: 1.1%pa	5,403	5,760	6,392	7,109	7,916	8,824
Peak Day Water Demand (ML/d)	Medium: 0.8%pa	32.5	36.1	40.1	44.0	47.6	51.5
	High: 1.1%pa	32.5	37.2	42.7	48.2	53.6	59.8

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

3.3.3 BUSINESS AS USUAL DEMAND MANAGEMENT

The Business as Usual (BAU) demand management includes:

- permanent water conservation measures; and
- an alternative water supply for the dual reticulation area.

The assumptions used to assess the market penetration and demand reduction potential of the permanent water conservation measures are provided in **Table 2.3**.

The Ploughmans Valley and North Orange (PVNO) development areas have the provision for a dual water supply scheme. This scheme provides non-potable water for toilet and outdoor use which reduces the potable water demand. The PVNO development area includes 4,500 residential allotments and, at the end of 2010, approximately 3,500 remain to be developed.

In 2011, the DoP granted approval for the use of harvested stormwater as an alternative supply for this system. As such, the impact of providing a non-potable water supply to the PVNO was assessed using the DSS model with the following data and assumptions.

Medium growth rate

- The population increase from 2010 to 2040 is 10,840 persons;
- At 2.48 people per household, this equates to around additional 4,400 households;
- Based on the remaining 3,500 lots, 80% of the projected population growth could occur in the PVNO development area;
- There is 10% infill development, therefore dual water is provided to 70% of all new development; and
- Dual water supply reduces household potable water consumption for toilets and outdoor use by 70%. This value is derived from modelling of the dual reticulation system.

High growth rate

- The population increase from 2010 to 2040 is 15,619 persons;
- At 2.48 people per household, this equates to around additional 6,300 households;
- Based on the remaining 3,500 lots, 55% of the projected population growth could occur in the PVNO development area;
- There is 10% infill development, therefore dual water is provided to 45% of all new development; and
- Dual water supply reduces household potable water consumption for toilets and outdoor use by 70%.

Potable water forecasts at 10 year intervals for the BAU demand management scenario are summarised in **Table 3.8**. It shows that the potable water demand in 2040 could be reduced by:

- around 450 ML/annum from the low level demand management case; or
- 800 to 850 ML/annum from the baseline case.

Peak day water demand remains within the capacity of the existing water treatment plant for the medium growth rate reaching 38 ML/day in 2040. Under the high population growth the peak day water demand reaches 42 ML/day by 2040; exceeding the existing plant capacity by 4 ML/day.

Table 3.8 – Orange forecast water demand – BAU

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	404	370	362	357	351	346
Average Annual (ML/a)	Medium: 0.8%pa	5,403	5,349	5,681	6,058	6,478	6,948
	High: 1.1%pa	5,403	5,515	6,045	6,655	7,347	8,135
Peak Day Water Demand (ML/d)	Medium: 0.8%pa	32.5	32.7	35.5	38.0	40.6	43.5
	High: 1.1%pa	32.5	33.9	37.9	42.0	46.4	51.4

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

3.3.4 HIGH LEVEL DEMAND MANAGEMENT

High level demand management would include the introduction of conservation pricing for residential users (on top of the BAU scenario). The assumptions used to assess the market penetration and demand reduction potential of this option are provided in **Table 2.3**.

Potable water forecasts at 10 year intervals for the medium level demand management scenario are summarised in **Table 3.9**. It shows that the potable water demand in 2040 could be reduced by:

- 220 to 240 ML/annum from the BAU case; or
- 1,020 to 1,090 ML/annum from the baseline case.

Peak day water demand remains within the capacity of the existing water treatment plant for the medium growth rate reaching 35.4 ML/day in 2040. Under the high population growth the peak day water demand reaches 39.2 ML/day; slightly exceeding the existing plant capacity in 2040.

Table 3.9 – Orange forecast water demand – high level demand management

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	404	356	349	344	339	334
Average Annual (ML/a)	Medium: 0.8%pa	5,407	5,157	5,474	5,838	6,244	6,698
	High: 1.1%pa	5,407	5,316	5,824	6,410	7,078	7,838
Peak Day Water Demand (ML/d)	Medium: 0.8%pa	32.5	30.5	33.1	35.4	37.9	40.6
	High: 1.1%pa	32.5	31.6	35.4	39.2	43.3	47.9

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

3.3.5 POTABLE WATER DEMAND SUMMARY

3.3.5.1 Annual Demand

Forecast trends in annual potable water demand under medium and high growth rates are shown in **Figure 6** and **Figure 7** respectively. These graphs represent the figures listed in **Tables 3.6** to **3.9** above.

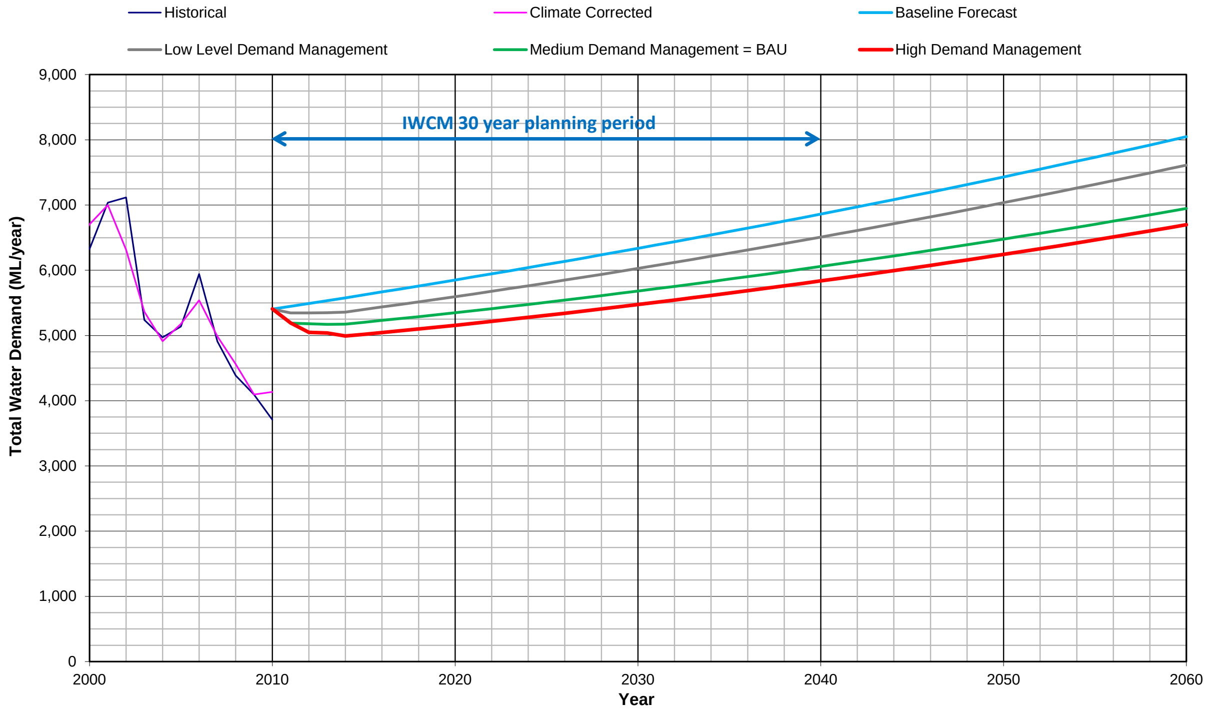


Figure 6: Forecast total annual potable water demand – city of Orange, medium growth

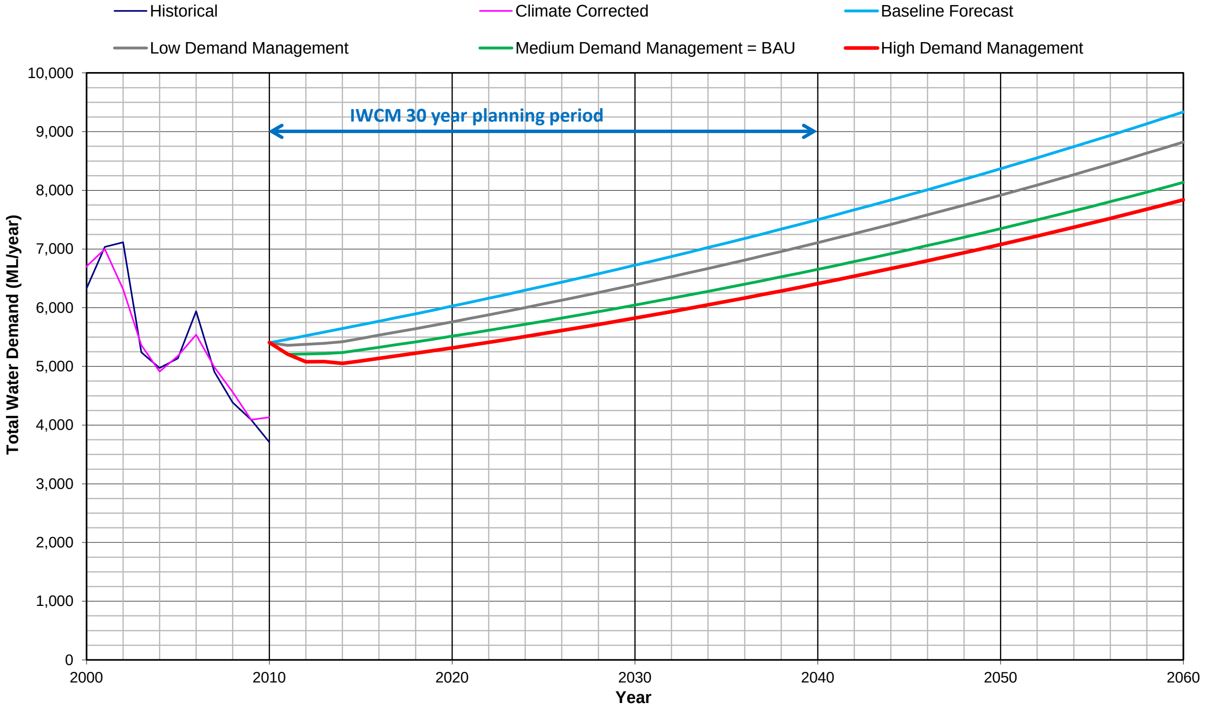


Figure 7: Forecast total annual potable water demand – city of Orange, high growth

3.3.5.2 Peak Day Potable Water Demand

Forecast trends in peak day potable water demand under medium and high growth rates are shown in **Figure 8** and **Figure 9** respectively. These graphs represent the figures listed in **Tables 3.6** to **3.9** above.

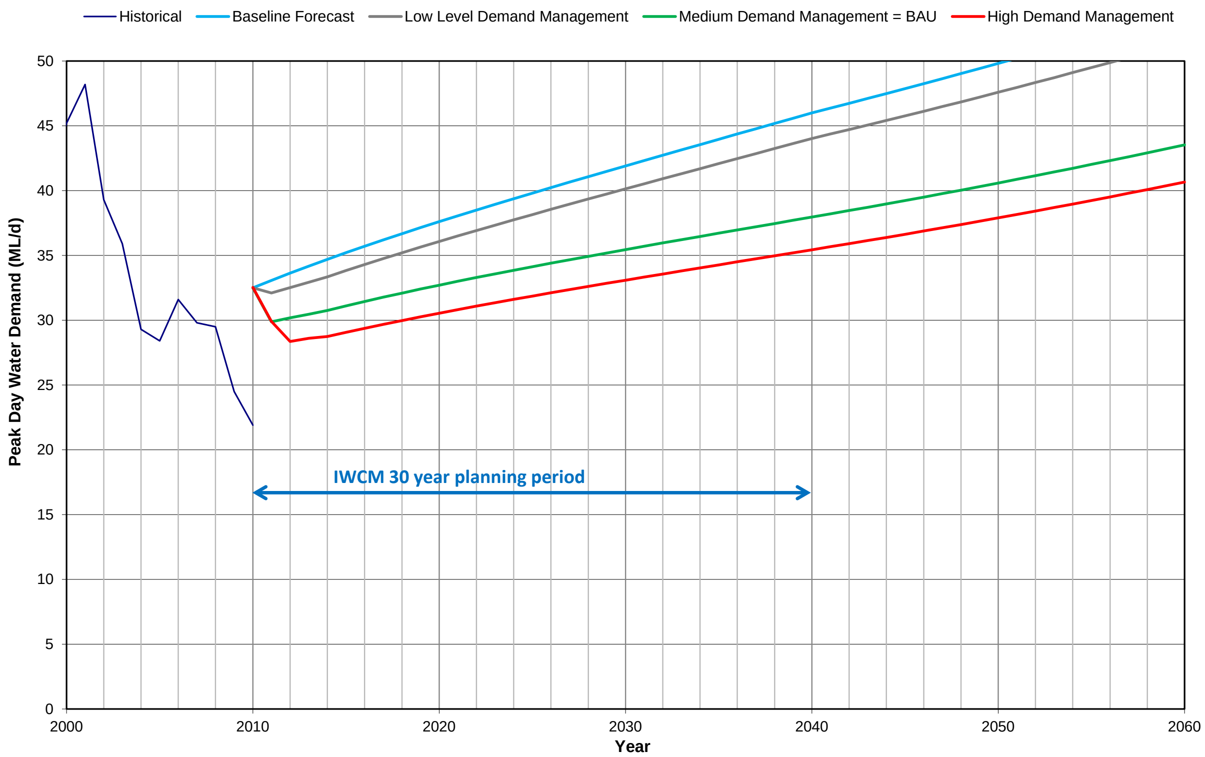


Figure 8: Forecast peak day potable water demand – city of Orange, medium growth

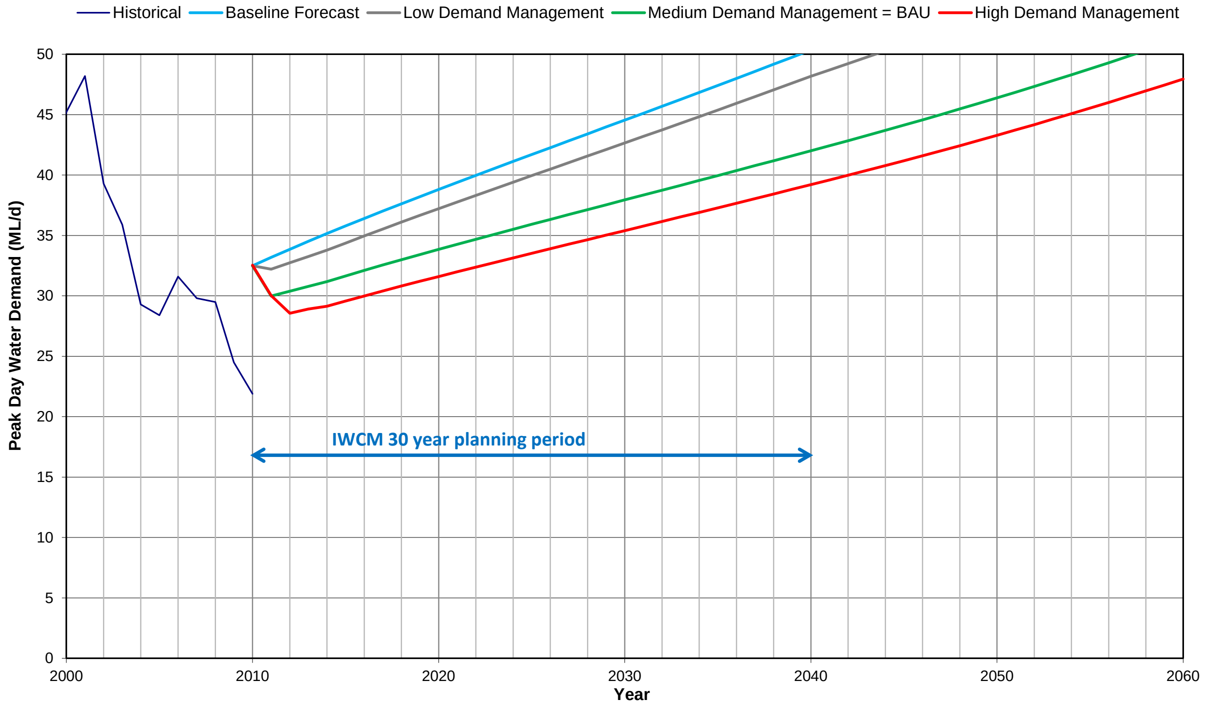


Figure 9: Forecast peak day potable water demand – city of Orange, high growth

3.3.6 IMPACT OF CLIMATE CHANGE ON WATER DEMAND

The Centroc Water Security Study (MWH, 2009) provided an assessment of the possible impact of climate change on water demand. For Orange, this assessment indicated that potable water demand could increase by around 7% or about 400 ML/year (in 2050).

It is therefore possible that the water demand forecasts presented in the preceding sections may increase.

3.4 EFFLUENT

3.4.1 EFFLUENT PRODUCTION

The DSS model includes an estimate of the forecast effluent production based on the potable water demand and data relating to the split between internal and external water use. The DSS model calculated the percentage of internal residential use as 62% with the overall percentage of internal use being around 65%. The DSS model calculates the:

- STP annual inflow;
- Average Dry Weather Flow (ADWF); and
- Wet Weather Flow (WWF).

Results for the baseline, BAU (medium level demand management) and high level demand management scenarios at 10 year intervals are summarised in **Table 3.10**.

Table 3.10 – Orange effluent production forecast

Scenario	Measure	Growth	2010	2020	2030	2040	2050	2060
Baseline	Annual inflow (ML/year)	Medium	3,481	3,587	3,795	4,064	4,401	4,766
		High	3,481	3,690	4,022	4,438	4,951	5,523
	ADWF (ML/day)	Medium	7.9	9.8	10.4	11.1	12.1	13.1
		High	7.9	10.1	11.0	12.2	13.6	15.1
	WWF (ML/day)	Medium	23.8	25.3	27.2	29.3	31.7	34.4
		High	23.8	26.1	28.8	32.0	35.7	39.9
BAU	Annual inflow (ML/year)	Medium	3,481	3,426	3,596	3,832	4,098	4,395
		High	3,481	3,521	3,806	4,180	4,614	5,110
	ADWF (ML/day)	Medium	7.9	7.7	8.0	8.5	9.1	9.7
		High	7.9	7.9	8.4	9.2	10.2	11.3
	WWF (ML/day)	Medium	23.8	24.9	26.6	28.7	34.6	38.3
		High	23.8	25.6	28.2	31.3	30.7	32.9
High Level Demand Management	Annual inflow (ML/year)	Medium	3,482	3,387	3,557	3,791	4,055	4,350
		High	3,482	3,481	3,765	4,135	4,565	5,056
	ADWF (ML/day)	Medium	8.0	7.6	7.9	8.4	8.9	9.6
		High	8.0	7.8	8.3	9.1	10.1	11.2
	WWF (ML/day)	Medium	23.8	24.8	26.5	28.6	30.5	32.8
		High	23.8	25.5	28.1	31.2	34.4	38.1

Forecast trends in annual effluent production under medium and high growth rates are shown in **Figure 10** and **Figure 11** respectively.

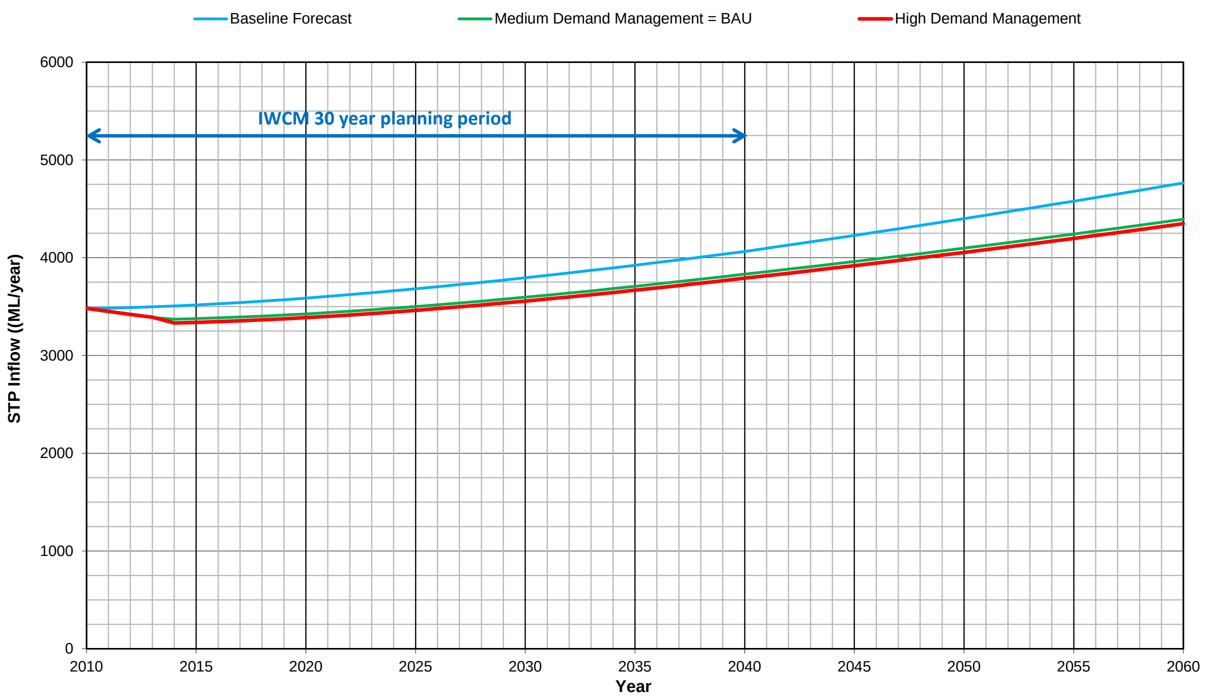


Figure 10: Forecast total annual effluent production – city of Orange, medium growth

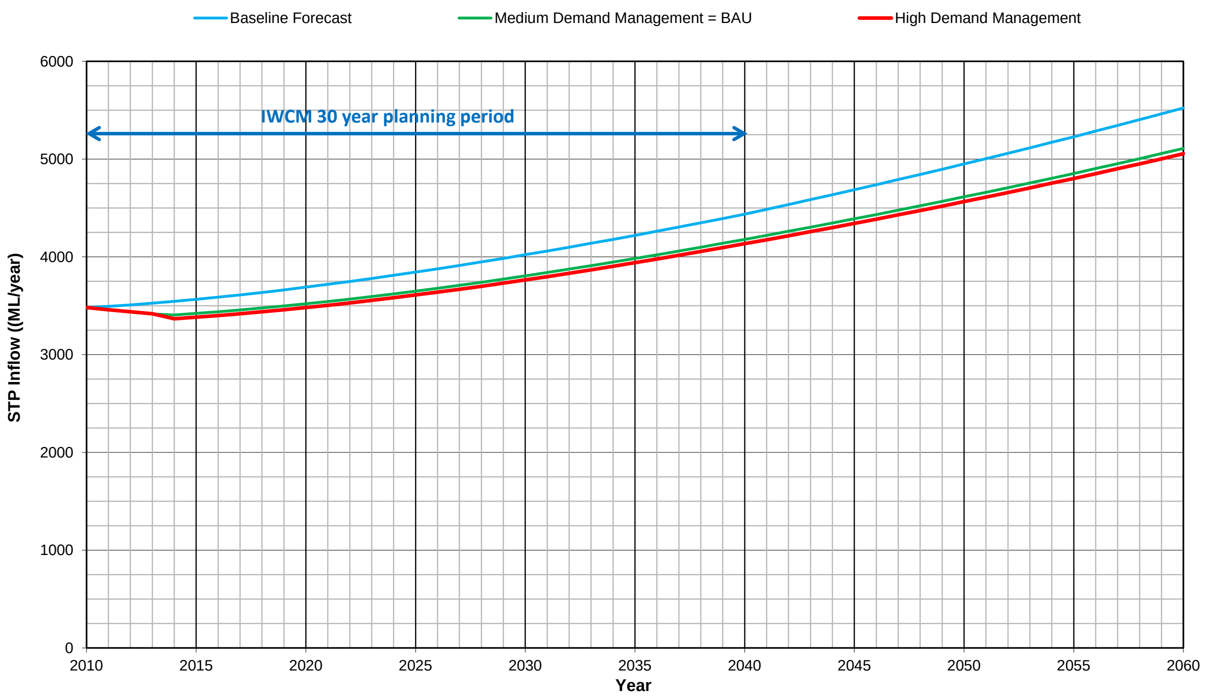


Figure 11: Forecast total annual effluent production – city of Orange, high growth

The Orange STP has a capacity of 60,000 EP or an approximate ADWF of 14 ML/day. The STP has capacity to provide full treatment up to approximately 43.2 ML/day (500 L/s).

The existing STP therefore has sufficient capacity to meet the forecast effluent production over the next 50 years under the BAU scenario.

3.4.2 EFFLUENT AVAILABILITY

Cadia Holding Pty Ltd undertake mining operations in or around Cadia (Cadia Valley Operations – CVO). Cadia Holdings is under contract with Orange City Council to receive recycled water from the Orange STP. This agreement gives CVO access to a minimum 10 ML/day with the ability to take up to 13 ML/day (the capacity of the transfer system) if the excess above 10 ML/day is not required by Council. The agreement provides CVO with access to at least 3,650 ML/year of treated effluent.

The water supply agreement started in December 1997 and was set to continue for the life of the mine. A recently approved expansion of mining operations has extended the life of the mine, and the need for the supply of treated effluent, until at least 2030. OCC and Cadia Holdings are currently negotiating a new water supply agreement including possibly placing a financial value on the recycled water.

This agreement reuses the majority of the treated effluent produced at the Orange STP. Data for the period 2001 to 2011 is provided in **Table 3.11** and shows an average of 72% of the effluent produced over this period was transferred to CVO. The annual transfer ranged from 28% to 94% and averaged 8.2 ML/day over this period. The low transfer year corresponded with a very high rainfall period and on site water sources for the mine were at or near capacity which reduced the need for effluent.

As indicated in **Table 3.10** the annual STP inflow from an annual water production of 5,400 ML/year is 3,481 ML/year. This indicates that with the reduced water production there is less effluent available and it is unlikely that CVO will transfer 10 ML/day. Modelling was used to estimate the average transfer over the next 20 years (to 2030) based on the forecast water production for the BAU scenario. This assessment determined an average transfer of 9.5 ML/day (3,467 ML/year).

The availability of spare treated effluent after meeting an average supply of 9.5 ML/day is indicated on **Figure 12** for the BAU scenario. This indicates that there is unlikely to be any consistent quantities of spare treated effluent until about 2025 under the medium growth rate and 2020 under the high growth rate.

Table 3.11 – Annual effluent transfer to CVO

Year	STP Inflow ML/year	Export to CVO ML/year	% Reuse
2001-2002	4,866	3,104	64%
2002-2003	4,011	3,033	76%
2003-2004	4,652	3,362	72%
2004-2005	4,445	3,360	76%
2005-2006	4,197	3,121	74%
2006-2007	2,847	2,665	94%
2007-2008	3,629	3,367	93%
2008-2009	3,565	3,063	86%
2009-2010	3,310	3,026	91%
2010-2011	5,924	1,674	28%
Ten year totals	41,446	29,775	72%

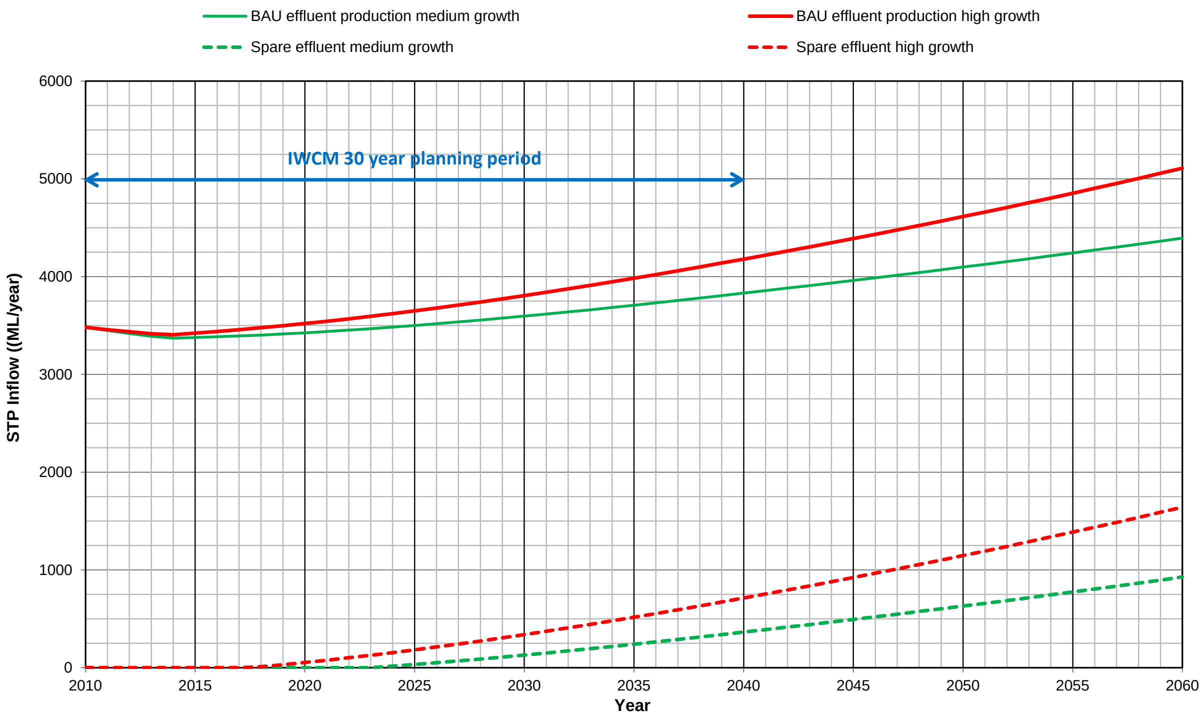


Figure 12: BAU treated effluent production and availability

3.5 ORANGE BAU SUMMARY

This section provides a water cycle summary for the BAU scenario in Orange. **Figure 13** shows:

- The total water demand;
- The forecast treated effluent production; and
- The volume of treated effluent available after reuse by Cadia Valley Operations.

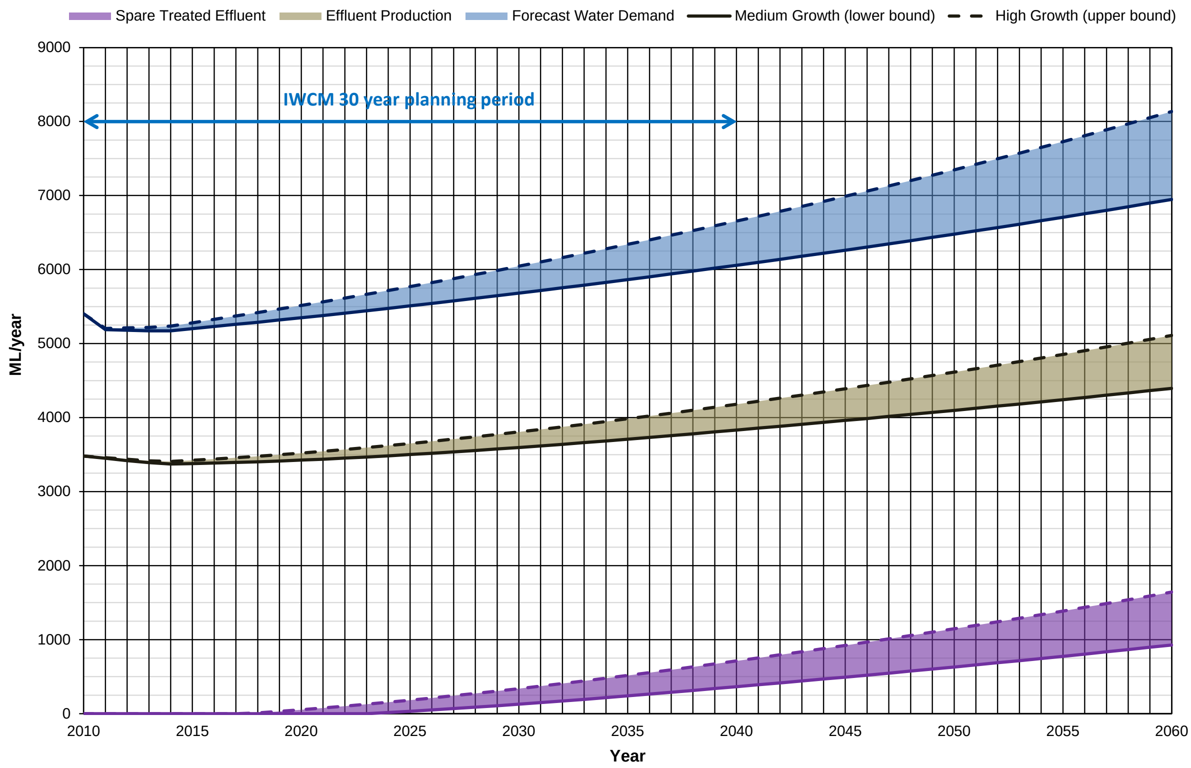


Figure 13: BAU water demand and effluent production summary for Orange

Putting the demand forecast into perspective

The total per capita water demand presented in Tables 3.6 to 3.9 includes residential and non-residential (i.e. commercial, industrial, public and opens space) use. The residential component of the total daily per capita demand is shown below for the 10 year intervals.

	2010	2020	2030	2040	2050	2060
Total per capita water demand (L/p/d)	404	370	362	357	351	346
Residential water demand (L/p/d)	259	236	232	228	225	223

Council's demand targets for water restrictions are:

Level 1	260 L/p/d
Level 2	240 L/p/d
Level 3	220 L/p/d
Level 4	200 L/p/d
Level 5	160 L/p/d
Level 5A	150 L/p/d

These targets indicate that the 2010 residential demand of 259 L/p/d is a good estimate of unrestricted demand, being around the Level 1 restriction target. The proposed water demand management measures in the BAU scenario reduce the residential consumption to 228 L/p/d in 2040 – this sits between the current target for Level 2 and 3 water restrictions. The 2060 forecast is approaching the Level 3 water restriction target.

This comparison indicates that the forecast water demand will require a change in community water consumption and, in the longer term, a revision to the restriction targets. Such a change is evident already as the community has not significantly increased water consumption following easing of restrictions from Level 5 to Level 2 in August 2010.

Figure 14 shows the forecast peak daily water production for the BAU scenario. Peak day water demand remains within the capacity of the existing water treatment plant for the medium growth rate until about 2040. Under the high population growth the peak day water demand reaches 38 ML/day in around 2030 and is forecast to be 42 ML/day by 2040.

The potable water distribution system in Orange includes nine service reservoirs throughout the city which have total clear water storage of 85.9 ML. This means that short terms periods of peak water demand above the plant capacity can be tolerated by the system storage.

Figure 15 shows the number of days of supply provided through system storage when peak daily demand exceeds plant capacity. Experience in Orange is that peak days do not usually last for more than four or five days. At a peak demand of 42 ML/day, the system has storage capacity of around 20 days. It is therefore considered that the existing WTP and distribution system has sufficient capacity to meet the forecast peak day demand under the high growth rate for the next 30 years.

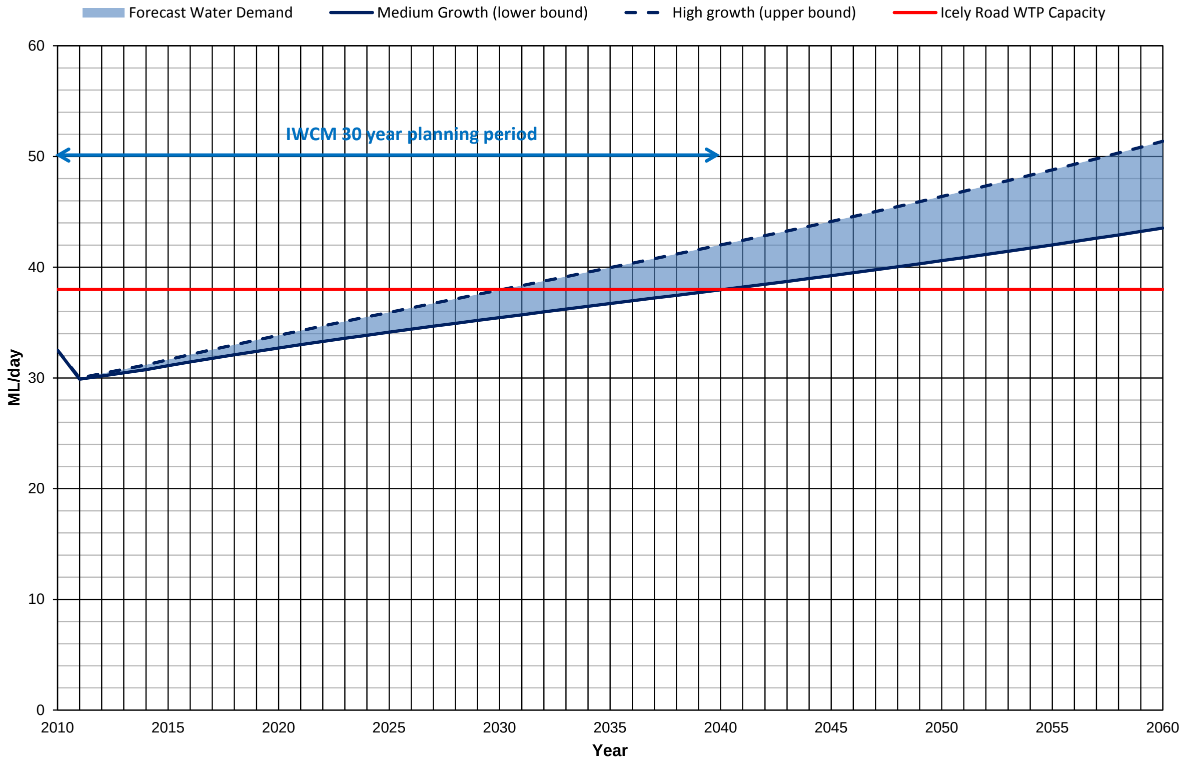


Figure 14: Forecast peak daily potable water demand for Orange

Orange City Council has the option of re-commissioning the Spring Creek WTP. This plant had a capacity to treat 12 ML/day which combined with the Icely Road WTP would provide a water treatment system capable of meeting forecast peak demand until around 2060.

The existing Orange sewage treatment plant has sufficient capacity to meet the forecast effluent production over the next 50 years under the BAU scenario.

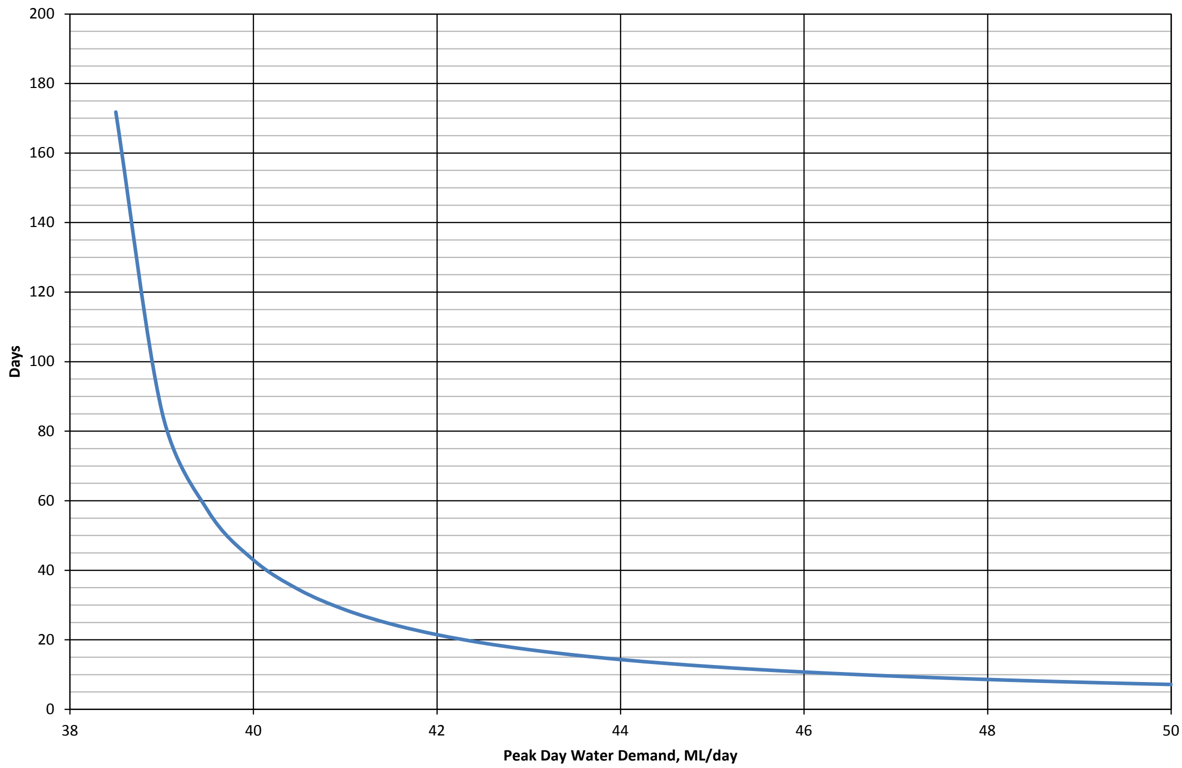


Figure 15: Days provided by system storage when peak daily water demand exceeds plant capacity

3.6 COMPARISON WITH OTHER DEMAND FORECASTS

The IWCM Concept Study (MWH, 2007) and Centroc regional water security study (MWH, 2009) both provided future water demand projections for Orange. These are illustrated on **Figure 16** and compared to the BAU scenario water forecasts developed from this current assessment. The former studies used the following population growth:

- IWCM Concept Study (MWH, 2007) – 0.57%pa
- Centroc study (MWH, 2009) – 0.46%pa

The Centroc water demand forecast presented on **Figure 16** include the recommended additional conservation programs as detailed in MWH (2009).

Comparison of the forecast water demand from previous two studies with the forecast generated for the IWCM Evaluation Study shows the following:

- The IWCM Evaluation Study adopts a significantly lower starting water demand;
- The forecast water demand generated for the IWCM Evaluation Study is significantly lower than that generated in the IWCM Concept Study; and
- The forecast water demand for 2059 generated for the IWCM Evaluation Study is lower than that used in the Centroc study (once the Centroc study data is adjusted to the adopted lower and upper population growth of 0.8%pa and 1.1%pa respectively).

This indicates that the IWCM Evaluation Study water demand forecasts are lower than the previous two studies. It also reflects that Council is expecting Orange to become significantly more water efficient.

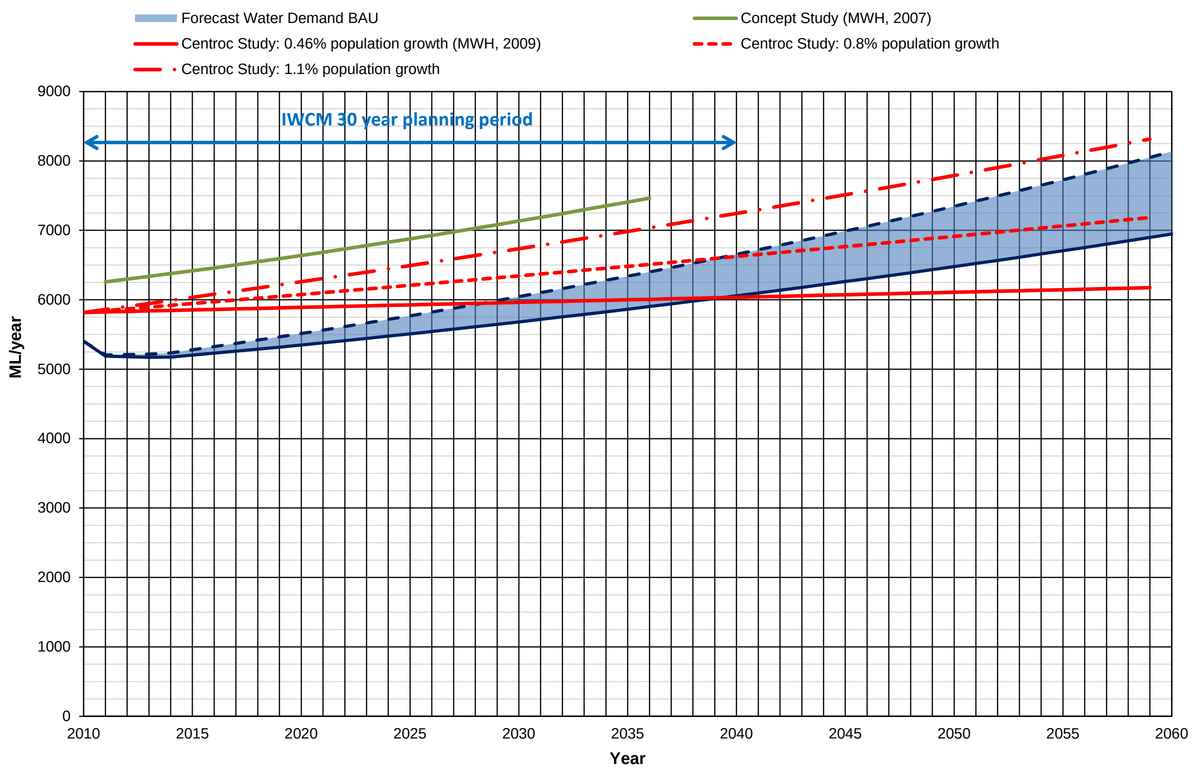


Figure 16: Comparison of forecast water demand – city of Orange

Spring Hill and Lucknow

4.1 POPULATION

4.1.1.1 Population and Population Served

Available census data for the villages of Spring Hill and Lucknow are provided in **Table 4.1**. This data shows a steady population during the 2001-2006 intercensal period. It was assumed that 100% of the village population was serviced with water and sewerage.

Table 4.1 – Population data – Spring Hill and Lucknow

Census Year	Spring Hill	Lucknow
2001	282	na
2006	276	145

Source: http://www.abs.gov.au/websitedbs/d3310114.nsf/home/census+data

4.1.1.2 Population Growth

Population data for Spring Hill and Lucknow show the village populations remained steady between 2001 and 2006.

Council has adopted a lower limit of zero and upper of 0.8% pa growth for Spring Hill and Lucknow villages.

4.2 EXISTING DEMAND – SPRING HILL AND LUCKNOW

4.2.1 DAILY HISTORICAL DEMAND

Climate correction was carried out for the Spring Hill and Lucknow production data to correct the production record for the influence of climate using the DEUS Water Demand Trend Tracking and Climate Correction software (v10). The observed and climate corrected daily production from 1 January 2000 to 31 December 2010 is shown in **Figure 17**. The water restriction regime since January 2003 and implementation of user pay water pricing are also indicated.

Prior to the introduction of user pay pricing, the climate corrected per capita water production ranged from 533 L/p/d to 605 L/p/d. This dropped following the introduction of Stage 1 user pay in July 2002 falling to around 460 L/p/d just prior to the Stage 2 user pay system being introduced in July 2004. However water demand through this period was also reduced by a water restriction regime that commenced with Level 1 in January 2003 and gradually increased to Level 3 in June 2004. Interestingly, the Stage 2 user pay scheme did not appear to have a significant effect on water demand with demand rising to around 480 L/p/d.

The climate corrected water demand fell to around 405 L/p/d through to the end of 2005 before starting to increase as water restrictions were eased and then lifted at the start of December 2005. The climate corrected daily production increased to 432 L/p/d in June 2006 before the water restriction regime, that commenced in October 2006 and rose to Level 5 in May 2008, reduced demand to 317 L/p/d by the end of 2010.

The daily production data shows that the peak day to climate corrected daily demand ratio is approximately 2.1:1.

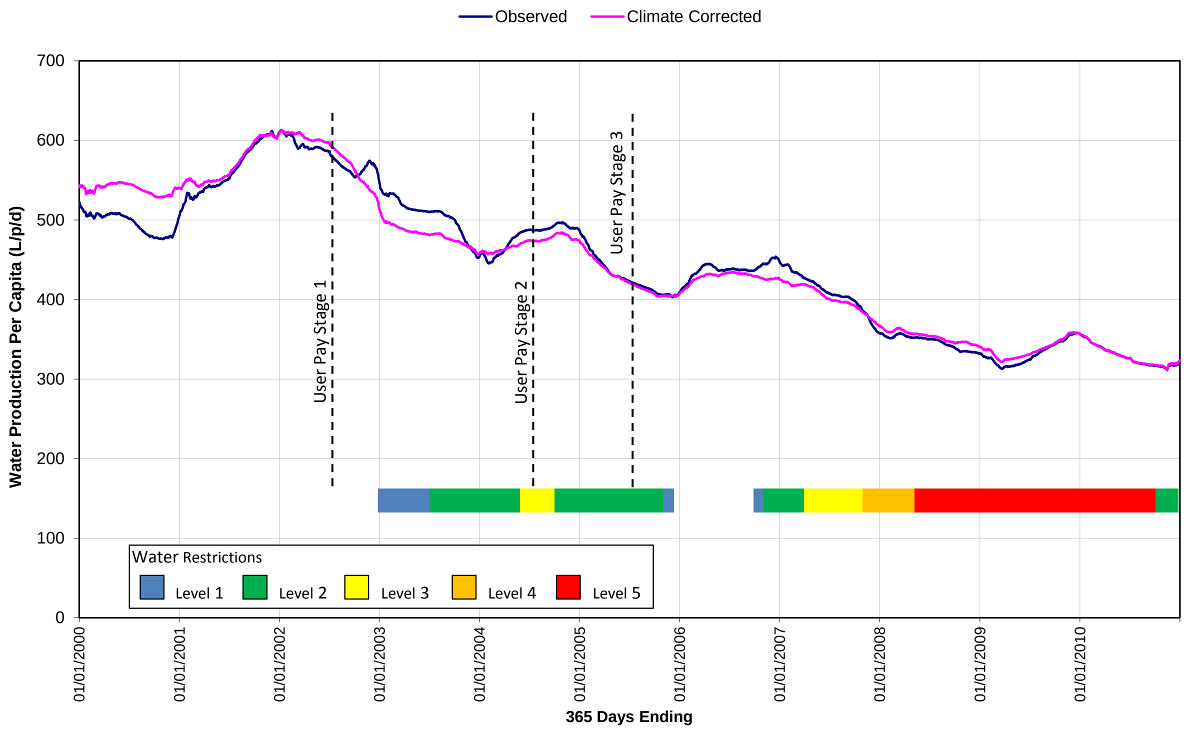


Figure 17: Observed and climate corrected demand – Spring Hill and Lucknow

4.2.2 BASELINE DEMAND

A climate corrected current per capita demand is required as the starting point for baseline demand estimates.

The period from December 2005 through to October 2006 is the only period of observed data that has no restrictions under the user pay water pricing system. It is considered to be the best estimate of current unrestricted demand. The per capita demand through this period rose to 432 L/p/d in June 2006. Therefore the adopted baseline per capita water demand was set at 432 L/p/d in 2010.

4.3 FUTURE WATER DEMAND

4.3.1 BASELINE WATER PRODUCTION FORECAST

The DEUS Demand Management Decision Support System (DSS) version S1.1 was used to provide a water production demand forecast and evaluation of demand management measures. Baseline demand was determined using:

- an average per capita water production volume (climate corrected) of 432 L/p/d (refer to **Section 4.2.2**); and
- a population served with water of 425 in 2010.

The most significant future demand driver for these villages over the next 50 years is population growth. Annual growth rates of zero and 0.8% have been used for demand forecasting.

Baseline potable water forecasts at 10 year intervals are summarised in **Table 4.2**.

Table 4.2 – Spring Hill and Lucknow forecast water demand – baseline

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	432	432	432	432	432	432
Average Annual (ML/a)	zero	67	67	67	67	67	67
	0.8% pa	67	73	79	85	92	100
Peak Day Water Demand (ML/d)	zero	0.39	0.40	0.41	0.41	0.41	0.41
	0.8% pa	0.39	0.43	0.48	0.52	0.57	0.62

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

Spring Hill and Lucknow are supplied with water from four boreholes. The water is chlorinated and pumped to storage tanks from which it is distributed to the villages. From Spring Hill reservoir (capacity 0.33 ML), the village of Spring Hill is serviced and a portion of the water is gravity fed to Lucknow reservoir (capacity 0.2 ML). Both reservoirs service their reticulation systems through gravity feed.

The four bores have a combined capacity of 6.7 L/s or 0.58 ML/day. Some peak day flow above this capacity could be provided by the service reservoirs. Analysis of the baseline potable water forecast shows that the peak day water demand remains within the capacity of the bores, slightly exceeding the capacity under the high population growth in 2060.

The volume of water extracted from the bore system for town water supply in any one year is limited by licence to 75 ML/year (licence 80BL025285). Current annual demand is within this limit. Baseline potable water forecasts indicate that this volume limit could be exceeded under the high growth scenario by around 2024.

4.3.2 LOW LEVEL DEMAND MANAGEMENT

The low level demand management measures include:

- User pay pricing structure;
- BASIX compliance;
- Community education/public awareness campaigns;
- Showerhead exchange program;
- Non-residential water audits; and
- Water restriction implementation.

The assumptions used to assess the market penetration and demand reduction potential of these options are provided in **Table 2.3**.

Potable water forecasts at 10 year intervals for the low level demand management scenario are summarised in **Table 4.3**. It shows that the potable water demand in 2040 could be reduced by around 6% from the baseline case; or by about 4 to 5 ML/annum.

Analysis of the low level demand management scenario shows that the peak day water demand remains within the capacity of the bores.

The annual water extraction for town water supply would exceed the licence limit after 2031 under the high growth scenario.

Table 4.3 – Spring Hill and Lucknow forecast water demand – low level demand management

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	432	412	410	409	408	407
Average Annual (ML/a)	zero	67	64	64	63	63	63
	0.8% pa	67	69	74	80	87	94
Peak Day Water Demand (ML/d)	zero	0.39	0.38	0.39	0.39	0.39	0.39
	0.8% pa	0.39	0.42	0.46	0.50	0.54	0.59

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

4.3.3 BUSINESS AS USUAL DEMAND MANAGEMENT

The Business as Usual (BAU) demand management would include the use of permanent water conservation measures (on top of the low level demand management scenario). The assumptions used to assess the market penetration and demand reduction potential of this option is provided in **Table 2.3**.

Potable water forecasts at 10 year intervals for the BAU demand management scenario are summarised in **Table 4.4**. It shows that the potable water demand in 2040 could be reduced by:

- 3 to 4 ML/annum from the low level demand management case; or
- 7 to 9 ML/annum from the baseline case.

Peak day water demand remains within the capacity of the existing bores. The annual water extraction for town water supply would slightly exceed the licence limit after 2038 under the high growth scenario.

Table 4.4 – Spring Hill and Lucknow forecast water demand – BAU

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	432	392	389	388	387	386
Average Annual (ML/a)	zero	67	61	60	60	60	59
	0.8% pa	67	66	71	76	82	89
Peak Day Water Demand (ML/d)	zero	0.39	0.35	0.36	0.36	0.36	0.36
	0.8% pa	0.39	0.38	0.42	0.46	0.50	0.54

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

4.3.4 HIGH LEVEL DEMAND MANAGEMENT

High level demand management would include the introduction of conservation pricing for residential users (on top of the medium level demand management scenario). The assumptions used to assess the market penetration and demand reduction potential of this option is provided in **Table 2.3**.

Potable water forecasts at 10 year intervals for the high level demand management scenario are summarised in **Table 4.5**. It shows that the potable water demand in 2040 could be reduced by:

- 3 to 4 ML/annum from the BAU demand management case; or
- 10 to 13 ML/annum from the baseline case.

Peak day water demand remains within the capacity of the existing bores for both the zero and high growth rates. The forecast annual water extraction remains within the licence limit of 75 ML/year to 2040 but exceeds it under the high population growth in about 2046.

Table 4.5 – Spring Hill and Lucknow forecast water demand – high level demand management

Demand	Growth	2010	2020	2030	2040	2050	2060
Per Capita Water Demand (L/p/d)	na	432	370	367	365	364	363
Average Annual (ML/a)	zero	67	57	57	57	56	56
	0.8% pa	67	62	66	72	77	83
Peak Day Water Demand (ML/d)	zero	0.39	0.32	0.33	0.33	0.33	0.33
	0.8% pa	0.39	0.35	0.39	0.42	0.46	0.50

The total per capita water demand includes non-residential use (i.e. commercial, industrial, public and open space water)

4.3.5 POTABLE WATER DEMAND SUMMARY

4.3.5.1 Annual Demand

Forecast trends in annual potable water demand under zero and high growth rates are shown in **Figure 18** and **Figure 19** respectively. These graphs represent the figures listed in **Tables 4.2** to **4.5** above.

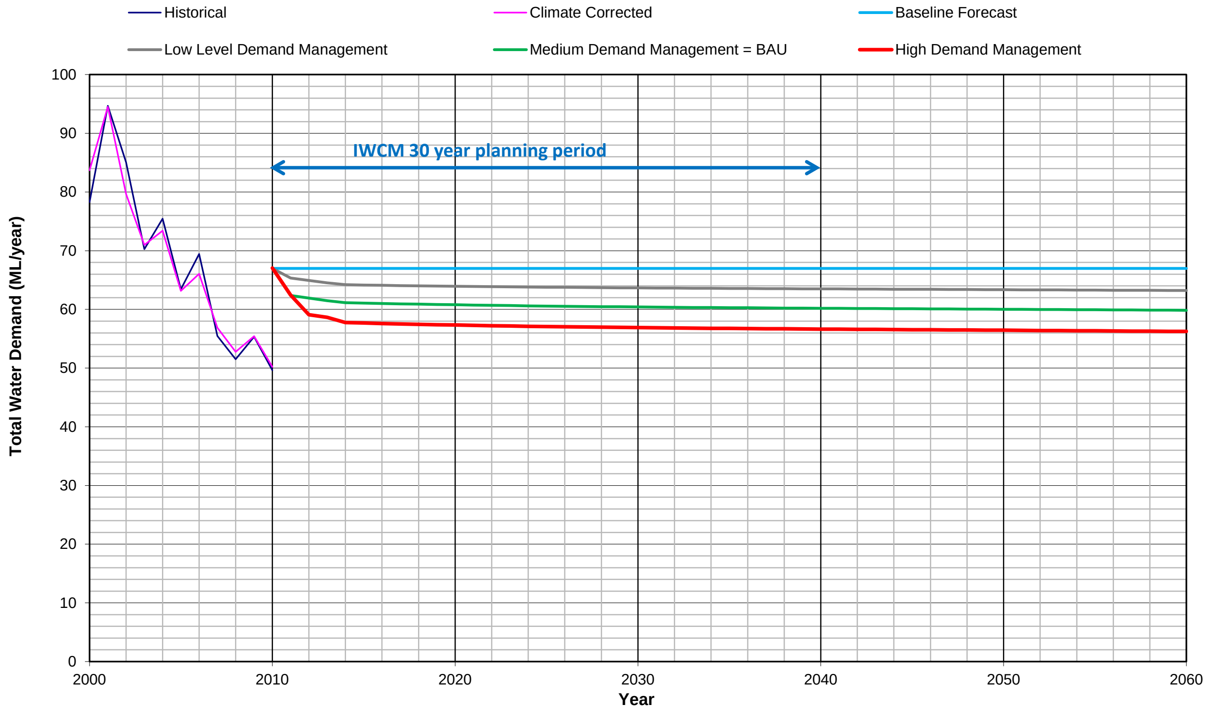


Figure 18: Forecast total annual potable water demand – Spring Hill and Lucknow, no growth

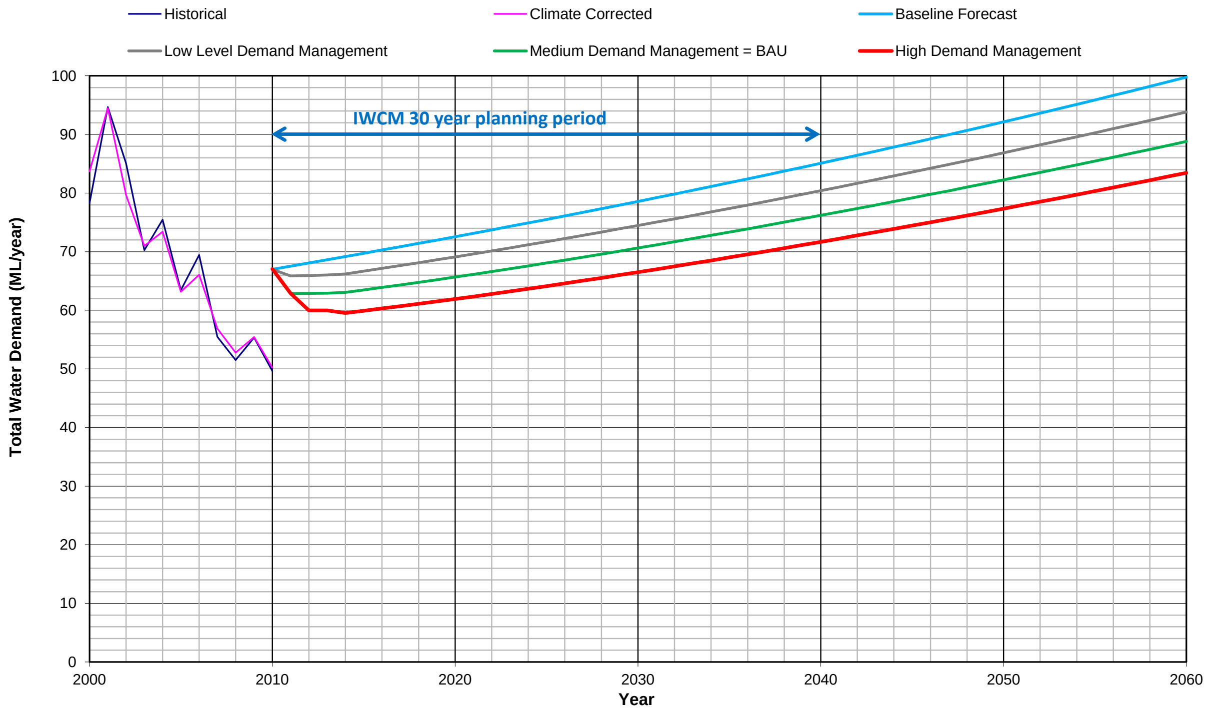


Figure 19: Forecast total annual potable water demand – Spring Hill and Lucknow, high growth

4.3.5.2 Peak Day Potable Water Demand

Forecast trends in peak day potable water demand under zero and high growth rates are shown in **Figure 20** and **Figure 21** respectively. These graphs represent the figures listed in **Tables 4.2** to **4.5** above.

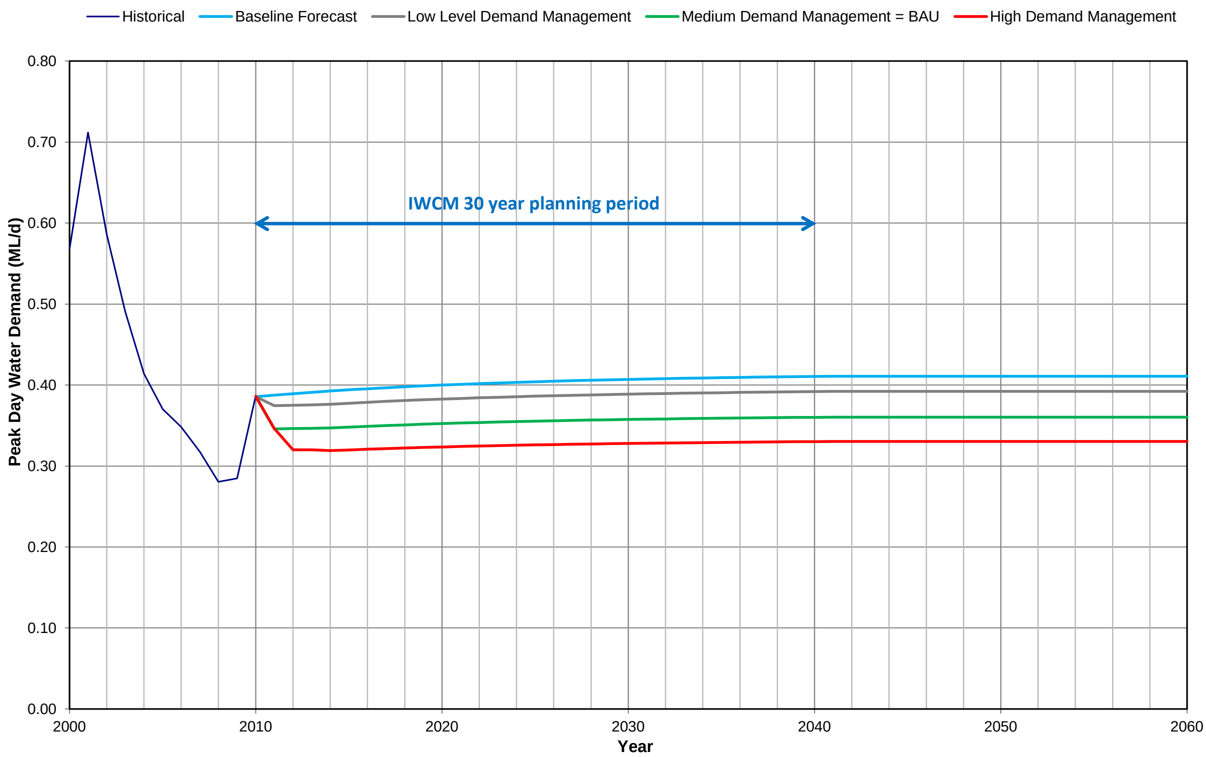


Figure 20: Forecast peak day potable water demand – Spring Hill and Lucknow, no growth

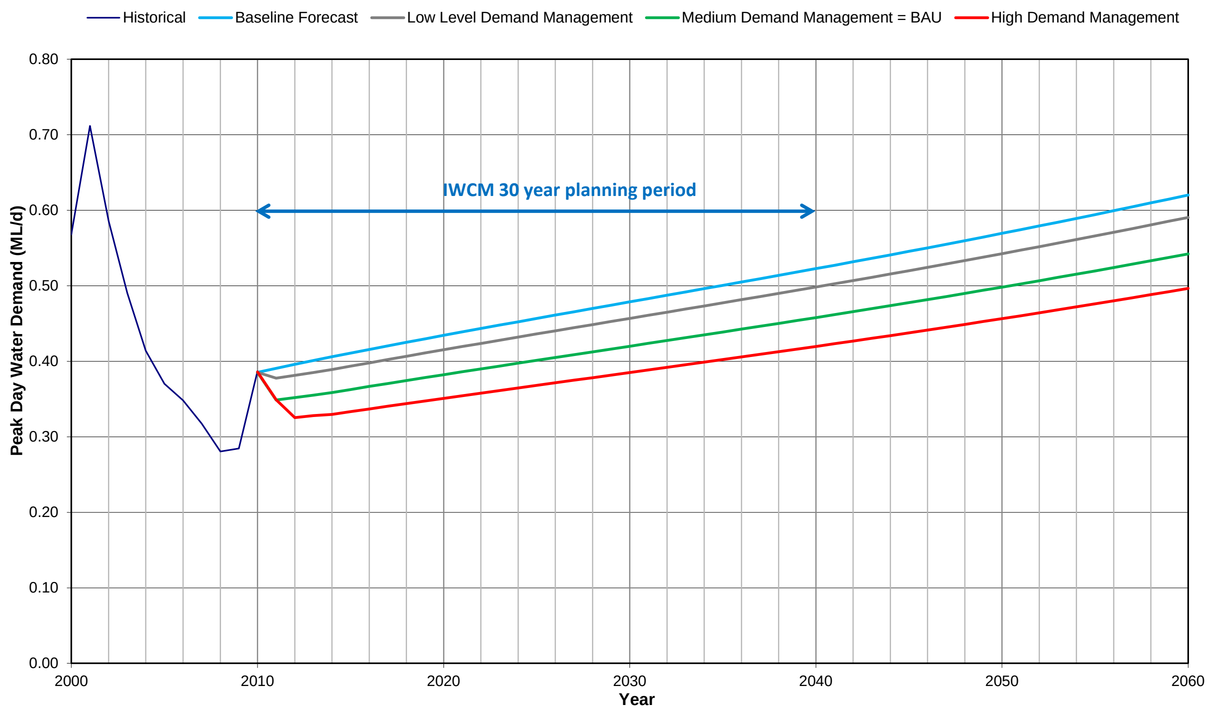


Figure 21: Forecast peak day potable water demand – Spring Hill and Lucknow, high growth

4.4 EFFLUENT

4.4.1 EFFLUENT PRODUCTION

The DSS model includes an estimate of the forecast effluent production based on the potable water demand and data relating to the split between internal and external water use. The DSS model calculated the percentage of internal residential use as 46%. The DSS model calculates the:

- STP annual inflow;
- Average Dry Weather Flow (ADWF); and
- Wet Weather Flow (WWF).

Results for the baseline, BAU and high level demand management scenarios at 10 year intervals are summarised in **Table 4.6**.

The DSS model results show that annual effluent production is forecast to range between 27 and 44 ML/year with ADWF ranging between 0.09 to 0.12 ML/day.

The Spring Hill STP has a capacity of 1,000 EP or an approximate ADWF of 0.28 ML/day. The STP has capacity to provide full treatment up to approximately 2.3 ML/day.

The existing STP therefore has sufficient capacity to meet the forecast effluent production over the next 50 years.

Table 4.6 – Spring Hill and Lucknow effluent production forecast

Scenario	Measure	Growth	2010	2020	2030	2040	2050	2060
Baseline	Annual inflow (ML/year)	Zero	34	31	30	30	30	30
		0.8%	34	34	35	38	41	44
	ADWF (ML/day)	Zero	0.08	0.09	0.08	0.08	0.08	0.08
		0.8%	0.08	0.09	0.10	0.10	0.11	0.12
	WWF (ML/day)	Zero	0.23	0.22	0.22	0.22	0.22	0.22
		0.8%	0.23	0.24	0.26	0.28	0.30	0.33
BAU	Annual inflow (ML/year)	Zero	34	30	28	28	28	28
		0.8%	34	32	33	35	38	41
	ADWF (ML/day)	Zero	0.08	0.07	0.06	0.06	0.06	0.06
		0.8%	0.08	0.07	0.07	0.08	0.08	0.09
	WWF (ML/day)	Zero	0.23	0.22	0.22	0.21	0.21	0.21
		0.8%	0.23	0.24	0.25	0.27	0.29	0.32
High Level Demand Management	Annual inflow (ML/year)	Zero	34	29	28	27	27	27
		0.8%	34	31	32	34	38	41
	ADWF (ML/day)	Zero	0.08	0.06	0.06	0.06	0.06	0.06
		0.8%	0.08	0.07	0.07	0.07	0.08	0.09
	WWF (ML/day)	Zero	0.23	0.22	0.21	0.21	0.21	0.21
		0.8%	0.23	0.23	0.25	0.27	0.29	0.32

4.5 SPRING HILL AND LUCKNOW BAU SUMMARY

This section provides a water cycle summary for the BAU scenario for the villages of Spring Hill and Lucknow. **Figure 22** shows:

- The total water demand; and
- The forecast treated effluent production.

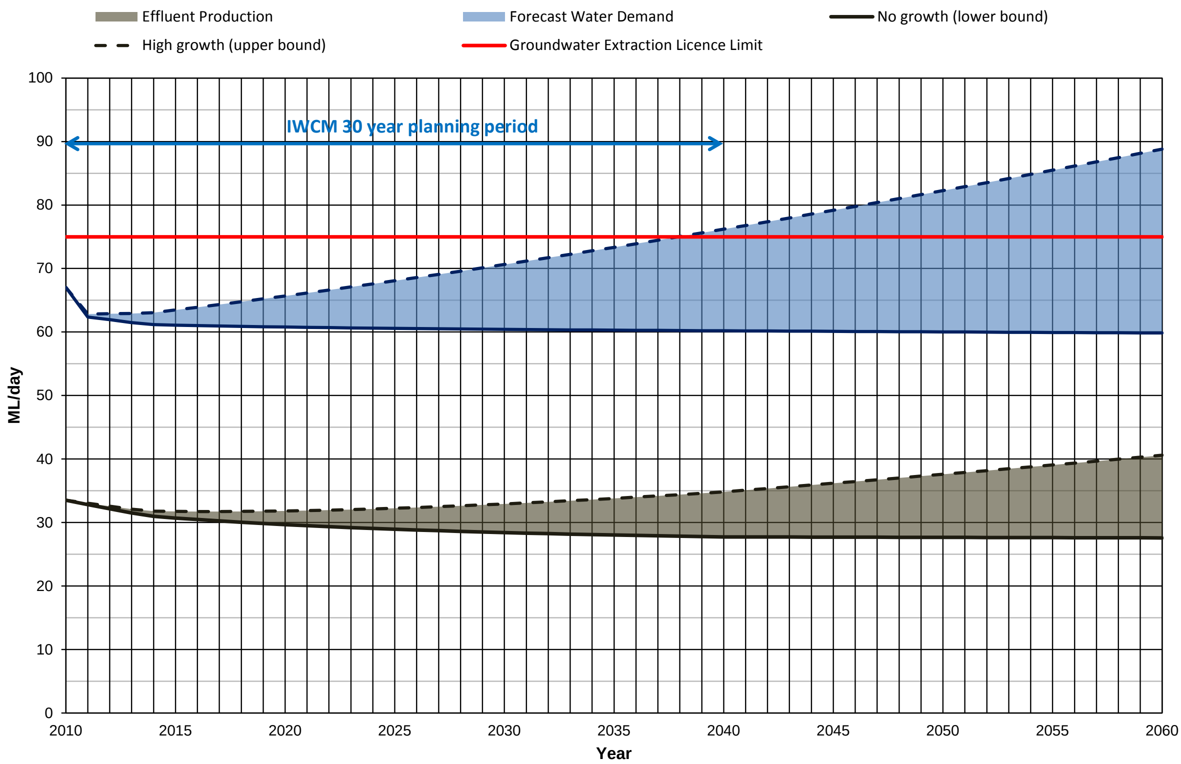


Figure 22: BAU water demand and effluent production summary for Spring Hill and Lucknow

The forecast water demand for the high growth scenario shows that the groundwater extraction licence limit could be exceeded by around 2038.

Figure 23 shows the forecast peak daily water production for the BAU scenario. Peak day water demand remains within the capacity of the existing bores.

The existing Spring Hill STP has sufficient capacity to meet the forecast effluent production over the next 50 years.

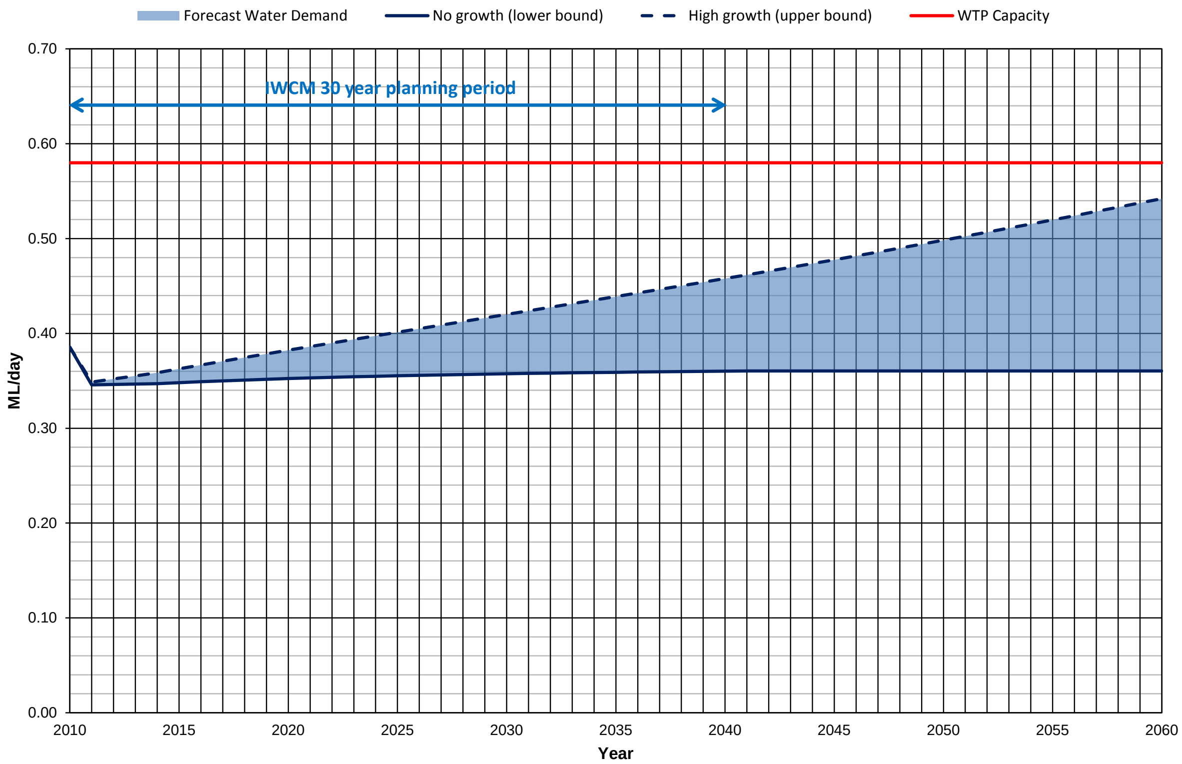


Figure 23: Forecast peak daily potable water demand for Spring Hill and Lucknow

References

Department of Energy, Utilities and Sustainability (2002) *Integrated Water Cycle Management Water Demand Trend Tracking and Climate Correction (Version 10)*. New South Wales Government.

Department of Energy, Utilities and Sustainability (2006) *Integrated Water Cycle Management Demand Side Management Decision Support System - Simplified (Version S1.1)*. New South Wales Government.

Leyshon Consulting (2005) *OCC Business Centre Strategy Review Study.*

MWH (2007) *Orange Integrated Water Cycle Management Concept Study*.

MWH (2009) *Centroc Water Security Study*.

Newplan (2010) *Orange Sustainable Settlement Strategy Update* (Draft).

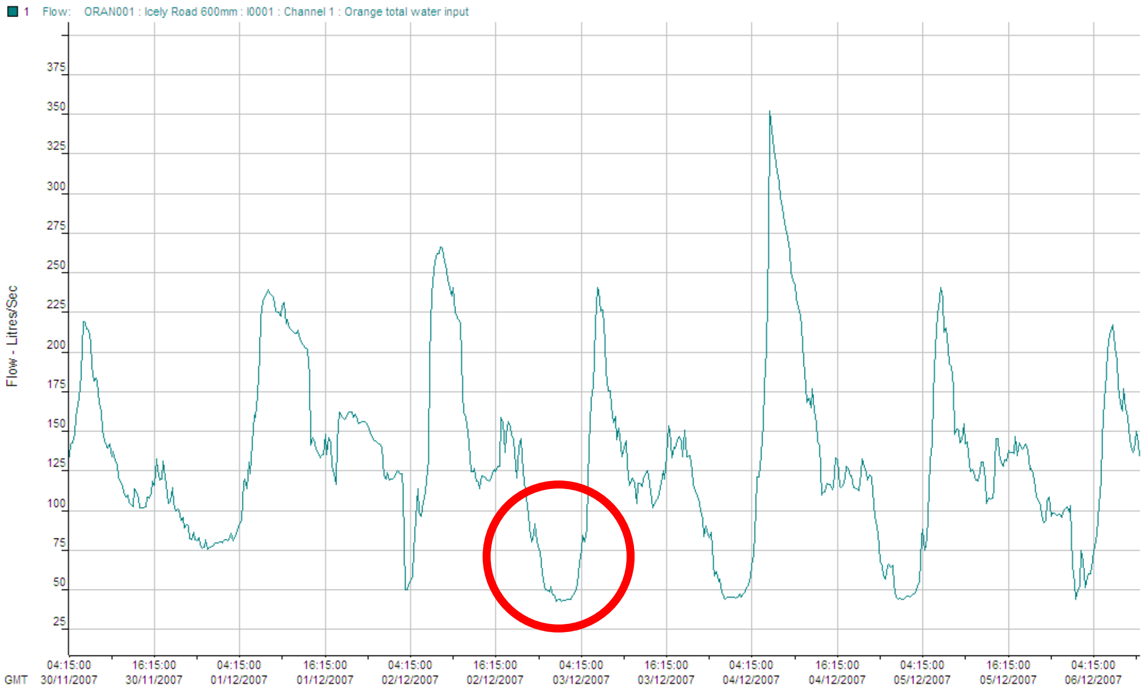
Parsons Brinkerhoff (2004) *Orange Sustainable Settlement Strategy.*

Western Research Institute (2008) *CENTROC Population Projections.*

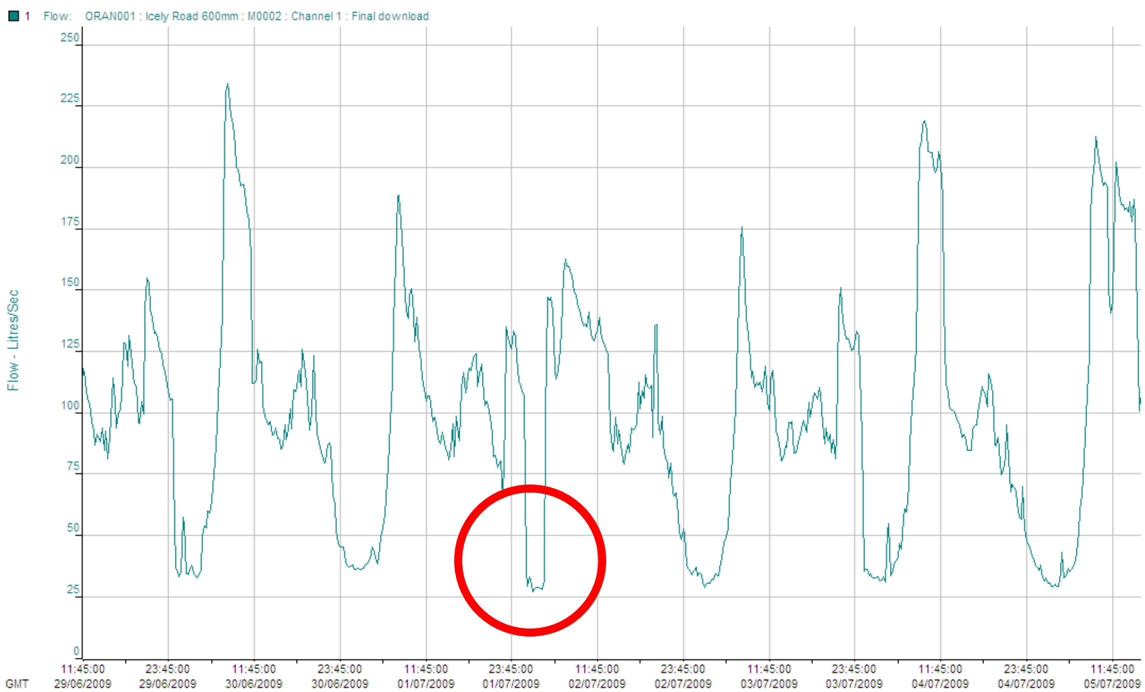
Appendix A

LEAK REDUCTION PROGRAM

Orange City Council – Water Loss project Results



Before: Minimum Night Flow recorded at 42.8 Litres per second



After: Minimum Night Flow recorded at 26.9 Litres per second

Difference = 15.9 Litres per second which equates to approximately 501 ML per annum

Water Loss Management Program
For Regional NSW Water Utilities

PROJECT COMPLETION / PAYMENT CLAIM

This form should be completed by the council undertaking the project to advise completion of a project and confirm the project scope of work and water loss savings.

Supporting Information required:
1. *water saving test documentation or reports*
2. *audited financial statements evidencing total cost of project*

Council details

Council Name	Orange City Council

Project Outcomes

Title: Leakage Reduction Project	
Expected total Project Cost: $ 455,000	Actual total Project Cost: $ 303,465.57
Expected water saving: 305 ML per year	Actual water saving: 501 ML per year
Expected cost effectiveness: $ 1,492 per ML	Actual cost effectiveness: $ 606 per ML
Expected finish date: October 2008	Actual finish date: July 2009
ICF prior to project: 2.9	ICF after project: 1.2
How were the actual water savings confirmed? Flowmeters have been installed on all feeds into the city. To get an accurate measurement all water is being supplied through one 600mm main with a full bore magnetic flow meter. This has been monitored for a period of 1 month and an exercise was also undertaken to isolate all reservoir on one night. The minimum night flow measured was consistent with the monthly figures.	
Have all external costs have been paid? Yes / ~~No~~	
Description of the conduct of the project: Leak Detection and repair, supply and install bulk water meters at Icely Road WTP. Number of leaks. Copy of final report attached	
Other environmental, economic and social benefits as a result of the program: Minimise leakage leading to less water wastage and subsequent reduction in energy demand/use at Icely Road WTP, staff capacity building	

Financial Assistance

What percentage of expected water savings were achieved?	164 %
What is the amount offered for the project?	The lower of $ 152,000 or 33%
What is the payment amount based on actual costs *(= actual cost x %offered)*	$ 100,144

What is the payment claim amount?	$ 100,144

Declaration

Orange City Council hereby claims payment of $ 100,144 as per the calculation shown above as final payment for the Leakage Reduction Project.

- All external costs have been paid.
- The water savings calculated are accurate and have been determined as described above.
- The attached financial statements show the total cost of the project.

I certify that the information provided in and supporting this application is true and correct and that I am legally authorised to sign this application for and on behalf of Orange City Council.

Signed ____________________ Date 21/8/09

Name CHRIS DEVITT Position A/GENERAL MANAGER

Please send form to the Water Loss Management Program working on this project or email: ian.maggs@lgsa.org.au or PO Box 7003 Sydney 2001 or fax. (02) 9242 4111.